



International Commission on Illumination  
Commission Internationale de l'Eclairage  
Internationale Beleuchtungskommission

# Proceedings of the CIE (International Commission on Illumination)



International Commission on Illumination  
Commission Internationale de l'Éclairage  
Internationale Beleuchtungskommission



SLOVENSKO DRUŠTVO ZA RAZSVETLJAVO / SDR  
LIGHTING ENGINEERING SOCIETY OF SLOVENIA

# Proceedings of the 30th Session of the CIE Ljubljana, Slovenia, September 15–23, 2023

Volume 2

Cite this publication as: CIE (International Commission on Illumination) (Ed.) (2025). *CIE x050-Vol2:2023 Proceedings of the 30th Session of the CIE, Ljubljana, Slovenia, September 15–23, 2023: Volume 2*. In: Proceedings of the CIE (International Commission on Illumination). <https://doi.org/10.25039/x50.Vol2.2023>

The Proceedings of the CIE (International Commission on Illumination) are registered as an international series with the ISSN no. 3061-015X (print), 3061-0168 (online).

Media owner / Publisher / Editor:

International Commission on Illumination (CIE)  
Commission International de l'Eclairage (CIE)  
Internationale Beleuchtungskommission (CIE)

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Place of publication: Vienna

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## **THE INTERNATIONAL COMMISSION ON ILLUMINATION**

The International Commission on Illumination (CIE) is an organization devoted to international co-operation and exchange of information among its member countries on all matters relating to the art and science of lighting. Its membership consists of the National Committees in about 40 countries.

The objectives of the CIE are:

1. To provide an international forum for the discussion of all matters relating to the science, technology and art in the fields of light and lighting and for the interchange of information in these fields between countries.
2. To develop basic standards and procedures of metrology in the fields of light and lighting.
3. To provide guidance in the application of principles and procedures in the development of international and national standards in the fields of light and lighting.
4. To prepare and publish standards, reports and other publications concerned with all matters relating to the science, technology and art in the fields of light and lighting.
5. To maintain liaison and technical interaction with other international organizations concerned with matters related to the science, technology, standardization and art in the fields of light and lighting.

The work of the CIE is carried out by Technical Committees, organized in six Divisions. This work covers subjects ranging from fundamental matters to all types of lighting applications. The standards and technical reports developed by these international Divisions of the CIE are accepted throughout the world.

A plenary session is held every four years at which the work of the Divisions and Technical Committees is reported and reviewed, and plans are made for the future. The CIE is recognized as the authority on all aspects of light and lighting. As such it occupies an important position among international organizations.

## **LA COMMISSION INTERNATIONALE DE L'ECLAIRAGE**

La Commission Internationale de l'Eclairage (CIE) est une organisation qui se donne pour but la coopération internationale et l'échange d'informations entre les Pays membres sur toutes les questions relatives à l'art et à la science de l'éclairage. Elle est composée de Comités Nationaux représentant environ 40 pays.

Les objectifs de la CIE sont :

1. De constituer un centre d'étude international pour toute matière relevant de la science, de la technologie et de l'art de la lumière et de l'éclairage et pour l'échange entre pays d'informations dans ces domaines.
2. D'élaborer des normes et des méthodes de base pour la métrologie dans les domaines de la lumière et de l'éclairage.
3. De donner des directives pour l'application des principes et des méthodes d'élaboration de normes internationales et nationales dans les domaines de la lumière et de l'éclairage.
4. De préparer et publier des normes, rapports et autres textes, concernant toutes matières relatives à la science, la technologie et l'art dans les domaines de la lumière et de l'éclairage.
5. De maintenir une liaison et une collaboration technique avec les autres organisations internationales concernées par des sujets relatifs à la science, la technologie, la normalisation et l'art dans les domaines de la lumière et de l'éclairage.

Les travaux de la CIE sont effectués par Comités Techniques, organisés en six Divisions. Les sujets d'études s'étendent des questions fondamentales, à tous les types d'applications de l'éclairage. Les normes et les rapports techniques élaborés par ces Divisions Internationales de la CIE sont reconnus dans le monde entier.

Tous les quatre ans, une Session plénière passe en revue le travail des Divisions et des Comités Techniques, en fait rapport et établit les projets de travaux pour l'avenir. La CIE est reconnue comme la plus haute autorité en ce qui concerne tous les aspects de la lumière et de l'éclairage. Elle occupe comme telle une position importante parmi les organisations internationales.

## **DIE INTERNATIONALE BELEUCHTUNGSKOMMISSION**

Die Internationale Beleuchtungskommission (CIE) ist eine Organisation, die sich der internationalen Zusammenarbeit und dem Austausch von Informationen zwischen ihren Mitgliedsländern bezüglich der Kunst und Wissenschaft der Lichttechnik widmet. Die Mitgliedschaft besteht aus den Nationalen Komitees in rund 40 Ländern.

Die Ziele der CIE sind:

1. Ein internationales Forum für Diskussionen aller Fragen auf dem Gebiet der Wissenschaft, Technik und Kunst der Lichttechnik und für den Informationsaustausch auf diesen Gebieten zwischen den einzelnen Ländern zu sein.
2. Grundnormen und Verfahren der Messtechnik auf dem Gebiet der Lichttechnik zu entwickeln.
3. Richtlinien für die Anwendung von Prinzipien und Vorgängen in der Entwicklung internationaler und nationaler Normen auf dem Gebiet der Lichttechnik zu erstellen.
4. Normen, Berichte und andere Publikationen zu erstellen und zu veröffentlichen, die alle Fragen auf dem Gebiet der Wissenschaft, Technik und Kunst der Lichttechnik betreffen.
5. Liaison und technische Zusammenarbeit mit anderen internationalen Organisationen zu unterhalten, die mit Fragen der Wissenschaft, Technik, Normung und Kunst auf dem Gebiet der Lichttechnik zu tun haben.

Die Arbeit der CIE wird durch Technische Komitees geleistet, die in sechs Divisionen organisiert sind. Diese Arbeit betrifft Gebiete mit grundlegendem Inhalt bis zu allen Arten der Lichtenwendung. Die Normen und Technischen Berichte, die von diesen international zusammengesetzten Divisionen ausgearbeitet werden, sind auf der ganzen Welt anerkannt.

Alle vier Jahre findet eine Session statt, in der die Arbeiten der Divisionen berichtet und überprüft werden, sowie neue Pläne für die Zukunft ausgearbeitet werden. Die CIE wird als höchste Autorität für alle Aspekte des Lichtes und der Beleuchtung angesehen. Auf diese Weise unterhält sie eine bedeutende Stellung unter den internationalen Organisationen.

## THE PRESIDENTS OF THE CIE

1913	T. Vauthier	France
1921	E.P. Hyde	USA
1927	C.C. Paterson	United Kingdom
1931	A.R. Meyer	Germany
1935	Ch. Fabry	France
1939	N.A. Halbertsma	Netherlands
1951	W. Harrison	USA
1955	J.W.T. Walsh	United Kingdom
1959	I. Folcker	Sweden
1963	L. Schneider	Germany, Fed. Rep.
1965	I. Folcker	Sweden
1967	D. Vermeulen	Netherlands
1971	W.R. Stevens	United Kingdom
1975	S.K. Guth	USA
1979	J.B. de Boer	Netherlands
1983	G. Wyszeccki	Canada
1985	A.M. Marsden	Hong Kong
1987	H. Bodmann	Germany, Fed. Rep.
1991	R.C. Aldworth	United Kingdom
1995	J. Hsia	USA
1999	H.A. Löfberg	Sweden
2003	W. v. Bommel	Netherlands
2007	F. Hengstberger	South Africa
2011	A.R. Webb	United Kingdom
2015	Y. Ohno	USA
2019	P. Blattner	Switzerland
2023	J. Veitch	Canada

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## 1 CIE Administrative Bodies 2019–2023

### Board of Administration

President of the CIE:	Peter Blattner
President-Elect:	Jennifer Veitch
Past-President:	Yoshihiro Ohno (until 2021)
Vice-President Publications:	Luoxi Hao
Vice-President Standards:	John O'Hagan
Vice-President Technical:	Jennifer Veitch
Vice-President:	Ron Gibbons
Vice-President:	Teresa Goodman
Vice-President:	Erkki Ikonen
Vice-President:	Anna Shakhparunyants
Vice-President:	Annette Steinbusch (until 2022)
Vice-President:	Kees Teunissen (since 2021)
Vice-President:	Lorne Whitehead
Secretary:	Ad de Visser
Treasurer:	Volker Seibicke (until 2020) Oliver Thissen (since 2020)

### Division Directors Committee

Chair: Jennifer Veitch  
Members: Division Directors

Division 1	Vision and Colour	Director: Youngshin Kwak
Division 2	Physical Measurement of Light and Radiation	Director: Tony Bergen
Division 3	Interior Environment and Lighting Design	Director: Peter Thorns
Division 4	Transportation and Exterior Applications	Director: Dionyz Gasparovsky
Division 6	Photobiology and Photochemistry	Director: Luc Schlangen
Division 8	Image Technology	Director: Po-Chieh Hung

### Central Bureau

General Secretary: Kathryn Nield (until 23 Sept. 2023)  
Secretary General: Diana Wernisch (since 23 Sept. 2023)  
Technical Manager: Peter Zwick (until 2022)  
Shahidul Islam (since 2022)  
Office Manager: Romana Floth (until 2021)  
Lavinia Lutai (since 2021)

## 2 Welcome Addresses

### 2.1 Message from the Incoming President, Jennifer A. Veitch, Ph.D.

In 1995, I was privileged to attend the CIE 23<sup>rd</sup> Session in New Delhi, India, where I was one of a small number of young researchers and an even smaller number of women. My colleague having fallen ill en-route from Canada, I unexpectedly was called upon to deliver his oral presentation. It was an intimidating experience, but I was quickly adopted into the CIE family and soon found myself a member of a technical committee, and later its Chair. The time spent in meetings, discussions, and document drafting on that committee and others paid back by filling in the gaps in my knowledge and by providing a means to translate research results into lighting practice. Along the way, I made long-time friends and built collegial relationships with other lighting scientists and professionals from academia, industry, and research institutions around the world. It was quickly apparent to me that, to paraphrase the words of the comic-strip character Calvin, of *Calvin and Hobbes* fame, the CIE is a great club!

I had little idea then that nearly 30 years later, I would step into the role of President of the CIE. No woman had yet served as President of the CIE (nor did, until Prof. Ann Webb in 2011–2015) and there had been few female Division Directors at the start of my CIE involvement. It gives me great pleasure to be the second female President and to lead a Governing Board of which half of the members are female and half are male, and with members from five continents. For the first time, in this term, we have a Vice-President of Education and have formed the intention of developing new activities to support the next generation of light and lighting leaders. The CIE of 2023 is not the CIE of yesteryear: It is a dynamic and forward-looking organization that is building on its 110-year history while adapting to the times and facing new challenges.

For evidence of the adaptability of this great organization, one need look only at our successes under the leadership of Dr Peter Blattner in the term just ended. He entered the role with the intention of fostering stronger relations with the National Committees in part by visiting many of them in person. With the unexpected intervention of the global COVID-19 pandemic, he adapted and used the power of online meetings to raise the CIE umbrella over the lighting community. NC Malaysia (*myCIE*) adapted also, hosting a very effective online conference in 2021 from Kuala Lumpur – our first major foray into an online meeting. Other online tutorials followed. During this time, the CIE offered two publications on UV disinfection free of charge as a small contribution to the global efforts to respond to this unexpected challenge. Also during his term, the CIE achieved full membership in the International Science Council; negotiated a renewed Partner Standards Developing Organization Agreement (PSDO) with the International Organization for Standardization (ISO) and a new Implementing Agreement establishing the ways of working with ISO/TC 274 *Light and Lighting*; signed the *Joint Statement of Intent On the Digital Transformation in the International Scientific and Quality Infrastructure* [an initiative of the International Committee for Weights and Measures (CIPM) and its Task Group on the Digital SI (CIPM-TG-DSI)]; oversaw the development of the metadata schema for and release of 41 CIE datasets as the first step towards digitalization of the CIE; and responded to the war in Ukraine having taken due consideration of our principles, our legal framework, and the responses of our global partners.

Dr Blattner's leadership will be a challenging act to follow, but he leaves the organization well situated for these times. Among his greatest achievements was to guide the CIE to revise its Statutes, which had last been amended in 2014 in a minor way without changing the basic structure, which featured a single Board of Administration (BA) that combined both policy direction and guidance of the technical work. The 2023 Statutes and the By-laws that implement them are very different because they separate the strategic and policy direction – now undertaken by the Governing Board (GB) – from the elaboration of the technical work programme of the Divisions – now the responsibility of the Technical Management Board (TMB). Leadership positions now have written job descriptions, nomination and election procedures are more transparent in the new By-laws, and the Code of Procedure (CoP) has been revised to reflect the changed structure and ways of working. The CIE's financial position is sound, and thanks to the General Assembly's decisions at its meeting in September 2023, the procedures for calculating member dues have been modernized. The executive function has been redefined in the new role of Secretary General, who functions as the Chief Executive Officer. We welcome Dr Diana Wernisch to the CIE as the first Secretary General.

As in the term just ended, the Governing Board has set broad objectives for the organization for the years 2023-2027, in the categories “CIE as the Global Lighting Organization”; “CIE as a Scientific Organization”, “CIE as a Standardization Organization”, and “CIE ongoing administrative responsibilities”. The Governing Board will set annual goals relating to each category, will undertake activities related to each goal, and will report back on its progress regularly. I invite everyone who cares about the CIE to engage with us in the work.

What do I mean by this? Take the CIE Research Strategy 2023-2027 as one example. This major revision recasts the subject matter of light and lighting into the framework of the United Nations 2030 Sustainable Development Goals (SDGs). Scientific advances following the six topical themes in the Research Strategy can contribute directly to 12 of the 17 SDGs, which is a powerful demonstration of the centrality of light, metrology, lighting, and image technology to life on Earth. Two overarching themes further emphasize this global reach: digitalization and inclusivity. The CIE Research Strategy exists to motivate scientists to build the knowledge foundation for the next generation of CIE publications, but transforming that knowledge into achieving the SDGs takes the active involvement of experts to collect, interpret, and implement that knowledge into consensus in Technical Reports and International Standards. As we do this, we will fulfil another SDG, number 17: *Partnerships for the Goals*. In the CIE’s case, this includes our work as a Standards Development Organization in concert with other global partners, particularly ISO and the International Electrotechnical Commission (IEC). Supported by our very capable Central Bureau (CB) staff, CIE experts will over these years show our organization to be the global leader in light and lighting science and standardization.

The new term starts off with a celebration that highlights our role in the world and the way we have always operated: with publications and guidance based on good science, with international consensus, and often in partnership with other global organizations. I speak of the centenary of the adoption of  $V(\lambda)$ , the spectral luminous efficiency function for photopic vision, at the 6<sup>th</sup> Session of the CIE in July 1924. With its adoption by the CIPM in 1933, this was the birth of physical photometry! We will share this celebration with the CIPM’s Consultative Committee on Photometry and Radiometry (CCPR) in Paris next June. The Joint CCPR-CIE Workshop at the Bureau Internationale des Poids et Mesures in Paris will also feature discussions about whether it is time to make updates to our systems of photometry and colorimetry taking into account scientific advances over the past century.

CIE Position Statements concisely express a corporate opinion on topics of public interest. Under the new structure, the Governing Board and the Technical Management Board share responsibility for CIE Position Statements to ensure that policy and science stay well aligned in them. Some of the existing Position Statements are due for a refresh to take into account advances in knowledge and experience since their publication 8-10 years ago; the updates are among our short-term goals for the new term. We also have an eye on important issues of the day and are considering whether the public good would be served by adding to the collection of CIE Position Statements.

The structural changes to the CIE leadership with the new Statutes have not fundamentally changed the work of the CIE: The Divisions form Technical Committees and appoint Division Reporters to undertake technical work leading to Technical Reports, Technical Notes, and International Standards. Experts discuss emerging topics in Research Fora that cut across the Divisions. None of this can happen without the active participation of the more than 1000 experts who are active in the technical work. An important goal for the next term is to understand better the needs of all of our experts and to develop better supports for them in their contributions to the CIE. There are many organizations claiming our time today: We want the time spent in contribution to the work of the CIE to be time well spent for everyone.

CIE Sessions are an ending and a beginning. CIE 2023, the 30<sup>th</sup> Session, was this more than most. It marked the end of the pandemic’s unexpected isolation from friends and the beginning of new friendships. We greeted one another with joy in meetings and in the best CIE dinner-dance I’ve ever attended. Before we know it, it will be July 2025 and the Midterm Meeting in Vienna will be upon us. It’s my privilege and honour to invite you to join us there.

### 3 Officers' Reports

#### 3.1 President's Report to the General Assembly, September 17, 2023, Dr Peter Blattner, CH

It is with respect and humility, but also with great pleasure, that I took over the presidency of the International Commission on Illumination CIE, this outstanding and honourable organization, in July 2019. In recent years, the lighting industry has gone through a turbulent period. This technological and structural change has had a direct impact on the work of the CIE. In order not to lose sight of the Commission's mission in these turbulent times, the Board of Administration set objectives for the next four years at the beginning of the term. In working out the goals, it once again became very clear how diverse the Commission is: on the one hand, it is the umbrella organization of the various national associations, on the other hand, it also takes on the role of a scientific organization and is a standardisation organization recognized by ISO. All these different aspects were taken into account in the Objectives 2023 and a large number of quantifiable indicators as well as responsibilities were defined. At a workshop with the NCs in spring 2021, we explored these goals in more depth and identified various potential action points. For example, the reach of the CIE can be significantly increased if the CIE documents are translated into different languages. For this to be possible, however, it also needs support from its members. Through this collaboration with the NC, several publications and position papers have been published in different languages over the last two years. In particular, I would like to mention the position paper on the *Use of Ultraviolet (UV) Radiation to Manage the Risk of COVID-19 Transmission*, has been translated into the following languages: Brazilian, Bulgarian, Chinese, Danish, Dutch, French, German, Japanese, Polish and Russian, and Spanish. Probably a record in the history of the CIE!

The Board has also actively discussed the cooperation with other organizations and published a policy document (available on the CIE website). It sets out in a structured way how we work with other organizations and serves as a basis for discussion of possible future MoUs.

An important partner of the CIE is the International Standard Organization (ISO) and in particular ISO TC 274 *Light and Lighting*, which is chaired by Ad de Visser (CIE BA secretary). In October 2019, the CIE and ISO signed a Partner Standards Developing Organization Agreement (PSDO), which defines the cooperation between the two organizations. I would like to thank Ad for leading the coordination of this important work.

In order to preserve the face of the CIE, respectively to protect the CIE logo, the Board has decided to register the CIE logo as a trademark. The process is close to completion. From my point of view, it is important that the CIE is perceived as a modern organization and that it protects itself from possible "attacks". However, a protected logo can also open up new business opportunities.

In order for the Commission to continue to be able to adapt to changing conditions, efficient procedures are needed, but also clear responsibilities for the various tasks. With this in mind, the Code of Procedure was revised and simplified. This very time-consuming work was carried out by a working group of the Board and brought to a successful conclusion in spring 2021. Another working group of the Board is dealing with the basic governing structure of the CIE.

It is essentially a matter of adapting certain remnants from the last comprehensive revision in 2013. The focus is on describing the responsibilities of the various bodies of the organization more precisely. The nomination process for the governing bodies should also be made more transparent and open. Finally, the working group proposes to divide the board into two parts: A strategically acting Governing Board and a Technical Management Board. This would simplify certain processes and reduce duplication, e.g. in reporting. It is important to the Board to discuss the proposals openly with the members and therefore invite the NC to give appropriate feedback on the first draft that is circulated to the NCs.

An unplanned event that has a direct impact on our daily lives must of course not be missing from my review: In spring 2020, the world was surprised by the COVID-19 pandemic. From one moment to the next, events were cancelled, schools, cultural institutions, restaurants, etc. were closed, and travel was severely restricted. Although there are now some signs of improvement, the social and economic impact will continue to reverberate. The CIE and especially our

members are feeling the effects. A direct consequence was that all CIE events during the pandemic have only been held online.

In order to make a small contribution in the fight against the pandemic, the Board decided to make two CIE publications on UV-C radiation freely available. This offer was actively used and the documents were downloaded more than 10,000 times. In addition, the position paper mentioned above was published. This global crisis also introduced uncertainties in shaping the trajectory of future events: we didn't receive any proposals from a National Committee for the organization of the Midterm Meeting 2025. The Board of Administration (BA) therefore decided to propose Vienna as the venue and to entrust the Central Bureau with the organization. The National Committee agreed to the proposal and I am already looking forward to the event which will take place in early July 2025.

When the pandemic subsided, two important events could still be held: The CIE Expert Tutorial and Symposium on the Measurement of Temporal Light Modulation in Athens (October 2022) and the CIE Tutorial on Urban Lighting Masterplanning in Istanbul (May 2023) were notable achievements. Both events were very well organized and I would like to thank everyone involved again. It was great to meet colleagues from all over the world again after the long-time of home office and online meetings.

Another challenge was and is the war in Ukraine. We had discussed the issue in detail in the Board of Administration (BA) at the outbreak of the war and based on that I had written the statement in March 2022. We have tried to define principles that guide us, taking into account the legal framework (such as the CIE Statutes) as well as other applicable documents (especially the Code of Ethics). We have also drawn on the responses of other global organizations, in particular the International Science Council (ISC), the union of all global scientific organizations. The [ISC](#), like the CIE, acts as a guardian of the Principle of Freedom and Responsibility in Science.

I also notice that there are currently tendencies to move away from globalization and increasingly into regional or politically strategic alliances, for various reasons. However, this is also a challenge for a globally active organization. And here, too, I am convinced that science, in particular, is a bridge builder, because only together can the major socio-economic and climate and environmentally induced challenges be mastered. In this context, I'm proud that the CIE is now a full member of the International Science Council (ISC). This membership opens up many new opportunities. The ISC is also a very large reservoir of information. I am convinced that the National Committees and also the experts of the CIE will benefit greatly from this membership.

An important project was the revision of the Statutes and Bylaws. The aim of the project was to revise the governance of the CIE and to define more clearly the roles of the individual bodies of the association. Necessary legal adjustments were also made. I am glad that the National Committee approved the changes. Another important work was the revision of the CIE Research Strategy. I would like to thank VPT Dr Jennifer Veitch and the Division Directors for the fundamental revision. The quality of the Research Strategy has once again increased significantly and I am sure that many research groups around the world will use it as a basis for funding requests.

Another highlight is the publication of datasets under the FAIR (Findable, Accessible, Interoperable, Reusable) principle with this action, the CIE directly supports the Open Science movement. All stakeholders can also benefit from this now freely accessible data. It is a first step into the field of digitization and more shall follow.

The various Technical Committees continued to be very active, as around 16 publications have been published and many more are about to be published. In this context, I would like to once again thank the now retired Technical Manager, Dr Peter Zwick. He was greatly responsible for the high quality of CIE publications. This brings me to some personnel changes that have just recently taken place: In the Central Bureau, Dr Shahidul Islam has taken over as Technical Manager and Lavinia Lutai as Office Administrator. After eight years, the General Secretary, Kathryn Nield will leave the CIE. I would like to thank her for her great commitment and good cooperation!

With the new statutes, the function of the General Secretary was also adapted and the position was advertised. As already announced, Dr Diana Wernisch will take up this position. I would like to welcome her warmly and look forward to working with her.

Finally, there are also several changes in the Board, in particular, Dr Jennifer Veitch will hold the presidency for the next 4 years. I am convinced that she will be a great President and will further develop the organization. Her election makes my departure as President a little easier. These past four years have been an exceptional journey defined by collective accomplishments and I had the chance to work with many great colleagues all around the globe!

I would like to thank everyone who has worked and continues to work for the CIE. May we continue to illuminate the path ahead, guided by our shared vision for a brighter future.

## 4 Quadrennial Report 2019–2023 of the Vice-President Technical

### 4.1 CIE General Assembly, September 24, 2021, Jennifer A. Veitch, Ph.D., CA

#### 4.1.1 Objectives and Outcomes

The tasks of the Vice-President Technical (VPT) are to oversee the technical work of the CIE, to chair the (at least) semi-annual meetings of the Division Directors' Committee (DDC), and to contribute to the achievement of the overall CIE Objectives for the quadrennium. Below is a short summary of tasks falling to the VPT, which are drawn from the objectives that the BA has set for itself. These tasks are in addition to the routine work of advising on or adjudicating when problems arise of TC compliance with the Code of Procedure, participating in Board of Administration Task Groups, and Chairing the International Scientific Committee for the CIE 2021 Midterm conference.

	<b>2019–2020 Objective</b>	<b>2021 Objective</b>	<b>Status 2021-08-13</b>
<b>CIE as a global lighting association</b>	1.4 New technical fields are explored (horticulture, myopia, ...) in collaboration with any existing organizations.		JTC19 (D6/D2) <i>Terms and Definitions of Horticultural Lighting</i> has been established. Other collaborations (e.g., IAU) are under discussion by other Officers.
<b>CIE as a scientific organization</b>	3.1 CIE is recognized as full member by ISC	BA decision on whether or not to proceed with full membership.	Met virtually with ISC leadership. Discussions under way
	3.2 Relationship to other scientific conferences (Lux Europa, Newrad, Lux Pacific, Balkanlight, Licht, Asian Lighting Conference, LS Conference...) is clarified	Preliminary discussions with leaders.	Papers not presented at the cancelled Lux Pacifica 2020 were welcomed for submission to CIE 2021.
	3.3 The number of papers submitted to the midterm conference and session is increased		Adapting the CIE 2021 conference to the pandemic took priority, although the decisions to link to Lux Pacifica 2020 and an extended submission deadline were aimed promoting at this outcome.
	3.4 The CIE addresses the topics needed by the stakeholders with suitable publications.	Coordination of new work proposals between Divisions to support this.	Regular DDC meetings, clarification of preparatory discussion procedures, should help in the development of robust work plans.
	3.5 Process of regular review and update of the Research Strategy is implemented.	Initiate renewal of Research Strategy.	Process developed in 2019, see below.
	<b>2019–2020 Objective</b>	<b>2021 Objective</b>	<b>Status 2021-08-13</b>
	3.6 Increase the participation from different region in TC work to ensure that topics are globally relevant.		DDC has been discussing barriers to TC participation with the aim of increasing diversity and depth of participation. This objective is a work in progress.

#### **4.1.2 Division Directors' Committee Meetings – Discussion Highlights**

All of the Division Directors' Committee meetings were held by Webex. The schedule was somewhat disrupted by the pandemic, as might be expected. The attendees included the Division Directors (or a designated member of each Division Management Team), the Vice-Presidents Technical, Publications, and Standards, the BA Secretary/ISO-TC 274 Convenor (by invitation), the Technical Manager and the General Secretary. The VPT takes notes; there are no minutes. Each meeting was three hours in length.

##### **2019-09-18 WebEx**

Topics: Research Strategy minor update. Co-ordinating cross-Division consultations during the development of new work items. Discussion about current work item proposals.

##### **2020-01-21 WebEx**

Topics: Research Strategy major update process. Issues related to standardization and inter-organizational work. Extended discussion on barriers that prevent experts from participating in TCs.

##### **2020-05-13 WebEx**

Topics: Events shifting to online format; how to make them engaging. Discussions of new work items of possible interest to more than one Division. Division Associates- definition and criteria [now incorporated in the new *Code of Procedure*. Annual review of Research Fora, decisions to continue with the three.

##### **2020-12-15 WebEx**

Topics: Submissions by CIE to the topic collection for the European Metrology Program (4 topics were suggested as needing research attention, one of which was selected as a research topic and funded, Metrology for temporal light modulation). Process for NCs to identify a CIE publication for trialling of the new annual distribution of a CIE publication to NCs for their members.

##### **2021-03-18 WebEx**

Topics: Lessons learned from online events in 2020. Extended discussion of Divisions' best practices to facilitate smooth TC operation.

##### **2021-06-15 WebEx**

Topics: Liaison Representatives' roles and responsibilities, and their importance to the CIE. annual review of Research Fora (see below). Review of all JTCs and their current status.

The next meeting is planned for late October 2021.

#### **4.1.3 Research Strategy and Research Support**

The 2015 Research Strategy was reviewed by the Division Directors in 2019, with the decision being taken to make minor changes to update the text where necessary. This was completed in December 2019. In winter 2020, we completed the development of a process for a complete updating of the Research Strategy, to be undertaken once every four years. The update is to start at a Midterm meeting (i.e. now) and for the new Research Strategy to be released in time for the end of the quadrennium. Thus, the Divisions are currently considering their long-term work plans and the research gaps that need to be filled in order to support their future work.

The individual Division inputs will be provided in late autumn 2021, and the VPT with the DDC will undertake to integrate them into one coherent plan for review and discussion.

The CIE began in 2019, a new program in which researchers who are seeking funding for a research project (e.g. from a national scientific agency) related to one of the CIE Research Strategy topics can request a letter of support from the CIE. These letters do not address the quality of the proposal, but identify the topic being studied as being relevant to the work of the CIE either currently (i.e. the research results could be quickly taken up by an existing TC) or in the future (the research addresses one or more of the topics in the Research Strategy). The letters are signed by the General Secretary, the VPT, and in some cases, also by the relevant Division Director. Over a dozen of these letters have been sent in the past two years, and feedback indicates that the letters have been well received, with some of the proposals having been funded.

#### 4.1.4 Research Fora

The Division Directors' Committee is responsible for deciding on the formation and dissolution of Research Fora. A template has been established for Research Forum convenors to report on their activities annually. These were discussed by the DDC in 2020 and 2021, and in each case, the decision was taken to continue the three existing Research Fora and their convenors:

RF Number	RF Title	Convenor Name
RF-01	Spectral Imaging	Masahiro Yamaguchi
RF-02	Matters relating to temporal light modulation	Jennifer Veitch
RF-03	Matters related to Colour Rendition	Kees Teunissen

#### 4.1.5 CIE Events

All CIE events since June 2019 have been fully online. In most cases, presentations have been pre-recorded and question-and-answer sessions have been live. We are exploring ways to re-use the pre-recorded content, particularly as material for other online tutorials or repeats of the same tutorial.

**July 28, 2020:** CIE Tutorials on Colorimetry and Visual Appearance

**August 25, 2020 to August 26, 2020:** CIE/ICNIRP Online Tutorial on the Measurement of Optical Radiation and its Effects on Photobiological Systems

**November 12, 2020 to November 13, 2020:** Online CIE Workshop on the Calculation and Measurement of Obtrusive Lighting

**July 6, 2021 to July 13, 2021:** Online CIE S 026:2018 Tutorial Understanding and application of CIE S 026/E:2018 *CIE System for Metrology of Optical Radiation for ipRGC-Influenced Responses to Light*. With the collaboration of CIE NC China, this event included Chinese subtitles for the tutorial lectures, and translation during one of the Q&A sessions. The event was accompanied by the release of a Chinese translation of CIE S 026/E:2018.

**Sept 26-28, 2021, CIE 2021 Mid-term Conference:** As all are aware, this conference has been transformed from an in-person event in Malaysia to a fully online event hosted from Kuala Lumpur. The International Scientific Committee met more times than is usual to prepare the conference, including planning interactive social events as part of the schedule.

#### 4.1.6 Other events

In addition to the above, I delivered two invited presentations on behalf of the CIE, one in person and one online:

Lerman, S., Moore-Ede, M., Rea, M. S., & Veitch, J. A. (2020, Feb. 12). Panel: Standards for circadian lighting. Panel presentation and discussion at Strategies in Light 2020, San Diego, CA. [Veitch, J. A. section: *Quantities and units for SI metrology of photobiological effects*.

Veitch, J. A. (2021, March 16). *How to judge applied lighting research, and how to do it well*. Invited lecture at Light and Lighting from East to West International Virtual Conference, March 16-17, 2021, hosted by the Society of Electrical, Electronic and Energy Engineers in Israel /the Israeli Committee of Illuminating Engineering – CIE Israel from Tel Aviv, Israel.

#### **4.1.7 Conclusion**

Collegiality among everyone involved in the CIE volunteer work is strong, and we have achieved much because of strong commitment on everyone's part, despite the inability to meet in person and the pandemic-related worries all have endured. I thank all who have regularly attended to the DDC meetings and participated in our discussions.

## 4.2 CIE General Assembly, September 17, 2023, Jennifer A. Veitch, Ph.D., CA

### 4.2.1 Objectives and Outcomes

The tasks of the Vice-President Technical are to oversee the technical work of the CIE, to chair the (at least) semi-annual meetings of the Division Directors' Committee (DDC), and to contribute to the achievement of the overall CIE Objectives for the Term. Below is a short summary of tasks falling to the VPT, which are drawn from the objectives that the BA has set for itself. These tasks are in addition to the routine work of advising on or adjudicating when problems arise of TC compliance with the Code of Procedure, participating in Board of Administration Task Groups, and Chairing the International Scientific Programme Committee for the CIE 2023 Session conference.

The overall picture is one of success, but with pointers for more work to be done and tasks to be handed over to my successor in the role of Vice-President Technical.

	<b>Indicators end 2023</b>	<b>Goals 2022, 2023</b>	<b>Current Status, 2023-07</b>
<b><i>CIE as a global lighting association</i></b>			
CIE is continuously recognized as the international forum for the discussion of all matters relating to the science, technology and art in the fields of light and lighting (c.f. Statutes 3.1)	New technical fields are explored (horticulture, myopia) in collaboration with any existing organizations	Improve TCC and DMT training, increase support to all volunteers but especially leaders.	<u>Indicator attained; volunteer support is a work in progress.</u>  New areas are being explored, for instance with a supplement to the International Lighting Vocabulary that will introduce new terms for horticultural lighting.  CB has made updates to the TCC and DMT training, but more remains to be done. To aid in this, a survey of volunteer needs has been developed and will be launched following the CIE 2023 Session, with follow-up left to the incoming Technical Management Board.
<b><i>CIE as a scientific organization</i></b>			
CIE is recognized in the international scientific community as the	CIE is recognized as full member by the International Science Council (ISC).	Submit ISC application (done 2022-02-28).  If successful, determine how best to participate	<u>Indicator attained, and work in progress.</u>  CIE is now a full member of the ISC. CIE representatives attended the ISC General
leading platform for the exchange of information in the		in the organization to increase CIE profile as a scientific union.	Assembly meeting in Paris in May 2023. CIE will also attend

field of light and lighting,			the Global Knowledge Dialogue Asia-Pacific in Kuala Lumpur, Malaysia, in October 2023.
	Relationship to other scientific conferences (Lux Europa, Newrad, Lux Pacific, Balkanlight, Licht, Asian Lighting Conference, LS Conference...) is clarified	Further information and discussion is required.	<u>Discussions in progress.</u> Some of these events were interrupted by the pandemic.
	The number of papers submitted to the mid-term conference and session is increased		<u>Indicator partly attained, work in progress.</u> After the pandemic drop, the submissions for 2023 have rebounded to nearly previous levels (2019 336 abstracts, 2021 143 abstracts, 2023 297 abstracts). Information from many academics is that a further increase depends on having CIE conference papers indexed in the major databases (Web of Science, Scopus...). This is to be a priority in the new term.
			<u>Indicator largely attained.</u> Several key publications have appeared since September 2021, including among others the updated ISO/CIE_23539:2023 Photometry, — The CIE system of physical photometry and ISO/CIE TR 21783:2022(E) Light and lighting — Integrative lighting — Non-visual effects
	The process of regular review and update of the Research Strategy is	Major revision of Research Strategy	<u>Indicator attained.</u>

	implemented		
	Increase the participation from different region in TC	Strategy on how to engage volunteers	<u>Work in progress.</u> Many discussions have been held to address this
	<b>Indicators end 2023</b>	<b>Goals 2022, 2023</b>	<b>Current Status, 2023-07</b>
	work to ensure that topics are globally relevant	for TC participation is drafted	challenge, but further progress depends on the survey inputs to be collected in late 2023.

#### 4.2.2 Division Directors' Committee Meetings – Discussion Highlights

The DDC continued to meet three times annually throughout the term, always by WebEx. The attendees included the Division Directors (or a designated member of each Division Management Team), the Vice-Presidents Technical, Publications, and Standards, the BA Secretary/ISO-TC 274 Convenor (by invitation), the Technical Manager and the General Secretary. The VPT takes notes; there are no minutes. Each meeting was three hours in length.

**2021-10-21:** This meeting approved a new Research Forum (see below); introduced a blind review process in the balloting of all CIE TRs and TNs; initiated the Research Strategy revision.

**2022-01-27:** This meeting featured co-ordination discussions between Divisions about potential new work items; a review of TC compliance with Code of Procedure requirements; discussion about the structure of the Research Strategy revision; preliminary planning of new events (in-person and online).

**2022-04-28:** This meeting included discussions concerning TCs that were having process difficulties; suggestions for process improvements and simplifications; recruitment of members for the BA Task Group on Digital Products.

**2022-09-13:** This meeting included further discussions about the Research Strategy update; a presentation from the CIE President concerning the work of the Task Group on Digital Products; co-ordination discussions concerning new work items; and preliminary planning for the International Scientific Programme Committee for CIE 2023.

**2023-01-19:** This meeting included the assignment of writing tasks to DDs for parts of the Research Strategy revision; discussions concerning new work items (TC proposals); discussion of possible Code of Procedure revisions; and a review of the status of all Research Fora.

**2023-04-25:** At this meeting, the incoming Division Directors for 2023-2027 attended as observers. Topics included the transition to the new organizational structure starting in September 2023; status of the Research Strategy draft; possible new work items; approval of a new Research Forum on Cone-fundamental-based photometry.

An in-person meeting of the DDC will be held in Ljubljana on September 15, 2023.

#### 4.2.3 Research Strategy and Research Support

A completely revised Research Strategy will be released at the General Assembly meeting in Ljubljana. It will replace the previous version (2015, updated 2019). The new version shows how each of the topic themes will support the achievement of the United Nations Sustainable Development Goals.

#### 4.2.4 Research Fora

The Division Directors' Committee is responsible for deciding on the formation and dissolution of Research Fora. A template has been established for Research Forum convenors to report on their activities annually. These were discussed by the DDC in 2023. RF-03 might undergo revision following its meeting in Ljubljana, but the others are expected to continue.

RF Number	RF Title	Convenor Name
RF-01	Spectral Imaging	Masahiro Yamaguchi
RF-02	Matters relating to temporal light modulation	Jennifer Veitch
RF-03	Matters related to Colour Rendition	Kees Teunissen
RF-04	Lighting in the Usage of Augmented, Virtual, and Mixed Reality Devices	Molly Mou
RF-05	Cone-fundamental-based photometry	Tony Bergen

#### 4.2.5 CIE Events

Since the online Midterm meeting in September 2021, the CIE has held two in-person events, in addition to planning the CIE 2023 Session conference in Ljubljana.

- CIE Expert Tutorial and Symposium on the Measurement of Temporal Light Modulation, Athens, Greece, Oct. 10-11, 2022. This event was hosted by NC Greece and held in conjunction with the annual meeting of CIE Division 2 and many technical committee meetings, including a hybrid meeting of RF-02.
- CIE Tutorial on Urban Lighting Masterplanning, Istanbul, Turkey, May 3-5, 2023. This event was hosted by NC Turkey.

Various Divisions have ideas for future events but none are confirmed as yet.

#### 4.2.6 Other activities

A highlight of the CIE 2021 conference was the first-ever awarding of Best Paper prizes:

- **Best paper:** Valerie Muzet, Sébastien Liandrat, Vincent Bour, Jérôme Dehon, & Jean-Pierre Christory *"Is it possible to achieve quality lighting without considering the photometry of the pavements?"*
- **Best poster paper:** Jim Uttley, Steve Fotios, Chloe Robbins, Claudia Moscoso, Veronka Zaikina, *"The effect of changes in light level on the numbers of cyclists"*
- **Best student paper:** Steffen Hartmeyer, F. S. Webler, & M. Andersen, *"Towards a framework for light dosimetry studies: Methodological considerations"*

A process for award selection has been developed and Best Paper prizes will be awarded at the CIE 2023 conference at the closing ceremony.

Following the CIE 2021 midterm conference, the CIE again partnered with the journal *Lighting Research and Technology* to produce a [special issue](#) with the best papers from the CIE 2021 conference. It is available online now. There will again be a special issue following the CIE 2023 conference.

#### 4.2.7 Conclusion

As always, the work is collaborative and depends on the contributions of many individuals, including both the staff of the CIE Central Bureau and the many volunteers. I am grateful to all of them for contributions to all of the work summarized here, and many more besides.

## 5 Quadrennial Report 2019–2023 of the Vice-President Publication

### 5.1 CIE General Assembly, September 24, 2021, Prof. Luoxi Hao, CN

#### 5.1.1 Objectives and Outcomes

As the CIE is a state-of-the-art publisher, the tasks of the Vice-President Publication (VPP) are to increase the popularization and sales of publications with open access options, stimulate the translation of CIE publications (following the CIE translation policy), ensure the maintenance of the quality of the publications, increase the participation in the ballot procedure to approve new publications, to lead the development of new policies for publishing digital content and so on.

According to the Objectives 2023 that the BA has set a summary of tasks falling to the VPP is showed below:

- Policy for publishing digital content (including data sets, toolboxes) and machine-readable documents are approved and implemented.
- The quality of the publications is maintained.
- Increase the participation in the ballot procedure for approval on new CIE publications (at the Division and BA level).
- Review the translation policy, in particular to modify aspects related to the distributions by NCs and those by CIE Central Bureau (CB), considering that the copyright of the publications resides with the CIE.
- Stimulate the translation of CIE publications following the CIE translation policy to increase the findability of CIE publications and explore possible collaborations with existing journals (in English language but also other main languages).
- Develop an open access policy.

#### 5.1.2 Publication Sales Report of 2019 and 2020

There were 32 new publications in 2019 and 2020 including 16 Technical Reports, 8 International Standards, 1 Draft International Standard, 3 Position Statements, 3 Technical Notes and 1 set of proceedings.

Other points to highlight:

- According to the income data in 2019 and 2020 that Webshop sales are the main distribution channel for publications. (Figure 1)
- About the total income, the top 10 purchasing countries in 2019–2020 were US, DE, JP, KR, GB, FR, IT, CA, ES and AU. The Webshop income generated by non-members accounts for the largest proportion of total income. Among them, US, DE and JP occupied 45 % of the total Webshop income. (Figure 2)
- About the total sales number, the top 10 purchasing countries in 2019–2020 were US, DE, JP, KR, FR, GB, ES, AU, CA and CH.
- The majority of sales in the period 2019 to 2020 were sales of publications produced before 2019. (Figure 3)
- The publication with the highest number of copies sold in the period 2019 to 2020 was CIE 015:2018 (4th Edition) *Colorimetry*.
- The publication returning the most revenue in the period 2019 to 2020 was CIE 232:2019 *Discomfort Caused by Glare from Luminaires with a Non-Uniform Source Luminance* (Figure 4)

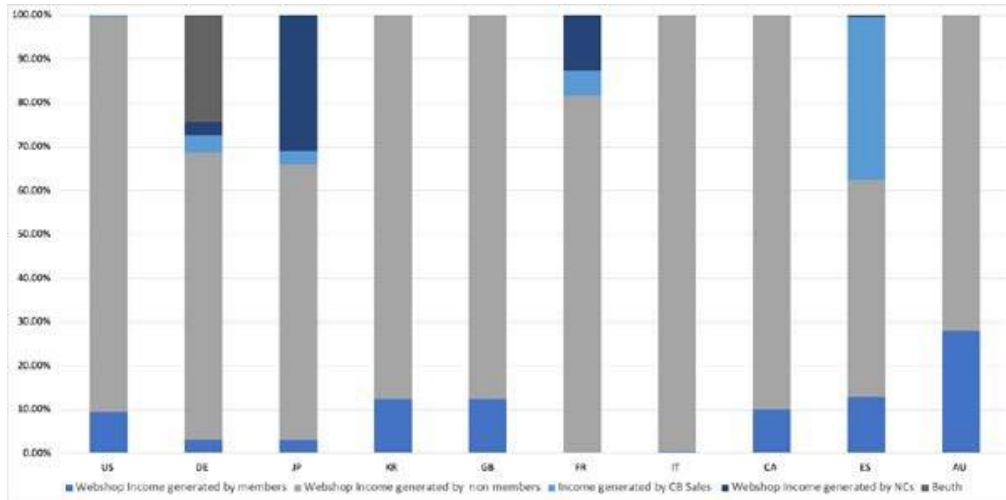


Figure 1 – Percent of income by top 10 countries in 2019–2020

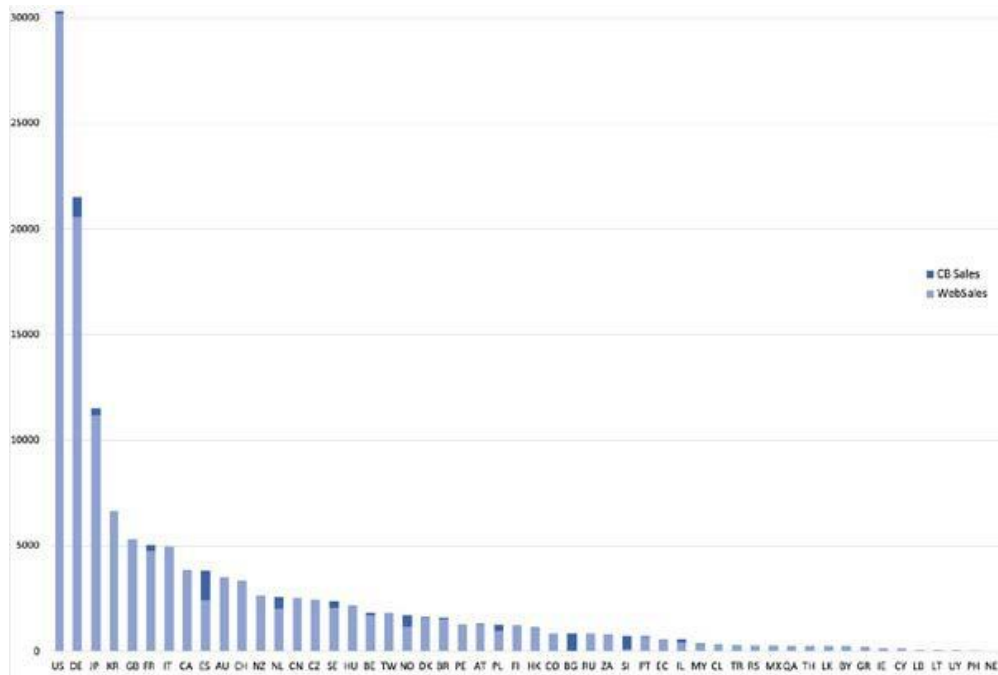


Figure 2 – Income from publications per country in 2019–2020

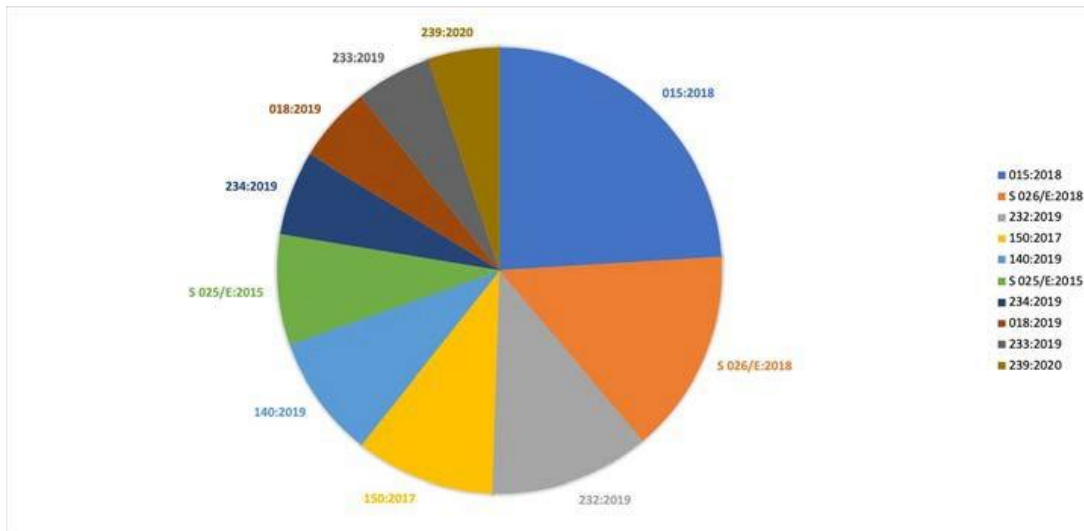


Figure 3 – 10 best-selling publications in 2019–2020

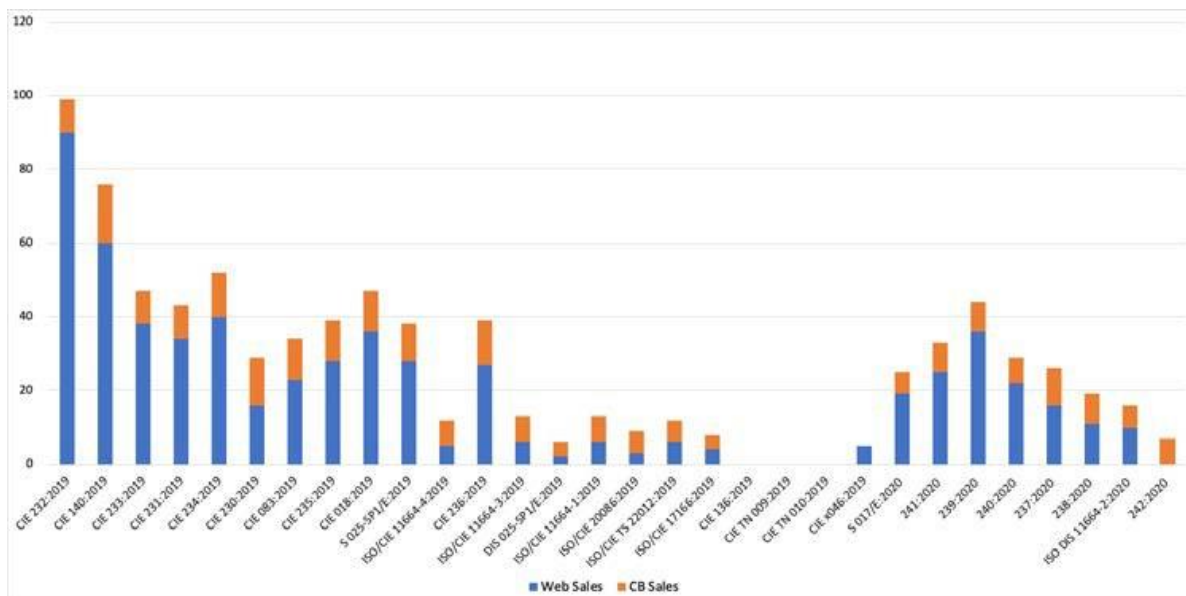


Figure 4 – The 2019–2020 publication sales from Webshop and CB

### 5.1.3 Annual Distribution of a CIE Publication to Members of CIE NCs and ANCs

Last year saw the trial of a new CIE NC and ANC entitlement, this being that a specific CIE publication would be made available to NCs and ANCs for them to share with their members. This trial entitlement was developed following discussions between CIE NC Spain and Central Bureau.

As with any entitlement, this one comes with provisions and exclusions on re-use and re-sharing, these were highlighted in the various notifications to NCs and ANCs about this opportunity, including NC CL2030 and the email sent to NCs and ANCs at the time the document selected for this year's sharing was distributed, CIE 227:2017.

One requirement for the annual distribution is that NCs and ANCs send a report to CIE CB with some summary information about the number of copies distributed in their country. An online survey will be prepared later this year for NCs and ANCs to submit this information. We look forward to your feedback.

Another aspect of the sharing of the publication was that the CIE Translation Policy be followed in the case that an NC or ANC wished to make a translation of the document. For this special

sharing, the requirement for a royalty to be paid to the CIE for each copy distributed was of course waived.

However, any NC or ANC preparing a translation was directed to contact CIE CB before preparing their translation, in order to ensure that the translation was prepared according to the CIE translation policy and CIE CB formatting procedures.

#### 5.1.4 CIE Translation Policy

The CIE has had a [Translation Policy](#) for many years, at least as far back as the 1990s. Not many NCs have been aware of this and moreover some aspects of the policy were not fully clarified or well-enabled. Some aspects that not well developed were:

- an understanding that the translation policy sets in place a license scheme for NCs and ANCs to translate and distribute translations in their countries of the CIE copyrighted publications;
- how the translated publication would be formatted;
- how to enable easy sharing of the original English version of the publication with the translation;
- an understanding that the CIE itself was able to distribute the translation.

Moving on at CIE CB, we have clarified how the translated publications should appear and as part of the formatting we simply include the original at the rear of the translation.



To distribute the translation, NCs are provided with hard-copy version, which they can on sell, with the payment of a royalty to the CIE of 20 % of the price of the original version. This 20 % is simply a fee to provide the original version.

CIE CB also distributes available translations from the CIE Webshop. The benefit of this distribution channel is that the publications are available in hard copy and as secure pdf. With these sales the respective NC that prepared the translation does receive credit notes (CNs) for sales in their country.

Of course, for some NCs, there is little opportunity or need to translate CIE publications, possibly because there is a low publication distribution potential and there is little need for translation. On this point, we learnt during the NC workshops, held earlier this year, that some NCs with low publication distribution potential hold seminars on new CIE publications to disseminate the CIE knowledge into their community in their own language.

This year has seen the publication of some CIE translations, with translations prepared by NCs China, Japan, Spain and Russia. This is a significant effort for NCs and it is hoped that their efforts bring attention to their NCs and the world of CIE in general.

### 5.1.5 BA Ad hoc Task Group on Education Matters

An ad hoc Task Group (AdH TG) on Education Matters has been approved by the BA. This group is investigating the coordination matters related to education and to strengthen the connection between the CIE and university educators/students. Several online meetings have been held on education matters by Wednesday, November 04, 2020 (14:00-15:30 CET) and May 25, 2021(15:00-16:30 CEST).

The Education TG put forward an idea to develop a strategy that will positively promote research cooperation among universities globally, creating a platform to share data and strengthen academic exchanges. This might include professional training courses at different levels, which provide opportunities for lighting professionals and students to have paid online learning, such as our recent CIE online tutorials. This is an effective approach to spreading knowledge, especially in the current epidemic situation and to those who could not traditionally attend CIE tutorials or workshops.

### 5.1.6 Other Highlights

#### 5.1.6.1 Policy for Publishing Digital Content

A BA TG on Digital Products had been formed to draft a CIE policy on digital products, covering toolboxes, data tables, data bases, data-formats, "Apps", "machine-readable standards".

#### 5.1.6.2 CIE Releases Two Key Publications about UV Disinfection

Supporting the global action to reduce the transmission of COVID-19, CIE released two key publications on ultraviolet radiation disinfection for free which lasted for three months, ended in November 2020. These two publications were accessed from the CIE website.

#### 5.1.6.3 To Increase the Participation in the Ballot Procedure for the Approval of CIE Publications (at Division and BA Level)

This can be addressed in several ways including the use of an online ballot sheet, and holding online discussion meetings prior to the ballot. On this first point recently several ballots for NCs, the BA and Divisions have used an online Google form.

#### 5.1.6.4 To Have an Open Access Policy

Open access is already available for CIE Technical Notes, the online version of the ILV, and that open access is now provided for CIE conference and symposium papers for a fee, with open access papers being available on the CIE website. However, based on the different situations in various countries, the proper open access policy should be further discussed in detail.

### 5.1.7 Publications in 2019 and 2020

International Standards	
1	CIE S 025-SP1/E:2019 Test Method for OLED Luminaires and OLED Light Sources
2	ISO/CIE 11664-1:2019(E) Colorimetry — Part 1: CIE standard colorimetric observers
3	ISO/CIE 11664-3:2019(E) Colorimetry — Part 3: CIE tristimulus values
4	ISO/CIE 11664-4:2019(E) Colorimetry — Part 4: CIE 1976 L*a*b* colour space

5	ISO/CIE 17166:2019(E) Erythema reference action spectrum and standard erythema dose
6	ISO/CIE 20086:2019(E) Light and Lighting — Energy Performance of Lighting in Buildings
7	ISO/CIE TS 22012:2019(E) Light and Lighting — Maintenance Factor Determination — Way of Working
8	CIE S 017/E:2020 ILV: International Lighting Vocabulary, 2nd Edition
<b>Draft International Standards</b>	
1	ISO/CIE DIS 11664-2:2020(E) Colorimetry – Part 2: CIE standard illuminants
<b>Technical Reports</b>	
1	CIE 236:2019 Lighting for Pedestrians: A Summary of Empirical Data
2	CIE 235:2019 Optical Measurement of LED Modules and Light Engines
3	CIE 234:2019 A Guide to Urban Lighting Masterplanning
4	CIE 233:2019 Calibration, Characterization and Use of Array Spectroradiometers
5	CIE 232:2019 Discomfort Caused by Glare from Luminaires with a Non-Uniform Source Luminance
6	CIE 231:2019 CIE Classification System of Illuminance and Luminance Meters
7	CIE 018:2019 The Basis of Physical Photometry, 3rd Edition
8	CIE 083:2019 Guide for the Lighting of Sports Events for Colour Television and Film Systems, 3rd Edition
9	CIE 140:2019 Road Lighting Calculations, 2nd Edition
10	CIE 230:2019 Validity of Formulae for Predicting Small Colour Differences
11	CIE 242:2020 Photometry of Curved and Flexible OLED and LED Sources
12	CIE 241:2020 Recommended Reference Solar Spectra for Industrial Applications
13	CIE 240:2020 Enhancement of Images for Colour-Deficient Observers
14	CIE 239:2020 Goniospectroradiometry of Optical Radiation Sources
15	CIE 238:2020 Characterization of AC-Driven LEDs for SSL Applications
16	CIE 237:2020 Non-Linearity of Optical Detector Systems
<b>Position Statements</b>	
1	Position Statement on Non-Visual Effects of Light - Recommending Proper Light at the Proper Time, 2nd edition (October 3, 2019)
2	Position Statement on the Blue Light Hazard (April 23, 2019)
3	CIE Position Statement on the Use of Ultraviolet (UV) Radiation to Manage the Risk of COVID-19 Transmission
<b>Conference and Symposia Proceedings</b>	
1	CIE x046:2019 Proceedings of the 29th Session of the CIE Washington D.C., USA, June 14–22, 2019
<b>Technical Notes</b>	
1	CIE TN 009:2019 The Use of “Accuracy” and Related Terms in the Specifications of Testing and Measurement Equipment
2	CIE TN 010:2019 Determination of the Optical Beam Axis, Centre Beam Intensity, and Beam Angle of Directional Light Sources
3	CIE TN 011:2020 What to document and report in studies of ipRGC-influenced responses to light

## 5.2 CIE General Assembly, Ljubljana, September 17, 2023, Prof. Luoxi Hao

### 5.2.1 Objectives and Outcomes

During the 2021–2023 reporting period, the role of the Vice-President Publication (VPP) has been dedicated to strengthening the scientific visibility, accessibility, and educational value of CIE publications, while also ensuring their technical quality and relevance. The work has focused on several key areas: maintaining editorial standards, supporting the publication and promotion of technical documents, improving international reach through translations and education, and aligning the publication process with current needs for digital and open-access formats.

### 5.2.2 Publication Sales Report of 2021–2023

From 2021 to 2023, the CIE published a total of 24 new documents. This includes:

- 9 Technical Reports (TRs),
- 3 Draft International Standards (DIS),
- 7 International Standards (IS),
- 3 Technical Notes (TNs), and
- 2 sets of Proceedings from major CIE events.

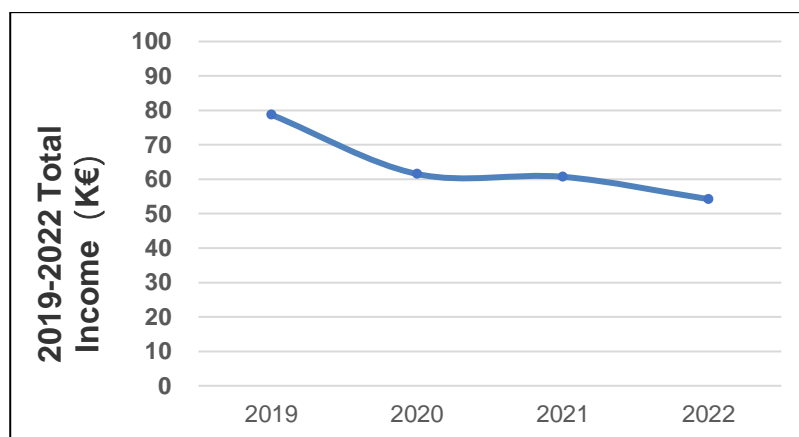


Figure 5 – The 2019–2022 total income through publication sales

An analysis of publication sales reveals that much of the revenue still stems from long-standing foundational documents. In 2021, over 90 % of sales income came from publications released before 2021. In 2022, this figure remained high at over 78 %, showing the continued relevance and value of existing CIE publications. Among the best-selling publications during this period were:

- CIE 015:2018 – Colorimetry, 4th Edition
- CIE 150:2017 – Guide on Limits of Obtrusive Light
- CIE S 026/E:2018 – Metrology for ipRGC-Influenced Responses

Countries with the highest number of purchases included the United States, Germany, Japan, South Korea, France, the United Kingdom, and China, with the USA, Germany, and Japan alone generating nearly 45 % of the webshop income.

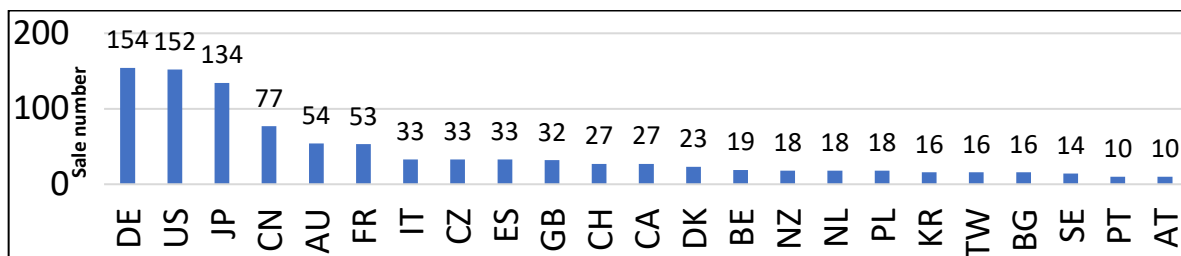


Figure 6 – Countries with purchases of at least 10 CIE publications in 2022

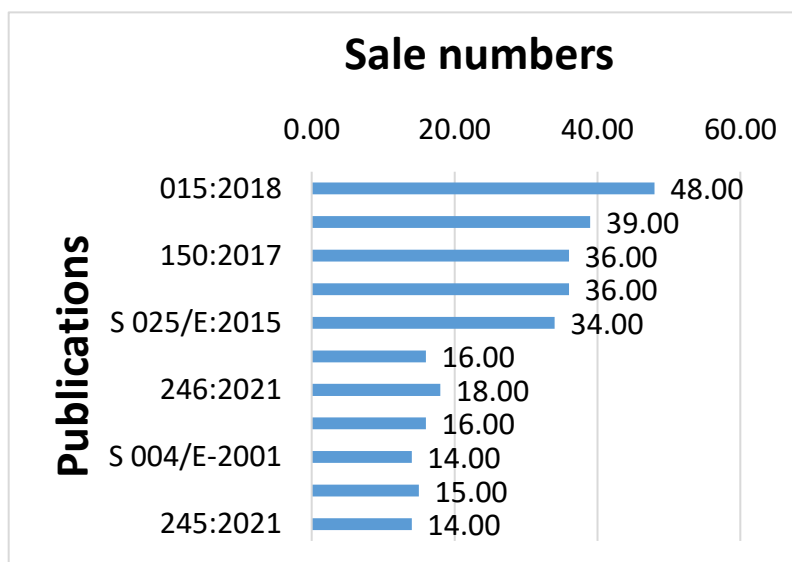


Figure 7 – Ten best-selling publications in 2022

### 5.2.3 Promotion Plans

To support outreach and promote newly released documents, the CIE Central Bureau produced promotional video summaries for several key publications. These videos are available on the CIE Vimeo platform and are designed to offer short, engaging overviews of each document's content and practical applications. It has been proposed that multi-language subtitles be added in future to increase accessibility and reflect the global nature of the CIE community.

### 5.2.4 Translation Activities

Several significant translation efforts were undertaken to broaden access to CIE materials. Translations were conducted for documents such as:

- CIE 234:2019 (Urban Lighting Masterplanning)
- ISO/CIE 11664-1 and 11664-4 (Colorimetry)
- CIE 227:2017 (Lighting for Older People)
- CIE S 026/E:2018 (Metrology of Optical Radiation)

Languages included Chinese, Spanish, French, and German.

These efforts aligned with the CIE Translation Policy and involved clear formatting standards and procedures managed by the Central Bureau.

## 5.2.5 Publication Distribution via NCs and ANCs

A shortlist of publications was compiled for national committees to distribute in 2024. Distribution guidelines and reuse conditions remain aligned with the CIE’s copyright and translation rules.

## 5.2.6 Publication Promotion Suggestions

To further enhance the reach and impact of CIE publications, several strategic actions have been initiated. These include organizing online tutorials, webinars, and video courses that not only provide educational content but also actively encourage participants to explore and purchase CIE publications. Efforts are being made to promote local translations in line with the official CIE Translation Policy, making content more accessible across different regions.

To strengthen academic engagement, university membership and subscription programs are being explored, offering institutions discounted or free access to CIE publications through their libraries. With the support of National Committees (NCs), publications are also being promoted through local media channels to better reach target user groups.

In addition, the CIE website is regularly updated to feature the latest publications and educational activities. Finally, to recognize excellence and encourage scholarly contributions, a Best Paper Award has been established in the proceedings, highlighting and promoting outstanding research results.

## 5.2.7 Publications in 2021–2023

<b>International Standards</b>	
1	ISO/CIE 11664-5:2023 Colorimetry — Part 5: CIE 1976 L*u*v* colour space and u', v' uniform chromaticity scale diagram
2	ISO/CIE 23539:2023 Photometry — The CIE system of physical photometry
3	ISO/CIE DIS 23603.2(E):2023 Standard method of assessing the spectral quality of daylight simulators for visual appraisal and measurement of colour
4	ISO/CIE DIS 28077(E):2023 Photocarcinogenesis action spectrum (non-melanoma skin cancers)
5	ISO/CIE TR 21783:2022(E) Light and lighting — Integrative lighting — Non-visual effects
6	ISO/CIE 11664-2:2022(E) Colorimetry — Part 2: CIE Standard Illuminants
7	ISO/CIE 11664-6:2022(E) Colorimetry-Part 6: CIEDE2000 Colour-Difference Formula
8	ISO/CIE DIS 23539:2021 Photometry – The CIE system of physical photometry
9	CIE DIS 027:2021 Photometry of road illumination devices, light signaling devices and retroreflective devices for road vehicles
<b>Draft International Standards</b>	
1	CIE DIS 017-SP2:2023 ILV: International Lighting Vocabulary –Supplement 2: Terms and Definitions for Horticultural Lighting
<b>Technical Reports</b>	
1	CIE 250:2022 Spectroradiometric measurement of optical radiation sources
2	CIE 249:2022 Visual Aspects of Time-Modulated Lighting Systems
3	CIE 248:2022 The CIE 2016 Colour Appearance Model for Colour Management Systems: CIECAM16
4	CIE 247:2021 Guide for the Gonioradiometric Measurement of Upper Air Ultraviolet Germicidal Irradiation Luminaires
5	CIE 246:2021 Colour Gamuts for Output Media
6	CIE 245:2021 Optical Safety of Infrared Eye Trackers Applied for Extended Durations

7	CIE 244:2021 Characterization of Imaging Luminance Measurement Devices (ILMDs)
8	CIE 243:2021 Discomfort Glare in Road Lighting and Vehicle Lighting
9	CIE 247:2021 Guide for the Gonioradiometric Measurement of Upper Air Ultraviolet Germicidal Irradiation Luminaires
<b>Conference and Symposia Proceedings</b>	
1	CIE x049:2022 Proceedings of the CIE symposium on the advances in measurement of temporal light modulation, October 11, 2022, Athens, Greece
2	CIE x048:2021 Proceedings of the Conference CIE 2021, September 27–29, 2021, hosted by the CIE National Committee (NC) Malaysia online
<b>Technical Notes</b>	
1	CIE TN 014:2023 Example Luminance Measurement Setup for UGR
2	CIE TN 013:2022 Terms related to Planckian radiation temperature for light sources
3	CIE TN 012:2021 Guidance on the Measurement of Temporal Light Modulation of Light Sources and Lighting Systems

## 6 Quadrennial Report 2019–2023 of the CIE Vice-President Standards

### 6.1 CIE General Assembly, September 24, 2021, Prof. John O'Hagan, GB

#### 6.1.1 Objectives and Outcomes

In addition to taking part in the general responsibility of the Board of Administration, to which the conduct of affairs of the Commission is delegated by the National Committees (NCs), the Vice-President Standards (VPS) is specifically responsible for procedures and reviewing of the standards work programme in the Commission and liaison with partner organizations.

In the case of ISO, this is the execution and regular review of the Working Arrangement and cooperation with ISO/TC274.

VPS works in close cooperation with:

- Vice-President Technical (VPT), who is responsible for coordination of the (technical) work in the Divisions;
- Division Directors Committee, which is responsible for developing the standards work programme; this programme includes maintenance of standards;
- Vice-President Publications (VPP), who is responsible for publications, including publication aspects of standards;
- General Secretary (GS), who provides support, along with the CIE Central Bureau, on liaison with partner organizations;
- Technical Manager of the CIE Central Bureau, who supports VPS and manages the details of the work;
- NCs, as necessary.

	2019–20 Objectives	2021 Objectives	Status 2021-08-13
<b><i>CIE as Global Lighting Organization</i></b>	1.3 CIE is recognized by WHO as non-state actor		No activity, WHO is presently busy with other topics
<b><i>CIE as Standardization Organization</i></b>	2.2 Standardization strategy is implemented	CIE approval procedures aligned with those of ISO	Revised CoP has been published
	2.3 MoU with IEC and CEN/CENELEC is updated		A meeting with IEC has been arranged. No progress with CEN/CENELEC
	2.4 Future chair of ISO TC 274 is BA member		Next Chair of TC274 has been agreed (DD3)
	2.5 Continue to be reliable partner to ISO TC 274 and stimulates the collaboration between the NCs and the NSBs	Participation in ISO TC 274, its JAG and CAG.	Participation is through the GS and experts from D3 and D4.

#### 6.1.2 Partner Standards Developing Organization (PSDO) Agreement

In December 1986 the CIE, the ISO and the International Electrotechnical Commission (IEC), entered into a Memorandum of Understanding (MoU). This MoU acknowledged the scope of each organization, each was to avoid overlapping work in light and lighting, and avoid duplication of each other's scope. Further to this in 1989, Council Resolution 10/1989, ISO formally recognized the CIE as an international standards development organization.

Moving on thirty years, and in recognition of the importance of the scope and work of the CIE in many aspects of daily life – thus having an impact on many Technical Committees in ISO (not only ISO/TC 274) – the 1989 MoU has been updated in the form of a Partner Standards Developing Organization Agreement (PSDO). The PSDO provides new opportunities to adopt and jointly develop international standards with ISO/TC 274 (Light and lighting), to serve the global community, specifically in application topics within the scope of the CIE.

Thanks to the sterling work of Ad de Visser, the previous VPS, to negotiate the PSDO, it was signed by the CIE General Secretary, Kathryn Nield, and the ISO Secretary General, Sergio Mujica, at Standards Austria on 10 October 2019.

### 6.1.3 Memorandum of Understanding with the International Electrotechnical Commission

As mentioned above, an MoU was signed with the IEC in December 1986. A supplement to the MoU was signed in 1992. Discussions have started between CIE and IEC to update the MoU.

### 6.1.4 Awareness of ISO/IEC Standards Under Development

The CIE has formal liaison with a number of ISO and IEC committees and relies on our Division has appointed liaison representatives to ensure that committees proposing new work are aware of potential conflicts with the work of the CIE. If this does not happen at the early stages, the CIE becomes aware of the new work through reports produced by the ISO and the IEC. This makes discussions more challenging.

However, it is recognized that optical radiation features in many standards where the CIE may not have formal liaison, but the work may be of interest to the CIE.

Over the past two years, the CIE has been in discussion with a number of committees to attempt to minimize conflicts. This can be quite time consuming.

From September 2020 to July 2021, Kathryn Nield and I represented CIE on an IEC TC 34 Advisory Group, number 17 (IEC TC34 AG17), which was established to consider (standardization) gaps in “UV-C radiation for disinfection and germicidal purposes”. Similarly, Peter Zwick (the CIE Technical Manager) actively represented the CIE on IEC TC 34 AG 14 “Horticultural lighting”. These are examples of increasing awareness of CIE responsibilities, work and publications on these topics. From IEC TC 34 AG 17, a report is being submitted to the main committee of TC 34 and CIE JTC 19 (D2/D3) *Terms and definitions of horticultural lighting* was formed partly due to the recommendations of IEC TC 34 AG 15.

### 6.1.5 Current CIE International Standards

1	CIE S 017/E:2020 ILV: International Lighting Vocabulary, 2nd Edition
2	CIE S 025-SP1/E:2019 Test Method for OLED Luminaires and OLED Light Sources ISO/CIE 11664-4:2019(E) Colorimetry — Part 4: CIE 1976 L*a*b* colour space
3	ISO/CIE 11664-4:2019(F) Colorimétrie — Partie 4: Espace chromatique L*a*b* CIE 1976 ISO/CIE 11664-3:2019(E) Colorimetry — Part 3: CIE tristimulus values
4	ISO/CIE 11664-3:2019(F) Colorimétrie — Partie 3: Composantes trichromatiques CIE ISO/CIE 11664-1:2019(E) Colorimetry — Part 1: CIE standard colorimetric observers
5	ISO/CIE 11664-1:2019(F) Colorimétrie — Partie 1: Observateurs CIE de référence pour la colorimétrie
6	ISO/CIE 17166:2019(E) Erythema reference action spectrum and standard erythema dose
7	ISO/CIE TS 22012:2019(E) Light and Lighting — Maintenance Factor Determination — Way of Working
8	ISO/CIE 20086:2019(E) Light and Lighting — Energy Performance of Lighting in Buildings
9	ISO/CIE 8995-3:2018(E) Lighting of Work Places – Part 3: Lighting Requirements for Safety and Security of Outdoor Work Places
10	CIE S 026/E:2018 CIE System for Metrology of Optical Radiation for ipRGC-Influenced Responses to Light

11	CIE S 026:2018 (CN) 内在光敏视网膜神经节细胞受光响应的光辐射计量系统
12	ISO/CIE 28077:2016(E) Photocarcinogenesis action spectrum (non-melanoma skin cancers)
13	ISO/CIE 11664-5:2016(E) Colorimetry — Part 5: CIE 1976 L*u*v* Colour Space and u', v' Uniform Chromaticity Scale Diagram
14	CIE S 025/E:2015 Test Method for LED Lamps, LED Luminaires and LED Modules
15	ISO/CIE 19476:2014(E) Characterization of the Performance of Illuminance Meters and Luminance Meters
16	ISO/CIE 11664-6:2014(E) Colorimetry-Part 6: CIEDE2000 Colour-Difference Formula
17	CIE S 021/E:2011 Vehicle Headlighting Systems Photometric Performance - Method of Assessment ISO 30061:2007(E)/CIE S 020/E:2007 Emergency Lighting
18	ISO 11664-2:2007(E)/CIE S 014-2/E:2006 Colorimetry — Part 2: CIE Standard Illuminants
19	IEC 62471:2006/CIE S 009:2002 Photobiological safety of lamps and lamp systems / Sécurité photobiologique des lampes et des appareils utilisant des lampes (bilingual edition)
20	CIE S 015/E:2005 Lighting of outdoor work places
21	ISO 23603:2005(E)/CIE S 012/E:2004 Standard method of assessing the spectral quality of daylight simulators for visual appraisal and measurement of colour
22	ISO 23539:2005(E)/CIE S 010/E:2004 Photometry - The CIE system of physical photometry
23	ISO 15469:2004(E)/CIE S 011/E:2003 Spatial distribution of daylight - CIE Standard General Sky CIE S 013/E:2003 International Standard Global Solar UV Index
24	CIE S 009/D:2002 Photobiologische Sicherheit von Lampen und Lampensystemen ISO 8995-1:2002(E)/CIE S 008/E:2001 Lighting of Work Places - Part 1: Indoor
25	CIE S 004/E:2001 Colours of light signals CIE S 004/D:2001 Farben von Signallichtern
26	CIE S 004/F:2001 Couleurs des signaux lumineux
27	ISO 17166:1999(F)/CIE S 007/F-1998 Spectre d'action érythémale de référence et dose érythémale normalisée
28	CIE S 007/D:1998 Erythemale Referenzwirkungsfunktion und standardisierte Erythemdosis
29	ISO 16508:1999(E)/CIE S 006.1/E-1998 Road traffic lights - Photometric properties of 200 mm roundel signals
30	ISO 16508:1999(F)/CIE S 006/F-1998 Feux de circulation - Caractéristiques photométriques des feux de signalisation avec un diamètre de 200 mm

### 6.1.6 CIE Draft International Standard

1	ISO/CIE DIS 11664-2:2020(E) Colorimetry – Part 2: CIE standard illuminants
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### 6.1.7 CIE International Standards in Preparation

1	TC 2-67: Photometry of lighting and light-signalling devices for road vehicles 2-81: Update of CIE 065:1985 (Absolute Radiometers)
2	TC 2-82: Revision of CIE S 014-2
3	TC 2-91: Optical measurement methods of LED packages and LED arrays
4	TC 2-93: Revision of ISO 23539:2005(E) / CIE S 010/E:2004 Photometry - the CIE system of physical photometry
5	TC 2-96: Revision of ISO/CIE 19476: 2014 Characterisation of the performance of illuminance meters and luminance meters
6	TC 3-54: Revision of CIE 16-1970: Daylight
7	TC 4-60: Road traffic lights – photometric properties of roundel signals JTC 05 (CIE-IEC): Review of IEC 62471/CIE S009
8	JTC 06 (CIE-ISO): Energy performance of lighting in buildings JTC 15 (CIE-ISO): Lighting of indoor workplaces
9	JTC19 (D6/D2): Terms and definitions of horticultural lighting

## **6.2 CIE General Assembly, Ljubljana, September 17, 2023, Prof. John O'Hagan, GB**

### **6.2.1 Objectives and Outcomes**

The Vice-President Standards report outlines the key developments, collaborations, and ongoing efforts of the CIE (International Commission on Illumination) in relation to international standardization over the 2021–2023 period. The report primarily focuses on CIE's strategic engagement with ISO and IEC, the two major international standardization bodies.

### **6.2.2 Collaboration with ISO**

The International Organization for Standardization (ISO) is a global, independent, non-governmental organization composed of 169 national standards bodies. Through these members, ISO coordinates global expert networks to develop voluntary, consensus-driven standards that are market-relevant and support innovation.

CIE continues to benefit from its Partnership Standards Development Organization (PSDO) cooperation agreement with ISO. This agreement has now been in place for four years. Ad de Visser monitors ongoing updates to the ISO/IEC statutes and ensures the PSDO agreement remains functional and relevant.

### **6.2.3 Interaction with IEC**

The International Electrotechnical Commission (IEC) is a not-for-profit membership organization with over 170 member countries, responsible for coordinating the work of more than 20,000 experts globally. Established in 1906, the IEC promotes safer, more efficient, and reliable electrical and electronic technologies.

CIE maintains an active relationship with the IEC, particularly regarding the update of the existing Memorandum of Understanding (MoU) between the two organizations. This work is being led by Kathryn Nield and Ad de Visser. The only current jointly published standard, CIE S 009/IEC 62471, was processed through the fast-track publication process. The update of this International Standard is expected to follow the same route. Discussions are also ongoing about potential new joint projects between CIE and IEC.

### **6.2.4 Awareness of Standards Under Development**

To prevent potential conflicts and duplication of work, the CIE has formal liaison relationships with multiple ISO and IEC committees. Division-appointed liaison representatives play a key role in ensuring these committees are informed about existing or planned CIE work that may be impacted.

Over the past three years, under the coordination of the General Secretary (GS), the CIE has been in active dialogue with several ISO and IEC committees. These efforts, while sometimes time-intensive, are essential to safeguard the integrity and relevance of CIE's own technical output in the broader standards landscape.

### **6.2.5 Current CIE International Standards**

1	ISO/CIE TR 3092:2023(E) Light and lighting — Energy performance of lighting in buildings — Explanation and justification of ISO/CIE 20086
2	ISO/CIE 23539:2023(E) Photometry — The CIE system of physical photometry
3	ISO/CIE TR 21783:2022(E) Light and lighting — Integrative lighting — Non-visual effects
4	CIE S 017/E:2020 ILV: International Lighting Vocabulary, 2nd Edition
5	CIE S 025-SP1/E:2019 Test Method for OLED Luminaires and OLED Light Sources ISO/CIE 11664-4:2019(E) Colorimetry — Part 4: CIE 1976 L*a*b* colour space
6	ISO/CIE 11664-4:2019(F) Colorimétrie — Partie 4: Espace chromatique L*a*b* CIE 1976 ISO/CIE 11664-3:2019(E) Colorimetry — Part 3: CIE tristimulus values
7	ISO/CIE 11664-3:2019(F) Colorimétrie — Partie 3: Composantes trichromatiques CIE

	ISO/CIE 11664-1:2019(E) Colorimetry — Part 1: CIE standard colorimetric observers
8	ISO/CIE 11664-1:2019(F) Colorimétrie — Partie 1: Observateurs CIE de référence pour la colorimétrie
9	ISO/CIE 17166:2019(E) Erythema reference action spectrum and standard erythema dose
10	ISO/CIE TS 22012:2019(E) Light and Lighting — Maintenance Factor Determination — Way of Working
11	ISO/CIE 20086:2019(E) Light and Lighting — Energy Performance of Lighting in Buildings
12	ISO/CIE 8995-3:2018(E) Lighting of Work Places – Part 3: Lighting Requirements for Safety and Security of Outdoor Work Places
13	CIE S 026/E:2018 CIE System for Metrology of Optical Radiation for ipRGC-Influenced Responses to Light
14	CIE S 026:2018 (CN) 内在光敏视网膜神经节细胞受光响应的光辐射计量系统
15	ISO/CIE 28077:2016(E) Photocarcinogenesis action spectrum (non-melanoma skin cancers)
16	ISO/CIE 11664-5:2016(E) Colorimetry — Part 5: CIE 1976 L*u*v* Colour Space and u', v' Uniform Chromaticity Scale Diagram
17	CIE S 025/E:2015 Test Method for LED Lamps, LED Luminaires and LED Modules
18	ISO/CIE 19476:2014(E) Characterization of the Performance of Illuminance Meters and Luminance Meters
19	ISO/CIE 11664-6:2014(E) Colorimetry-Part 6: CIEDE2000 Colour-Difference Formula
20	CIE S 021/E:2011 Vehicle Headlighting Systems Photometric Performance - Method of Assessment ISO 30061:2007(E)/CIE S 020/E:2007 Emergency Lighting
21	ISO 11664-2:2007(E)/CIE S 014-2/E:2006 Colorimetry — Part 2: CIE Standard Illuminants
22	IEC 62471:2006/CIE S 009:2002 Photobiological safety of lamps and lamp systems / Sécurité photobiologique des lampes et des appareils utilisant des lampes (bilingual edition)
23	CIE S 015/E:2005 Lighting of outdoor work places
24	ISO 23603:2005(E)/CIE S 012/E:2004 Standard method of assessing the spectral quality of daylight simulators for visual appraisal and measurement of colour
25	ISO 23539:2005(E)/CIE S 010/E:2004 Photometry - The CIE system of physical photometry
26	ISO 15469:2004(E)/CIE S 011/E:2003 Spatial distribution of daylight - CIE Standard General Sky CIE S 013/E:2003 International Standard Global Solar UV Index
27	CIE S 009/D:2002 Photobiologische Sicherheit von Lampen und Lampensystemen ISO 8995-1:2002(E)/CIE S 008/E:2001 Lighting of Work Places - Part 1: Indoor
28	CIE S 004/E:2001 Colours of light signals CIE S 004/D:2001 Farben von Signallichtern
29	CIE S 004/F:2001 Couleurs des signaux lumineux
30	ISO 17166:1999(F)/CIE S 007/F-1998 Spectre d'action érythémale de référence et dose érythémale normalisée
31	CIE S 007/D:1998 Erythemale Referenzwirkungsfunktion und standardisierte Erythemdosis
32	ISO 16508:1999(E)/CIE S 006.1/E-1998 Road traffic lights - Photometric properties of 200 mm roundel signals
33	ISO 16508:1999(F)/CIE S 006/F-1998 Feux de circulation - Caractéristiques photométriques des feux de signalisation avec un diamètre de 200 mm

### 6.2.6 CIE Draft International Standard

1	ISO/CIE DIS 8995-1:2023 Light and lighting — Lighting of work places —Part 1: Indoor
2	ISO/CIE DIS 23539:2021 Photometry – The CIE system of physical photometry
3	CIE DIS 027:2021 Photometry of road illumination devices, light signalling devices and retroreflective devices for road vehicles.
4	ISO/CIE DIS 11664-2:2020(E) Colorimetry – Part 2: CIE standard illuminants

### 6.2.7 CIE International Standards in Preparation

1	2-67: Photometry of Lighting and Light-Signalling Devices for Road Vehicles
2	JTC 19: Terms and definitions for horticultural lighting
3	ISO/CIE DTR 3092 - Light and lighting – Energy performance of lighting in buildings – Explanation and justification of ISO/CIE 20086
4	ISO/CIE/CD 10916 - Calculation of the impact of daylight utilization on the net and final

	energy demand for lighting
5	ISO/CIE DIS 28077:2023: Photocarcinogenesis action spectrum (non-melanoma skin cancers)
6	ISO/CIE DIS 11664-5:2023: Colorimetry — Part 5: CIE 1976 L*u*v* colour space and u', v' uniform chromaticity scale diagram

## 7 Quadrennial Report 2019–2023 of the CIE Treasurer

### 7.1 CIE General Assembly, September 24, 2021, Oliver Thissen, DE

#### 7.1.1 General

The consolidated financial report and the financial statements prepared by our accounting firm have already been approved by the Board of Administration.

Furthermore, Nigel Parry, representing NC GB, has undertaken an internal audit of these financial statements and the related bookkeeping documents of the Central Bureau.

This report summarizes the financial performance of the CIE over the past two years and discusses its current financial status.

It is advised to refer to the separate Excel sheets for a more detailed discussion of the FY 2020 financial statements.

#### 7.1.2 Discussion of the Consolidated P&L Statements of the Past Term

The table below shows major account items for the years 2018 to 2020 and the 2021 budget (all values are in kEUR).

Year	2018	2019	2020	2021 Budget	2021 YTD June
Revenue from Sales	130	139	109	94	34
Membership Dues	294	306	316	314	167
Other revenue	0	1	21	0	0
<b>Total Income</b>	<b>424</b>	<b>446</b>	<b>446</b>	<b>408</b>	<b>201</b>
Cost of sales	3	7	15	21	1
<b>Gross Profit</b>	<b>421</b>	<b>439</b>	<b>431</b>	<b>387</b>	<b>200</b>
Personnel costs	246	242	242	251	123
Depreciation and write-offs	14	9	15	18	0
Operating costs	112	113	87	118	40
<b>Total Expenses</b>	<b>372</b>	<b>364</b>	<b>343</b>	<b>387</b>	<b>163</b>
<b>EBIT</b>	<b>49</b>	<b>75</b>	<b>88</b>	<b>0</b>	<b>37</b>
Financial profit, loss *	0	0	0	0	0
Tax	-2	-2	-2	-2	-1
<b>Net Profit/Loss</b>	<b>47</b>	<b>73</b>	<b>86</b>	<b>-2</b>	<b>36</b>
<b>Cash and bonds</b>	<b>297</b>	<b>345</b>	<b>422</b>	<b>400</b>	<b>539</b>
<b>Equity</b>	<b>394</b>	<b>467</b>	<b>553</b>	<b>551</b>	<b>590</b>

\*YTD 2021 figures include a monthly accrual of the annual membership fees

Important account items are as follows:

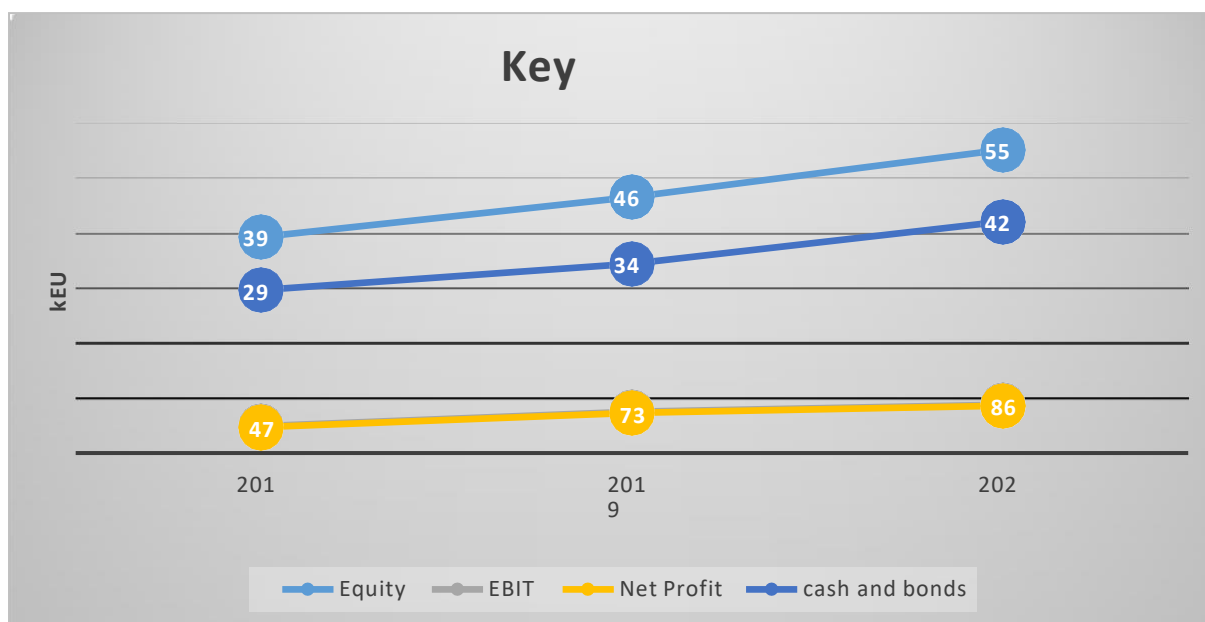
- Membership dues have increased continuously as a result of the NC dues increase process which faded out in 2019.
- The special situation in 2020 based on the ongoing COVID-19 pandemic has led to a significant decrease of certain cost items.

- In summary, Total Income has more or less increased and Total Expenses decreased over the past years resulting in a continuous improvement of Net Profit/Loss in the current term.

### 7.1.3 Discussion of the Financial Status of the CIE and Its Outlook

As a result of the financial performance in the past two years, the CIE has already exceeded prudent reserves level of 300 kEuro in Cash and Bonds after passing the lowest value of 210 kEuro in 2016.

The budget for 2021 continues this positive trend of fostering a healthy and stable financial status of the CIE going forward.



There is a certain risk that the CIE status as a “non-profit organization” could be questioned if the equity position exceeds the yearly budget constantly.

This leads to the comfortable situation that the BA has to make up its mind with regards to sound investment planning which should start already in 2021.

There are actually quite many projects that the CIE could (finally) implement, including the digitalization of the archive, a CIE publication database, the upgrade of the website (when the current version of Drupal is no longer supported), etc.

In addition, we have to keep in mind that for the succession of TM a larger amount could be necessary to secure a quite long overlap between Peter Zwick and his successor.

Moreover, the years 2019 and 2021 have been not usual, with 2019 being influenced by higher publications sales and a conference, and 2021 plus 2021 influenced by the pandemic which led to public grants and a lack of expenditure. Finally, I'd like to thank the President, the GS and CB staff for their support in the first months, helping me to fulfil my duty as the CIE Treasurer. I also like to thank the members of the BA and the NCs for their trust.

## 7.2 CIE General Assembly, Ljubljana, September 17, 2023, Oliver Thissen, DE

### 7.2.1 General

The consolidated financial reports and the individual financial statements for FY 2021, prepared by the CIE accountants, were previously approved by the Board of Administration. Furthermore, Nigel Parry, representing, NC United Kingdom, and Grega Bijak, NC Slovenia, undertook an internal audit of the financial statements and related bookkeeping documents of the CIE Central Bureau. The financial reports and the internal audit report were provided to the NCs as NC CL2219.

The financial reports for FY 2022 are still in the process of an external review which is conducted by the international audit company Mazars.

This report summarizes the financial performance of the CIE over the past two years since the Midterm Meeting and discusses its current financial status.

### 7.2.2 Consolidated Profit and Loss Statements 2020–Q2 2023

The table below shows major account items for the years 2020 to 2022, the FY 2023 budget is included along with the figures for the first half of 2023 (all values are in k€).

Year	2020	2021	2022	2023 Budget	2023 YTD June*
Revenue from Sales	109	127	89	134	19'
Membership Dues	316	291	319	311	163
Other revenue	21	0	9	0	11
<b>Total Income</b>	<b>446</b>	<b>418</b>	<b>417</b>	<b>445</b>	<b>174</b>
Cost of sales	15	15	8	27	20
<b>Gross Profit</b>	<b>431</b>	<b>403</b>	<b>409</b>	<b>418</b>	<b>154</b>
Personnel costs	242	243	254	284	105
Depreciation and write-offs	15	16	18	7	0
Operating costs	87	97	131	167	88
<b>Total Expenses</b>	<b>343</b>	<b>356</b>	<b>403</b>	<b>458</b>	<b>193</b>
<b>EBIT</b>	<b>88</b>	<b>47</b>	<b>6</b>	<b>-40</b>	<b>-39</b>
Financial profit, loss *	0	0	0	0	0
Tax	2	2	2	2	1
<b>Net Profit/Loss</b>	<b>86</b>	<b>45</b>	<b>4</b>	<b>-42</b>	<b>-40</b>
<b>Cash and bonds</b>	<b>422</b>	<b>510</b>	<b>503</b>		
<b>Equity</b>	<b>553</b>	<b>598</b>	<b>602</b>	<b>560</b>	
* without depreciation of financial assets					
'only Q1/2023					

\*YTD 2023 figures includes a monthly accrual of annual membership fees

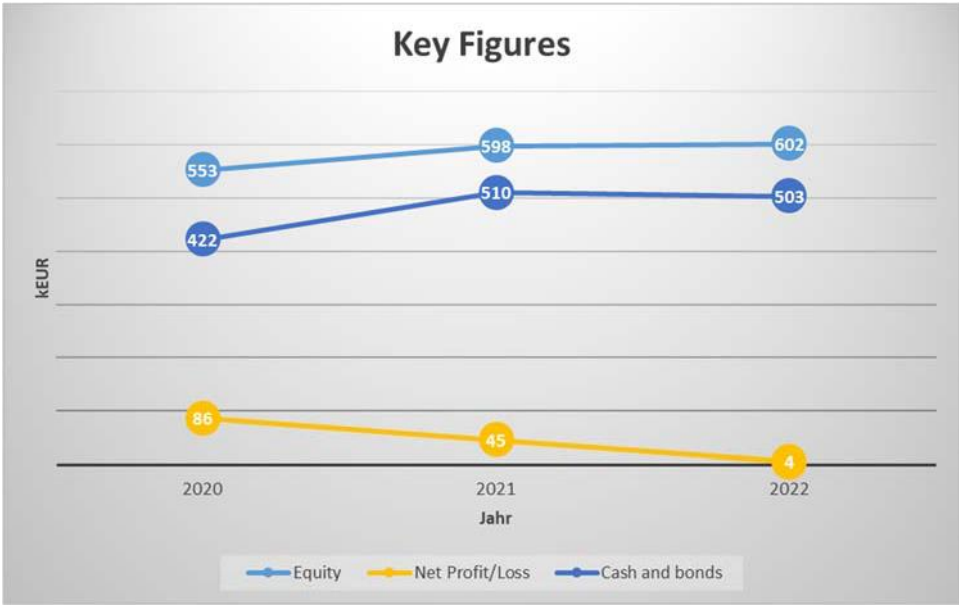
The special situation in 2020 based on the COVID-19 pandemic led to a significant decrease of certain cost items and increase in income due to Austrian public subsidies, and the re-introduction of the former debt of NC Italy into the accounts, as agreed upon their return to the CIE. Thus, the result (€ 86k) was extraordinarily high in 2020, pushing the CIE ahead in the programme to accrue funds.

The CIE ended the 2021 fiscal year with a consolidated nett profit of € 45k, as a result of slightly higher revenues from sales in combination with the still reduced expenditure due to the COVID-19 pandemic.

In 2022, the net profit was reduced to € 4k. This was due to higher spending on items such as Sponsorship for the Manchester workshop (this was considered part of the investment plan), consultancy from Peter Zwick and legal advice on statutes. Income was lower due to the small number of Division level events and the low attendance at the event that was organized.

**7.2.3 Discussion of the Financial Status of the CIE and Its outlook**

The results of the past years have further improved the financial stability of the CIE organization. Thus, there is a still a certain tax risk that the CIE status as a “non-profit organization” could become questioned if the cash reserves exceed the yearly budgeted expenses regularly. To avoid this situation, an investment plan has been established to direct the organization in the use of these and any future profits, which take the cash reserves to levels above the annual expenses.



Additionally, it should be noted that expenses of the organization will increase in 2023 and onwards with a return to higher levels of expenditure for items such as travel and increase in other expenses due to inflationary pressure.

**7.2.4 Special Thanks**

I would like to thank Nigel Parry, NC GB, and Grega Bijak, NC SI, for conducting the CIE internal audit of the accounts for 2021.

Finally, I'd like to thank the President, the GS and CB staff for their support during the last two years, helping me to fulfil my duty as the CIE Treasurer and, of course, the members of the BA and the NCs for their trust.

## **8 Quadrennial Report 2019–2023 of the CIE General Secretary**

### **8.1 CIE General Assembly, September 24, 2021, Kathryn Nield, AT**

#### **8.1.1 General**

The past two years have seen changes for all of us. Fortunately for the CIE, as an international body, we already had many resources to enable our work and communication. The pandemic has however driven new ways of working for the CIE, particularly in regards to our meetings, both administrative and scientific. This report will focus on the work at CIE Central Bureau that has supported the new ways of running CIE scientific events and other communications.

#### **8.1.2 CIE Online Events and Meetings**

CIE events was a major focus to support as a result of the pandemic with hosts of two of our events could no longer make in-person events a reality.

With the strong support of CIE experts and our hosts events were re-arranged, for example the 5th CIE Symposium on Colour and Visual Appearance, which was hosted by NC Hong Kong, was converted into a set of four tutorials, CIE CB took on the administration of the CIE/ICNIRP Tutorial and The Technical University of Ostrava (CZ) continued to administer the Workshop on Obtrusive Light and work with CIE CB on the hosting of the event online. Moving on to this year, CIE CB has managed the recent online tutorial on CIE S 026/E:2018 with strong cooperation and support from NC China.

To support these online events required the preparation of resources for pre-recordings of presentations, securing resources to store recordings and host the events. We also needed to develop a concept to hold these online events and settled on the model to provide the recorded material at least three weeks in advance of questions and answer sessions hosted by the presenting experts.

An additional offering on for our tutorial material this year has been the adding of English subtitles to the pre-recorded presentations and in the case of the CIE S 026 tutorial the subtitles were also provided in Chinese.

After four online events, our processes have matured and the impression is that short online tutorials are a great opportunity to give easy access to CIE content without the need for the overhead of travel.

It is expected that the material we have accumulated can be re-used for future tutorials – with such tutorials being composed of a limited number of presentations.

#### **8.1.3 Use of Online Forms**

As an initiative to support easier participation in CIE ballots and surveys, we have been trialling the use of Google Forms for NCs and Divisions to provide their feedback. The first attempt at using Google Forms was for a survey to select the publication to distribute to NCs (as outlined in the report of the VPP).

Since then, Google Forms have been used for registration for Division meetings and this GA and more recently for specific ballots. We have learnt a lot from you all in your use of these online forms particularly what questions are needed and the best way to phrase the questions.

Google Form does have its limitations, for example, we currently do not enable uploading of files to our Google Forms (such as commenting forms) as this would require users to sign in with a Google account. We will of course review how successful this approach to participate in CIE ballots and surveys and modify our approach as needed.

#### **8.1.4 Collaboration Platform**

In September 2020, the CIE database and resources provided in the IEC Collaboration Tools (CollTools) were migrated to the newer IEC Collaboration Platform (CP). This brought new learning experience for us all as we encounter the new way to access this resource and its various features.

Some features worth mentioning are the ability to re-set your password, rather than contacting us at CIE CB to do this, and that you can view documents online rather than needing to download them.

There have been a few teething problems for our experts, particularly for Division Management Teams and TC Chairs with regard to notifications but we hope that these have been resolved by the implementation of customized distribution lists in each workspace.

One other issue has been the request to accept the IEC copyright and IP policies. We can assure you that this is merely a formality and does not apply to any CIE work or material provided to the CIE workspace within the IEC CP.

CIE CB is in contact with colleagues at the IEC in the case that a problem with CP is outside our ability to support. Although CIE CB is not able to manage specific structural issues regarding the platform, we are of course available to support CIE experts on basic information on how to use it, this includes advice to TC Chairs as part of their training with CIE CB staff.

#### **8.1.5 National Committee Purchases from the Webshop**

CIE Central Bureau has been the main point of contact for NCs to make their purchases of CIE publications with the 80 % discount. These purchases could only be made in hard copy. As reported at the GA in 2019, CIE CB had initiated NC sales from the Webshop, using a special coupon code with access to the coupon code given to a specific person in the NC (usually the secretariat of the NC).

Purchases from the Webshop have the advantage that secure pdfs can be acquired in addition to hard copies; further it has reduced administrative costs in the supply of publications to NCs at this heavily discounted rate. With the pandemic, this option became the best way for NCs to access CIE publications as often over the past year, there has been no ability to always run operations from the CB premises with staff being in home office.

#### **8.1.6 Advice on Credit Notes**

For sales from the Webshop, except those using the 80 % discount coupon, NCs receive credit notes (CNs) based on the sales within their country. These credit notes can be used to offset the dues invoice for the following year but if an NC has difficulty making this transaction, then please approach us at CIE CB for advice.

Other NC CNs are derived from Supportive Membership dues and in 2020, special CNs were issued to NCs with experts contributing to and attendees participating at the CIE/ICNIRP tutorial.

In the past year, credit notes amounting to around €40k were distributed to NCs, derived from income of €131k.

#### **8.1.7 CB Staff Update**

Soon there will be changes at CIE CB with the retirement of Dr Peter Zwick, who has been the CIE Technical Manager since 2008.

Peter's ownership of this role has seen more rigour in the preparation of CIE publications. Peter has also supported CIE liaison with other partners, such as ISO and IEC. Peter also has been the chair of CIE JTC 8 since its inception and has managed all the coordination of the

terminology work between the Divisions along with liaising with the IEC on the harmonization of the IEC Electropedia section 845 with the CIE ILV.

Although Peter will still be with us for some time, I am certain that all the experts involved in CIE work will want to thank him and wish him well for the future.

## **8.2 September 17, 2023, Ljubljana, Slovenia, Kathryn Nield, AT**

### **8.2.1 General**

This is the end of the yet another quadrennium of the CIE, which brings the Commission to a point in time to reflect on its recent achievements and time to look ahead. The substantive matters are reported on by the President and the other Officers of the Commission who hold a portfolio. For me, this is my fourth and last report as General Secretary of the CIE, I leave knowing that the Commission now has improved resources to support ongoing work and from which to develop new initiatives.

The report below gives a glimpse into the activities of the CIE Central Bureau to support the mission of the CIE over the past two years.

### **8.2.2 Support for Members**

CIE CB regular manages requests from members, including simple support to collaboration platform through to promoting and supporting events of members through the CIE Website, Newsletter and LinkedIn feed.

The one-on-one meetings with NCs, the CIE President and CB have continued, particularly in cases where there have been changes in their executive board or we have had no recent direct interaction has continued. I hope that these dialogues continue.

At the GA on September 17, you will be voting on the CIE publication that will be made freely available to all members of CIE National and Associate National Committees in 2024. This initiative was developed by CB following discussions with NC Spain. There has been positive feedback on this initiative, in some NCs it is a topic that is keenly discussed.

### **8.2.3 Support for the Board**

CB Preparation support for eighteen Board meetings over the past four years. In addition, CB has provided input and support to meetings of Board Task Groups (TGs), key ones being on External Organizations, Governance, Code of Procedure and Digital Products.

CB also contributed to and supported the TG to prepare a new CIE Brochure, to which NC Italy also contributed. The brochure was made available last year. The brochure and graphical elements have since been re-used, including a mini-brochure for the Frankfurt Light+Build in 2022 and CIE promotional material for organizations such as the International Science Council.

### **8.2.4 Support for the Divisions**

CB provides support for the establishment of TCs, Reportership and Research Fora. In the past two years, we have modified the “training” of new TC Chairs converting these to information exchange sessions, and providing recordings of previous trainings when there are insufficient new TC Chairs to participate in these sessions.

CB also provides additional support to Divisions with a new service, and upon request, to collate ballots for Division level ballots.

### **8.2.5 Dissemination of CIE work**

CIE has liaison status to over [30 ISO TCs](#), reflecting the many areas that the scope of the CIE touches. These technical liaisons are supported in many cases by Liaison Representative (LR) volunteers from the Divisions. To support these liaisons, CB has been highlighting specific documents to the Divisions and their LRs, which might need review and feedback from the CIE. Since early 2021, this has resulted in 206 comments on 13 ISO documents, prepared by CIE CB and the Divisions.

As previously announced, the CIE has provided easier access to many key datasets. CB has supported the preparation of the datasets and their promotion, which are now available or highlighted on the [CIE Website](#).

Noting previous requests for CIE documents to be easily accessible to students, enquiries have been made about university subscriptions to the CIE portfolio of documents from a variety of providers, including the Techstreet platform.

A significant change in the past year has been the appointment of Dr Shahidul Islam as the new CIE Technical Manager, following the retirement of Dr Peter Zwick. The handover of the work has been substantial and CB thanks the members and volunteers for their support during this transition. Of course, I am certain that all reading this report are grateful for the excellent work of Peter during his 14 years at CIE Technical Manager.

### **8.2.6 Liaison with Other Stakeholders**

In addition to the ISO and the IEC, the CIE is in formal and informal liaison with other international organizations. Over the past two years, CB has supported the liaison with:

- International Science Council (ISC)
- International Astronomical Union (IAU)
- International Colour Association (AIC)
- International Dark Sky Association (IDA)
- Society for Moving Pictures and Television Engineers (SMPTE)
- EURAMET
- CEN

### **8.2.7 Events**

CIE has supported and contributed to the planning and preparation of CIE events. This has included coordination on CIE 2023 and the ISPCS for the conference, the proposal for CIE 2025, and tutorials for Division 2 and Division 4.

I make particular note of the work of the new CIE Technical Manager's strong contributions to the preparation of the scientific content of the current CIE 2023 conference and to the Office Administrator's support for the statutory meetings now taking place. Thank you Shahidul and Lavinia.

### **8.2.8 Looking Ahead**

Social media, the rapid increase in diverse communication channels and other groups forming on topics aligned with those of the CIE, are both opportunities and challenges for the future. The world of "light and lighting" now has many parties involved, one CIE opportunity for the future is to bring together these diverse communities together. A challenge lies to identify who to partner with so that awareness of the Commission is increased without losing focus of the purpose of the Commission.

I close this report reflecting on the message from the late Janos Schanda (CIE Executive Secretary 1987-1995, VPT 2007–2011, and awardee of the de Boer Services Gold Pin in 2007) in his report to the General Assembly, at the occasion of the 27th Quadrennial Session of the CIE in South Africa (GA1108).

In his report he reflected on the work of the volunteers who contribute so much to this organization and that this contribution is vital. At the same time, he noted that, "*Accepting a highly esteemed position means accepting its tasks too*".

I am certain going forward that the newly established Governing Board and Technical Management Board members can rely on the member organizations to support them in their work.

With that, I wish the Commission future success and thank you all for opportunity to support you and to work with you over the past eight years.

## 9 CIE Awards

### 9.1 CIE Session in Ljubljana, 2023

#### 9.1.1 CIE Gold Pins Were Handed Out in Ljubljana

CIE Gold Pins are the highest honour awarded by the CIE. Established in 2007, the awards are granted once every four years at the time of the CIE Session. A distinguished committee of the President, President-Elect and Past President selects nominees, which are confirmed by the Governing Board. At the opening Session of the 30th Session in Ljubljana, the awards were handed out:

- One for Exceptional Outstanding Contribution in Fundamental Research: This award recognizes exceptional work in any area of fundamental research in a field related to light and lighting, with a special focus on work that relates to a recent CIE publication.
- One for Exceptional Outstanding Contribution in Applied Illuminating Engineering: This award recognizes exceptional work in any area of applied illuminating engineering, with a special focus on work that relates to a recent CIE publication.
- One for Distinguished Services Award for Organization/Administration: This award recognizes exceptional contributions to build the international reputation of the CIE over an extended period.

##### 9.1.1.1 Prof Luc Schlangen Received the Gold Pin for Fundamentals: The Wyszecski Award

Dr Schlangen is a University Researcher at the Technical University of Eindhoven, the Netherlands, in the Intelligent Lighting Institute and the Human Technology Interaction group.

He also has served as Director of CIE Division 6 since 2019. His research addresses the effects of light and lighting on neurobehavioral processes including ipRGC-influenced effects; he has published over 50 scientific papers on these topics, including several of the most-cited works. He chaired the CIE Joint Technical Committee that produced CIE S 026/E:2018 *CIE system for metrology of optical radiation for ipRGC-influenced responses to light*. This document provides the foundation for replicable research and traceable measurement in this area. He has promoted the use of this metrology system in many journal articles and presentations since its publication.

He led the development of the *CIE 2019 Position Statement on Non-Visual Effects of Light – Recommending Proper Light at the Proper Time*, and is a strong advocate for using fundamental science to inform lighting applications for good health. In 2020, he co-chaired the successful joint online tutorial between CIE and the International Council for Non-Ionizing Radiation Protection (ICNIRP) on the Measurement of Optical Radiation and its Effects on Photobiological Systems, which was a first collaboration between the CIE and ICNIRP and the first CIE online tutorial.

The CIE thanks Luc for his ongoing commitment to furthering progress to establish the proper light.

##### 9.1.1.2 Naomi Miller Received the Gold Pin for Application: The Waldram Award

Ms Miller is a Senior Lighting Scientist at the Pacific Northwest National Laboratory in Portland, Oregon, USA. As a lighting researcher, she focuses on aspects of LED lighting that can impede wise application: glare, temporal light modulation, and obtrusive lighting. She also is an inspiring speaker and communicator about good lighting quality and how to achieve it, and works with all aspects of the lighting industry to improve applications from seniors' residences to automotive lighting. She has contributed her expertise as an author to three important Technical Reports in three CIE Divisions since 2019: CIE 236:2019 *Lighting for pedestrians – A summary of empirical data* (CIE Division 4); CIE 232: 2019 *Discomfort caused by glare from*

*luminaires with a non-uniform source luminance* (CIE Divisions 1 and 3); CIE 249:2022 *Visual aspects of time-modulated lighting systems* (CIE Division 1).

In her recent research, she has focused on predicting phantom array visibility, work that holds great promise to fill a knowledge gap identified in CIE 249:2022 and to lead to new ways to protect observers from ill effects of temporal light modulation.

Previously, she served on Technical Committees that developed the CIE Colour Fidelity Index (CIE 227:2017) and Protocols for Describing Lighting (CIE 213:2014). Few people have contributed to such a wide range of CIE technical topics.

The CIE is grateful to Naomi for her outstanding and diverse contributions to improving lighting.

### **9.1.1.3 Mr Tony Bergen Received the Gold Pin for Organization and Administration: The de Boer Award**

Tony has contributed in several capacities to the CIE over many years: as a Technical Committee (TC) member, TC Chair, Division 2 Secretary, and Division 2 Director. In the past term, as Division 2 Director during the pandemic, he was a motivating force for continued work in Division 2, watching over the technical committee work and shepherding 11 Division 2 publications to completion (of the total 28 publications since 2019).

Mr. Bergen chairs TC 2-78 “The Goniophotometry of Lamps and Luminaires”, which is very close to publication. As Chair of TC 2-77 “Fundamental concepts” he made sure that collaboration and sharing continued in an online format even in the height of the pandemic.

In his role as Division 2 Secretary and Division 2 Director, he initiated and co-organized many events, including the CIE Workshop/Tutorials in Bled 2013, Vienna 2014, Braunschweig 2015, Bern 2017, Moscow 2018 and Athens 2022. He deserves great credit for making the name of the CIE known globally. As a member of the Board of Administration, he brought wise counsel to all our meetings, and kept in mind the need to attend to the well-being of volunteers while upholding progress on good technical work.

He has a talent for solving challenging tasks, always looking for a practical and solution-oriented approach. Additionally, at the online conference CIE 2021, when in-person meeting was impossible, he organized and co-hosted an important social event, the CIE Quiz Night.

The CIE thanks Tony for his many contributions both to the progress of optical radiation measurement and to the life of the CIE.

## 9.2 CIE Award at the 30<sup>th</sup> CIE Session and the CIE Midterm Meeting 2021

The following persons have received a CIE Award at the 30<sup>th</sup> CIE Session and the CIE Midterm Meeting 2021:

Name	Country	Year
Baozhou Zhang	CN	2023
Feng Zang	CN	2023
Guangxu Wang	CN	2023
Guoqing Tang	CN	2023
Haisong Xu	CN	2023
Qiang Liu	CN	2023
Rui Dang	CN	2023
Steve Lau	CN	2023
Teresa Goodman	GB	2023
Stuart Mucklejohn	GB	2023
John O'Hagan	GB	2023
Tapio Kallasjoki	FI	2023
Tomoko Kotani	JP	2023
Marko Bizjak	SI	2023
Hsueh-Ling Yu	TW	2021
Jia-Ruey Duann	TW	2021
Pei-Ting Chou	TW	2021
Nikolina Ivanova Yaneva	BG	2021
Radoslav Ivanov Kyuchukov	BG	2021
Angel Sarakinov Pachamanov	BG	2021
André Laperrière	CA	2021
Hui Liu	CN	2021
Jianguan Pan	CN	2021
Wang Shuxiao	CN	2021
Weiqiang Zhao	CN	2021
Vladimir Dvořáček	CZ	2021
Tomáš Novák	CZ	2021
Klaus Richter	DE	2021
Joaquín Campos Acosta	ES	2021
Hugh Barton	GB	2021
Minchen (Tommy) Wei	HK	2021
Masao Aizu	JP	2021
Naoya Hara	JP	2021
Shigeo Suga	JP	2021
Takashi Saito	JP	2021
Toshie Iwata	JP	2021
Yasuko Koga	JP	2021
Müjgan Şerefhanoglu Sözen	TR	2021
George P Eppeldauer	US	2021
Po-Chieh Hung	US	2021

### 9.2.1 BA Past Board Members Awards

Name	Country
John O'Hagen	GB
Ad de Visser	NL
Teresa Goodman	GB
Erkki Ikonen	FI
Ron Gibbons	US
Lorne Whitehead	CA
Anna Shakhparunyants	RU
Annette Steinbusch	NL

## 9.2.2 Best Paper Awards

The Best Paper Awards were first introduced in 2021, an initiative implemented by Vice-President Technical, Jennifer Veitch. The awards were well received and were presented again in 2023.

<b>Name</b>	<b>Award</b>	<b>Country</b>	<b>Year</b>
Kevin Houser	Best Oral Paper	US	2023
Alfiya Orman	Best Student Paper	US	2023
Enoch Saint-Jacques	Best Poster Paper	FR	2023
Jim Uttley	Best Poster Paper	GB	2021
Valérie Muzet	Best Oral Paper	FR	2021
Steffen Hartmeyer	Best Student Paper	CH	2021

## 10 Quadrennial Reports of the Divisions

### 10.1 Division 1: Vision and Colour Quadrennial Report 2019–2023, Youngshin Kwak, KR (DD)

#### 10.1.1 Terms of Reference

To study visual responses to light and to establish standards of response functions, models and procedures of specification relevant to photometry, colorimetry, colour rendering, visual performance and visual assessment of light and lighting.

#### 10.1.2 Division Officers

2015–2019:	Director:	Youngshin Kwak (KR)
	Associate Director (Vision):	Nana Itoh (JP)
	Associate Director (Colour):	Ellen Carter (US)
	Secretary:	Li-Chen Ou (TW)
	Editor:	Phil Green (GB)
2019–2023:	Director:	Youngshin Kwak (KR)
	Associate Director (Vision):	Yoko Mizokami (JP)
	Associate Director (Colour):	Kaida Xiao (GB)
	Secretary:	Li-Chen Ou (TW)
	Editor:	Peter Hanselaer (BE)

#### 10.1.3 Division Meetings

2019:	Washington DC (US), 2019-06-21 (meeting held in conjunction with the 29th CIE Session)
2020:	Online, 2020-08-13 40 attendances including 20 national representatives
2021:	Online, 2021-08-26 54 attendances including 21 national representatives
2022:	Online, 2022-08-05 35 attendances including 17 national representatives
2023:	Ljubljana, Slovenia, 2023-09-22 (meeting held in conjunction with the 30th Session of the CIE) 41 attendances including 15 national representatives

#### 10.1.4 Symposia and Workshops

- Understanding and application of CIE S 026/E:2018 CIE System for Metrology of Optical Radiation for ipRGC-Influenced Responses to Light – online July 6/13, 2021 (joint with Division 2 and Division 6)
- CIE Tutorials on Colorimetry and Visual Appearance Online, July 28, 2020 (joint with Division 2)

#### 10.1.5 Strategy

D1 has identified the following four key research topics in the field of Vision and Colour to inspire researchers in developing future guidelines and standards.

- Cone-Fundamental based Colorimetry
- Advanced Color Appearance Model
- Visual Appearance: Perception, Measurement and Metrics
- Color Difference Equation

#### **10.1.6 Administrative Matters and Communication**

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#### **10.1.7 Publications**

##### **10.1.7.1 Published During the Term**

###### **10.1.7.1.1 CIE Technical Reports & Proceedings**

- CIE 249:2022 Visual Aspects of Time-Modulated Lighting Systems
- CIE 248:2022 The CIE 2016 Colour Appearance Model for Colour Management Systems: CIECAM16
- CIE x047:2020 Collection of papers accepted for the 5th CIE Symposium on Colour and Visual Appearance, April 21–22, 2020, Hong Kong, CN
- CIE 240:2020 Enhancement of Images for Colour-Deficient Observers

###### **10.1.7.1.2 CIE Standards**

- CIE S 017/E:2020 ILV: International Lighting Vocabulary, 2nd Edition

###### **10.1.7.1.3 Joint ISO/IEC/CIE International Standards**

- ISO/CIE 11664-5:2023 Colorimetry — Part 5: CIE 1976  $L^*u^*v^*$  colour space and  $u'$ ,  $v'$  uniform chromaticity scale diagram
- ISO/CIE TR 21783:2022(E) Light and lighting — Integrative lighting — Non-visual effects

###### **10.1.7.1.4 Draft International Standards**

- ISO/CIE DIS 23603.2(E):2023 Standard method of assessing the spectral quality of daylight simulators for visual appraisal and measurement of colour

###### **10.1.7.1.5 Reports by Reporterships**

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###### **10.1.7.2 Expected**

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###### **10.1.7.3 Review**

###### **10.1.7.3.1 Reviewed Publications**

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### 10.1.7.3.2 Status of Publications

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## 10.1.8 Technical Committees (TCs)

### 10.1.8.1 Closed TCs

TC 1-83	Visual aspects of time-modulated lighting systems (chair: Małgorzata Perz, NL) Publication: CIE249:2022.
JTC 10	CIECAM16. Publication (chair: Changjun Li, CN) Publication: CIE248:2022.

### 10.1.8.2 New and Closed TCs

### 10.1.8.3 TCs in Progress

TC 1-84	Definition of visual field for conspicuity (chair: Nana Itoh, JP)
TC 1-91	Methods for evaluating the colour quality of white-light sources (chair: Yandan Lin, CN)
TC 1-92	Skin colour database (chair: Kaida Xiao, GB)
TC 1-95	The validity of the CIE whiteness and tint equations (chair: Minchen Wei, HK)
TC 1-96	Advances in colour appearance models (chair: Ronnier Luo, GB)
TC 1-97	World Age- and field-size-parameterised calculation of cone-fundamental-based spectral tristimulus values (chair: Jan Henrik, NO)
TC 1-98	A roadmap toward basing CIE colorimetry on cone-fundamentals (chair: Lorne Whitehead, CA)
TC 1-99	Modelling two-dimensional colour appearance scales (chair: Ronnier Luo, GB)
JTC 12 (D2/D1/D8)	The measurement of sparkle and graininess (chair: Alejandro Ferrero, ES)
JTC 16 (D1/D8)	Validity of chromatic adaptation (chair: Minchen Wei, HK)
JTC 17 (D1/D2/D8)	Gloss measurement and gloss perception – A framework for the definition and standardization of visual cues to gloss (chair: Frédéric Leloup, BE)

### 10.1.8.4 New TCs

TC 1-100	To recommend CAM16-UCS as the CIE uniform colour space (chair: Ronnier Luo, GB)
TC 1-101	Influence of ipRGCs on brightness

	perception (chair: Sei-ichi Tsujimura, JP)
TC 1-102	CN Method for calculating CIE tristimulus values (chair: Changjun Li, CN)

#### 10.1.8.5 Proposed TCs

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#### 10.1.8.6 Miscellaneous

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### 10.1.9 Reporterships (DRs)

#### 10.1.9.1 Closed DRs

DR 1-63	Tristimulus Integration (Changjun Li, CN)
DR 1-66	The effect of dynamic and stereo visual images on human health (Hiroyasu Ujike, JP)

#### 10.1.9.2 New and Closed DRs

DR 1-71	Melanopsin contribution to visual perception (Sei-ichi Tsujimura, JP)
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#### 10.1.9.3 DRs in Progress

DR 1-60	Future colour-difference evaluation (Ruili He, GB)
DR 1-62	Typical LED spectra (Sophie Jost, FR)
DR1-64	Real colour gamut (Changjun Li, CN)
DR 1-67	Revisiting correlated colour temperature (Youngshin Kwak, KR)
DR 1-69	Applicability of metrics for evaluating reflected glare on displays (Shao-Tang Hung, TW)
DR 1-70	Visual assessment methods of perceptual colour shifts in high-dynamic-range (HDR) luminance conditions (Jisoo Hwang, KR)

#### 10.1.9.4 New DRs

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#### 10.1.9.5 Proposed DRs

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### 10.1.10 Liaisons

#### 10.1.10.1 Official Liaisons

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#### 10.1.10.2 Informal Contacts

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### **10.1.11 Future Activities**

To be planned.

## **10.2 Division 2: Physical Measurement of Light and Radiation Quadrennial Report 2019–2023, Tony Bergen, AU (DD)**

### **10.2.1 Terms of Reference**

To study standard procedures for the evaluation of ultraviolet, visible and infrared radiation, global radiation, and optical properties of materials and luminaires.

To study optical properties and performance of physical detectors and other devices required for their evaluation.

### **10.2.2 Division Officers**

2015–2019:	Director:	Peter Blattner (CH)
	Associate Directors:	Joanne Zwinkels (CA)
		Hiroshi Shitomi (JP)
		Armin Sperling (DE)
	Secretary:	Tony Bergen (AU)
Editor:	Jim Gardner (AU)	
2015–2019:	Director:	Tony Bergen (AU)
	Associate Directors:	Joanne Zwinkels (CA)
		Hiroshi Shitomi (JP)
		Armin Sperling (DE)
		Gaël Obein (FR), 2022-2023
Secretary:	Dong-Hoon Lee (KR)	
Editor:	Thiago Menegotto (BR)	

### **10.2.3 Division Meetings**

2019:	Washington DC (USA), 2019-06-20 (meeting held in conjunction with the 2019 Quadrennial Session of the CIE)
2020:	Part 1: Online, 2020-07-16 Part 2: Online, 2020-08-27
2021:	Part 1: Online, 2021-09-02 Part 2: Online, 2021-09-30
2022:	Part 1: Online, 2022-09-14 Part 2: Athens, Greece, 2022-10-12 (meeting held in conjunction with the CIE Expert Tutorial and Symposium on the Measurement of Temporal Light Modulation)
2023:	Ljubljana, Slovenia, 2023-09-22 (meeting held in conjunction with the 30th Session of the CIE)

### **10.2.4 Symposia and Workshops**

- CIE Tutorials on Colorimetry and Visual Appearance, Online, July 28, 2020 (joint with Division 1)

- CIE/ICNIRP Online Tutorial on the Measurement of Optical Radiation and its Effects on Photobiological Systems, August 25/26 2020 (Joint with Division 6)
- CIE Workshop on the Calculation and Measurement of Obtrusive Lighting - November 12/13, 2020 (Joint with Division 4)
- Understanding and application of CIE S 026/E:2018 CIE System for Metrology of Optical Radiation for ipRGC-Influenced Responses to Light – online July 6/13, 2021 (joint with Division 1 and Division 6)
- CIE Expert Tutorial and Symposium on the Measurement of Temporal Light Modulation, Athens October 10-11, 2022

### 10.2.5 Strategy

The strategy 2019 to 2023 is an extension of the strategy 2015 to 2019. Unfortunately, the COVID-19 pandemic caused a lot of difficulty and uncertainty for many D2 members, and to some extent the creation of new work programs was limited.

Three new TCs were established to revise ISO/CIE and CIE standards:

- TC 2-93 Revision of ISO 23539:2005(E) / CIE S 010/E:2004 Photometry - The CIE system of physical photometry, Chair: Anders Thorseth (DK)
- TC 2-96 Revision of ISO/CIE 19476:2014: Characterisation of the performance of illuminance meters and luminance meters, Chair: Armin Sperling (DE)
- TC 2-97 Revision of CIE S 025/E:2015 Test Method for LED Lamps, LED Luminaires and LED Modules and its supplement, Chair: Anders Thorseth (DK)

During the term, D2 established a reportership to establish a CIE D2 Strategy on Spectrophotometry and Optical Properties of Materials, led by Joanne Zwinkels (CA). This document provides a roadmap for ongoing maintenance and revision of nine D2 publications. Two TCs were established relating to this topic or as an outcome of the strategy:

- TC 2-94 Measurement of total transmittance, diffuse transmittance, and transmittance haze, Chair: Hsueh-Ling Yu (TW)
- TC 2-98 Revision of CIE 130-1998 Practical Methods for the Measurement of Reflectance and Transmittance, Chair: Catherine Cooksey (US)

Additionally, the creation of the following TCs and RFs indicated a new topic that has become more important for the CIE as an organization:

- TC 2-95 Measurement of Obtrusive Light and Sky Glow, Chair: Constantinos Bouroussis (GR)
- JTC 19 (D6/D2) Terms and Definitions of Horticultural Lighting, Chair: Wei Zhang (CN)
- JTC 20 (D6/D2) Wearable alpha-opic dosimetry and light logging methods, limitations, device calibration and data schemes, Chair: Manuel Spitschan (DE)
- RF-05 Implementation of CIE 2006 Cone Fundamentals in Photometric and Colorimetric Measurements, Convenor: Tony Bergen (AU)

The CIE Research Strategy has triggered several research projects, in particular in the framework of EMPIR (European Metrology Programme for Innovation and Research). These

projects have positive effects on D2 work as the results of the projects can be used as the basis for TC work. Also, new experts could be identified and many scientific papers were submitted to CIE conferences.

“Digital products” was another major theme with CIE’s support and signing of the BIPM’s Joint Statement of Intent on the digital transformation in the international scientific and quality infrastructure. CIE has now published a set of CIE Datasets on CIE website including metadata according to FAIR principles. New TCs are in planning, which have a strong emphasis on the creation of digital products:

- Software Validation Spectra, Derived Quantities and Metrics
- Standard File Format for Electronic Transfer of Optical Radiation Data for Luminaires, Lamps and LED modules

## 10.2.6 Administrative Matters and Communication

All communications to the Division, the publication of D2 meeting documents and Division ballots are done using the IEC Collaboration Tool, which was replaced by the IEC Collaboration Platform. In the period 2019–2023, a total of 52 D2 letter ballots were conducted, which included D2 management decisions and publication approvals. Ballots on critical D2 management items (e.g. creation of new TCs) are carried out in two steps: a commenting/discussion phase (typically 1 month) and a Yes/No/Abstain ballot (1 month).

Furthermore, the D2 Division Associate room includes about 240 people interested in D2 activities. About 25 communiqués were sent out to D2 Division Associate room. All TCs in Division 2 are using the Collaboration Tool/Platform.

- To further prioritize the work of our TCs, D2 Management Team has identified a small number of TCs (typically between 3 and 5) that are of special relevance and time-critical to the stakeholders. These “urgent” TCs get support by a “mentor”, i.e. a dedicated Associate Division Director but are also closely monitored. This has had a positive impact on the progress of these urgent TCs. The present urgent TCs at the end of the term are:
- TC 2-86 Glare Measurement by Imaging Luminance Measurement Device (ILMD), TCC: Jan Wienold (CH), Mentor: Hiroshi Shitomi (JP);
- TC 2-89 Measurement of Temporal Light Modulation of Light Sources and Lighting Systems, TCC: Cherry Li (CN), Mentor: Joanne Zwinkels (CA);
- TC 2-90 LED Reference Spectrum for Photometer Calibration (recently published), TCC: Tuomas Poikonen (FI), Mentor: Armin Sperling (DE);
- TC 2-96 Revision of ISO/CIE 19476:2014: Characterisation of the performance of illuminance meters and luminance meters, TCC: Armin Sperling (DE), Mentor: Dong-Hoon Lee (KR).

## 10.2.7 Publications

### 10.2.7.1 Published During the Term

#### 10.2.7.1.1 CIE Technical Reports

- CIE 251:2023 LED Reference Spectrum for Photometer Calibration
- CIE 250:2022 Spectroradiometric measurement of optical radiation sources
- CIE 244:2021 Characterization of Imaging Luminance Measurement Devices (ILMDs)
- CIE 242:2020 Photometry of Curved and Flexible OLED and LED Sources

- CIE 239:2020 Goniospectroradiometry of Optical Radiation Sources
- CIE 238:2020 Characterization of AC-Driven LEDs for SSL Applications
- CIE 237:2020 Non-Linearity of Optical Detector Systems
- CIE 241:2020 Recommended Reference Solar Spectra for Industrial Applications
- CIE 235:2019 Optical Measurement of LED Modules and Light Engines
- CIE 233:2019 Calibration, Characterization and Use of Array Spectroradiometers
- CIE 231:2019 CIE Classification System of Illuminance and Luminance Meters
- CIE 018:2019 The Basis of Physical Photometry, 3rd Edition

#### **10.2.7.1.2 CIE Standards**

- CIE S 017/E:2020 ILV: International Lighting Vocabulary, 2nd Edition
- CIE S 025-SP1/E:2019 Test Method for OLED Luminaires and OLED Light Sources

#### **10.2.7.1.3 Joint ISO/IEC/CIE Standards**

- ISO/CIE 11664-2:2022(E) Colorimetry — Part 2: CIE Standard Illuminants

#### **10.2.7.1.4 CIE Draft Standards**

- CIE DIS 017-SP2:2023 ILV: International Lighting Vocabulary –Supplement 2: Terms and Definitions for Horticultural Lighting
- ISO/CIE DIS 23539:2021 Photometry – The CIE system of physical photometry
- CIE DIS 027:2021 Photometry of road illumination devices, light signalling devices and retroreflective devices for road vehicles.

#### **10.2.7.1.5 CIE Technical Notes**

- CIE TN 013:2022 Terms related to Planckian radiation temperature for light sources
- CIE TN 012:2021 Guidance on the Measurement of Temporal Light Modulation of Light Sources and Lighting Systems
- CIE TN 010:2019 Determination of the Optical Beam Axis, Centre Beam Intensity, and Beam Angle of Directional Light Sources
- CIE TN 009:2019 The Use of “Accuracy” and Related Terms in the Specifications of Testing and Measurement Equipment

#### **10.2.7.1.6 Proceedings**

- CIE x049:2022 Proceedings of the CIE symposium on the advances in measurement of temporal light modulation, October 11, 2022, Athens, Greece

#### **10.2.7.1.7 Reports by Reportership**

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#### **10.2.7.2 Expected**

The following TCs are expected to be finishing their work and publishing soon

- TC 2-67 Photometry of Lighting and Light-signalling Devices for Road Vehicles, Chair: Thomas Reiners (DE)
- TC 2-68 Optical Measurement Methods for OLEDs used for Lighting, Chair: Hiroshi Shitomi (JP)
- TC 2-78 The Goniophotometry of Lamps and Luminaires, Chair: Tony Bergen (AU)

- TC 2-79 Integrating sphere photometry and spectroradiometry, Chair: Dong-Hoon Lee (KR)
- TC 2-81 Update of CIE 065:1985 (Absolute Radiometers), Chair: Marek Smid (CZ)
- TC 2-82 Revision of CIE S014-2, Chair: Peter Csuti (HU)

### 10.2.7.3 Review

#### 10.2.7.3.1 Reviewed Publications

The status of all publications is maintained in a spreadsheet. The review of status is done according to the Code of Procedure (i.e. every 5 years for Technical Reports and 3 years for International Standards).

The following publications are listed as “Current”:

- CIE 244:2021 Characterization of Imaging Luminance Measurement Devices (ILMDs)
- CIE TN 012:2021 Guidance on the Measurement of Temporal Light Modulation of Light Sources and Lighting Systems
- CIE 242:2020 Photometry of Curved and Flexible OLED and LED Sources
- CIE 241:2020 Recommended Reference Solar Spectra for Industrial Applications
- CIE 239:2020 Goniospectroradiometry of Optical Radiation Sources
- CIE 238:2020 Characterization of AC-Driven LEDs for SSL Applications
- CIE 237:2020 Non-Linearity of Optical Detector Systems
- CIE TN 010:2019 Determination of the Optical Beam Axis, Centre Beam Intensity, and Beam Angle of Directional Light Sources
- CIE 235:2019 Optical Measurement of LED Modules and Light Engines
- CIE TN 009:2019 The Use of “Accuracy” and Related Terms in the Specifications of Testing and Measurement Equipment
- CIE 233:2019 Calibration, Characterization and Use of Array Spectroradiometers
- CIE 231:2019 CIE Classification System of Illuminance and Luminance Meters
- CIE 018:2019 The Basis of Physical Photometry, 3rd Edition
- CIE 198-SP2:2018 Determination of Measurement Uncertainties in Photometry Supplement 2: Spectral measurements and derivative quantities
- CIE 220:2016 Characterization and Calibration Methods of UV Radiometers
- CIE 214:2014 Effect of Instrumental Bandpass Function and Measurement Interval on Spectral Quantities
- CIE 198:2011 Determination of Measurement Uncertainties in Photometry
- CIE 182:2007 Calibration methods and photoluminescent standards for total radiance factor measurements
- CIE 179:2007 Methods for characterising tristimulus colorimeters for measuring the colour of light
- ISO 11664-2:2007(E)/CIE S 014-2/E:2022 Colorimetry — Part 2: CIE Standard Illuminants for Colorimetry
- CIE 176:2006 Geometric tolerances for colour measurements
- CIE 054.2-2001 Retroreflection: Definition & Measurement

The following publications are listed as “Under revision or replacement”:

- CIE S 025-SP1/E:2019 Test Method for OLED Luminaires and OLED Light Sources

- DIS 025-SP1/E:2019 Test Method for OLED Luminaires and OLED Light Sources
- CIE 226:2017 High-Speed Testing Methods for LEDs
- CIE 225:2017 Optical Measurement of High-Power LEDs
- CIE S 025/E:2015 Test Method for LED Lamps, LED Luminaires and LED Modules
- ISO/CIE 19476:2014(E) Characterization of the Performance of Illuminance Meters and Luminance Meters
- CIE 130-1998 Practical Methods for the Measurement of Reflectance and Transmittance
- CIE 084-1989 Measurement of luminous flux
- CIE 070-1987 The measurement of absolute luminous intensity distributions

The following publications are listed as "Revision recommended":

- CIE 229:2018 Groundwork for Measurement of Effective Intensity of Flashing Lights
- CIE 059-1984 Polarization: Definitions and nomenclature, instrument polarization
- CIE 046-1979 A review of publications on properties and reflection values of material reflection standards
- CIE 044-1979 Absolute methods for reflection measurements
- CIE 043-1979 Photometry of floodlights
- CIE 038-1977 Radiometric and photometric characteristics of materials and their measurement

The following publications are listed as "Historical":

- CIE x041:2016 Proceedings of CIE Expert Symposium on the CIE S 025 LED Lamps, LED Luminaires and LED Modules Test Standard, November 2015, Braunschweig, Germany
- CIE x040:2014 Proceedings of CIE Expert Symposium on Measurement Uncertainties in Photometry and Radiometry for Industry, September 2014, Vienna, Austria
- CIE x036:2010 Proceedings of the CIE Expert Symposium on Spectral and Imaging Methods for Photometry and Radiometry, 30–31 August 2010, Bern, Switzerland
- CIE x033:2008 Proceedings of the 2nd CIE Expert Symposium on "Advances in Photometry and Colorimetry", 7–8 July 2008, Turin, Italy
- x029:2006 Proceedings of the 2nd CIE Expert Symposium on Uncertainty, 12–13 June 2006, Braunschweig, Germany
- x028:2005 Proceedings of the CIE Symposium 2005 "Vision and Lighting in Mesopic Conditions", 21 May 2005, Leon, Spain
- CIE 153:2003 Report on intercomparison of measurement of the luminous flux of high-pressure sodium lamps
- x025:2003 Proceedings of the CIE Symposium 2002 on "Temporal & Spatial Aspects of Light and Colour Perception and Measurement", 22–23 August 2002, Veszprém, Hungary
- x022:2001 Proceedings of the 2nd CIE Expert Symposium on LED Measurement "Standard methods for specifying and measuring LED and LED cluster characteristics"
- x018-1999 Proceedings of the CIE Symposium '99 "75 years of CIE photometry", 30 September–2 October 1999, Budapest, Hungary
- CIE 122-1996 The Relationship between digital and colorimetric data for computer-controlled CRT displays
- x009-1995 Proceedings of the CIE Expert Symposium '95 on "Advances in Photometry", 1–3 December 1994, Vienna, Austria
- CIE 114-1994 CIE Collection in photometry and radiometry
- CIE 089-1991 CIE Technical Collection 1990

- CIE 076-1988 Intercomparison on measurement of (total) spectral radiance factor of luminescent specimens

## 10.2.8 Technical Committees (TCs)

### 10.2.8.1 Closed TCs

TC 2-29	Measurement of Detector Linearity (chair: George Eppeldauer, US), started in 1988
TC 2-50	Measurement of the Optical Properties of LED Assemblies (chair: Richard Distl, DE), started in 1999
TC 2-59	Characterisation of Imaging Luminance Measurement Devices (chair: Udo Krueger, DE), started in 2004
TC 2-74	Goniospectroradiometry of Optical Radiation Sources (chair: Jianguan Pan, CN), started in 2011
TC 2-75	Photometry of Curved and Flexible OLED and LED Sources (chair: Hsueh-Ling Yu, TW), started in 2011
TC 2-76	Characterization of AC-Driven LED Products for SSL Applications (chair: Pei-Ting Chou, TW), started in 2011
TC 2-80	Spectroradiometric measurement of light sources (chair: Tobias Schneider, DE), started in 2013

### 10.2.8.2 New and Closed TCs

#### 10.2.8.2.1 TCs in Progress

TC 2-62	Imaging-Photometer-Based Near-Field Goniophotometry (chair: Udo Krueger, DE), started in 2007
TC 2-67	Photometry of Lighting and Light-signalling Devices for Road Vehicles (chair: Thomas Reiners, DE), started in 2010
TC 2-68	Optical Measurement Methods for OLEDs used for Lighting (chair: Yasuki Yamauchi, JP), started in 2010
TC 2-77	Fundamental Concepts (chair: Tony Bergen, AU), started in 2013
TC 2-78	The Goniophotometry of Lamps and Luminaires (chair: Tony Bergen, AU), started in 2013
TC 2-79	Integrating sphere photometry and spectroradiometry (chair: Dong-Hoon Lee, KR), started in 2013
TC 2-81	Update of CIE 065:1985 (Absolute Radiometers) (chair: Smid Marek, CZ), started in 2015
TC 2-84	Recommendations on LED package test data reporting (chair: Andras Poppe, HU), started in 2016
TC 2-85	Recommendation on the geometrical parameters for the measurement of the Bidirectional Reflectance Distribution Function (BRDF) (chair: Gaël Obein, FR), started in 2016
TC 2-86	Glare Measurement by Imaging Luminance Measurement Device (ILMD) (chair: Jan Wienold, CH), started in 2016

TC 2-89	Measurement of Temporal Light Modulation of Light Sources and Lighting Systems (chair: Qian (Cherry) Li, CN), started in 2017
TC 2-91	Optical Measurement Methods of LED Packages and LED Arrays (chair: Markus Schneider, DE), started in 2018
TC 2-94	Measurement of Total Transmittance, Diffuse Transmittance and Transmittance Haze (chair: Hsueh-Ling Yu, TW), started in 2019
TC 2-95	Measurement of Obtrusive Light and Sky Glow (chair: Constantinos Bouroussis, GR), started in 2021
TC 2-96	Revision of ISO/CIE 19476: 2014 Characterisation of the performance of illuminance meters and luminance meters (chair: Armin Sperling, DE), started in 2021
TC 2-97	Revision of CIE S 025/E:2015 Test Method for LED Lamps, LED Luminaires and LED Modules and its supplement (chair: Anders Torseth, DK), started in 2022

### 10.2.8.3 New TCs

TC 2-98	Revision of CIE 130-1998, Practical Methods for the Measurement of Reflectance and Transmittance (Catherine Cooksey, US)
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### 10.2.8.4 Proposed TCs

- Standard File Format for Electronic Transfer of Optical Radiation Data for Luminaires, Lamps and LED modules with TCC Danilo Giannetti (IT)

### 10.2.9 Reporterships (DRs)

#### 10.2.9.1 Closed DRs

R 2-70	Guide for the Field Photometric Measurements for the Verification of Lighting Systems (Roman Dubnicka, SK)
R 2-76	TN on measurement uncertainties for testing of LED Lamps, Luminaires and Modules (Yoshi Ohno, US)
R 2-77	Measurement of Quantities Relating to Photobiological Safety of Lighting Products (Tongsheng Mou, CN)
R 2-78	Investigation of the need for documentary guidance relating to 0°:d (d:0°) reflectance instrument (Annette Koo, NZ)
R 2-79	Measurement of total transmittance, diffuse transmittance, and transmittance haze (Hsueh-Ling Yu, TW)
R 2-83	Characterization and measurement of horticultural lighting products (Qian (Cherry) Li, CN)
R 2-85	Quality indices for light dosimeters including visual and non-visual effects (Florian Stuker, CH)
R 2-86	Definitions for bidirectional scattering surface reflectance distribution function (BSSRDF) (Alejandro Ferrero, ES)

### 10.2.9.2 New and Closed DRs

R 2-88	Temperature quantities used in colour appearance properties of light sources (Richard Young, DE)
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### 10.2.9.3 DRs in Progress

R 2-64	Review of Draft TC 2-82 in preparation of archiving it as a D2 internal report (Edwin Mofokeng, ZA)
R 2-69	TN on the validation of a near-field goniophotometer in support of CIE S 025 (Johannes Ledig, DE)
R 2-74	Physical characterisation of new visual effects in the field of appearance of materials (Alejandro Ferrero, ZA)
R 2-80	Metrology of laser-based lighting (Anders Thorseth, DK)
R 2-81	Flash effective intensity calculation (Couzin Dennis, US)
R 2-82	TN on Clarification of the difference between adjustment, calibration and verification (Menegotto Thiago, BR)
R 2-87	Terminology in single/few photon metrology (Dong-Hoon Lee, KR)

### 10.2.9.4 New DRs

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### 10.2.9.5 Proposed DRs

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### 10.2.10 Official Liaisons

D2 has the following record of official Liaison Representatives and Division Correspondents:

No	Organization	Liaison Officer to D2	Liaison Officer from D2
L 2-01	CCPR - Consultative Committee of Photometry and Radiometry	Yoshi Ohno	DD2
L 2-03	ISO TC6 Paper, board & pulps	Luke Sandilands	
L 2-04	IEC TC 34: Lamps and related equipment	Quan Li	Guy Vandermeersch
L 2-05	ISO Reflectance and Transmittance Issues		
L 2-08	EURAMET/20NRM01/MetTLM "Metrology for temporal light modulation"		Dong-Hoon Lee
L 2-12	Monitoring progress in EMPIR	Marek Smid	
L 2-13	Technical Committee of Standardization (TCS) of the International SSL Alliance	He Yang	
L 2-14	IEC TC34/JWG21 Photobiological Safety	Hiroshi Shitomi	
DC 2-01	ICDM		Udo Krueger
DC 2-03	OIML TC 11 & TC 14	Armin Sperling	
DC 2-07	IALA (International Association of Lighthouse Authorities)		Alwyn Williams

### 10.2.11 Future Activities

We continue to work closely with the Consultative Committee on Photometry and Radiometry (CCPR), and an event is in planning to celebrate the 100<sup>th</sup> anniversary of  $V(\lambda)$  in Paris in June 2024. It is also planned that the D2 annual meeting and TC meetings will be held in conjunction with this event. We will continue to monitor the development of cone fundamentals and how they could be applied effectively to photometry.

D2 is planning more activity on support for laboratories, particularly second and third tier laboratories, on evaluation of measurement uncertainties, mainly using the Monte Carlo method. It is anticipated that there will be several TCs created to support this work.

In the past, we have held focused, laboratory-based workshops such as on S 025-SP1/E:2019. These included basic theory but also practical demonstrations. These were put on hold due to COVID-19, but with when the revision of S 025-SP1/E:2019 is finished, they could be resumed, including in other areas such as Asia, South America, Africa.

## **10.3 Division 3: Interior Environment and Lighting Design Quadrennial Report 2019–2023, Peter Thorns, UK (DD)**

### **10.3.1 Terms of Reference**

Division 3 of the CIE is concerned with factors which influence the satisfaction of the occupants of a building with their environment, including the effects of both daylighting and electric lighting.

Its objectives are to study and evaluate those factors to provide guidance on relevant design criteria, to study design techniques (including relevant calculations) for the interior lighting of buildings, to incorporate the findings and those of other CIE divisions into lighting guides for interiors in general or of particular types.

### **10.3.2 Division Officers**

2015–2019:

Director:	Jennifer A. Veitch (CA)
Associate Director 1 (Daylighting):	John Mardaljevic (UK)
Associate Director 2 (Electric Lighting):	Nozomu Yoshizawa (JP)
Secretary:	Martine Knoop (DE)
Editor:	Peter Thorns (UK)

2019–2023:

Director:	Peter Thorns (UK)
Associate Director 1 (Daylighting):	Martine Knoop (DE)
Associate Director 2 (Electric Lighting):	Nozomu Yoshizawa (JP)
Secretary:	Adrie de Vries (NL)
Editor:	Veronica Garcia-Hansen (AU)

### **10.3.3 Division Meetings**

- 2019: Washington, DC, 21-Jun-2019: The meeting was held in conjunction with the 29th Session of the CIE. There were 35 attendees from 19 countries, including 13 national representatives.
- 2020: Online, 6<sup>th</sup>-Jul-2020: There were 26 attendees from 17 countries, including 16 national representatives
- 2021: Online, 29<sup>th</sup> -Jun-2021: There were 31 attendees from 21 countries including 20 national representatives
- 2022: Online, 27<sup>th</sup>-Jun-2022: There we 27 attendees from 19 countries including 18 national representatives
- 2023: Ljubljana, Slovenia, 2023-09-21 (meeting held in conjunction with the 30th Session of the CIE)

### **10.3.4 Symposia and Workshops**

An internal Division 3 workshop was held in 2023 as a part of the Divisional meeting, asking whether we at CIE have enough courage to create a new system of metrics, do the basic research and make recommendations for measurement and verification, as standards themselves do not create new standards. Three short presentations were given.

Pordis Hardardottir referred to defining and communicating lighting intent, and on the difficulties and importance of dynamic lighting solutions. Specifically with respect to metrics, she pointed out that the current metrics do not consider that lighting design is a lot about ratios; from a planning perspective, a “task” lighting solution may not meet the required standardized lighting

level, but with the desired luminance ratios of a lighting design, all lighting levels would need to be increased for compliance, which would unnecessarily increase the overall energy demand.

Peter Boyce discussed which metrics and measures are routinely used in indoor lighting design, which could be used and which should be used. He pointed out the shortcomings of existing metrics and suggested alternatives for metrics that provide a more comprehensive picture of the quality of a lighting solution. In general, the level of detail of available data from the environment determines which metrics and measures can be used for a more detailed quality assessment.

Kevin Shaw showed how illuminance requirements have increased in the past without any clear reason for this and questioned why street lighting is rated based on luminance but indoor lighting is not, although this has been a topic in the past. According to Kevin Shaw, even though a luminance-based approach is easier for lighting designers, LiDO is a very useful tool to support a room-based lighting design, also for engineers who are more concerned with numbers.

Key discussion points were as follow:

- Do we need to introduce other metrics for modelling of LED packages, beyond useful lifetime based on luminous flux depreciation? Possibly deterioration in stability, more flicker and shift in colour. We are coming to the end of age of the first generation of LEDs, and there seems not to be much research on how these LEDs fail.
- Can we offer categories or other building blocks to close “the gap”, and support the usage of LiDO by lighting engineers? It is not difficult to use and helps you think about how the lighting should be in the room.
- To what extent is the colour setting of a room part of the lighting design? We do not have a say about the colour setting, but will try to enhance what the architect is trying to achieve. For this, it is necessary to discuss the function of the colour and the priority of other functions in the space. If you have a given colour, you will try to support that with the light source. If you do not know, you will make assumptions about the reflection.
- We are all in different sub-disciplines, and each discipline has difficulties with the requirements of other disciplines. We have experience and some understanding of colour, and thus we can respond to these requirements. With the circadian stimulus it is still more difficult. In fact, we need to think more about people that work at night. We cannot do anything with lighting for people in a rotating night shift.
- What about the adaptation level, if we are aware of contrast and contrast sensitivity? Do we need to look at adaptation levels to know more about colour contrast and brightness contrast? We have a huge range of adaptation, and this is not considered in the design approach at all. We do not usually have a uniform visual field, so adaptation is a topic.
- People, not lighting experts, do not really have a problem with bad lighting, if glare and flicker are taken care of. Until we can define why it is important and what lighting quality is, we cannot really move away from putting 6 luminaires up in a class room. Do we need uniformity as a quality criterion, if not, why is it still included in the standard? Uniformity will give you flexibility if you want to be able to move furniture. We need to know the user of the space and where they are. Lighting should be in line with the intent.

### **10.3.5 Strategy**

In 2019 meeting, the following items were identified for consideration within Division 3:

- Integration of daylight and artificial light,

- Determination method of lighting requirements for workplaces,
- Better methods for daylight provision,
- Office lighting,
- Healthcare lighting,
- Perceived room brightness,
- The effect of coloured light in indoor applications,
- User reaction to lighting management interfaces,
- Colour rendering of glass,
- Revision of CIE 60,
- Lighting for myopia,
- Industry lighting,
- Museum lighting,
- Emergency lighting,
- Spectral sky measurements,
- Glare

### **10.3.6 Administrative Matters and Communication**

A Division 3 newsletter was initiated to update members on activities and opportunities.

As a part of the 2023 Quadrennial Divisional meeting, a poll was performed. Responses for questions;

#### What makes it difficult to participate or be more active in CIE activities?

- Time
- Distance
- Language
- Budget
- Unclear returns
- Slow progress
- Manager permission
- Time difference
- Recognition
- Copyright

#### What is the main benefit of being active in CIE?

- Knowledge
- Expertise
- Influence
- Network
- Collaboration
- Updated on research advances

Can you give one suggestion what CIE CB or Division 3 Officers can do to support your activities within CIE?

- Use collaboration tool better
- More journal articles out of reports
- More publications
- Hybrid meetings
- More information
- Access to different resources
- Open access
- Clarify code compliance
- Promote the use of TC output

### **10.3.7 Publications**

#### **10.3.7.1 CIE Technical Reports**

- CIE 232:2019 Discomfort Caused by Glare from Luminaires with a Non-Uniform Source Luminance

#### **10.3.7.2 CIE Standards**

- CIE S 017/E:2020 International Lighting Vocabulary (2<sup>nd</sup> Edition)

#### **10.3.7.3 Joint ISO/IEC/CIE Standards**

- ISO/CIE TS 22012:2019(E) Light and Lighting — Maintenance Factor Determination — Way of Working
- ISO/CIE 20086:2019(E) Light and Lighting — Energy Performance of Lighting in Buildings

#### **10.3.7.4 CIE Draft Standards**

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#### **10.3.7.5 CIE Technical Notes**

- CIE TN 011:2020 What to Document and Report in Studies of iPRGC Influenced Responses to Light
- CIE TN 014:2023 Example Measurement Setup for UGR

#### **10.3.7.6 Proceedings**

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### **10.3.8 Technical Committees (TCs)**

#### **10.3.8.1 Closed TCs**

TC 3-55	Metrics for sunlighting and daylight passing through sunshading devices (chair: Marc Fontoynt), started in 2012
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#### **10.3.8.2 New and Closed TCs**

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### 10.3.8.3 TCs in Progress

TC 3-58	Visual Ergonomics and Digital Display Use Current status - committee draft corrected according to comments from CB is now circulated among TC members (till September 11th) (chair: Thomas Reiners, DE), started in 2010
TC 3-54	Revision of CIE 16-1970: Daylight (chair: Yannick Sutter, FR), started in 2012
TC 3-59	The integration of daylight and electric lighting – photometric, colorimetric and radiometric requirements for the spectral design of indoor lighting (chair: Peng Xue, CN), started in 2021
TC 3-60	Spectral Daylight Characteristics (chair: Toshie Iwata, JP), started in 2015
TC 3-56	Assessment of Discomfort Glare from Daylight in Buildings (chair: Martine Knoop, DE), started in 2021
TC 3-57	A Generic Discomfort Glare Sensation Mode (chair: Gilles Vissenberg, NL), started in 2020
JTC 6	Energy performance of lighting in building (chair: Thomas Reiners, DE), started in 2015
JTC 8	Terminology in light and lighting (chair: Laura Bellia, IT), started in 2015
JTC 13	Depreciation and maintenance of lighting systems (chair: Dionyz Gasparovsky, SK), started in 2018
JTC 15	Lighting of indoor workplaces (ISO/TC 274 JWG5) (chair: Etsuko Mochizuki, JP), started in 201
JTC 18	Lighting education (chairs: Piotr Pracki, PL; Dionyz Gasparovsky, SK), started in 2019

### 10.3.8.4 New TCs

TC 3-62	Resilient Lighting (Yuki Akizuki, JP)
TC 3-63	Decision scheme to determine lighting requirements for indoor environments (Anna Pellegrino, IT)
TC 3-61	Review of regional daylight requirement to assess the feasibility of global harmonization (Claudia Amorin, BR)

### 10.3.8.5 Proposed TCs

Resilient Lighting	proposed TCC Prof. Akizuki
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### 10.3.9 Reporterships (DRs)

#### 10.3.9.1 Closed DRs

DR 3-33	PoE guidelines
DR 3-3	Luminance Measurement for UGR (CIE TN 014:2023)

#### 10.3.9.2 New DRs

DR 3-37	Use of VR for lighting research on indoor spaces (Kynthia Chamilothoni, NL)
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### 10.3.10 Liaisons

#### 10.3.10.1 Official Liaisons

ISO/TC 159/SC 4	Ergonomics of human-system interaction
ISO/TC 159/SC 5	Ergonomics of the physical environment
ISO/TC 160	Glass in buildings
ISO/TC 160/SC 2	Use considerations
ISO/TC 163	Thermal performance and energy use in the built environment
ISO/TC 163/SC 2	Calculation methods
ISO/TC163/WG4	Joint ISO/TC 163 - ISO/TC 205 WG: Energy performance of buildings using holistic approach
ISO/TC 205/WG 7	Indoor Visual Environment
CEN/TC169/WG2	Lighting of Work Places
CEN/TC169/WG3	Emergency Lighting in Buildings
CEN/TC169/WG9	Energy Performance of Buildings
CEN/TC169/WG11	Daylight
Illuminating Engineering Institute of Japan	
International Dark-Sky Association	

#### 10.3.10.2 Informal Contacts

International Association of Lighting Designers

#### 10.3.11 Future Activities

These were embodied within the strategy.

#### 10.3.12 Other Achievements, Issues, etc.

An exercise was performed to identify key historical papers from the history of CIE and Division 3 to publish open access. This was subsequently extended to all Divisions.

## **10.4 Division 4: Transportation and Exterior Applications Quadrennial Report 2019–2023, Dionyz Gasparovsky, SK (DD)**

### **10.4.1 Terms of Reference**

To study and prepare guides for the design of exterior lighting and light signalling.

### **10.4.2 Division Officers**

Half-term 2015–2017, Division 4:

Director:	Ron Gibbons (US)
Associate Director 1:	Yandan Lin (CN)
Associate Director 2:	Dionyz Gasparovsky (SK)
Secretary:	Maurice Donners (NL)
Editor:	Nigel Parry (GB)

Half-term 2015–2017, Division 5:

Director:	Peter Schwarcz (HU)
Secretary:	Dionyz Gasparovsky (SK)
Editor:	Warren Julian (AU)

Half-term 2017–2019, Division 4:

Director:	Dionyz Gasparovsky (SK)
Associate Director 1:	Steve Fotios (GB)
Associate Director 2:	Raoul Lorphevre (BE)
Associate Director 3:	Sermin Onaygil (TR)
Secretary:	Maurice Donners (NL)
Editor:	Nigel Parry (GB)

2019–2023:

Director:	Dionyz Gasparovsky (SK)
Associate Director 1:	Steve Fotios (GB)
Associate Director 2:	Raoul Lorphevre (BE) (2019–2020) Maurice Donners (NL) (2021–2023)
Associate Director 3:	Sermin Onaygil (TR)
Secretary:	Maurice Donners (NL) (2019–2021) Steve Lau (CN) (2021–2023)
Editor:	Nigel Parry (GB)

### **10.4.3 Division Meetings**

- 2019: Washington D.C. (US), 20–21 June, 2019  
(meeting held in conjunction with the CIE 2019 29<sup>th</sup> Quadrennial Session)  
43 attendances including 12 national representatives
- 2020: Webex, 20 May 2020  
36 attendances including 20 national representatives

- 2021: Webex, 12&14 October 2021  
33 attendances including 18 national representatives
- 2022: Prague (CZ), 23–24 September 2022  
(meeting held in conjunction with the LUX EUROPA 2022 Conference)  
19 attendances (16 onsite, 3 online) including 11 national representatives
- 2023: Istanbul (TR), 03 May 2023 (Biannual Division Meeting)
- 2023: Ljubljana (SI), 21–22 September 2023  
(meeting held in conjunction with the CIE 2023 30<sup>th</sup> Quadrennial Session)  
16 attendances including 5 national representatives

#### 10.4.4 Symposia and Workshops



- 2020: CIE Workshop on the Calculation and Measurement of Obtrusive Lighting  
(Joint with Division 2)  
Ostrava (CZ) + online, 12–13 November, 2020



- 2023: CIE Tutorial on Urban Lighting Masterplanning Istanbul  
Istanbul (TR), 04–05 May, 2023

#### 10.4.5 Strategy

**Back to roots:** Many new topics and work items have been opened previously. However, it has been proved that there is strong need to update Technical Reports of key significance to the Division – road lighting as traffic accidents countermeasure, road lighting recommendations, lighting of urban areas, road lighting calculations.

**Lighting for future:** The Division's wish list comprises new work item proposals calling for attention. It will also be necessary to follow the CIE Research Strategy and to report state-of-the-art in many specific fields of modern outdoor lighting with aspects focused on digitalization, ageing population, promoting healthy travel, environmental impacts etc. Problems like lighting in pandemic periods, energy crisis and other unusual conditions are challenging and need to be addressed.

**Enhancing involvement:** There is still gap in involvement of Division Members in everyday life and work of the Division. Balloting rate is below expectations. Annual Division Meetings are long and exhausting, resulting in reduction of participants' attention. Intended measure is to organize a certain number of short but straightforward and effective online meetings of the Division throughout the year between annual meetings. Ballots will be batched and aligned with these meetings where accompanying explanations will be given. More operative Letter Ballots will be applied to urgent matters.

**New approach to collaborations:** Former Liaison Officers regularly reported within annual Division meetings. However, as it has been found out, many Division Members are even not aware about mission of our partners. It has been decided that this reporting will be taken out of the annual meetings programme and a self-standing time slot within the technical meetings schedule will be dedicated to collaborations. New entities – Liaison Representatives and Division Correspondents will be requested to present the mission, structure (committees, working groups), current works, future plans and everything else that might be important or to the interest of the CIE Division 4, in a more interactive way. The officers will be invited to attend some of the DMT meetings to coordinate actions where particular works are running or where transfer of information is needed.

**Improvement of the administration:** Minor improvements would be beneficial to increase the effectiveness of the Division's administration. Associate Directors will have clearer outline of their duties and stronger position in managing of the Division, having ability to back up the Director and looking towards smooth continuation of the Division's management once the next term will come near the end.

#### 10.4.6 Administrative Matters and Communication

**Biannual Division Meetings:** New format of Division Meeting is proposed, tried and tested. Biannual meetings, to be held approximately in a half-year period between regular annual meetings aim to lessen burden on annual meetings, avoid long lasting and two-part-split meetings, limiting the meeting length to maximum three hours. First rehearsal biannual meeting has been held in Istanbul (TR) in conjunction with the Urban Lighting Masterplanning Tutorial, feedbacked positively. Agenda points to be moved to biannual meetings include: reporters, liaisons, research (including Research Fora), education, standardization, also brief summary of TC progress reports and New Work Item Proposals in addition to annual meetings in order to be more responsive to the actual needs.

**Interim Division Meetings:** Additional online operative Division meetings can be called twice a year objectives of which include amongst others collecting ballots for online voting where a chance is given to explain the subject of ballots and to give opportunity for questions.

**Deeper involvement of Division Members:** Individual communications with "less active" Division Members, encouraging National Committees to nominate their representative for void Division Member position. Strategy for more operative communication with Division Members comprise actions such as sorting and sending CIE news and D4 news, arranging quick polls to know opinion of DMs, etc.

#### 10.4.7 Publications

##### 10.4.7.1 Published During the Term

###### 10.4.7.1.1 CIE Technical Reports

- CIE 243:2021 (CN) 道路照明和车辆照明中的不舒适眩光
- CIE 243:2021(ES) Deslumbramiento molesto en la iluminación de carreteras y vehículos
- CIE 243:2021 Discomfort Glare in Road Lighting and Vehicle Lighting
- CIE S 017/E:2020 ILV: International Lighting Vocabulary, 2nd Edition
- CIE 236:2019 Lighting for Pedestrians: A Summary of Empirical Data

- CIE 234:2019 (CN) 城市照明总体规划指南
- CIE 234:2019 (ES) Guía para un plan director de iluminación urbana
- CIE 234:2019 A Guide to Urban Lighting Masterplanning
- CIE 083:2019 Guide for the Lighting of Sports Events for Colour Television and Film Systems, 3rd Edition
- CIE 140:2019 Road Lighting Calculations, 2nd Edition

#### 10.4.7.1.2 CIE Standards

- CIE S 017/E:2020 ILV: International Lighting Vocabulary, 2nd Edition

#### 10.4.7.1.3 Joint ISO/IEC/CIE Standards

- ISO/CIE 8995-3:2018(E) Lighting of Work Places – Part 3: Lighting Requirements for Safety and Security of Outdoor Work Places
- ISO/CIE TS 22012:2019(E) Light and Lighting — Maintenance Factor Determination — Way of Working

### 10.4.8 Technical Committees (TCs)

#### 10.4.8.1 Closed TCs

TC 4-33	Discomfort Glare in Road Lighting (chair: Stephan Völker, DE), closed 2021
TC 4-51	Optimization of Road Lighting (chair: Pal J. Larsen, NO), closed 2022
TC 4-52	Lighting for Pedestrians: New Empirical Data (chair: Steve Fotios, GB), closed 2019
TC 4-54	Road Lighting for Ageing Drivers (chair: Maurice Donners, NL), closed 2022
TC 4-56	A Guide to Urban Lighting Masterplanning (chair: Müjgan Serefhanoglu-Sözen, TR), closed 2019

#### 10.4.8.2 New and Closed TCs

#### 10.4.8.3 TCs in Progress

TC 4-11	High Level Matters (chair: Nigel Parry, UK)
TC 4-47	Application of LEDs in Transport Lighting and Signalling (chair: Hugh Barton, UK)
TC 4-50	Road Surface Characterization for Lighting Applications (chairs: Stephan Völker, DE (2019–2021), Valerie Muzet, FR (since 2021))
TC 4-53	Tunnel Lighting Evolution (chair: Jerome Dehon, BE)
TC 4-57	Guide for Sports Lighting (chair: Alan Smith, UK)
TC 4-58	Obtrusive Light from Colourful and Dynamic Lighting and its Limitation (chair: Steve Lau, CN)
TC 4-59	Guide for Lighting Urban Elements (chair:

	Diana del Negro, PT)
TC 4-60	Road Traffic Lights – Photometric Properties of Roundel Signals (chair: Ron Gibbons, US)
JTC 01	Implementation of CIE 191:2010 Mesopic Photometry in Outdoor Lighting (D4/D1/D2) (chair: Stuart Mucklejohn, UK)
JTC 13	Depreciation and Maintenance of Lighting Systems (D4/D3) (chair: Dionyz Gasparovsky, SK)

#### 10.4.8.4 New TCs

TC 4-61	Artificial Lighting and its Impact on the Natural Environment (chair: Annika K Jägerbrand, SE), established 2020
TC 4-62	Adaptive Road Lighting (chair: Thomas Baenziger, CH (2020–2023), Paolo di Lecce, IT (since 2023)), established 2020
JTC 18	Lighting Education (D3/D4) (chair: Piotr Pracki, PL), established 2019

#### 10.4.8.5 Proposed TCs

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#### 10.4.9 Reporterships (DRs)

##### 10.4.9.1 Closed DRs

DR 4-49	Flicker from Lighting on High Speed Road (Chao-Hua Wen, TW), closed 2021
DR 4-51	Visibility and Glare Study of LED Traffic Signs (Tsung-Xian Lee, TW) closed 2021
DR 4-52	Visibility under Adverse Weather Conditions (Chan-Su Lee, KR), closed 2021

##### 10.4.9.2 New DRs

DR 4-50	Document Status and Review (Dionyz Gasparovsky, SK)
DR 4-53	Environmental Aspects of Obtrusive Light from Outdoor Lighting Installations (Constantinos Bouroussis, GR)
DR 4-54	Lighting for Cycling – Establishing the State of Knowledge (Jim Uttley, GB) established 2022

#### 10.4.10 Liaisons

##### 10.4.10.1 Official Liaisons

No	Organization	Liaison Officer
L 4-06	LUCI (Lighting Urban Community International)	(liaison officer: Tuba Baskan, TR (since 2023))

L 4-08	CEN/TC 169/WG12 Road Lighting	(liaison officer: Sermin Onaygil, TR (since: 2020))
L 4-09	ISO/TC22/SC35 Lighting and Visibility	(liaison officer: Paola Iacomussi, IT (since: 2022))

#### 10.4.10.2 Division Correspondents

No	Organization	Liaison Officer
DC4-01	IAU (International Astronomical Union)	(liaison officer: Richard Wainscoat, US), formerly as liaisonship L4-3
DC4-02	PIARC (World Road Association – Permanent International Association of Road Congresses)	(liaison officer: Jean-Claude Martin, FR), formerly as liaisonship L4-4
DC4-03	GTB (The International Automotive Lighting and Light Signalling Expert Group – Groupe de Travail "Bruxelles 1952")	(liaison officer: Ad de Visser, NL (2019–2021), Yandan Lin, CN (since 2021)), formerly as liaisonship L4-5
DC4-04	IALA (International Association of Marine Aids to Navigation and Lighthouse Authorities)	(liaison officer: Alwyn Williams, UK), formerly as liaisonship L4-7

#### 10.4.10.3 Informal Contacts

- IDA (International Dark-sky Association)
- IALD (International Association of Lighting Designers), (A. Tammes), *discontinued*
- ISA (SSL Alliance), (He Yang), *discontinued*

#### 10.4.11 Future Activities

None.

##### 10.4.11.1 Other Issues

None.

## **10.5 Division 6: Photobiology and Photochemistry Quadrennial Report 2019–2023, Luc Schlangen, NL (DD)**

### **10.5.1 Terms of Reference**

To study and evaluate the effects of optical radiation on biological and photochemical systems (exclusive of vision).

### **10.5.2 Division Officers**

2015–2019:

Director:	John O’Hagan (GB)
Associate Director 1:	Karl Schulmeister (AT)
Associate Director 2:	David Sliney (US)
Associate Director 3:	Shu Takeshita (JP)
Secretary:	Luke Price (GB)
Editor:	Eric Liggins (GB)

2019–2023:

Director:	Luc Schlangen (NL)
Associate Director 1:	David Sliney (US)
Associate Director 2:	Shu Takeshita (JP)
Secretary:	Luke Price (GB)
Editor:	Eric Liggins (GB)

### **10.5.3 Division Meetings**

- 2019: Washington (US), 2019-06-20  
Held in conjunction with the 29th CIE Session  
There were 35 participants including 11 national representatives
- 2020: WebEx, 2020-06-30  
Held during the COVID pandemic  
There were 16 participants including 8 national representatives
- 2021: WebEx, 2021-09-09  
Held preceding the CIE Midterm meeting 2021 Malaysia (online)  
There were 15 participants including 8 national representatives
- 2022: WebEx, 2023-10-06  
There were 16 participants including 8 national representatives
- 2023: Ljubljana (SI), 2023-09-21  
Held in conjunction with the 30th CIE Session  
There were 22 participants including 15 national representatives

### **10.5.4 Symposia and Workshops**

CIE/ICNIRP Online Tutorial on the Measurement of Optical Radiation and its Effects on Photobiological Systems (August 25–26, 2020).

CIE S 026:2018 Tutorial - Understanding and application of CIE S 026/E:2018 CIE System for Metrology of Optical Radiation for ipRGC-Influenced Responses to Light (July 6–13, 2021).

Workshop Integrative Lighting Activities and Applications - conveners: Peter Thorns/Luc Schlangen - CIE Midterm Meeting Malaysia (online), Sept 27, 2021.

Workshop Pre-Vitamin D Action Spectrum: Challenging CIE Towards a Standard - convener: Ann Webb - CIE Midterm Meeting Malaysia (online), Sept 27, 2021.

CIE co-sponsored an International Workshop on Measurement and Standardisation of Lighting for Laboratory Mammals, held at the University of Manchester, convenors: Rob Lucas/ Stuart Peirson, February 4–6th, 2023. The consensus view of the workshop is now published as Lucas et al, "Recommendations for measuring and standardizing light for laboratory mammals to improve welfare and reproducibility in animal research", PLOS Biology, 2024.

### 10.5.5 Strategy

The strategy of the division Photobiology and Photochemistry was discussed at the different annual meetings. After the 2022 annual meeting this resulted in the following description of topics and research questions for the division:

#### Divisional description

There are many ways that optical radiation interacts with biological and photochemical systems. We study everything from organic and inorganic photosensitive materials through to sleep and long-term human health.

#### Divisional topics

action spectra, radiometric quantities, terms, definitions and calculations for photochemical, photobiological and related thermal effects of optical radiation

#### Divisional Research Strategy: key themes and questions

The listing below comprises both the current activities, targets and plans as well as longer term external research aspirations of Division 6.

1. Establish (spectral) sensitivity functions and dose-response relationships for photobiological and photochemical effects of optical radiation.
2. Interindividual differences in light sensitivity. To what extent does (personal) light history influence light sensitivity?
3. What daily pattern of light (intensity, spectrum, timing, duration) and dark best supports well-being (for younger and older humans/livestock/organisms)?
  - a. Metrics, methods and devices to characterize (personal) light dose and light-dark patterns accurately across days or even months. Online open access database on typical human light exposure.
  - b. Recommendations for health and wellbeing supportive light exposures and integrative lighting (particular contexts, shift work, light at night indoors,...)?
4. Photobiological safety of lamps, eye safety, (retinal) hazards.
5. Next to circadian regulation, what physiological and psychological processes are influenced by ocular light exposure? To what extent does the amount, timing and spectral composition of light exposure during childhood influence the development/progression of myopia?
6. Current definition of daylight is based on visual sensation only, also the non-visual aspects merit to be included/considered in the definition.
7. Effects of optical radiation (UV-visible-IR-fIR) on humans, for instance Vit D synthesis and medical uses of light like the treatment of hyperbilirubinaemia, skin conditions and Photo Dynamic Therapy.
8. UV disinfection: UV hazard; safety & applications; UV induced mutagenesis in micro-organisms; hybridization of light sources and UV in indoor systems.
9. Impact of solar radiation and artificial light at night on organisms, species, ecosystems and the environment (flora and fauna)
10. Horticulture lighting: terms & definitions, action spectra and new insights.

11. Livestock lighting: There is no international metrology for the spectral sensitivity of livestock (poultry, pigs, cows, sheep, etc.) that enables to specify the quantity and quality of light with respect to its visual and non-visual effects in these species. In humans, proper lighting secures adequate colour vision, supports visual performance and comfort and reinforces health and wellbeing. A new metrology needs to be developed to enable for useful specification and evaluation of lighting installations, as to secure adequate visual performance, comfort and welfare in livestock.

During the first half of 2023, a major revision of the CIE Research Strategy was undertaken and the above divisional input was implemented in this update. In the updated strategy, the CIE aims to contribute to the United Nations 2030 Sustainable Development Goals (SDGs), in particular to SDG numbers 2,3,4, 6, 8, 9 and 10-15. The updated CIE strategy identifies 2 overarching themes (Digital transformation of metrology, science & towards inclusive, equitable lighting) and 6 topical themes/research domains. Three of the topical themes are strongly, but not exclusively, related to D6. These themes are given below along with some key points of attention:

- Integrative lighting for people: designing lighting for individual needs, light/dark patterns and better use of daylight, all with the aim to support human health/wellbeing/vision.
- Fundamentals of photobiology for agriculture and aquaculture: optimal optical radiation for plant and animal facilities.
- Enabling the application of safe & beneficial optical radiation: proper light at the proper time, myopia, effects of actinic and NIR radiation, tracking optical radiation for health/wellbeing.

The updated CIE Research Strategy is launched at the 2023 quadrennial meeting and can be found on the CIE website.

## **10.5.6 Administrative Matters and Communication**

All communications to the Division, the publication of D2 meeting documents and Division ballots are done using the IEC Collaboration Platform. During the 2019–2023 quadrennium, the division conducted 20 ballots and sent out about 65 messages. Ballots on critical items (e.g. creation of new (J)TCs) are typically carried out in two steps: a commenting/discussion phase (typically 1 month) and a Yes/No/Abstain ballot (1 month). Division reporterships are initiated after a 4week enquiry period to collect suggestions and ensure there are no critical objections.

The D6 division associate room contains about 75 people interested in D6 activities, of which 34 are members or alternate members of the division. All (J)TCs of Division 6 are using the IEC Collaboration Platform.

These quadrennial revisions were made to the CIE statutes, CoP and By-Laws. A key change is the split of the existing Board of Administration into a Governing Board (GB) appointed by the National Committees and a Technical Management Board (TMB) appointed by the Governing Board. In this way, the CIE follows the example of the ISO and the IEC.

## **10.5.7 Publications**

### **10.5.7.1 Published During the Term**

#### **10.5.7.1.1 CIE Technical Reports**

- CIE 245:2021 Optical Safety of Infrared Eye Trackers Applied for Extended Durations
- CIE 247:2021 Guide for the Gonioradiometric Measurement of Upper Air Ultraviolet Germicidal Irradiation Luminaires

#### **10.5.7.1.2 CIE standards**

- CIE S 017/E:2020 ILV: International Lighting Vocabulary, 2nd Edition
- CIE S 026:2018 (CN) 内在光敏视网膜神经节细胞受光响应的光辐射计量系统 (CIE System for Metrology of Optical Radiation for ipRGC-Influenced Responses to Light)

#### **10.5.7.1.3 Joint ISO/IEC/CIE Standards**

- ISO/CIE TR 21783:2022 Light and lighting — Integrative lighting — Non-visual effects

#### **10.5.7.1.4 CIE Draft Standards**

- CIE DIS 017-SP2:2023 ILV: International Lighting Vocabulary –Supplement 2: Terms and Definitions for Horticultural Lighting
- ISO/CIE DIS 28077(E):2023 Photocarcinogenesis action spectrum (non-melanoma skin cancers)

#### **10.5.7.1.5 CIE Technical Notes, Toolboxes and User Guides**

- CIE TN 011:2020 What to document and report in studies of ipRGC-influenced responses to light
- CIE S 026  $\alpha$ -opic Toolbox (v1.49a - November 2020)
- CIE S 026 User Guide to the  $\alpha$ -opic Toolbox
- CIE TN 015:2023 Second International Workshop on Circadian and Neurophysiological Photoreception (DR 6-46, Luke Price)

#### **10.5.7.1.6 Reports by Reporterships**

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#### **10.5.7.1.7 Expected**

### **10.5.7.2 Review**

#### **10.5.7.2.1 Reviewed Publications**

No active reviewing of the publications was done during this quadrennium.

#### **10.5.7.2.2 Status of publications**

Current:

- CIE TN 015:2023 Second International Workshop on Circadian and Neurophysiological Photoreception
- CIE DIS 017-SP2:2023 ILV: International Lighting Vocabulary –Supplement 2: Terms and Definitions for Horticultural Lighting
- ISO/CIE DIS 28077(E):2023 Photocarcinogenesis action spectrum (non-melanoma skin cancers)
- ISO/CIE TR 21783:2022(E) Light and lighting — Integrative lighting — Non-visual effects
- CIE 247:2021 Guide for the Gonioradiometric Measurement of Upper Air Ultraviolet Germicidal Irradiation Luminaires
- CIE 245:2021 Optical Safety of Infrared Eye Trackers Applied for Extended Durations
- CIE S 017/E:2020 ILV: International Lighting Vocabulary, 2nd Edition
- ISO/CIE 17166:2019(E) Erythema reference action spectrum and standard erythema dose

- CIE S 026/E:2018 CIE System for Metrology of Optical Radiation for ipRGC-Influenced Responses to Light
- CIE S 026:2018 (CN) 内在光敏视网膜神经节细胞受光响应的光辐射计量系统 (CIE System for Metrology of Optical Radiation for ipRGC-Influenced Responses to Light)
- CIE TN 008:2017 Final Report CIE Stakeholder Workshop for Temporal Light Modulation Standards for Lighting Systems
- CIE 221:2016 Infrared Cataract
- CIE 219:2016 Maintaining Summer Levels of 25(OH)D during Winter by Minimal Exposure to Sunbeds: Requirements and Weighing the Advantages and Disadvantages
- ISO/CIE 28077:2016(E) Photocarcinogenesis action spectrum (non-melanoma skin cancers)
- CIE TN 003:2015 Report on the First International Workshop on Circadian and Neurophysiological Photometry, 2013
- CIE 209:2014 Rationalizing Nomenclature for UV Doses and Effects on Humans
- CIE 207:2014 Sensitivity of Human Skin to Ultraviolet Radiation, Expressed as Minimal Erythema Dose (MED)
- CIE 203:2012 (incl. Erratum) A Computerized Approach to Transmission and Absorption Characteristics of the Human Eye
- CIE 201:2011 Recommendations on Minimum Levels of Solar UV Exposure
- CIE 187:2010 UV-C photocarcinogenesis risks from germicidal lamps
- CIE 187:2010 (RU) Опасность фотоканцерогенеза при воздействии УФ-С излучения бактерицидных ламп [UV-C photocarcinogenesis risks from germicidal lamps]
- CIE 186:2010 UV-A protection and sunscreens
- CIE 158:2009 (including Erratum 1) Ocular Lighting Effects on Human Physiology and Behaviour
- CIE 181:2007 Hand protection by disposable gloves against occupational UV exposure
- CIE x031:2006 Proceedings of the 2nd CIE Expert Symposium on Lighting and Health, 7–8 September 2006, Ottawa, Canada
- CIE 174:2006 Action spectrum for the production of previtamin D3 in human skin
- CIE 172:2006 UV protection and clothing
- IEC 62471:2006/CIE S 009:2002 Photobiological safety of lamps and lamp systems / Sécurité photobiologique des lampes et des appareils utilisant des lampes (bilingual edition)
- CIE x026:2005 CIE Symposium 2004 "LEDs Light Sources: Physical Measurement and Visual and Photobiological Assessment", 7–8 June 2004, Tokyo, Japan
- CIE x027:2004 CIE Symposium 2004 "Light and Health: non-visual effects", 30 September–2 October 2004, Vienna, Austria
- CIE 155:2003 Ultraviolet Air Disinfection
- CIE 155:2003 (RU) Дезинфекция воздуха ультрафиолетовым излучением [Ultraviolet Air Disinfection]
- CIE 151:2003 Spectral weighting of solar ultraviolet radiation
- CIE S 013/E:2003 International Standard Global Solar UV Index
- CIE 148:2002 Action spectroscopy of skin with tunable lasers
- CIE S 009/D:2002 Photobiologische Sicherheit von Lampen und Lampensystemen [Photobiological safety of lamps and lamp systems]
- CIE 139:2001 The Influence of Daylight and artificial light variations in humans. A bibliography
- CIE 138-2000 CIE Collection in photobiology and photochemistry 2000
- CIE 134-1999 CIE Collection in Photobiology & Photochemistry 1999

- CIE x016-1998 Measurements of Optical Radiation Hazards, Gaithersburg, Maryland, USA
- CIE 125-1997 Standard Erythema Dose, a Review
- CIE 106-1993 CIE Collection in photobiology and photochemistry
- CIE 098-1992 Personal dosimetry of UV radiation
- CIE 090-1991 Sunscreen testing (UV.B)

Under review:

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Superseded/Archive/Withdrawn

## 10.5.8 Technical Committees (TCs)

### 10.5.8.1 Closed TCs

TC 6-52	Proper Measurement of Passive UV Air Disinfection Sources (Richard Vincent, US). Closed upon publication of CIE 247:2021. Started in 2000
TC 6-64	Optical Safety of Infrared Eye Trackers Applied for Extended-Durations (David Sliney, US). Closed upon publication of CIE 245:202. Started in 2008
JTC 14	(CIE-ISO) Integrative Lighting (John O'Hagan, GB). Closed upon publication of ISO/CIE TR 21783:2022(E). Started in 2019

### 10.5.8.2 New TCs

JTC 20 (D6/D2)	Wearable alpha-opic dosimetry and light logging methods, limitations, device calibration and data schemes (Manuel Spitschan, DE)
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### 10.5.8.3 TCs in Progress

JTC 05 (CIE-IEC)	Review of IEC 62471/CIE S009 (chair: John O'Hagan, GB), started in 2012
JTC 08 (D1/2/3/4/6/8)	Terminology in Light and Lighting (chair: Peter Zwick, DE), started in 2015
JTC 19 (D6/D2)	Terms and Definitions of Horticultural Lighting (chair: Wei Zhang, CN; co-chair: Paul Dekker, NL), started in 2020

### 10.5.8.4 Proposed TCs

None

## 10.5.9 Reporterships (DRs)

### 10.5.9.1 Closed DRs

DR 6-46	Second International Workshop on Circadian and Neurophysiological Photoreception (Luke Price, GB). Closed upon publication of CIE TN 015:2023.
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### 10.5.9.2 New DRs

DR 6-48	A Comprehensive Checklist for Reporting Light
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	Characteristics in In-laboratory Human Studies Using Light as an Intervention (Ray Najjar, SG).
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### 10.5.9.3 DRs in Progress

DR 6-43	Illuminators for Treatment of Infant Hyperbilirubinemia (Michael Lynn, GB).
DR 6-45	Publication and Maintenance of the CIE S026 Toolbox (Luke Price, GB).
DR 6-47	The Role of Light and Lighting Conditions in the Prevention, Development and Mitigation of Myopia: a Literature Review (Coralie Barrau, FR).

### 10.5.9.4 New DRs – Converted Informal Liaisons

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### 10.5.9.5 Proposed DRs

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## 10.5.10 Liaisons and Correspondences (Ls and DCs)

### 10.5.10.110.1 Official Liaisons and Correspondences

L6-1	IEC/TC 76/WG 9 International Electrotechnical Commission: Optical radiation safety and laser equipment/Non coherent sources	David Sliney
L6-8	CEN/TC 169/WG 8 Photobiology	John O'Hagan
L6-10	IEC/TC 34 Lamps and related equipment	John O'Hagan
L6-11	ISO/TC142/WG2 UV-C Devices – Safety information – Permissible human exposure	Ewan Eadie
DC6-1	World Health Organization	John O'Hagan
DC6-2	ICNIRP International Commission on Non-Ionizing Radiation Protection	John O'Hagan
DC6-3	American Society for Photobiology	David Sliney
DC6-4	World Meteorological Organization	Ann Webb

### 10.5.10.2 Informal Contacts

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## 10.5.11 Future Activities

The division will continue to explore possibilities for focused workshops and tutorials.

The next annual meeting of Division 6 is planned on September 23rd 2024 by WebEx. The 2025 annual meeting of Division 6 will normally take place in conjunction with the CIE Midterm Meeting 2025.

### **10.5.12 Other Achievements, Issues, etc.**

None.

## **10.6 Division 8: Image Technology Quadrennial Report 2019–2023, Po-Chieh Hung, US (DD)**

### **10.6.1 Terms of Reference**

To study procedures and prepare guides and standards for the optical, visual and metrological aspects of the communication, processing and reproduction of images, using all types of analogue and digital imaging devices, storage media and imaging media.

### **10.6.2 Division Officers**

2015–2019:

Director:	Po-Chieh Hung (JP/US)
Secretary:	Christine Fernandez-Maloigne (FR)
Editor:	Danny Rich (US)

2019–2023:

Director:	Po-Chieh Hung (US)
Secretary:	Christine Fernandez-Maloigne (FR)
Editor:	Danny Rich (US), Ellen Carter (US) (from October 2022, upon death of Dr Rich)

### **10.6.3 Division Meetings**

2019: Washington D.C. (US) 2019-06-21 (Formal meeting held in conjunction with the CIE Quadrennial Session) 42 attendees including 14 national representatives

2020: Online meeting 2020-11-17 (Formal meeting) 34 attendees including 13 national representatives

2021: Online meeting 2021-11-09 (Formal meeting) 22 attendees including 7 national representatives

2022: Scottsdale, AZ (US) 2022-11-14 (Formal meeting) 32 attendees including 9 national representatives

2023: Ljubljana, Slovenia, 2023-09-21 (meeting held in conjunction with the 30th Session of the CIE) 33 attendees including 7 national representatives

### **10.6.4 Workshop**

- CIE Tutorials on Colorimetry and Visual Appearance Online, July 28, 2020 (Joint with Division 1 and Division 2)

### **10.6.5 Strategy**

Use of social media to increase opportunities for discussion

Easy entrance to the CIE activity using Reportership, rigid review for publication

### **10.6.6 Administrative Matters and Communication**

New Division Management Team has been formed for 2023–2027.

Director: Noël Richard (FR)

Secretary: Hermine Chatoux (FR)

Editor: Manuel Melgosa (ES)

## 10.6.7 Publications

### 10.6.7.1 Published During the Term

#### 10.6.7.1.1 CIE Technical Reports

- CIE 248:2022 The CIE 2016 Colour Appearance Model for Colour Management Systems: CIECAM16
- CIE 246:2021 Colour Gamuts for Output Media

#### 10.6.7.1.2 CIE Standards

- CIE S 017/E:2020 ILV: International Lighting Vocabulary, 2nd Edition

#### 10.6.7.1.3 Joint ISO/IEC/CIE Standards

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#### 10.6.7.1.4 CIE Draft Standards

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#### 10.6.7.1.5 CIE Technical Notes, Toolboxes and User Guides

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#### 10.6.7.1.6 Reports by Reporterships

R 8-16	Material Adjustment Transforms (Max Derhak, US)
R 8-17	Literature Survey on Uniform Colour Space for Imaging Applications including Wide Colour Gamut and High Dynamic Range Images (Youngshin Kwak, KR)

### 10.6.7.2 Expected

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### 10.6.7.3 Review

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#### 10.6.7.3.1 Reviewed Publications

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#### 10.6.7.3.2 Status of publications

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Under review:

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Superseded/Archive/Withdrawn

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## 10.6.8 Technical Committees (TCs)

### 10.6.8.1 Closed TCs

TC 8-13	Colour Gamuts for Output Media (chair: Kiran Deshpande, GB), started in 2013 with publication of CIE Technical Report 246
JTC 10	A new colour appearance model for colour management systems: CIECAM16 (chair: Changjun Li, CN), started in 2017 with publication of CIE Technical Report 248

### 10.6.8.2 TCs in Progress

TC 8-12	Image and Video Compression Assessment (chair: Pascal Bourdon, FR), started in 2007	ToR: To establish and report on the display and viewing conditions and materials for image and video compression quality evaluation in different applications including, but not limited to, web, mobile phones, HDTV, home cinema and digital cinema.
TC 8-14	Specification of Spatio-Chromatic Complexity (chair: Noël Richard, FR), started in 2015	ToR: To produce a state-of-the-art report on the existing definitions of the complexity notation related to the aspects of non-uniform surfaces, generally defined as textured. To combine these definitions in order to produce a single embedding of the spatial and chromatic variations in a generic and vector form.
TC 8-16	Consistency of colour appearance within a single reproduction medium (chair: Craig Revie, UK), started in 2017	ToR: To study and report on sets of reproductions of the same source image that have a consistent colour appearance and are most similar to a reference reproduction, including recommending assessment methods that measure the similarity of reproductions of an image with different colour gamuts, for printed images on substrates with approximately similar characteristics in a fixed viewing environment. Only the effect of colour reproduction on appearance will be considered by this TC and so the assessment will be performed using hard copy or soft copy proofing. To propose

		a metric which can measure consistency of colour appearance.
TC 8-17	Methods for Evaluating Colour Difference between 3D Colour Objects (chair: Kaida Xiao, GB), started in 2017	ToR: To study the subjective assessment methods and recommend a dataset for colour difference evaluation of pairs of 3D colour objects. To prepare a report on the investigations of the effects on the perception of colour difference that may be caused by differences of 3D shape, gloss and material.

### 10.6.8.3 New TC

TC 8-18	Guidelines for Definition and Evaluation of High Dynamic Range Images and Image Sequences (Mekides Assefa Abebe, NO) , started in 2021	ToR: To propose a definition of High Dynamic Range (HDR) images and image sequences (Images, hereafter), including luminance level, contrast, and spatial/temporal distribution. To define luminance levels, observing environment, adopted white point, the kinds of Images to be used in research experiments and their assessment. To recommend methods of calculating key characteristics of the HDR Images.
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### 10.6.8.4 Proposed TCs

TC 8-xx	Data representation space for spectral imaging (Jean-Baptiste THOMAS, FR/NO, tentative)	ToR (Tentative): To define the specifications of common representation spaces of spectral data suitable for multi-/hyper-spectral imaging. To study the transformations between the common space and the device and/or application dependent spaces. To suggest the data formats that describe multi-/hyper-spectral image data in the common spectral presentation spaces.
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### 10.6.8.5 Miscellaneous

None.

### 10.6.9 Reporterships (DRs)

#### 10.6.9.1 Closed DRs

R 8-16	Material Adjustment Transforms (Max Derhak, US), with reportership report
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R 8-17	Literature Survey on Uniform Colour Space for Imaging Applications including Wide Colour Gamut and High Dynamic Range Images (Youngshin Kwak, KR), with reportership report and has been promoted to TC 8-18
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#### 10.6.9.2 New and Closed DRs

None

#### 10.6.9.3 DRs in Progress

None

#### 10.6.9.4 New DRs

None

#### 10.6.9.5 New DRs – Converted Informal Liaisons

None

#### 10.6.9.6 Proposed DRs

None

#### 10.6.9.7 Miscellaneous

None

#### 10.6.10 Liaisons

L 8-01	ISO/TC 36 Cinematography	CIE Central Bureau
L 8-02	ISO/TC 130 Graphic Technology	Andreas Kraushaar
L 8-03	ISO/TC 42 Photography	Hideyasu Kuniba
L 8-04	ISO/TC 159/SC 4/WG 2 Visual Display Requirements	Po-Chieh Hung
L 8-05	ISO/IEC/JTC 1/SC 29 Coding of Audio, Picture, Multimedia and Hypermedia Information	Olfa Ben Ahmed
L 8-06	IEC/TC 100/TA 2 Multimedia Systems and Equipment	Hideyasu Kuniba
L 8-08	ISO/IEC/JTC 1/SC 28 Office Equipment	Klaus Richter
DC 8-01	ASTM/E12: Colour and Appearance	Ellen Carter
DC 8-02	International Color Consortium (ICC)	Maxim Derhak

#### 10.6.11 Future Activities

To be planned.

#### 10.6.12 Other Achievements, Issues, etc.

None.

## 11 Report of the NC Workshop on the Occasion of the General Assembly

The NC/ANC delegates at the GA and the observers were invited to participate in a workshop on the afternoon of September 17. The goal was to obtain their input to prepare the CIE Objectives 2023-2027. There were 7 tables and two discussion rounds separated by a coffee break. Participants self-selected their topics but had to choose a different table for each round.

The question put to the attendees was:

*What would success look like for the CIE in 2027 with respect to:*

- Education → VPE-Elect, Luoxi Hao
- Science → VPT-Elect, Tony Bergen
- Business strategy and revenues → Treasurer, Oliver Thissen
- Digitalization → President, Peter Blattner
- Standardization → VPS-Elect, Peter Thorns
- Promotion and Communication → President-Elect, Jennifer Veitch
- NC support and interaction → Secretary General (SG) incoming, Diana Wernisch, BA member Kees Teunissen

What follows is a brief summary of the notes taken at the event. In October, the Governing Board and Technical Management Board met (in two sessions to accommodate time zones) to review the input and to further discuss the Objectives 2023-2027. The Governing Board will review the complete draft Objectives at a meeting in December and approve them by letter ballot in early 2024. At that time, the Objectives for this CIE Term will be shared with the National Committees.

### NC Support and Interaction

Facilitators: Diana Wernisch, Kees Teunissen

1. **Direct contact** of CIE (president, board members) to the NCs and its members is seen as important.

- Use online events, present at NC meetings online

2. Support broader **participation in voting**

- Provide feedback to NCs about their overall voting participation; reward those who have a good result.

3. Support **promotion of publications** locally

- Webinars on new publications showing how to use them

4. Provide **communication channels between NCs**

General notes and comments:

- Translations are often helpful to ensure dissemination in a country.
- CIE is an international organization, geographically dispersed and culturally diverse. It's important to provide transparency and clarity in decisions and communications.

## **Standardization**

Facilitator: Peter Thorns

**Subjects for Standardization:** Fundamental standards should be created from existing authoritative documents. Examples given included photometry, colour rendering, daylight, colour and UV/IR effects.

- Existing documents should be revised in the light of new concerns. These include obtrusive light, fundamental metrics, light for/on people and visual efficiency (the sensitivity curve), glare.
- New standards should be created for topics such as safe application of UV-C, lighting control (use, comparison between systems, ergonomics, specification, installation), integrative lighting, good daylight design and verification of daylight design within a space, luminance design.
- CIE as a global standards organization should try to standardize regional standards. This includes use of language and level of detail as these can significantly differ.
- Standards should be more timely.

### **Process for Standardization:**

- CIE needs to engage more experts. For this, recognition of work and input of experts needs to be made.
- There needs to be better recognition of CIE Standards.
- There needs to be better education on and dissemination of information about CIE Standards.
- Liaison roles need a better understanding of how CIE / ISO / IEC can interact (a code of conduct), how CIE information can be used by other organizations, and how fragmented national committee responsibilities operate.

## **Promotion and Communications**

Facilitator: Jennifer Veitch

### **Attraction:**

- Attract young professionals; one way to do this is to emphasize the relationships and bonds that can build between individuals through the CIE connections.
- Among students, connect with interior architecture/interior design programs, landscape architecture programs
- Could the CIE website be a source of opportunities for young people, a place to share and to find info, a networking source — social media for lighting
- Strengthening our links to the energy efficiency in buildings movement would be a good idea; we can help (e.g., with daylighting, controls).

### **Promotion Modernization**

Overcome the perception that we are too scientific and not accessible to outsiders.

Our messaging needs updating, and needs to be communicated differently for different audiences: government, industry, researchers, students, general public.

For new documents, improve the press releases — use short summaries in everyday language: What is this document for; how can you use it? — Improve findability of these also.

- But not too simple! We don't want to hide our expertise.

Our documents need to be findable! Get into Web of Science and Scopus urgently.

Be faster with approvals, and revise sooner — to have good up-to-date messages

### **New Activities**

Consider holding a design competition outside the conference (in addition to the paper awards), especially something for students. Examples are the Daylight Award or the Howard Branston Lighting Design Competition.

Could the CIE offer to host the technical review for research projects, perhaps through a Research Forum? Could this help us to enable access to funding mechanisms like EU Horizon or Euramet?

Consider which media to use to reach target audiences (Youtube? Tiktok? Threads? etc.)

### **Science**

Facilitator: Tony Bergen

#### **Increase CIE Recognition:**

- We want CIE publications to be used instead of publications by other organizations. [Implying we need greater publicity and use, especially in areas where other organizations are dominant.]
- More exposure on social media
- Add more people to newsletters
- Contact/interaction with other organizations
- Then people maybe more likely to volunteer

#### **Publications:**

- Target: > 68 publications in next quadrennium, i.e. 20 % increase from previous quadrennium;
- Require that TCs publish within 3 years of establishment:
  - CB may need additional staff to process more quickly,
  - Need more volunteers/TCMs willing to actively contribute.
- Have an equivalent to "Sharepoint" (accessible everywhere: Sharepoint isn't accessible in China) for more efficient work on drafts;
- ILV to be used universally: other organizations to adopt ILV definitions;
- Have our publications and conference papers with greater level of recognition:
  - Scopus,
  - Connect with journal.
- Recognition of authors of CIE publications for their contributions;
- More collaboration with other organizations;
- More involvement in each other's activities;
- Jointly develop publications;
- Specific new publication topics were proposed.

### **Conferences/Workshops/Tutorials/Webinars:**

- In person events are still good, but we have to expect reduced attendance, so maybe more collaboration with other organizations to get more attendees.
- More online workshops and tutorials, some short (20-30 min), including student-related workshops, all with option to purchase access to a recording (as well as real-time attendance).

### **Resources:**

- Have CIE Github/Colab repository;
- Sample python scripts on MU/Monte Carlo, etc;
- Have CIE experts (volunteers) available to help researchers (esp. students) to design experiments, how to use equipment, etc.:
  - Income for CIE,
  - Recognition for the volunteer.

### **Volunteers:**

- Want employers (private companies) more willing to let their staff contribute to TCs – maybe need greater recognition of the work of TCMs
- Want higher levels of volunteers motivated to be involved to CIE
- Want our volunteers to have higher motivation to contribute to CIE
- Have scholarships available to give students the opportunity to attend and contribute.
- Want more \*young\* research scientists involved in CIE activities (TCs, conferences, etc.).

### **Research Strategy:**

- Goal: Research strategy to be well known and used widely by industry in 2027.

### **Education**

#### **Facilitator: Luoxi Hao**

#### **Language & Translation:**

- Very few CIE publication were translated, but increasing this would help expand reach. It is easier to translate with new AI translation tools, but some NCs see the CIE Translation Policy as a barrier.
- It would be helpful to provide the ILV in more languages.

#### **Industry Help Education:**

- Industry has been willing to pay for education and research, but in some places, this is at a lower level than previously.
- CIE Summer Schools to develop student skills could be developed, with sponsorships or fees for students – noting that flight tickets are a significant cost, so locations need to move around.

#### **Financial Support for Education:**

- Some countries don't support student travel to international events, so finding financial support to help students attend CIE events would be helpful.
- We can have one exclusive day for students to encourage them to attend such conferences. It's always good to have more chances for students to get exposed.

## Business Strategy & Revenue

Facilitator: Oliver Thissen

Business Strategy		Revenue Stream
Increase findability of publications, proceedings, and documents	Increase services (make publications free)	Develop an open-access CIE Journal with page charges paid by authors
Make small popular videos on basic lighting subjects to increase visibility of the CIE	Google ads for publications	Social media advertising revenue
CIE publications should be national standards in NC countries		
Collaboration between CIE CB and NCs should increase		Find website sponsors, ease the way to place donations
Open a 'young CIE' section on the website for sharing info, projects, etc.		
Strengthen relationships with international funding bodies to address lighting topics in funding programs		Participation in funded projects
Academic persons especially young people should be supported by the CIE (e.g., webinars)	Strengthen relationships with academia to reach future researchers	Run more own meetings, symposiums, etc.

## Digitalization Table

Facilitator: Peter Blattner

1. How can CIE support the digitization process taking place in society, business and academia?

The initiative to make datasets available was seen as an important step. In addition, we could look into:

- Digital interfaces (API),
- Machine-accessible CIE documents,
- Definition of standard formats for data representation in the field of photometry and radiometry, an axiomatic vocabulary, ... ,
- "Building Information Modelling" BIM:
  - Role of the CIE vs ISO on this is not completely clear.
- Ways to make documents accessible:
  - Cloud-based services, similar to the IES Lighting Library was mentioned, which has integrated linking of individual documents. This could be developed further. Open Browsing Platform, freely available from ISO (<https://www.iso.org/obp/ui>). This platform can be used to query all the definitions contained in ISO standards.
  - Based on an ad hoc query to chatGTP, it was found that chatGTP finds correct answers based on the publicly available information. However, when it comes to questions about the content details of CIE publications, chatGTP fails. This includes, of course, the fundamental question of how much the CIE should publish in the public domain. One could even think of a cieGTP.

2. How can CIE benefit from digitization?

- The collaboration platform no longer meets today's requirements for the joint development of documents. CIE should also follow developments in ISO and IEC (<https://www.iso.org/OSD>) or other cloud-based services. However, it is important that such cloud solutions are accessible to all countries.

- Processes in development of our technical documents could be streamlined with digitization; partner organizations might provide input.
- Some business models were discussed:
  - For example, a “donate button” could be added to the CIE website, as there are people willing to donate money to OpenScience initiatives (see e.g. Wikipedia).
  - Make the data available on a tiered basis (i.e. a minimum set is free and you have to pay for more, etc.).

## **12 Reports on Workshops in the Scientific Programme of the Session**

### **12.1 Workshop - Interior Lighting Design: Metrics and Methods**

**Convenor:**

**Thorns, P.**

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#### **12.1.1 Abstract**

##### **12.1.1.1 Motivation, Specific Objective**

The lighting industry, and lighting design in particular, uses a well-established set of metrics and methods when designing lighting installations. These have become coded into standards and regulations, providing established benchmarks for both measurement and design. However whilst these have proven useful and have produced many good designs, they may not be the best solution for new technologies, energy efficiency and sustainability requirements, and with the increased understanding of both visual and biological impacts of light.

There is a need to reassess our use of common metrics and methods, and the possible suitability of proposed new metrics and methods, based upon current knowledge. It is important that any new system for design ensures that;

- Criteria and methods exist or can be developed.
- Criteria are calculable in design and measurable/verifiable in the field after installation.
- Criteria and methods produce outcomes that preserve or enhance lighting quality whilst being energy efficient and sustainable.
- New criteria and methods can co-exist with existing criteria to allow a managed change within standards and regulations, and are accepted by the design community, the value chain of developers / building owners etc., and by regulators/policy-makers.
- Criteria and methods are easy to understand and use.

This review should cover all metrics used within design and should also consider whether any additional metrics would be beneficial.

##### **12.1.1.2 Methods**

This will be in the form of a workshop to be held during the CIE 2023 Quadrennial Session, with 3 small presentations to set the scene, followed by a mediated open discussion.

##### **12.1.1.3 Results**

Output from the workshop to be fed as input into CIE Research Strategy and/or Divisional work plan.

##### **12.1.1.4 Conclusions**

Not applicable until after the workshop.

## 12.2 Can Cone Fundamentals be Used in Everyday Photometry?

Convenor:

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### 12.2.1 Abstract

Since its beginning, colorimetry and photometry were directly related through the CIE colour-matching

function  $\bar{y}(\lambda)$  of the CIE 1931 standard colorimetric system which was set to be identical with the spectral luminous efficiency function for photopic vision,  $V(\lambda)$ . It is also well known that  $V(\lambda)$  is not a perfect match to human vision and in particular it underestimates the visual response in the blue region. The physiology-based function, known as the cone-fundamental-based spectral luminous efficiency function,  $V_F(\lambda)$ , is defined in CIE publication CIE 170-2:2015, and again relates photometry to modern (i.e. cone-fundamental-based) colorimetry.

But switching to photometry based on cone fundamentals would have consequences including:

- The possible need to replace photometers with new devices that are either matched to the  $V_F(\lambda)$  function instead of  $V(\lambda)$ , or which directly take spectrally resolved measurements and derive luminous quantities through software integration.
- The possible need for the definition of a new defining constant  $K_{cd,F}$  for cone-fundamental-based photometry, the intention of which is to reduce the impacts of a change in photometrical scales.
- The replacement or supplementation of the existing colour-matching functions used in colorimetry with new functions based on cone fundamentals, including the possible need to replace tristimulus colorimeters with new devices that are matched to the new functions instead of the existing colour-matching functions and to update software or firmware for instruments which directly take spectrally resolved measurements and derive colorimetric quantities through software integration.
- The corresponding effects on scotopic photometry (including the quantity “S/P ratio” used to characterise sources) and mesopic photometry.

This workshop will feature three short presentations to introduce the topic, followed by a panel discussion with interaction from the audience to explore the implications of moving towards cone-fundamental-based photometry. The introductory presentations will be as follows:

1. Dr Lorne Whitehead (CA) – Introduction to cone fundamentals and the  $V_F(\lambda)$  function;
2. Yoshi Ohno (US) – Viewpoint from CCPR and traceability;
3. Peter Blattner (CH) – Ideas for practical implementation of cone fundamental-based photometry.

## **12.3 Lighting Education: Methods, Approaches and Experiences**

**Convenor:**

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### **12.3.1 Abstract**

#### **12.3.1.1 Motivation, Specific Objective**

The workshop targets to strengthen the influence of CIE on education and improve the collaborations among universities on the CIE platform. It aims to attract educators, researchers, and students from universities all over the world on participate and follow the CIE academic activities, and promote professional training in the lighting industry, establishing the connection between academia and industry on lighting.

#### **12.3.1.2 Methods**

The workshop will take 90 minutes, including a 5-minute introduction, a 30-minute invited speech session, a 50-minute open discussion session, and a 5-minute conclusion session. The location and time of the workshop will follow the arrangement of the 30th Quadrennial Session of the CIE. Three speakers will be invited from different fields for a 10-minute presentation, respectively, sharing their experience in academic research and profession training on lighting. During the discussion session, a list of topics will be discussed on the role and future work of CIE Education, understanding attendants' needs for CIE Education and collecting ideas & advices from the audience. Finally, the key points collected will be summarized in the conclusion session. The invited presentations will be as follows:

- I. Laura Bellia (IT): Teaching Lighting in Degree and Master Degree Programs
- II. Houser Kevin (US): Contemporary considerations for teaching and learning about lighting
- III. Nozomu Yoshizawa (JP): Lighting education curriculum - lectures and studios

#### **12.3.1.3 Topics for Discussion**

The following topics will be proposed for the 50-minute discussion:

- What role can CIE play in the lighting education for professionals?
- What are the expectations towards CIE in terms of academic education (access to publications, conferences, services, etc.)?
- What CIE resources would be useful for the academic learning?
- What supporting programs from CIE would be useful to encourage the work of young scientist and scholars?
- How can CIE further support the continuing education of lighting professionals, including support to the education providers?
- How to carry out the international certification of professional education?
- What criteria could be set to indicate the level of knowledge, understanding, application and further dissemination on CIE lighting topics?

#### **12.3.1.4 Conclusions**

Above all, the workshop is proposed to raise the interest of attendants on CIE Education and understand the needs of academic scholars and industrial professionals from various aeras on CIE, collecting their ideas and advices to pre-plan the future work of CIE Education.

## 12.4 Workshop – Looking Ahead: Lighting for Preparedness

### Convenors:

**Fotios, S.**<sup>1</sup>, Veitch, J. A.<sup>2</sup>

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### Abstract

The world has experienced several major shocks in recent years: pandemic illness, earthquakes, extreme weather, geopolitical instability, and war. This workshop considered how lighting can factor into preparedness efforts, and how the CIE might support this with guidance.

*Keywords:* Preparedness; resilience; health protection; emergency response

### 12.4.1 Introduction

As a community associated with the research, design, application and operation of lighting, are we prepared for unusual or extreme events? At a micro scale, the level of individual buildings, then the answer is broadly yes. Emergency lighting is installed in many buildings to support occupant safety and egress in the event that a failure in electricity supply means there is no interior lighting. Emergency lighting has been the focus of research to establish what lighting qualities are needed, it has been the focus of life safety regulations, product design and installation, and is the ongoing focus of maintenance.

This workshop initiated discussion about the macro scale by raising questions about the degree to which lighting is prepared for unexpected major events, several of which have occurred in recent years. This short report summarizes the presentations and discussions to document the event as a stimulus to further developments.

### 12.4.2 Panellist Presentations

#### 12.4.2.1 Setting the Stage

Steve Fotios opened the workshop with examples of why preparedness matters, beyond the existence of emergency lighting intended to enable egress. In recent years several events have occurred that placed large sections of society into crisis situations.

One such major event was the Covid-19 pandemic. Here lighting has a direct role, with ultraviolet radiation (UVR) offering one means of infection control. The CIE responded by issuing a position statement to describe what should and should not be done with UV lighting (*Position Statement on the Use of Ultraviolet (UV) Radiation to Manage the Risk of COVID-19 Transmission*; available at <https://www.cie.co.at/publications>). Further discussion could consider how the CIE can support the world in having lighting that is ready for the next pandemic, and perhaps even to limit its effects.

In February 2023 a series of massive earthquakes hit Syria and Turkey, causing the collapse of many buildings. The immediate response to such an event is the search for survivors: a subsequent response is the provision of temporary accommodation for large numbers of displaced survivors. Preparation for this is unknown. For example, are there stockpiles of portable lighting to support the search for survivors? Are there suitable lighting systems ready for immediate use in temporary accommodation?

One charitable response came from Shelterbox, which sent a portable, cheap, solar-powered lamp. It was developed by Luminaid in response to the 2010 earthquake in Haiti (<https://luminaid.com/> and see also <https://www.bbc.com/future/article/20120207-lantern-shines-light-on-disasters>). Although this is a step in the right direction, the Luminaid lamp has a short life and is not recyclable, and therefore in the long run it is a source of scattered waste. Perhaps this workshop can inspire the development of a more sustainable version.

In addition to the immediate reaction, there may be a need to plan ahead for longer term responses. Some macro level events may cause disruption to the energy supply, either by increased costs or reduced availability: Rather than switching off the road lighting in a city, CIE guidance might instead promote lower light levels, or the use of control systems to concentrate lighting on key transport routes so that the benefit of crash reduction is not entirely lost. There may be a need to plan for disruption to industry (and hence to national economies), requiring reconfiguration or repurposing of industrial and commercial spaces, requiring backup lighting systems in the same way that emergency lighting is installed for disruption to power supplies.

This introduction prompted discussion about how preparedness differs from resilience. Following exchanges with audience members, a consensus began to emerge: Preparedness occurs before the event, puts plans and equipment into place in order to enable resilience. Resilience occurs because the plan is executed.

#### **12.4.2.2 Preparing for Potential Infection**

John O'Hagan introduced the science behind using UVR to prevent diseases from spreading. He observed that life on Earth was made possible by the existence of sufficient atmosphere to block all UV-C radiation. UV-C (wavelengths below 280 nm) acts very quickly to degrade DNA and RNA. The UV-B, UV-A, and violet ranges of the spectrum are slow acting, and therefore less effective for disinfection.

Upper-room air disinfection was first developed in the 1940s using mercury lamps with emissions peaking at 254 nm. Its first use was to stop the spread of measles and tuberculosis, and it is still in use today in settings where there is a high risk of disease spread. Interest in these systems understandably increased during the COVID-19 pandemic. The technology is proven and effective, but not without risks. The systems work best when there is no possibility of accidental exposure of live tissue (e.g., in air ducts or for water disinfection). Plants as well as people will be harmed if the UVR in the space is of sufficient quantity to effectively disinfect. Material degradation is also a known risk.

Excimer lamps with emissions at 222 nm have recently been developed. It has been claimed that these ought to be safer for use where humans are present because this shorter wavelength will penetrate less deeply into tissue. Further research is recommended before this sees widespread application. In addition to possible unintended health effects, the potential for harm to materials remains unclear.

#### **12.4.2.3 Resilience to the Unexpected**

Yuki Akizuki, Chair of CIE TC 3-62, introduced the framework that will guide the work of this new TC. She had developed this framework during her prior Division reportship, and from experience with crisis response in Japan, which had both immediate and longer-term components.

The time course influences the operational responses. In the immediate aftermath, emergency responders may need temporary lighting to facilitate search, rescue, and evacuation. Established emergency egress lighting will contribute to this, so long as it is operational, but portable and targeted lighting may also be required. There will be night-time operations to support, particularly during the time of active rescue. Crime prevention is a further consideration, for example to stop looters in the affected areas.

Health management begins with triage of the injured and treatment of acute injuries, and has specific lighting needs. Over the longer term the health problems change to treatment of chronic health issues and support for mental health.

Those who are evacuating need a lit path to a secure area, and once there the lighting should contribute to a sense of safety in that place and all the spaces in it. Emergency shelters often occupy public spaces such as schools or sports facilities. The lighting for those activities might not be suitable for long-term communal living. Often sleep is difficult for displaced people, and keeping the sports lighting on all night is unhelpful. Resilience could be improved by making possible a temporary lighting redesign.

The potential for significant energy reductions as a consequence of the crisis cannot be ignored. The lighting plan for resilience should take into account at least short-term disruptions to the electricity supply, although in some instances longer-term disruptions will occur if the generation capacity or distribution grid are substantially damaged.

These dimensions of the problem will form the basis for a CIE Technical Report, work on which is in the beginning stages. The first meeting was scheduled to take place a few days later.



**12.4.3 Discussion**

Audience participation raised further questions:

- Whose responsibility is it to pay for resilience? Clearly governments have a role, as in all emergency preparedness, but is there a place for private interests to act? Builders must provide emergency egress lighting, but ought they also to have a plan for resilience?
- In the case of specific places like shelters, are there less expensive options rather than complex lighting controls to provide a suitable sleeping environment: make sleeping masks and earplugs standard issue along with bedrolls and cots?
- To what extent can lighting systems be installed ‘just in case’ for resilience? Or is it better to plan for portable or temporary installations after an emergency takes place?
- Are local decision-makers competent to make lighting decisions in these complex situations?

This last question led to discussion of the response to the unexpected energy crisis in Europe in the autumn of 2022, when it was expected that reduced gas availability would require sudden reductions in electricity use. Division 4 held discussions about the possible response to this, summarized in Table 1 and still under consideration.

**Table 1 – D4 2022 proposal for energy-saving responses to an energy availability crisis.**

Level	Action taken	Energy saving potential	Reduction in benefit to road users
0	None	None	None
1	Dim the lighting dynamically, according to time of day and/or numbers of road users	Low	Low
2	Permanently dim the lighting by one level of the lighting class.		
3	Permanently dim the lighting by more than one level of the lighting class.		
4	Permanently reduce the light level to the lowest in that class		
5	Switch off the lighting for some periods of the night, e.g. when the numbers of road users is expected to be low.		
6	Do not switch on the lighting at any period of the night (in which case: see also ‘additional measures’).	High	High

Audience members commented that some of their local authorities were wary of reducing road lighting because of the liability associated with a possible increase in road accidents. Providing information in the format outlined above could help local authorities to understand the potential implications of the choices they make. In the event, many places did not reduce road lighting generally; if dimming was not available, completely turning off the lighting was viewed as too risky. Small reductions were obtained by instituting a curfew for decorative exterior lighting, turning it off at 22:00.

Behaviour change, rather than lighting adjustment, might be an effective response: Another way to justify a lower light level would be to reduce road speeds, effectively reducing the lighting class; however, those in the audience with experience felt that most authorities would be unwilling to take this step because of public opinion.

#### **12.4.4 Conclusions**

The intent of this workshop was to spark discussion and debate, and in this it met its goal. The range of conditions for which society must prepare is extensive and variable, and so are the possible ways for lighting to contribute and the target audiences for the lighting message. Relief agencies, local authorities, and international bodies all could be recipients of CIE guidance for inexpensive, practical strategies and tactics to adapt lighting in support of long-term resilience. Delivering this guidance in a Technical Note: short, easily available, and at no cost, emerged as the preferred vehicle.

## 12.5 Metrics for the Design and Implementation of Road Lighting

Convenor:

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### 12.5.1 Abstract

#### 12.5.1.1 Motivation, Specific Objective

Road lighting installations are designed to meet the quality criteria stated in national/international standards and recommendations such as CIE-115:2010. The main purpose of road lighting is to ensure that road users can travel safely and comfortably: it is therefore expected that the quality criteria are optimised to meet those needs, both at the time of installation and during the lifetime of the installation.

There are however many uncertainties in the current quality criteria.

- It is not known whether the existing quality criteria are sufficient and optimal to provide the necessary safety and comfort. One reason for this is that the empirical basis for the quantitative criteria is unknown.
- Values measured in the field after installation may not match the standard used as the target for design; the reason for discrepancy is unknown.
- It is not knowing the extent to which field measurements recorded at the point of installation are sufficient for their performance qualifications throughout the lifetime of the installation.
- Due to the emergency in energy supply, some public administrations are employing ad hoc changes in operation of road lighting: it is not known how this affects the safety of road users.
- The extent to which adaptive lighting applications are a solution in terms of safety and energy emergency is not yet known.

The direct aim of this workshop is to discuss the uncertainties of current road lighting guidance and define what needs to be done next. The long-term aim is to produce a revision to CIE 115.

#### 12.5.1.2 Methods

This will be a 90-minute workshop with three presentations to stimulate discussion. The workshop program is shown below.

Presentation 1: "Adequacy of current road lighting recommendations in real field applications" (10 minutes) *speaker proposal: Steve Fotios*

Presentation 2: "The differences between design and field measurements" (10 minutes) *speaker proposal: Valerie Muzet*

*Discussion 1: The relevance of current standards and further research needed (40 minutes)*

Presentation 3: "Examination of current practices and solution proposals due to energy emergency" (10 minutes) *speaker proposal: Dionyz Gasparovsky*

Discussion 2: What to do next (20 minutes)

#### 12.5.1.3 Results

The need for additional research studies and technical report update, especially within the scope of CIE 115.

Inconsistencies between design and implementation results for reasons such as estimation of road pavement properties in accordance with real conditions, difference of LED luminaire photometry compared to conventional luminaires.

Safety problems caused by turning off road lighting.

Suggestions for solutions that will not create a safety problem in the face of the energy crisis and therefore the desire to save energy

#### **12.5.1.4 Conclusions**

At the end of the workshop, it is aimed to define the deficiencies in providing road lighting in accordance with the real conditions, the research and technical committee studies that are currently being worked on or to be planned, and to determine a road map.