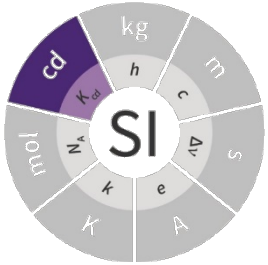


2024 CCPR WG-SP Meeting
TG10 on Strategy Document

June 4, 2024, 9:00 – 13:00 UTC+1
June 5, 2024, 9:00 – 13:00 UTC+1
BIPM, Sèvres, France

Maria E. Nadal, NIST
Chair

CCPR-WG-SP

TG10: CCPR Strategy Document Report

Term of Reference: to establish and maintain a strategic planning document for the CCPR in line with the CIPM guidance document for CCs.

Members: Peter Blattner, Joaquin Campos Acosta, Paul Dekker, Nigel Fox, Annette Koo, Stefan kück, Dong-Hoon Lee, Maria Luisa Rastello, Gael Obein, Marek Smid, Emma Woolliams and Tressa Goodman, Li-Lin Tay, Maria Nadal (Chair), and Joële Viallon (ex-officio member).

Thank you to TG10 members

Vision and Mission statements (2022):

*The **CCPR vision** is a world in which all photometric and radiometric measurements are made at the required level of accuracy to meet the needs of society.*

*The **CCPR mission** is to advance global compatibility of photometric and radiometric measurements through promoting traceability to the SI photometric unit, the candela, and associated derived units, enabling member states and associates to make measurements with confidence.*

https://www.bipm.org/documents/20126/41532221/CCPR+Strategy/cf06f769-aec9-f0dc-53a8-c47adbf5574d

Review of TG10 past activities

2022 CCPR Survey to gain better understanding of the metrological needs and priorities of the CCPR stakeholders (members and observers)

- ✓ 33 Questions
  - Radiometry, Photometry, and Optical properties of materials
  - Needs for Workshops
  - Needs for Comparisons and Pilot Studies
  - Needs for New CMCs
  - Likert scale, ranking, and comments
- ✓ 24 Responses
- ✓ Responses guided TG10 members in the strategic document and to formulate CCPR roadmap for 2022 - 2032

CCPR-WG-SP/2023-07

CCPR Roadmap 2022-2032

M. Nadal

28/02/2024

Updates on TG10: CCPR Roadmap

Strategic Priority	Plans for 2022-2025	Long Term Plans (2025-2032)
SI-future of the candela	• Form task group under SP • Select task group chair • Establish term of reference • Workshop on cone fundamentals	• Develop a strategy for implementing a new photometry system based on cone fundamentals

Updates:

- Established new task group in June 2022
- TG16: Cone Fundamental
- Chair: Yoshi Ohno

Strategic priority: SI-future of the candela

- ToR: To investigate the needs and benefits of introducing the cone-fundamental-based spectral luminous efficiency functions (and the color-matching functions) defined in CIE 170-2:2015 into the SI photometric quantities, and if appropriate, to propose approaches and strategies for introducing the cone-fundamental-based functions and resulting photometric quantities (and basic colorimetric quantities) in the SI.
- **CCPR-CIE Expert Workshop: 100 Years of *V*(*l*) and Future of Photometry (3 June 2024)**
- **Workshop on the Future of the Candela (4 June 2024)**
- Additional information will be presented during the TG16 progress report.
- **NEXT:** Provide recommendations to the CCPR

Strategic Priority	Plans for 2022-2025	Long Term Plans (2025-2032)
SI framework for digitalization in photometry and radiometry	• Form task group under SP • Select task group chair • Establish term of reference	• Address challenges in the field of photometry and radiometry caused by digital revolution in the global measurement system • Work with WG-CMC to address metrological needs for digitization of calibration certificates for photometry and radiometry CMCs.

Updates:

- Established new task group in April 2022
- TG15: The Impact of Digitalization on Matters Related to the CCPR
- Chair: Petter Blattner

Strategic Priority: SI framework for digitalization in photometry and radiometry

Updates:

- Term of Reference:To monitor activities related to digitalization in the field of photometry and radiometry, and initiate activities in response to identified needs.
- New Chair: Thiago Menegotto
- Current work: WG-CMC TG2 on harmonization of CCPR CMC entries for machine reading.
- Additional information will be presented during the TG15 progress report.

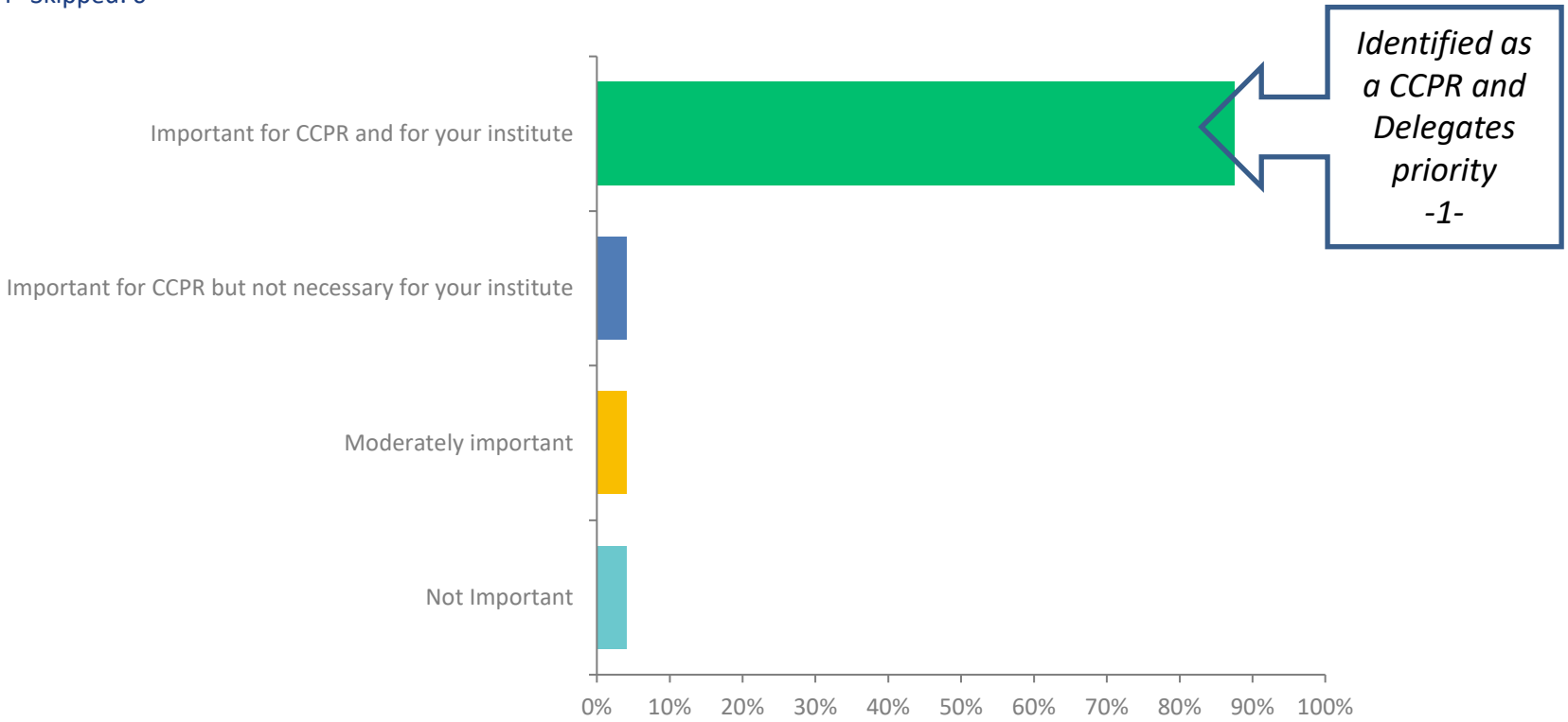
Development of LED-based standard lamps to replace incandescent standard lamps in the field of photometry	• Survey to determine the best suitable LED-based standard sources for photometry (TG12)	• To develop a strategy to deal with the rapid changes in technology to ensure availability and stability of the selected artefacts.
		• Conduct and complete pilot study on selected candidates for
		  ○ Luminous Intensity
		  ○ Luminous flux
		  ○ Total spectral radiant flux
		• Workshop on capacity transfer to all members and observers of the CCPR
		• If needed, new CMCs

Updates:

- TG12: Discussion Forum on the Use of White LED Sources for Photometry
- Thank you to: Hiroshi Shitomi
- New Chair: Zhao Weiqiang
- ToR: to carry out a survey of activity in NMIs and to identify priorities for future work of the TG, including the possibility of joint TC with CIE Division 2

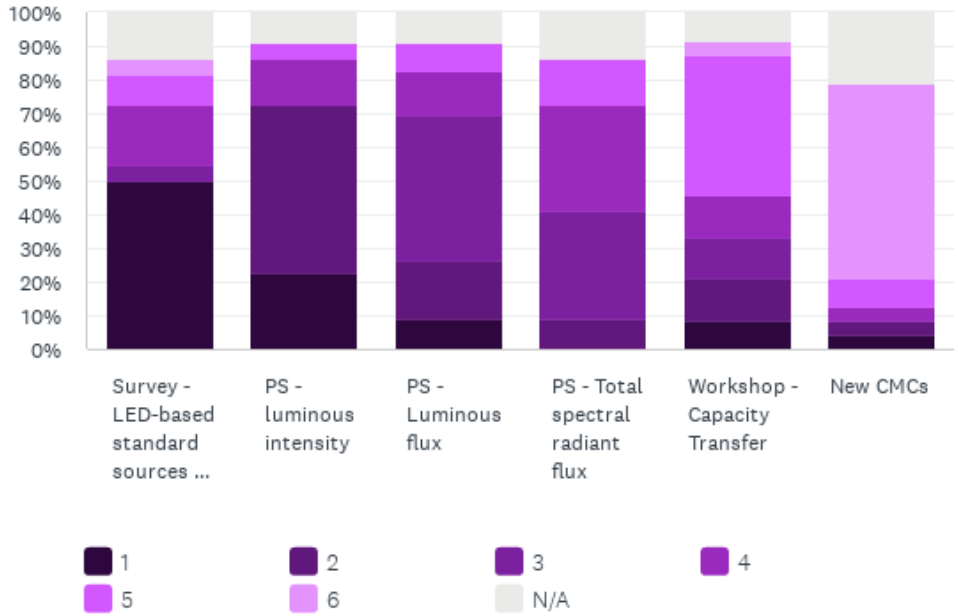
Q6: Development of LED-based standard lamps to replace incandescent standard lamps in the field of photometry

- Answered: 24 Skipped: 0



Q7: Rank the following activities according to your NMI's priorities for the deveopment of LED-based standard lamps to replace incandescent standard lamps in the field of photometry

- Answered: 24 Skipped: 0



For all Ranking Questions:
The average ranking or score is a weighted mean calculated from the total number of replies minus the N/A, and with a weight of 5 for rank 1 decreasing to 1 for rank 5.

PS: Pilot Study

: Indicates highest collective priority for the CCPR

Strategic Priority: Development of LED-based standard lamps to replace incandescent standard lamps in the field of photometry

Updates:

- 2018 Questionnaire consisted of: (summary will be available on the CCPR site)
  1. What kinds of activity do you have regarding LED sources for photometry?
  2. What kind of LED light source is preferable for your purpose?
  3. Do/Did you collaborate, or do you plan to collaborate with LED manufacturer?
  4. Do/Did you collaborate, or do you plan to collaborate with other organization (university, research institute or manufacturer association and so on) except for LED manufacturer?
  5. Any other comments?

Strategic Priority: Development of LED-based standard lamps to replace incandescent standard lamps in the field of photometry

Proposed next activity to be carry out by the TG12 Chair:

2nd questionnaire to survey the field. New topic is activities related to the LED reference spectrum by CIE (L41) and research activities related to the LED-based calibration sources for photometry.

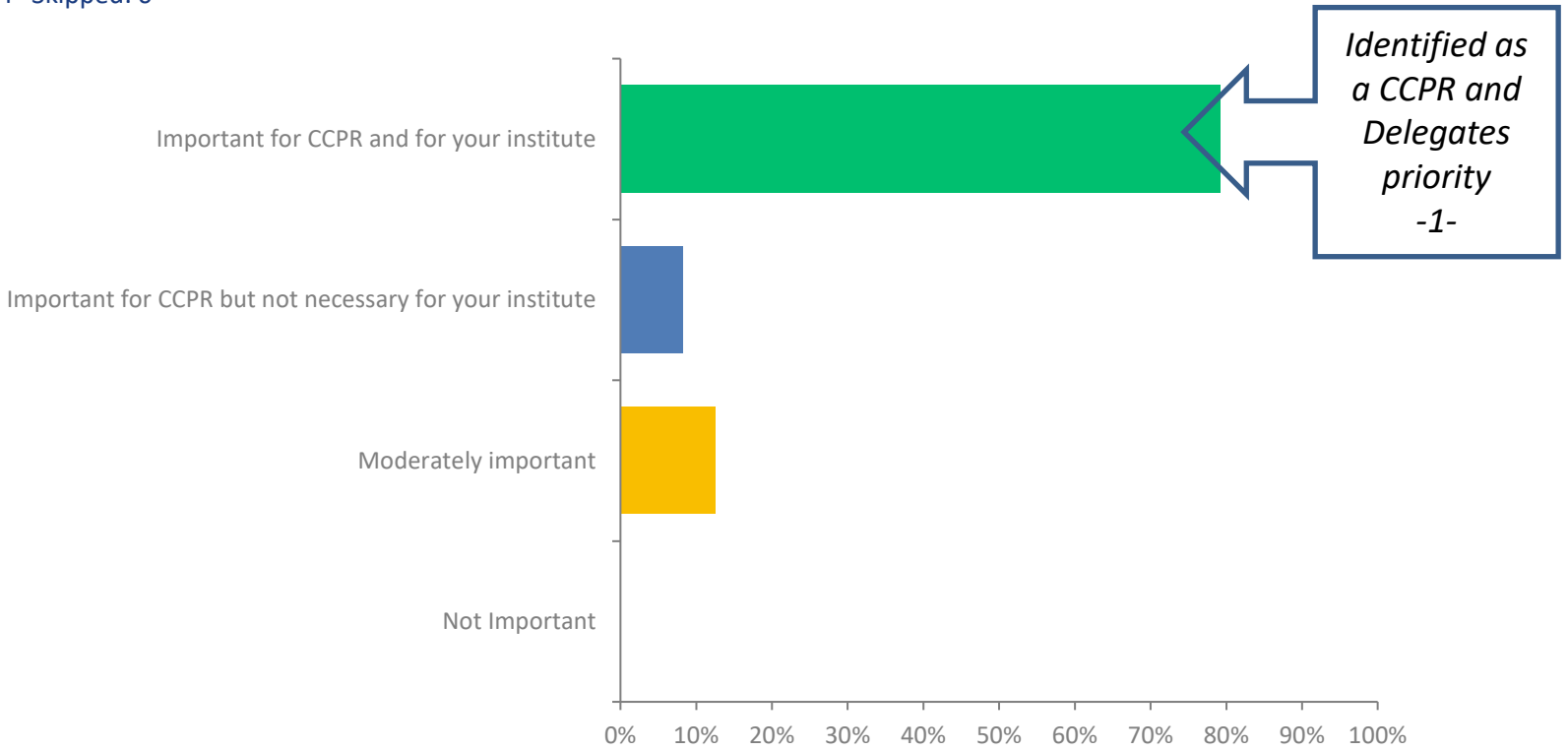
Replacement of source-based photometry by detector-based spectroradiometry	• Form task group under WG-SP • Select task group chair • Establish term of reference	• Workshop/webinar on Methodologies for calibration of detector based spectroradiometry for luminous intensity and total luminous flux measurements

Need input:

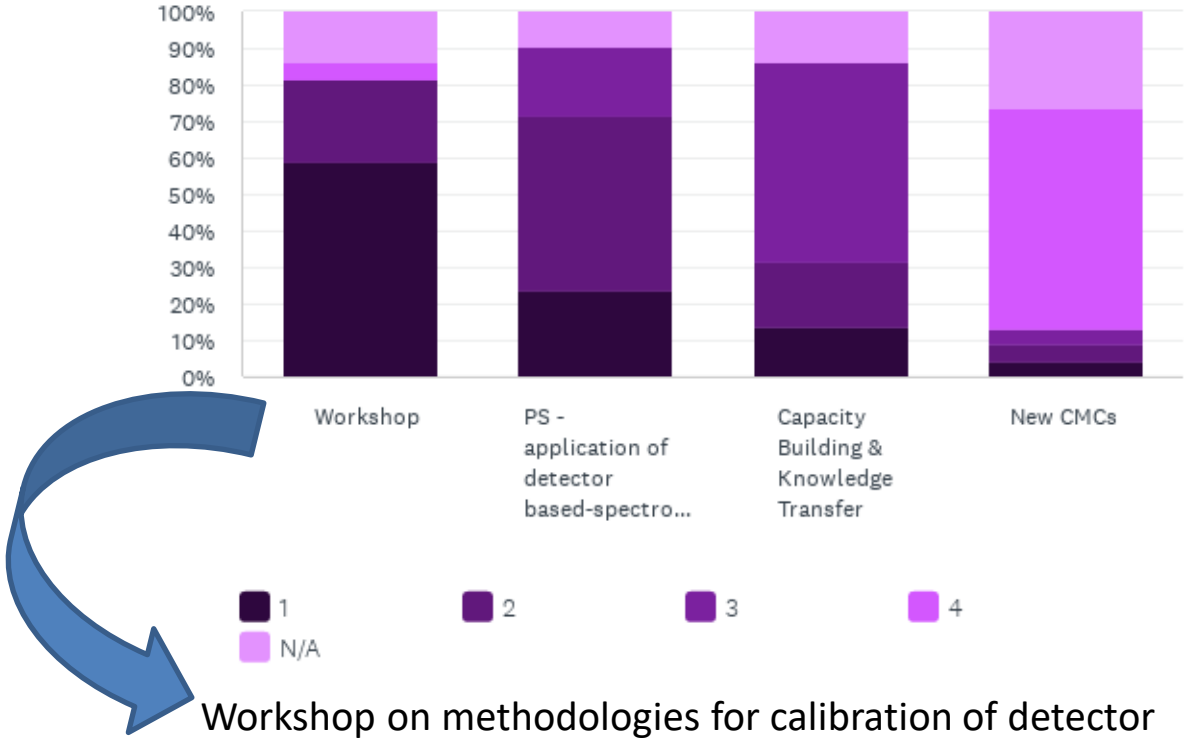
- ✓ Revised statement?: Replacement of broad band photometers with spectroradiometers
- ✓ Need new Task Group?
- ✓ Volunteer for chairperson?
- ✓ 2025 Workshop?

Q8: Detector based-spectroradiometry to replace source-based photometry

- Answered: 24 Skipped: 0



Q9: Ranking –
replacement of source-based photometry by detector based spectroradiometry



Workshop on methodologies for calibration of detector based spectroradiometry for luminous intensity and total luminous flux measurements

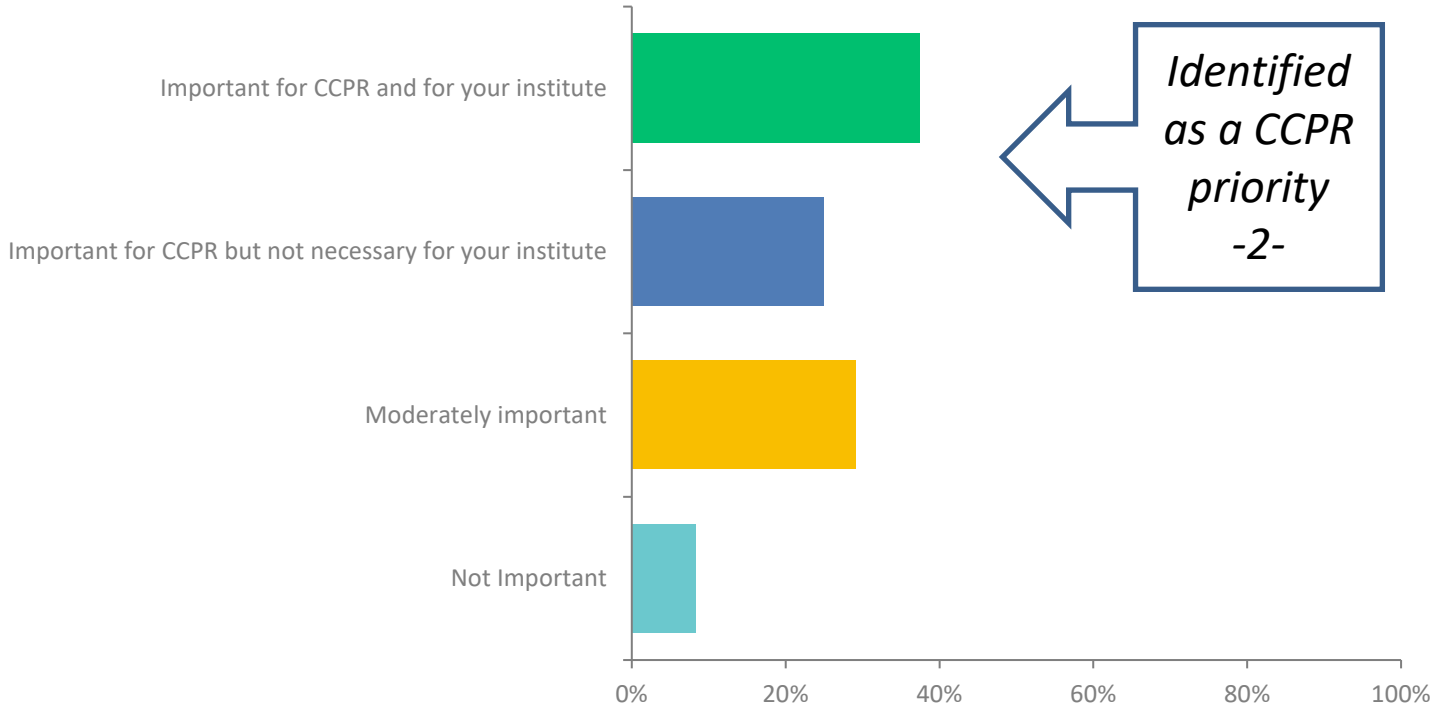
Development of near-field gonio-photometry standards	• WG-SP to investigate if interested NMIs have the need to form a new task group • If needed, form new task group under WG-SP	• If needed, Workshop to determine current capabilities and calibration needs for Imaging Luminance Measurement Devices (ILMDs) and then workshop on near-field gonio-photometers capabilities and needs

Proposed next activity to be carry out by the WG-SP Chair:

Investigate (by email) if interested NMIs have the need to form a new task group

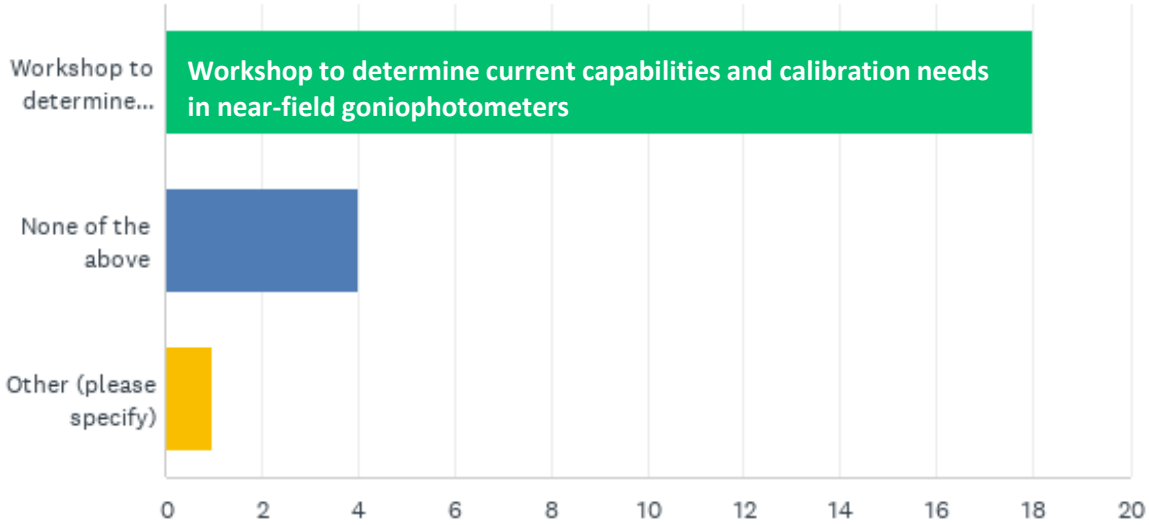
Q10: Near-field gonio-photometry

- Answered: 24 Skipped: 0



Q11: Which activities in near-field gonio-photometry?

- Answered: 23 Skipped: 1



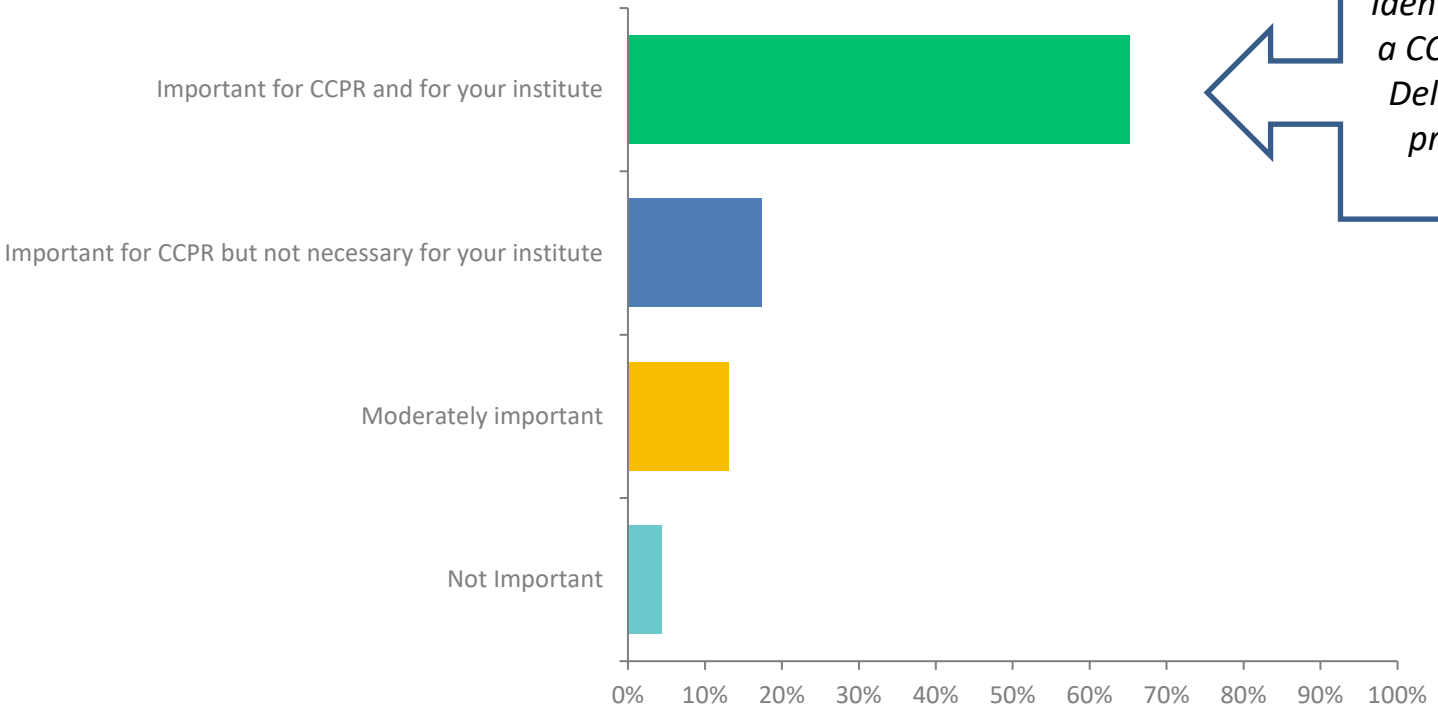
Additional reply : *"Workshop to determine current capabilities and calibration needs for Imaging Luminance Measurement Devices (ILMDs) and then workshop on near-field gonio-photometers capabilities and needs"*

Few photons metrology	• Survey for best available few photon detectors and sources for the realization of SI traceable radiometry	• Workshop on traceability chain to classical radiometry by overlapping power ranges • If needed, pilot study of selected candidates for the measurand of total spectral radiant flux • If needed, new CMCs

Proposed next activity to be carry out by the TG7: Discussion Forum on Few Photons Metrology (Angela Gamouras)

Q14: Few photon metrologies

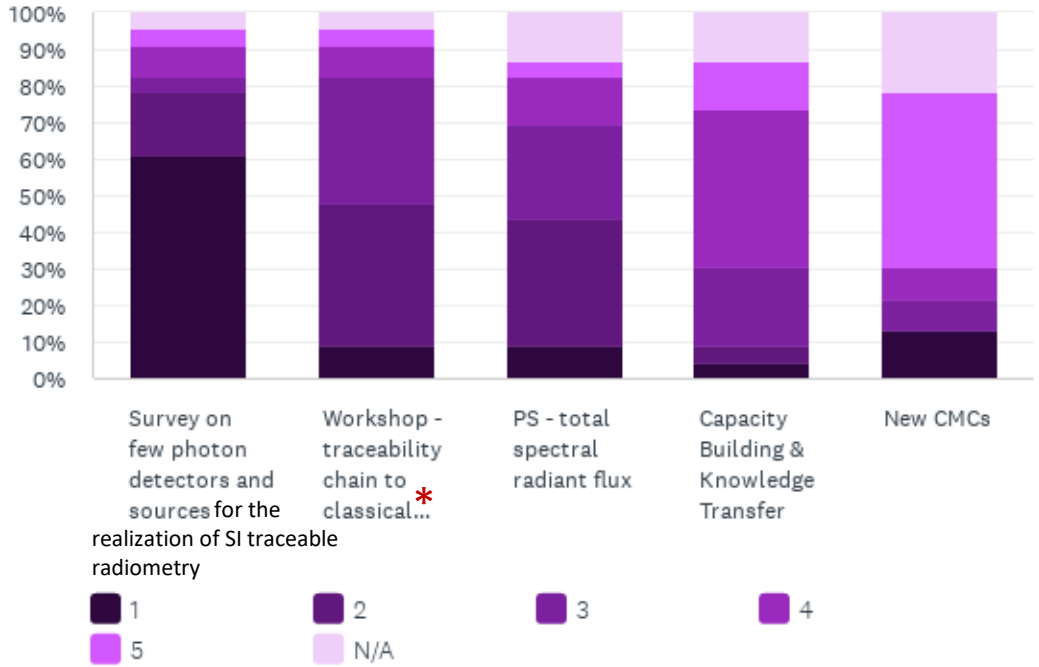
- Answered: 23 Skipped: 1



Identified as a CCPR and Delegates priority -1-

Q15: Ranking – few photon metrology

- Answered: 23 Skipped: 1



* Workshop - traceability chain to classical radiometry by overlapping power ranges

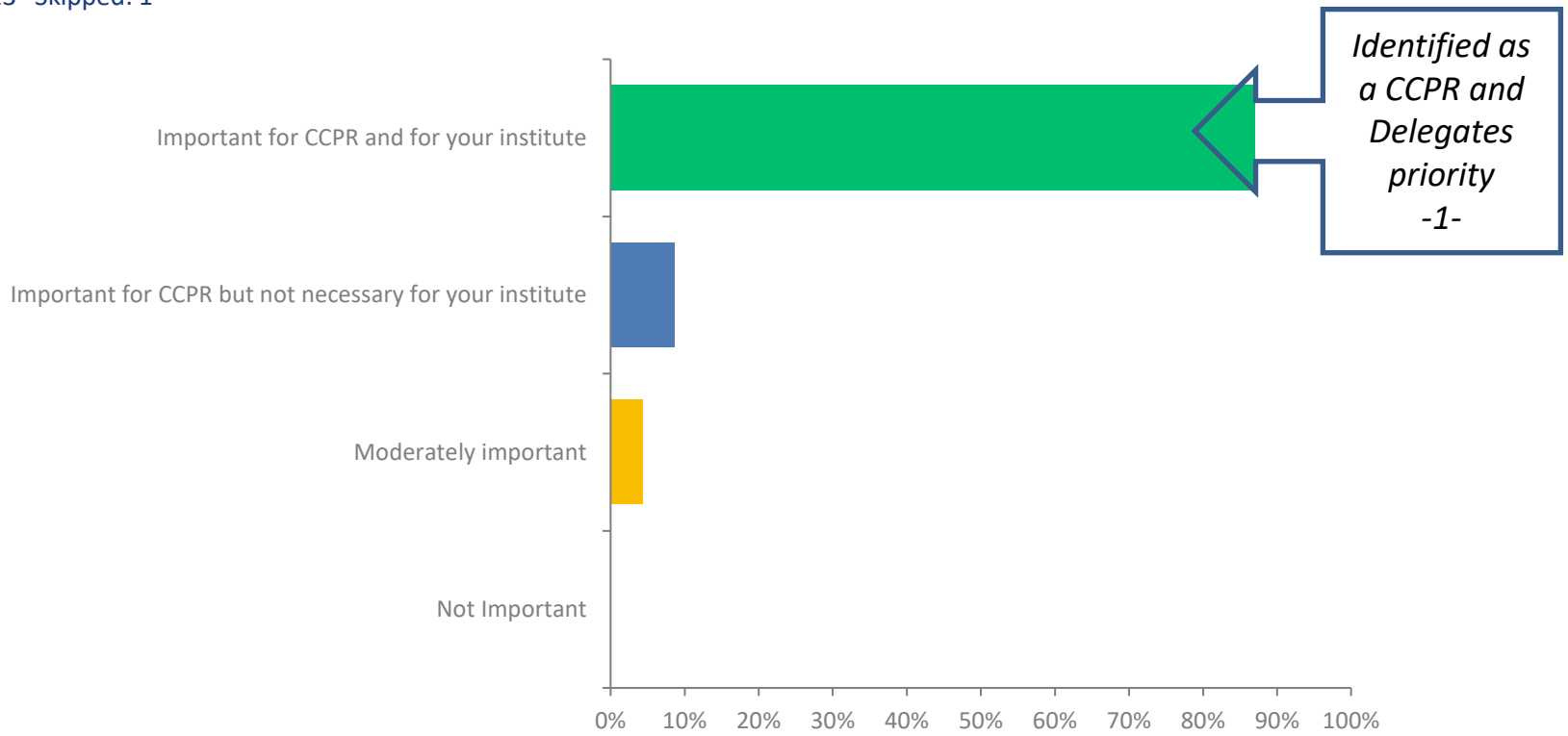
UV metrology	• Form task group under WG-SP • Select task group chair • Establish term of reference	• To develop a strategy to deal with the rapid changes in technology today to ensure availability and stability of the artefacts. • Survey to determine best available UV sources and detectors • Workshop on UV metrology emerging technologies

Need input:

- ✓ Limit wavelength range to 200 nm to 400 nm?
- ✓ Need new Task Group?
- ✓ Volunteer for chairperson?

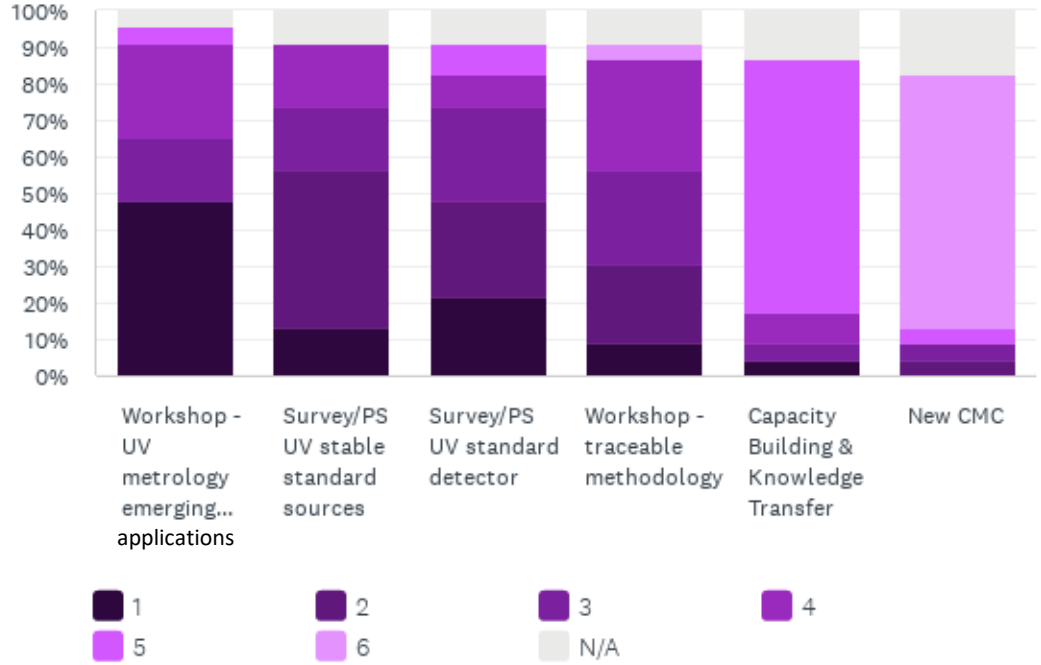
Q16: UV metrology

- Answered: 23 Skipped: 1



Q17: Ranking - UV metrology

- Answered: 23 Skipped: 1



Climate and environmental observations	• Study the 2022 BIPM-WMO metrology workshop for climate action report. • Ensure representation in the CIPM Sectorial Task Group on Climate Change and Environment	• Establish Task Group on metrology for satellite observations (as it relates to radiometry) to engage WMO and Space Agencies – *New Business*

Updates:

- Established new task group in October 2023
- TG 17: Discussion Forum on Metrology for Satellite Observations
- Chair: Emma Woolliams
- ToR: To provide a consistent and coordinated response from the NMI radiometry community to the needs of the satellite-observation communities, particularly those related to climate change.
- Detailed information was presented during the TG17 progress report.

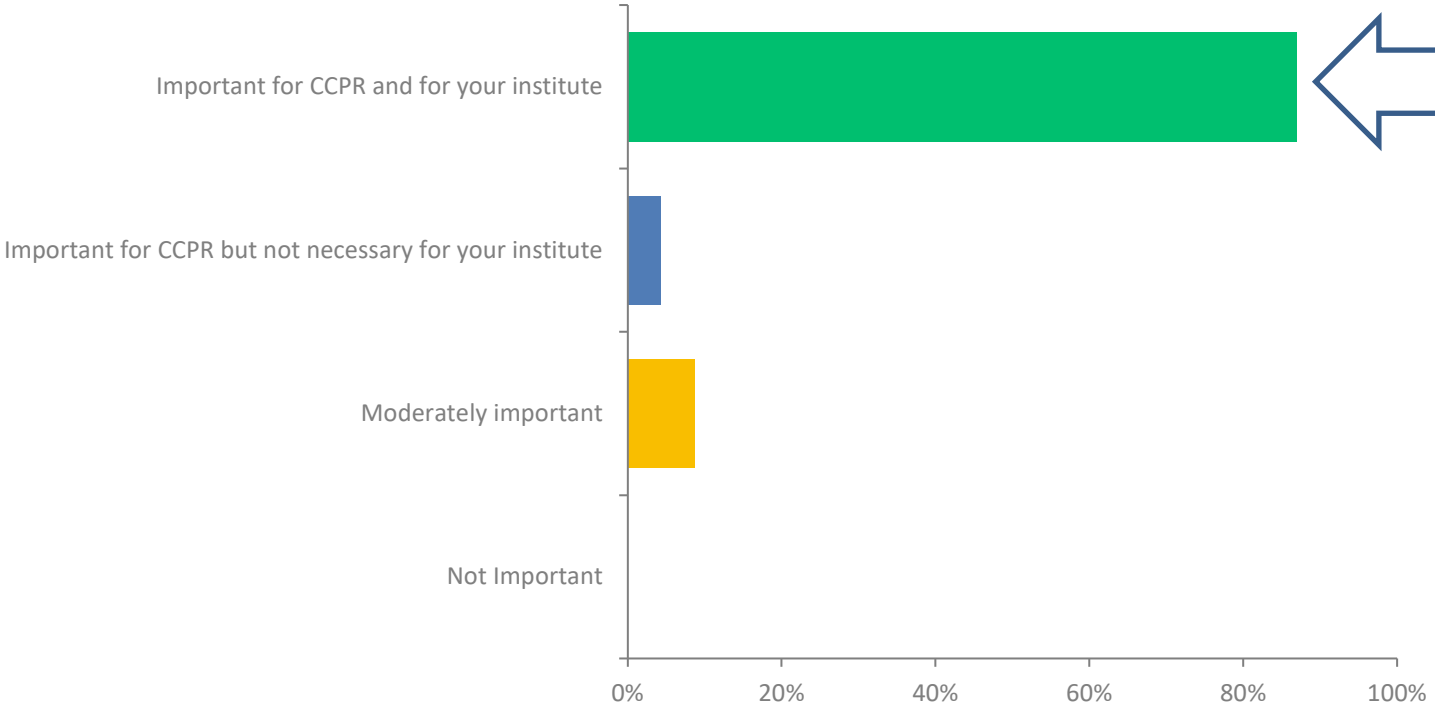
Standards to replace incandescent lamps in the field of radiometry	• Form task group under SP
	• Select task group chair
	• Establish term of reference
		• To develop a strategy to deal with the rapid changes in technology and to ensure availability and stability of the artefacts.
		• Identified artifacts for pilot studies on:
		  ○ Total spectral radiance flux
		  ○ Spectral irradiance
		  ○ Spectral radiance

Need input:

- ✓ Need new Task Group?
- ✓ Volunteer for chair?
- ✓ 2026 Workshop?

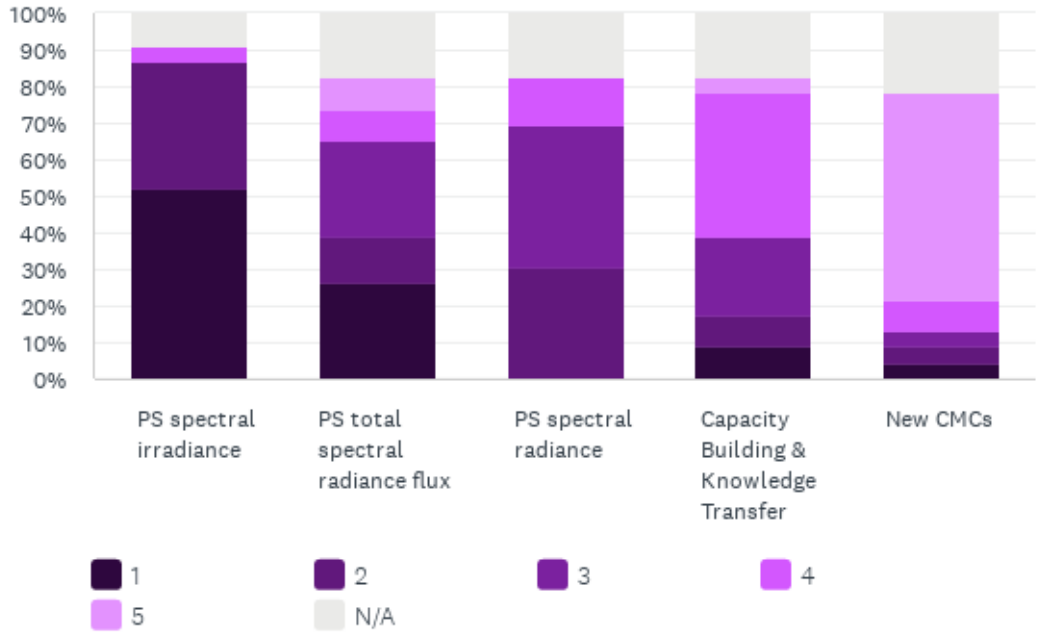
Q22: Development of LED-based standard lamps to replace incandescent standard lamps in the field of radiometry

- Answered: 23 Skipped: 1

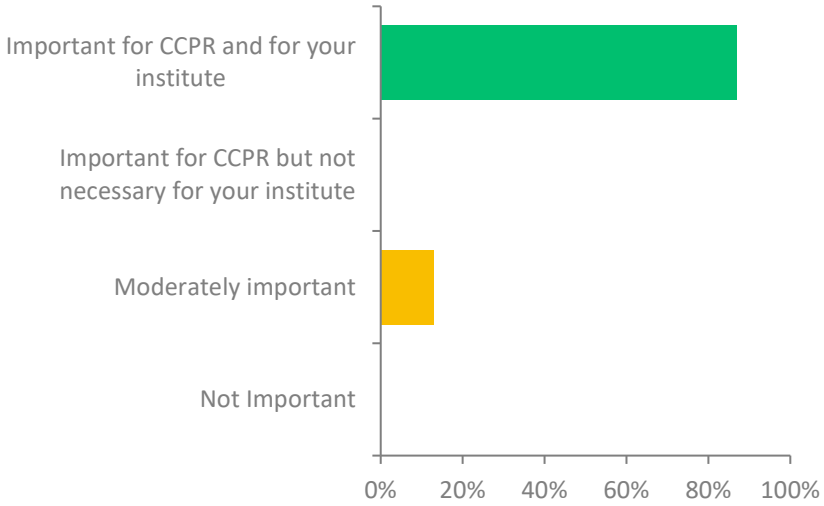


Q23: Ranking - development of LED-based standard lamps

- Answered: 23 Skipped: 1



Optical properties of materials	• Survey on specific metrology needs and priorities • SP to investigate if interested NMIs have the need to form a new task group • If needed, form new task group under WG-SP Form task group under WG-SP and establish term of reference	• Workshop on optical properties of materials measurands, methodologies, and standards

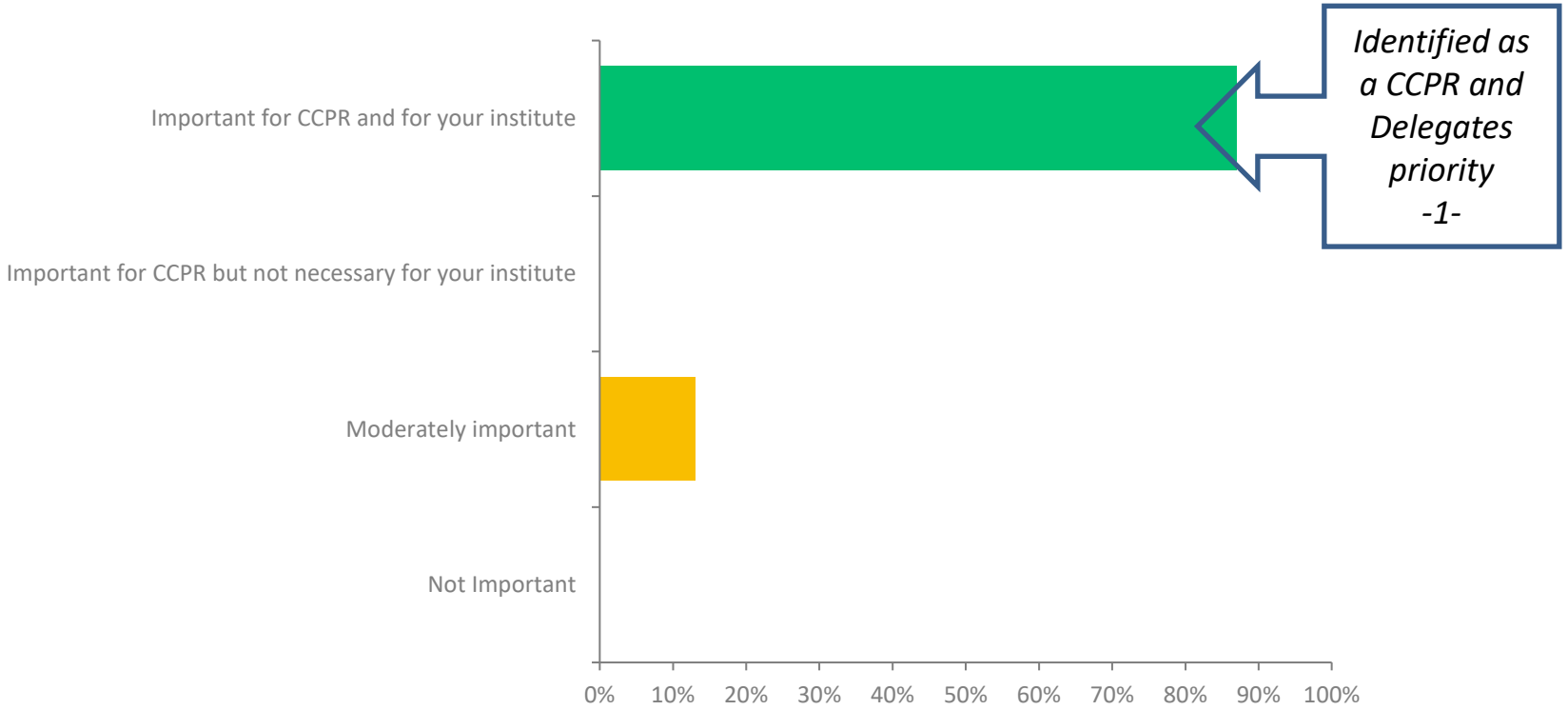


Which Measurand?
BRDF and BTDF
BRDF, BTDF
spectral reflectance, spectral transmittance
Diffuse Reflectance
BTDF
Haze
BRDF, reflectance, transmittance
low-level transmittance, non-white reflectance
reflectance and transmittance
Carbon nanotubes for reflectivity

1st task: select 3-5 metrological areas (Gael Obein)

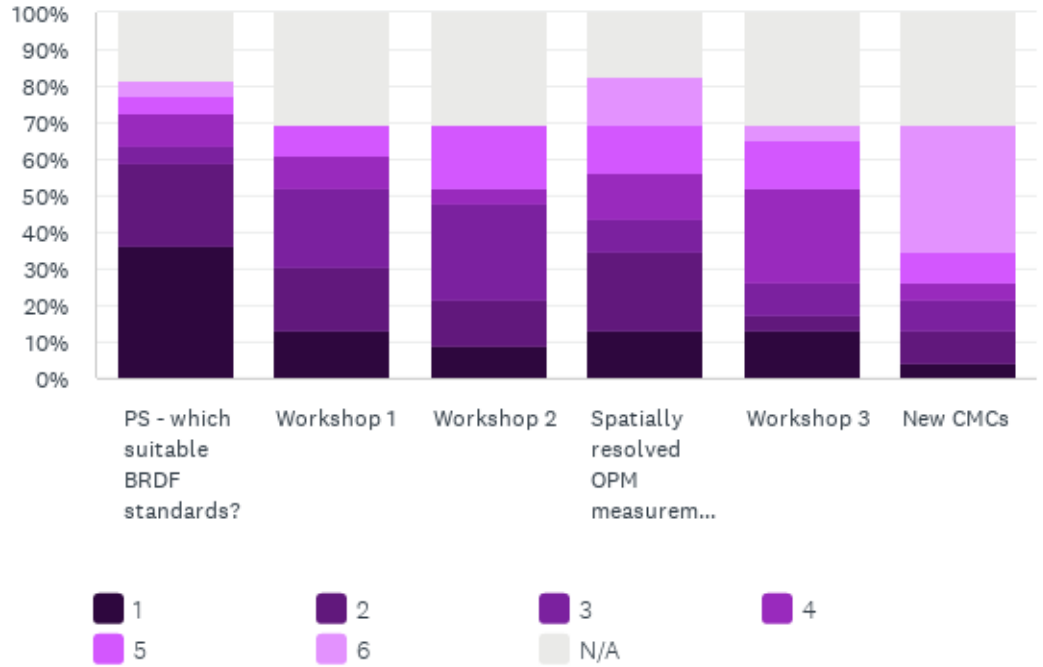
Q25: Optical Properties of Materials

- Answered: 23 Skipped: 1



Q26: Ranking - Optical Properties of Materials

- Answered: 23 Skipped: 1



Workshop 1 - on methodologies to improve OPM measurements to support laser-based advanced manufacturing

Workshop 2 - micro-spectrophometric methodologies of meta-surfaces, nano-materials and embedded devices

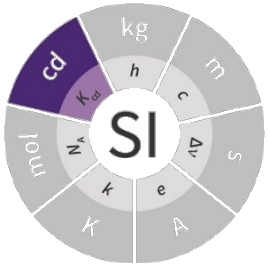
Workshop 3- on methodologies for OPM spectral calibrations in the range of 200 nm to 250 nm

Which CMC?
BRDF and BTDF
BRDF, BTDF
spectral reflectance, spectral transmittance
Diffuse Reflectance
BTDF
Haze
BRDF, reflectance, transmittance
low-level transmittance, non-white reflectance
reflectance and transmittance
Carbon nanotubes for reflectivity

Additional technical areas were considered during the 2022 CCPR survey but not enough interest was demonstrated by the respondents. This roadmap is not excluding any activities but prioritizing the activities of the CCPR as identified from the results of the 2022 CCPR survey. The CCPR will revisit these technical areas in a future survey including ***imaging photometry and radiometry, standards for optical quantum technologies, comparison on luminance and source colors for display, photovoltaic standards, 3D manufacturing, health and life sciences, radiative energy transfer, radiometric traceability for THz sources and detectors for security applications, and extreme UV lithography.***

Need input:

- ✓ Any of the listed activities need to be prioritized by the CCPR
- ✓ Any new activities



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