

Report from the BIPM... to the 28th COOMET Committee Meeting

Dr Martin J.T. Milton
Director of the BIPM

11-12 April 2018

Bureau
♦ **I**nternational des
♦ **P**oids et
♦ **M**esures



The BIPM – an international organisation

“the intergovernmental organization through which Member States act together on matters related to measurement science and measurement standards”

Established in 1875 when 17 States signed the Metre Convention.



CGPM – Conférence Générale des Poids et Mesures

Official representatives of Member States.



CIPM – Comité International des Poids et Mesures

Eighteen individuals of different nationalities elected by the CGPM.



BIPM Director and Staff

- *International coordination and liaison*
- *Technical coordination – laboratories*
- *Capacity building*

Consultative Committees (CCs)

CCAUV – Acoustics, US & Vibration

CCEM – Electricity & Magnetism

CCL – Length

CCM – Mass and related

CCPR – Photometry & Radiometry

CCQM – Amount of substance

CCRI – Ionizing Radiation

CCT – Thermometry

CCTF – Time & Frequency

CCU – Units

Member States and Associates

As of today, there are:

- 59 Member States
- 42 Associates States and Economies of the CGPM

109 of the 193 states listed by the UN participate in the BIPM's activities, covering 98 % of the world's GDP according to 2016 World Bank data.

Montenegro, which has been an Associate since 2011, became a **Member State** on 24 January 2018




Kuwait became an **Associate State of the CGPM** on 23rd March 2018.

Ethiopia became an **Associate State of the CGPM** on 1st January 2018.

Yemen is **excluded** as an Associate State on 1st January 2018 due to non-payment (three years subscriptions).

Tanzania became an **Associate State of the CGPM** on 1st January 2018.

CIPM Decisions on Micro-CEEMS *(Countries with Emerging Metrology Systems)*

Decision CIPM/106-20	October 2017
<p>The CIPM decided that when considering whether it is appropriate for an Associate State of the General Conference on Weights and Measures (CGPM) to be encouraged to accede to the Metre Convention and hence become a Member State, it will take into account whether it has:</p> <ul style="list-style-type: none"> • been an Associate State of the CGPM for at least 5 years, • a National Metrology Institute (NMI) that has signed the CIPM MRA, • published comparison results in the key comparison database (KCDB), • one or more Calibration and Measurement Capability (CMC) listed in the KCDB, • a percentage higher than 0.02 on the <i>"Scale of assessments for the apportionment of the expenses of the United Nations"</i>. <p>The above criteria will be applied in the implementation of Resolution 4 of the CGPM (2011) <i>"On the status of Associate State of the General Conference"</i>.</p> <p>This decision revises the criteria adopted by the CIPM at its 98th (2009) and 99th (2010) meetings.</p> <p>The above notwithstanding, the CIPM reaffirmed that an Associate State of the CGPM may choose to accede to the Metre Convention and become a Member State at any time should it so wish.</p>	 [Decisions]
Decision CIPM/106-21	October 2017
<p>The CIPM decided that an Associate State of the CGPM that does not meet the criteria set in Decision CIPM/106-20 and that has already been encouraged to accede to the Metre Convention, and as a result is paying an increased subscription, shall have its subscription reduced to the minimum for an Associate State. The reduction will come into force in 2018 and will not be retroactive.</p>	 [Decisions]
Decision CIPM/106-22	October 2017
<p>The CIPM asked the BIPM to work with any Associate State included in Decision CIPM/106-21 and that is in arrears in order to establish a rescheduling agreement.</p>	 [Decisions]

The 'encouragement' criteria in practice (2017)

RESOLUTION 4 of the 24th CGPM (2011):
Associates who have been encouraged to become a Member States

6 Micro-CEEMS are already
on escalator

3 Micro-CEEMS will be on
escalator in 2018

Discussions of AS to MS:

Belarus
Costa Rica
Ecuador
Panama
Ukraine
Paraguay
Bosnia and Herzegovina
Montenegro

Associate State	Date meeting criteria	Period of increasing subscription	
		Start	90% MS
Belarus	in 2011	2013	2017
Costa Rica	in 2011	2013	2017
Cuba	in 2011	2013	2017
Ecuador	in 2011	2013	2017
Jamaica	in 2011	2013	2017
Latvia	in 2011	2013	2017
Panama	in 2011	2013	2017
Ukraine	in 2011	2013	2017
Viet Nam	in 2011	2013	2017
Albania	April 2013	2015	2019
Macedonia, the FYR of	July 2013	2015	2019
Moldova, Republic of	September 2013	2015	2019
Estonia	May 2014	2016	2020
Georgia	May 2014	2016	2020
Paraguay	May 2014	2016	2020
Peru	May 2014	2016	2020
Republic of Philippines	December 2013	2016	2020
Bolivia	July 2016	2018	2022
Bosnia and Herzegovina	May 2016	2018	2022
Montenegro	August 2016	2018	2022

Step on
escalator:

5

3

2

0

The 'encouragement' criteria in practice (2018)

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Discussions of AS to MS:

- Belarus
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- Panama
- Ukraine
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Ukraine	in 2011	2013	2017
Viet Nam	in 2011	2013	2017
Estonia	May 2014	2016	2020
Peru	May 2014	2016	2020
Republic of Philippines	December 2013	2016	2020

Step on ladder:

5

3

Liaison and Coordination

**Bureau
International des
Poids et
Mesures**

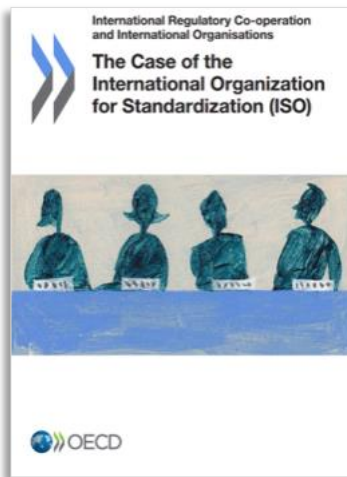
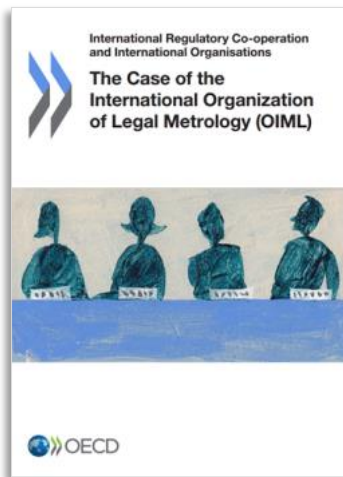
*BIPM works to foster cooperation
with international organizations
and promotes the world-wide
comparability of measurement.*



BIPM LIAISONS

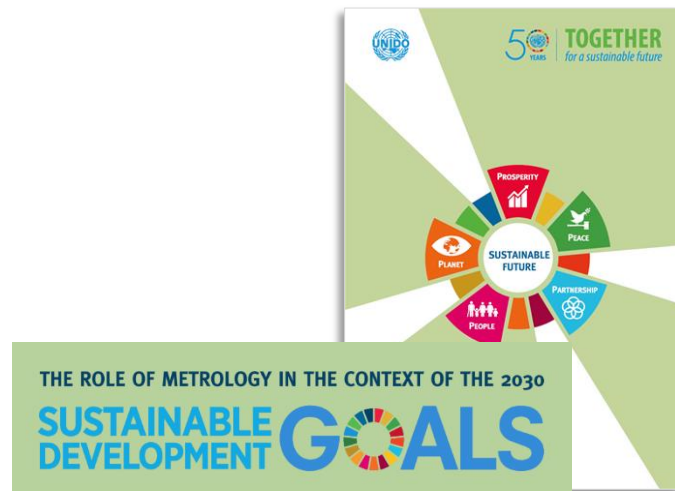
Future OECD case studies (2017-2019)

BIPM, WTO, ASTM International



UNIDO-BIPM-OIML joint publication

<https://www.bipm.org/en/worldwide-metrology/liaisons/unido.html>



<https://www.bipm.org/utls/common/liaisons/unido-bipm-oiml-brochure.pdf>

UNIDO brochures on [standardization](#) and [accreditation](#) are also available

On the future revision of the SI

Future revision of the SI

What?

Why?

When?

Ongoing work

Key documents

FAQs; More info.

Task Group for the Promotion of the SI

Revised SI: Download Area

→ At its 25th meeting (November 2014) the CGPM adopted a Resolution on the future revision of the International System of Units. This Resolution built on the CGPM's previous Resolution (2011), which took note of the CIPM's intention to propose a revision of the SI and set out a detailed roadmap towards the future changes.

In the revised SI four of the SI base units – namely the **kilogram**, the **ampere**, the **kelvin** and the **mole** – will be redefined in terms of constants; the new definitions will be based on fixed numerical values of the Planck constant (h), the elementary charge (e), the Boltzmann constant (k_B), and the Avogadro constant (N_A), respectively. Further, the definitions of all seven base units of the SI will also be uniformly expressed using the explicit-constant formulation, and specific *mises en pratique* will be drawn up to explain the realization of the definitions of each of the base units in a practical way.



- Expected at the CGPM in November 2018
- Implementation date is 20 May 2019
- The Task Group on raising of the public awareness has been created
- It has developed a 'brand book' supporting redefinition: is available from the [BIPM SI download area](#)
- The awareness campaign will be launched on 20 May (WMD) 2018 and run through to 20 May 2019

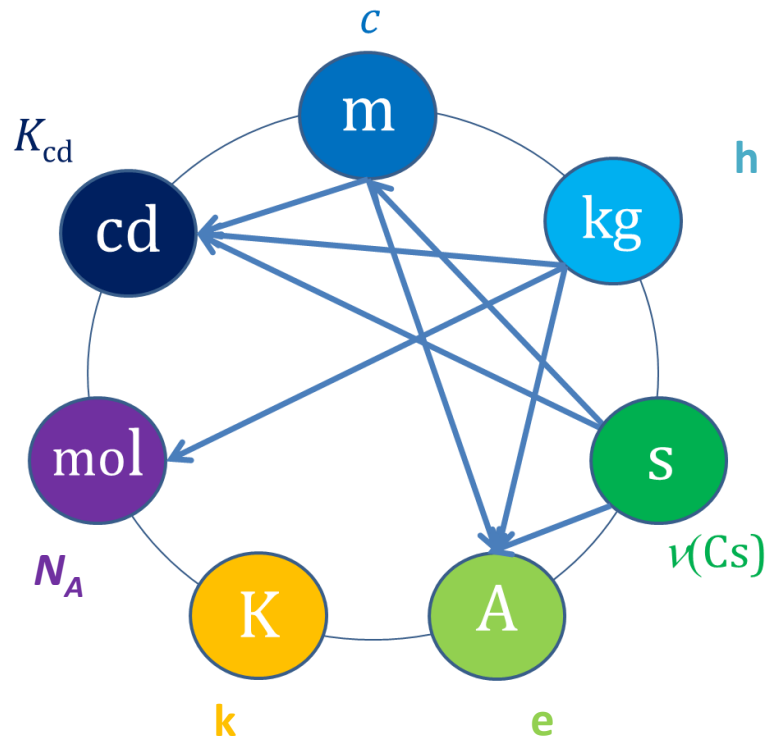
Proposal for 4 new definitions

Definitions based on **fundamental**
(or **conventional**) constants:

- *kilogram* (h)
- *ampere* (e)
- *kelvin* (k)
- *mole* (N_A)
- *metre* (c)
- *candela* (K_{cd})

Definition based on **material property**:

- *second* (^{133}Cs)



(Metrologia, 2017)

The definition of the kilogram in the SI

**The kilogram is the unit of mass -
it is equal to the mass of the
international prototype of the kilogram.**

- manufactured around 1880 and ratified in 1889
- represents the mass of 1 dm³ of H₂O at its maximum density (4 °C)
- alloy of 90% Pt and 10% Ir
- cylindrical shape, $\varnothing = h \sim 39$ mm
- kept at the BIPM in ambient air

**The kilogram is the last SI base
unit defined by a material artefact.**



How can we explain the new definitions?

- ♦ **The new definitions will “facilitate universality of access to the agreed basis for worldwide measurements”.**
 - This has been an ambition for the “metric system” that goes back more than 200 years. The 2018 definitions will make it possible for the first time.
- ♦ **The changes will underpin future requirements for increases in accuracy**
 - As science and technology advances, the demands for the accuracy of measurements will continue to increase accuracy. The 2018 definitions will provide for these needs for many years to come.
- ♦ **The new definitions use “the rules of nature to create the rules of measurement”.**
 - The use of constants in nature enable you to link from the smallest to the largest measurements quantities. It will tie measurements at the atomic (and quantum) scales to those at the macroscopic level. This introduces the appeal of a fundamental (“quantum”) basis for the changes.



Information for users about the proposed revision of the SI

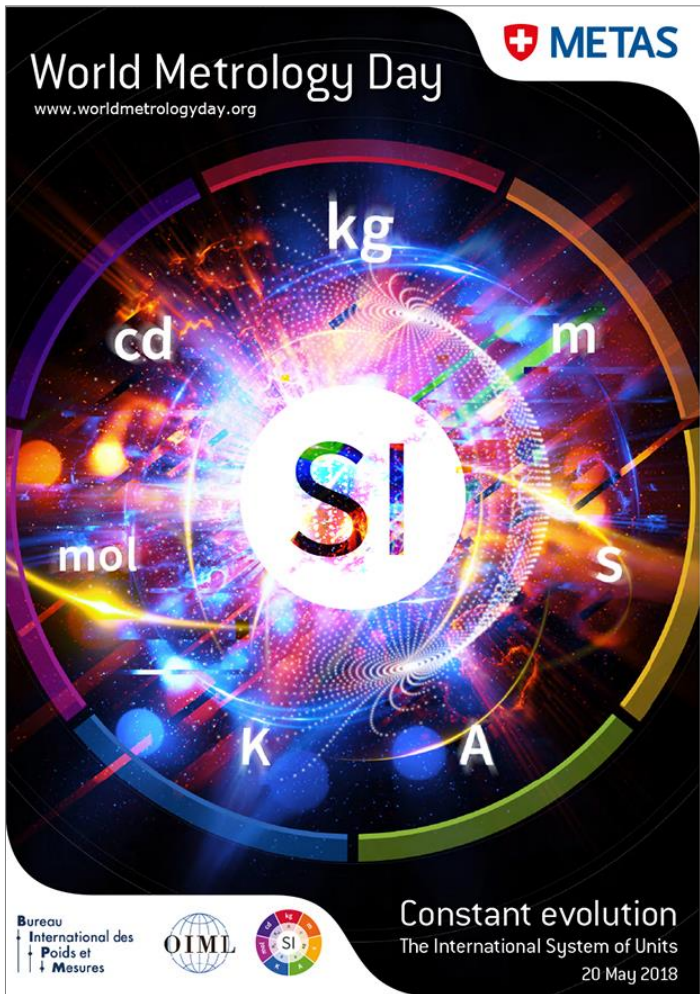
The International System of Units¹, the SI, which is based on the **second**, the **metre**, the **kilogram**, the **ampere**, the **kelvin**, the **mole** and the **candela** (the base units), is being revised to update the definitions of four of these units. In November 2018 revised definitions of the **kilogram**, **ampere**, **kelvin** and **mole** are expected to be approved by the General Conference on Weights and Measures (CGPM), the international body responsible for the global comparability of measurements. The revised definitions are expected to come into force on 20 May 2019.

The revised definitions will be based on seven physical constants (for example the speed of light, the Planck constant and the Avogadro constant) and are therefore inherently stable. The quantities have been chosen so that the revised definitions will not need to be modified to accommodate future improvements in the technologies used to realize them. The revision of the SI in this way was foreseen in Resolutions of the CGPM adopted in 2011 and 2014^{2,3}. Additional requirements contained in these Resolutions will ensure a smooth transition to the four revised definitions. Most users will not notice the change. A new edition of the SI Brochure¹ will provide essential information for users and will be available after the revised definitions are adopted formally. Guidance on the practical realization of the units will be available⁴⁻⁸.

- **The kilogram ...** The uncertainties offered by NMIs to their calibration customers will also be broadly unaffected.
- **The ampere...** Practitioners working at the highest level of accuracy may need to adjust the values of their standards and review their measurement uncertainty budgets.
- **The kelvin** will be redefined with no immediate effect on temperature measurement practice or on the traceability of temperature measurements, and for most users, it will pass unnoticed.
- **The mole...** This uncertainty will be so small that the revised definition of the mole will not require any change to common practice

World Metrology Day posters





World Metrology Day - 2018

theme: “Constant evolution”

Poster was prepared by METAS

As of today,

- *Poster translated into 14 Languages*
- *Events recorded in 8 countries*

<http://www.worldmetrologyday.org>

BIPM Capacity Building & Knowledge Transfer Programme

The aim of the BIPM CB&KT programme is to increase the effectiveness with which Member States and Associates engage in the world-wide coordinated metrological system.

CB&KT initiatives

8 Completed
4 Ongoing
6 Planned so far

Around 190 participants (around 100 at the BIPM) from 74 countries participated in various training courses!

Strategy of the programme



Focused capacity building opportunities (typically) at the BIPM



Engagement with the Global QI capacity building community



Scientific comparisons of particular interest to Member States that are developing countries



RMO representatives included in CC Presidents meeting

Decision CIPM/106-27 October 2017

The CIPM asked the CIPM President to invite each RMO to send one or two representatives to the next meeting of the CC Presidents (19-20 June 2018). These representatives should be prepared to address the recommendations of the review of the CIPM MRA in order to ensure common understanding between the CCs and the RMOs on technical and quality-system issues.

<https://www.bipm.org/en/committees/cipm/meeting/106.html>

BIPM Secondees and guest workers

BIPM International Liaison and Communication Department:

- **Ms Sally Bruce**, from NIST (USA) - from 9 April 2018 to 6 July 2018.
- **Ms Juan Cai**, from NIM (China) - from 3 April 2018 to 25 March 2019.
- **Mr Nikita Zviagin**, from VNIIM (Russian Federation) - from 1 January 2017 to 31 December 2018.

BIPM Chemistry Department:

- **Dr Jintana Nammoonov**, from the NIMT (Thailand) – from 3 April 2018 until 31 December 2018.
- **Dr Dennis Mkhize**, from the NMISA (South Africa) - from 3 April 2018 until 30 June 2018.
- **Dr Burcu Bínící**, from TÜBITAK (Turkey) - from 3 April 2018 to 30 June 2018.
- **Dr Zhen Guo**, from NIM (China) - from 4 December 2017 to 30 November 2018.
- **Dr Ming Li**, from NIM (China) - from 21 April 2017 to 20 April 2018.
- **Dr Francesca Rolle**, from INRIM (Italy) - from 1 February to 31 July 2018.
- **Dr Napo Godwill Ntsasa**, from NMISA (South Africa) - from 1 February to 31 July 2018.
- **Dr Christophe Sutour**, from LNE (France) - from 18 September 2017 to 16 November 2018.
- **Dr Wei Zhang**, from NIM(China) - from 16 January to 13 April 2018.

BIPM Physical Metrology Department:

- **Dr Mun-Seong Kim**, from KRISS (Republic of Korea) - from 2 October 2017 to 30 September 2018.
- **Dr Norihiko Sakamoto**, from NMIJ-AIST (Japan) - from 2 October 2017 to 30 September 2018.
- **Dr Huang Lu**, from NIM (China) - from 10 April 2018 to 31 July 2018

26th meeting of the CGPM: 13-16 November 2018

Meeting logistics

- Attendance and registration
 - Provisional timetable
- Map/location
- Hotels in Versailles



Working documents

- BIPM strategic plan
- Convocation
- Draft Resolutions

Work of the BIPM

- Mission, Role and Objectives
- Organigram
- Member States
- Associate States and Economies
- Financial Report
- Annual Director's Report
- Compendium of main rules and practices applicable to the BIPM
- Calculating Member State contributions
- Calculating Associate subscriptions

The CIPM

- List of members
- Process for election of CIPM members
- Reports of the CIPM
- The Consultative Committees

Impact of metrology

- The CIPM Mutual Recognition Arrangement
- Impact and case studies related to metrology

26th meeting of the CGPM

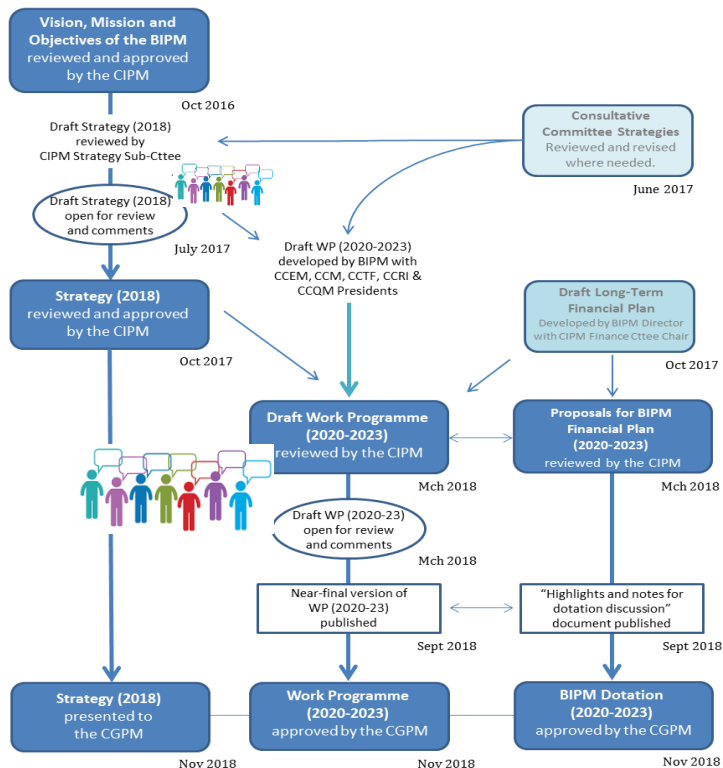
<https://www.bipm.org/en/cgpm-2018/>

List of Draft Resolutions

- A On the revision of the International System of Units (SI)
- B On the definition of time scales
- C On the objectives of the BIPM
- D On the dotation of the BIPM for the years 2020 to 2023
- E On financial arrears of Member States and the process of exclusion

BIPM Strategy and Work Programme

Timeline for development and agreement of the BIPM Strategy and Work Programme for the 26th CGPM (2018)



The BIPM work is directed to support its Member States

- BIPM Strategic Plan aims to implement the BIPM vision, mission and objectives
- The strategy documents of CCs are subject to review and comment by Member State Representatives and NMI Directors
- BIPM Strategic Plan is complementary to the strategic plans developed the Consultative Committees, and is subject to review and comment by Member State representatives and NMI Directors
- BIPM Work Programme is built on the interactions with NMI Directors and Member State representatives, and has been the subject of specific consultation with the Member States
- The BIPM Work Programme is presented to the CGPM alongside the BIPM strategy and requested 'dotation'
- Progress against the Work Programme is reviewed annually by the CIPM

Draft Work Programme of the BIPM for 2020-2023 is now available for comments at <https://www.bipm.org/utis/en/pdf/CGPM/BIPM-work-programme.pdf>

Upcoming meetings and events at the BIPM

From 15 to 21 April 2018

From 11 to 15 June 2018

From 19 to 20 June 2018

From 21 to 22 June 2018

From 25 to 29 June 2018

From 2 to 3 July 2018

3 July 2018

4 July 2018

From 13 to 16 November 2018

From 26 to 30 November 2018

3 December 2018

From 4 to 7 December 2018

24th meeting of the CCQM and related meetings

17th meeting of the CCL and related meetings

Meeting of CC Presidents

107th meeting of the CIPM

Meeting of the JCGM WG 2: VIM

Meeting of CCPR WG-CMC (2 July, afternoon/3 July, morning)

Meeting of CCPR WG-SP (3 July, afternoon)

Meeting of CCPR WG-KC

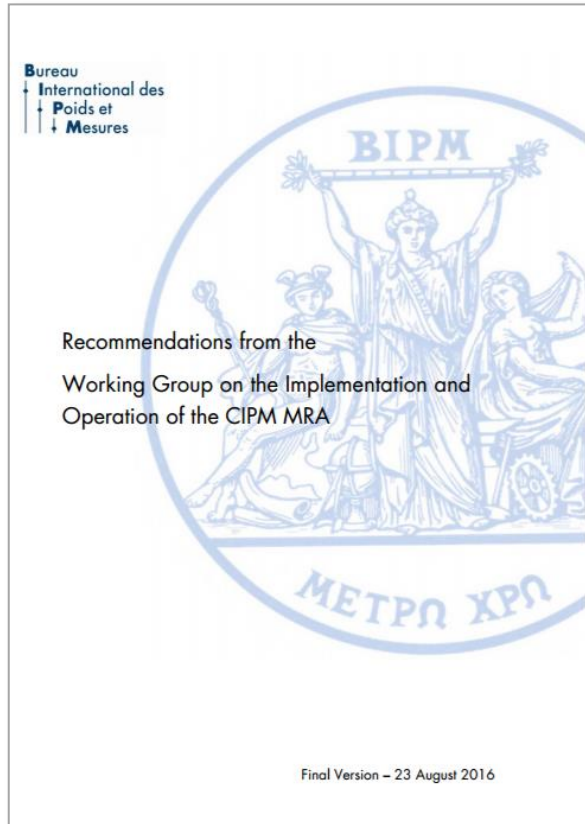
26th meeting of the CGPM

Meeting of the JCGM WG 2: VIM

Meeting of the JCGM

Meeting of the JCGM WG 1: GUM

CIPM MRA Review



- ◆ Review triggered at the 2014 CGPM, and conducted by a working group in 2015/2016
- ◆ Extensive workshop and consultation process (NMIs, CCs, JCRB, RMOs, BIPM, ILAC...)
- ◆ 9 Recommendation, 28 action items
- ◆ **Now in the implementation phase**