

CCQM President's Report

28th CGPM (2026)



Working together to
promote and advance
the global comparability
of measurement

Report by the President of the CCQM

Dr S.-R. Park President of the Consultative Committee for Amount of Substance: Metrology in Chemistry and Biology (*Comité consultatif pour la quantité de matière : métrologie en chimie et biologie*, CCQM) presented the report on the activities of the CCQM since the 27th meeting of the CGPM (2022).

CCQM Executive summary

The Consultative Committee for Amount of Substance: Metrology in Chemistry and Biology (CCQM) is the largest of the ten Consultative Committees of the International Committee for Weights and Measures (CIPM), bringing together over 70 National Metrology Institutes (NMIs) and Designated Institutes (DIs) and more than 600 scientists to advance the global comparability of chemical and biological measurements. This report summarizes CCQM activities and achievements over the period October 2022 to September 2026.

Against its seven strategic aims, the CCQM has delivered concrete progress on some of the most pressing global measurement challenges. The Committee's response to infectious disease pandemic preparedness matured from a 2022 Roadmap into operational 'fire drill' exercises demonstrating rapid deployment of nucleic acid (2024) and protein (2025/2026) reference measurement capability, work that is now feeding into the international 100 Days Mission. In environmental metrology, new NMI measurement infrastructure for atmospheric science and an expanding portfolio of isotope-ratio and particle-metrology activities are underpinning measurements in environmental applications world-wide. In healthcare, the Joint Committee for Traceability in Laboratory Medicine (JCTLM) database is being modernized, and a new workshop on (multi-)omics measurements has set the direction for the next generation of clinical reference measurement systems. The Committee has also embraced digitalization and artificial intelligence, establishing a dedicated Task Group on Data Digitalization.

The CCQM has continued to manage its comparison programme efficiently, maintaining the number of new comparisons at around 18 per year while the number of Calibration and Measurement Capabilities (CMCs) it underpins grew past 6 500. Capacity building for developing NMIs and DIs has been strengthened through new Working Group Knowledge Transfer and Capacity Building Task Groups, an expanding e-learning platform, and coordinated comparisons such as the mycotoxin calibration series. The Committee has maintained its organizational vitality by completing a full revision of its Strategy Document to 2034, forming new Task Groups in emerging areas such as gene delivery systems and lithium-ion battery metrology, and managing an orderly transition of Working Group leadership.

The Committee's technical programme continues to be underpinned by the BIPM Chemistry Department, which coordinates priority comparisons, delivers knowledge transfer and capacity building to NMIs and DIs, maintains shared databases such as the JCTLM, and provides the CCQM's Executive Secretary.

Looking ahead, the CCQM is preparing to address a set of new and emerging technical activities that will shape its next strategy period: multi-omics measurements in clinical diagnostics; metrology for gene and cell therapies; lithium-ion battery metrology; nano- and microplastics measurement and standards; PFAS and other emerging persistent contaminants; digital transformation, FAIR data and AI-readiness of reference data; aerosol and bioaerosol metrology; and detection of gene-edited organisms and next-generation nucleic acid testing.

Scope of the CCQM

The CCQM was established by the CIPM in 1993 to bring together the world's experts in metrology in chemistry and biology, and is the only Consultative Committee working solely in this domain. It has grown to encompass nine technical subject Working Groups – Organic Analysis (OAWG), Inorganic Analysis (IAWG), Gas Analysis (GAWG), Isotope Ratio (IRWG), Surface Analysis (SAWG), Electrochemical Analysis and Classical Methods (EAWG), Protein Analysis (PAWG), Nucleic Acid Analysis (NAWG) and Cell Analysis (CAWG) – supported by the Key Comparison and CMC Quality Working Group (KCWG), an *ad hoc* WG on the mole, a strategic planning working group (SPWG), a series of cross-cutting Task Groups, and the BIPM Chemistry Department. Since its creation, the CCQM has coordinated over 400 international comparisons, at a current rate of

approximately 18 per year, underpinning more than 6 500 Calibration and Measurement Capabilities (CMCs) registered by over 70 institutes world-wide in the BIPM Key Comparison Database (KCDB).

The Committee's vision is a world in which all chemical and biological measurements are made at the required level of accuracy to meet the needs of society. Its mission is to advance the global comparability of chemical and biological measurement standards and capabilities, enabling Member States and Associates to make measurements with confidence. Its formal responsibilities are to: demonstrate the global comparability of chemical and biological measurements and promote traceability to the SI; advise the CIPM on matters relating to chemical and biological measurement, including the definition and realization of the mole; reach out to stakeholders to promote the international measurement system; progress the state of the art of measurement science as a forum for exchange; and contribute to the implementation and maintenance of the CIPM Mutual Recognition Arrangement (CIPM MRA).

Strategy

The CCQM 2030+ Strategy Document (a revision of the 2021-2030 strategy, approved at the 31st CCQM meeting in April 2026 and extending the planning horizon to 2034 and beyond) sets out seven strategic aims that structure the Committee's work programme:

- Aim 1 – Global challenges: to contribute to the resolution of global challenges such as climate change and environmental monitoring, energy supply, food safety, and healthcare including infectious disease pandemics, by identifying and prioritizing critical measurement issues and developing comparison studies.
- Aim 2 – Promoting uptake: to promote the uptake of metrologically traceable chemical and biological measurements through workshops and roundtable discussions with stakeholder organizations, feeding stakeholder priorities into CCQM work programmes.
- Aim 3 – State of the art: to progress the state of the art of chemical and biological measurement science by investigating new and evolving technologies, methods and standards.
- Aim 4 – Efficiency of comparisons: to improve the efficiency and efficacy of the global system of comparisons by developing strategies for a manageable number of comparisons that cover core capabilities.
- Aim 5 – Evolution of CMCs: to continue the evolution of CMCs to meet stakeholder needs, including the use of broad-claim CMCs and improved presentation of CMC data.
- Aim 6 – Capacity building: to support the development of capabilities at NMIs and DIs with emerging activities, through close working relationships with Regional Metrology Organizations (RMOs), mentoring, knowledge transfer and secondments.
- Aim 7 – Organizational vitality: to maintain organizational vitality by regularly reviewing and, where required, updating the CCQM structure to respond to the evolution of global measurement needs.

The strategy also identifies nine sectors whose scientific, economic and social challenges drive the CCQM work programme: Environment and Climate; Healthcare and Life Sciences; Food Safety, Trade and Authenticity; Energy; Legal Metrology; Fundamental Metrology and support of the SI; Forensic Sciences and Anti-doping; Advanced Manufacturing; and Biotechnology and Drug Discovery. Thirty-four technical activities have been identified across the nine Working Groups, including a newly added multi-omics activity for the 2025-2034 period.

Activities and achievements since the last meeting of the CGPM

For each of the seven CCQM strategic aims, the three examples of high impact activities and achievements are identified:

Aim 1 – Contributing to the resolution of global challenges

- Operational pandemic-preparedness 'fire drill' exercises: Building on the 2022 CCQM Roadmap to Metrology Readiness

for Infectious Disease Pandemic Response, the CCQM Task Group on Pandemic Preparedness initiated the first full-scale ‘fire drill’ exercises: a Nucleic Acid Working Group study using an H5N1 avian-influenza model (CCQM-P232, completed 2024) and a Protein Analysis Working Group study (CCQM-P257, 2025–2026) that timed each step from calibrant sourcing to comparison exercise completion. These exercises demonstrated the metrology community's capability for rapid deployment of diagnostic reference measurements and are now informing the international 100 Days Mission response framework.

- Global implementation of a new ozone cross-section reference value: Following BIPM research that provided new high-accuracy ozone absorption cross-section measurements, the CCQM approved a new consensus SI-traceable value at 253.65 nm (CCQM.O3.2019). A dedicated GAWG Task Group then managed a coordinated global transition through 2023–2026, working with environment agencies, regulators, standards bodies and instrument manufacturers to revise documentary standards, update historic data trends and communicate the change, delivering more accurate ground-level ozone measurements world-wide in support of efforts for cleaner-air.
- Delivery of the Nano- and Microplastics Task Group report: Following a 2022 CCQM workshop, a multi-year NMI survey and a stakeholder workshop, the CCQM Nano- and Microplastics Measurements and Standards Task Group delivered its final report and recommendations to the 31st CCQM meeting (2026), setting out priority comparisons and cross-Working-Group coordination mechanisms for this rapidly growing environmental and food-safety concern.

Aim 2 – Promoting uptake of traceable measurements

- CCQM Task Group on Food Measurement stakeholder strategy: Established in response to the CIPM's evolving-needs process, the CCQM Task Group on Food Measurement engaged all nine technical subject Working Groups together with the Consultative Committees for Thermometry, Photometry and Radiometry, Mass, and Ionizing Radiation, and ran an internal workshop (2024) followed by a four-day external stakeholder workshop (February 2025) covering authenticity, novel foods, gene-edited organisms and emerging contaminants – directly feeding stakeholder priorities into a comprehensive CCQM food-safety strategy and work programme.
- CCQM Workshop on Metrology for (Multi-)omics Measurements in Clinical Diagnostics: Held in March 2026 with joint participation from NAWG, PAWG, OAWG and CAWG, this workshop engaged clinical and industry stakeholders on emerging multi-omics diagnostic needs and directly informed the addition of a new multi-omics activity to the CCQM 2030+ Strategy.
- Modernization and closer integration of the JCTLM database: The Joint Committee for Traceability in Laboratory Medicine, jointly supported by the BIPM and International Federation of Clinical Chemistry and Laboratory Medicine (IFCC), progressed a new web-based nomination and review platform (targeted for release in 2027) and eLearning modules on the submission process.

Aim 3 – Progressing the state of the art of measurement science

- Establishment of the CCQM Task Group on Data Digitalization: Formed in 2025 following a September 2024 workshop on Digital and FAIR Chemical and Biological Reference Data and Certificates, the Task Group has established three teams covering: unique identifiers, CRM certificate digitalization, and FAIR/AI principles applied to databases.
- Advances in single-particle and nanoparticle characterization techniques: The IAWG studied single-particle ICP-MS as a technique for measuring the size, size distribution and number concentration of particles suspended in liquids, working with SAWG to demonstrate equivalence with more established methods. In a related advance, pilot study CCQM-P248 benchmarked new analytical methods, including atom probe tomography, for the simultaneous measurement of chemical composition and structure of metal alloy films at the sub-nanometre scale.
- Revision of the *mise-en-pratique* for the definition of the mole: Following the 2023 CCU/CCQM workshop ‘The metrology of quantities which can be counted’, the CCQM *ad hoc* Working Group on the Mole worked with a new CCU Focus Group

on Counting and Number Quantities to review the SI Brochure; the resulting changes were approved by the CCU in April 2024, and an updated *mise-en-pratique* for the mole was published in 2025.

Aim 4 – Improving efficiency and efficacy of the comparison system

- Sustained comparison output within a manageable programme: The CCQM has kept its comparison programme at or below the targeted 18 studies per year throughout 2022–2026, while the underlying CMC base grew from 6 346 (2021) to 6 535 (2025), demonstrating that broad-claim and core-capability comparison models are successfully containing the growth in the number of individual studies required.
- Updated guidance on consensus KCRV estimation: The CCQM Task Group on KCRV Estimation is revising the Committee's core statistical guidance note on estimating a consensus Key Comparison Reference Value, addressing over-dispersion, asymmetry and the choice of estimator, and adding new graphical and Bayesian methods – directly improving the consistency and defensibility of comparison outcomes across all Working Groups.
- Standardized comparison coordination tools adopted CCQM-wide: The OAWG Practices and Guidelines Document, together with its Comparison Coordination Checklist and standard protocol/report templates, has become the basis for coordination documents in other Working Groups, reducing the administrative burden on study coordinators and improving the consistency of comparison reporting.

Aim 5 – Evolution of CMCs

- Continued rollout of broad-claim CMC models: Broad-claim CMCs, which allow a single comparison to demonstrate capability across a wider range of matrices and analytes, have continued to be implemented across Working Groups, reducing the number of individual KCDB entries that must be separately reviewed while maintaining evidential rigour.
- OAWG CMC Task Group to manage CMC quality and lifecycle: Established in 2025, this Task Group is developing new criteria for CMC acceptance, maintenance, under-performance management and withdrawal, directly responding to the growing administrative burden created by a proliferation of single-analyte CMCs and to requests from the KCWG for clearer, more consistent review standards.
- Early exploration of AI-assisted CMC review: In 2026 the CCQM began exploring the use of large language models to pre-screen CMC claims before submission, drawing on the JCTLM database's recent 'flattening' into a machine-readable structure as a model for how the KCDB's CMC data might in future be made more accessible to automated review tools.

Aim 6 – Supporting capability development at NMIs and DIs

- New Working Group Capacity Building and Knowledge Transfer Task Groups: OAWG established a dedicated Knowledge Transfer Task Group in 2024, and GAWG followed with its own Capacity Building Task Group in 2026 (convening at LACOMET, Costa Rica, in October 2026), both building on the established BIPM Capacity Building and Knowledge Transfer (CBKT) chemistry programme to help developing NMIs and DIs acquire core comparison-ready capabilities.
- Coordinated mycotoxin calibration comparison series: The CCQM-K154 series of key comparisons on mycotoxin calibration solutions (aflatoxin B1, deoxynivalenol, patulin), coordinated by the BIPM, has directly built NMI capability for producing and value-assigning food-safety calibrants that underpin accurate and traceable measurement services in the food sector.
- Expansion of the BIPM eLearning platform and technical schools: New eLearning modules covering qNMR for organic standards, FTIR analysis for gas standards, stable isotope measurements and non-structure-related impurity content, together with a qNMR summer school hosted at BIPM headquarters, have broadened the pool of NMI scientists able to undertake core reference-material characterization techniques.

Aim 7 – Maintaining organizational vitality

- Completion of the CCQM 2030+ Strategy revision: Coordinated across all nine technical subject Working Groups, the revised CCQM Strategy Document was finalized and approved at the 31st CCQM meeting (April 2026), extending the planning horizon to 2034, and aligning the Committee's nine priority sectors with the CIPM's own 2030+ strategy published in May 2025.
- Formation of new Task Groups in emerging technical areas: In response to evolving stakeholder needs, the CCQM established new Task Groups on Gene Delivery Systems (2025, following a workshop on metrology for viral vectors as molecular tools), Metrology for Li-ion Batteries, and Comparison Material Transportation, ensuring the Committee's structure keeps pace with new and cross-cutting measurement fields.
- Orderly renewal of Working Group and CCQM leadership: New Working Group Chairs and Vice-Chairs were appointed across the 2023–2027 cycle (including OAWG, PAWG, SAWG and KCWG), and a structured timeline and selection process was agreed in 2026 for the 2027–2031 leadership cycle.

Support of CCQM activities by the BIPM Chemistry Department

Across the reporting period, the BIPM Chemistry Department has underpinned the CCQM's work programme in four complementary roles: providing the CCQM Executive Secretary function; coordinating international comparisons in priority technical areas; delivering knowledge transfer and capacity building for NMIs and DIs; and providing liaison and coordination for stakeholder engagement, workshops and shared databases. Departmental activity is reported to each CCQM plenary meeting and is aligned to the CCQM Strategy.

Comparison coordination and measurement infrastructure

The Department remains one of the leading coordinators of CCQM key comparisons and pilot studies, particularly in gas and isotope analysis and in the purity of organic, peptide and protein materials. In the 2020-2023 programme it coordinated comparison exercises involving 313 NMI participations, spanning stable gases, isotope ratios, air quality gases, organics, proteins/peptides and SARS-CoV-2 antibody quantification. The Department continues to strongly support core-capability comparisons for small organics and protein purity underpinning the OAWG and PAWG traceability hierarchy.

Knowledge Transfer and Capacity Building

The Department's laboratory-based Capacity Building and Knowledge Transfer (CBKT) programme, initiated in 2016 in Metrology for Safe Food and Feed and Clean Air, has continued to expand, with future coverage foreseen for pesticides and veterinary drug residues, dynamic standards for air quality gases, and pure peptides for laboratory medicine. This has been complemented by an expanding online eLearning offering – including modules on organic purity measurement (over 100 subscribed participants), FTIR analysis for gas standards, stable isotope measurements and qNMR – and by the Department's first qNMR Summer School, held in June 2024 and repeated in subsequent years for NMI scientists.

The visiting scientist secondment programme remains a central mechanism for two-way knowledge transfer between the BIPM and NMIs, with an average of eleven placements a year, and a growing number funded directly by home institutes reflecting strong and sustained NMI commitment to the partnership model. Visiting scientist collaborations have supported at least 12 peer-reviewed publications since 2020, on topics spanning gas and isotope ratio reference methods, monoclonal antibody and virus-like particle quantification, and organic and peptide purity.

Databases, digitalization and stakeholder liaison

The Department maintains and continues to modernize the JCTLM database of reference materials, methods and services for laboratory medicine, launching a new database version during the period and progressing a web-based nomination and review platform for release in 2027. It is also involved in the CCQM's wider digitalization agenda, developing FAIR-compliant, machine-readable databases for gas and ozone standards, a new Isotope Ratio Reference Systems (IRRS) database requested by the IRWG, and the exploration of AI tools to streamline JCTLM data entry and review.

The Department organized or hosted more than 150 online meetings in support of Working Group and Task Group activities, in addition to major stakeholder events such as the BIPM-WMO Workshop and the workshop on accurate ozone measurement that underpinned the global roll-out of the new ozone cross-section value. Its status as an intergovernmental organization has also enabled direct liaison with bodies such as the IFCC and International Atomic Energy Agency (IAEA), extending the reach of CCQM outputs beyond the metrology community.

Outlook in the short and long term

Alongside its established comparison programme, the CCQM is positioning itself to address a set of new and emerging technical activities identified through recent workshops, Task Group reports and Working Group strategy updates. These areas are expected to shape the Committee's work programme over the coming strategy period.

1. Multi-omics measurements in clinical diagnostics. Following the March 2026 CCQM workshop on metrology for (multi-)omics measurements, a new activity has been added to the CCQM 2030+ Strategy to develop reference measurement approaches spanning genomics, transcriptomics, proteomics and metabolomics, coordinated jointly across the NAWG, PAWG, OAWG and CAWG.
2. Metrology for gene and cell therapies. Building on the outcomes of the CCQM workshop on metrology for viral vectors as molecular tools, the newly formed Task Group on Gene Delivery Systems is developing reference measurement capabilities for viral vector titre, integrity and potency to support the rapidly growing regenerative medicine and gene therapy sector.
3. Lithium-ion battery metrology. A new CCQM Task Group on Metrology for Li-ion Batteries has been established to identify measurement needs for battery materials and performance, reflecting the growing importance of energy storage technologies.
4. Nano- and microplastics measurement and standards. With the Nano- and Microplastics Measurements and Standards Task Group having delivered its final recommendations, the CCQM must now translate these into a coordinated programme of pilot studies on microplastic and nanoplastic particle number, size and mass concentration across environmental and food matrices.
5. PFAS and other emerging persistent contaminants. Per- and polyfluoroalkyl substances (PFAS), alongside emerging mycotoxins, endocrine disruptor compounds and packaging-migration contaminants, have been identified by the Task Group on Food Measurement and by OAWG as priority measurement challenges requiring new reference materials and comparison capability.
6. Digital transformation, FAIR data and AI-readiness. The CCQM Task Group on Data Digitalization is progressing unique identifiers, digitalized CRM certificates and FAIR-compliant, machine-readable comparison reports and Digital Calibration Certificates; extending this work across the KCDB and CMC database, following the model of the restructured JCTLM database, is an emerging priority.
7. Aerosol and bioaerosol metrology. The GAWG Aerosol Metrology Task Group has developed a roadmap spanning bio-aerosols, chemical composition and particle mass/number, identifying environmental DNA (eDNA) as a new cross-cutting measurand requiring future collaboration between the GAWG, NAWG and SAWG.
8. Detection of gene-edited organisms and next-generation nucleic acid testing. NAWG stakeholder consultation has identified the detection of precision-bred and gene-edited organisms, alongside GMO biomarkers and short tandem repeat/single nucleotide variant analysis, as an emerging measurement need for food authenticity, biosafety and regulatory compliance.

CCQM Data

CCQM set up in 1993

President: S.-R. Park

Membership:

List of CCQM members and observers:

Executive Secretary: R.I. Wielgosz

25 members, 6 liaisons and 12 observers

<https://www.bipm.org/en/committees/cc/ccqm/members>

Meetings since the 27th CGPM meeting:

27-28 April 2023, 25-26 April 2024, 10-11 April 2025, 16-17 April 2026

Full reports of the CCQM meetings:

<https://www.bipm.org/en/committees/cc/ccqm/publications>

Eleven Working Groups:

<https://www.bipm.org/en/committees/cc/ccqm/working-groups.html>

- Cell Analysis (CCQM-CAWG)
- Electrochemical Analysis (CCQM-EAWG)
- Gas Analysis (CCQM-GAWG)
- Inorganic Analysis (CCQM-IAWG)
- Isotope Ratios (CCQM-IRWG)
- Key Comparisons and CMC Quality (CCQM-KCWG)
- Nucleic Acid Analysis (CCQM-NAWG)
- Organic Analysis (CCQM-OAWG)
- Protein Analysis (CCQM-PAWG)
- Strategic Planning (CCQM-SPWG)
- Surface Analysis (CCQM-SAWG)

One *ad hoc* Working Group:

- *ad hoc* Working Group on the Mole (CCQM-AH-WG-MOLE)

CCQM Comparison activity	Completed/ In progress	Planned
CCQM key comparisons	251	12 per year
BIPM ongoing comparisons	3	7
CC pilot studies	160	6
CMCs	6 612 CMCs in 67 service categories registered in the KCDB	