PARTNERSHIP EVENTS in 2024 (highlighting engagement with stakeholders) included the following:

European Geosciences Union (EGU) General Assembly

14 – 19 April 2024, Vienna, Austria

The EGU General Assembly 2024 brings together geoscientists from all over the world to one meeting covering all disciplines of the Earth, planetary, and space sciences. The EGU aims to provide a forum where scientists, especially early career researchers, can present their work and discuss their ideas with experts in all fields of geoscience.
One of the splinter meetings in the programme will be partially co-convened by the consortium of Metrology Partnership project Metrology for multi-scale monitoring of soil moisture (SoMMet, 21GRD08). This meeting on Thursday 18 April will have the title 'In situ soil moisture: What are the errors sources, and how can we derive a traceable uncertainty budget?' and will facilitate the information exchange and discussions on the open problems of establishing the SI-traceability for soil moisture measurement under laboratory and outdoor conditions. This topic is one of the main objectives of the project SoMMet. Findings from this event will be used to feed back into the future work of the project.
Full information, including programme and registration

Validation of Methods for Biomethane Conformity Assessment Workshop

22 April 2024, Goteborg, Sweden & online

The European Partnership on Metrology project project 'Protocol for SI-traceable validation of methods for biomethane conformity assessment' (21NRM04, BiometCAP) project team is holding a free one-day workshop on 22 April, on validation of methods for biomethane conformity assessment. Registration is open until **31 March 2024**.
The event is hosted at RISE Research Institutes of Sweden facilities, in Göteborg, Sweden.
The workshop will also be held in virtual form to make sure everyone can participate.
The event will discuss how to improve confidence in the analysis instruments performances, biomethane sampling, and progresses towards standardisation.

Register here.

Advanced characterisation of materials symposium - to be held at Spring 2024 meeting of the European Materials Research Society

27 – 31 May 2024, Strasbourg, France

Spring 2024 meeting of the European Materials Research Society
The European Materials Research Society 2024 Spring conference will consist of parallel symposia with invited speakers, oral and poster presentations in a series of plenary sessions to provide an international forum for discussing recent advances in the field of materials science.
The scientific program will address different topics organised into 21 symposia arranged in 6 clusters covering the fields of:

- Decarbonised energy and sustainability

- Materials for human well-being
- 2D materials and surfaces: synthesis, characterisation and perspectives
- Advanced characterisation of materials
- Materials sciences for cultural heritage
- Electronics, magnetics and photonics

Full details of EMRS 2024 Spring meeting

Abstract submission for ALTECH 2024 - **Deadline 18 January 2024**

Advanced characterisation of materials symposium
The ALTECH 2024 symposium entitled Analytical techniques for accurate nanoscale characterization of advanced materials symposium, is supported by the European Metrology Network on Advanced Manufacturing and by the European Metrology projects: Memristive devices as quantum standard for nanometrology (20FUN06, MEMQuD), Operando metrology for energy storage materials (21GRD01, OpMetBat), Electrical nanoscale metrology in industry (20IND12, ELENA), and Metrology in manufacturing compound semiconductors for power electronics (20IND09, PowerElec).
Topics to be covered by this symposium include:

- Hybrid and correlative metrology for complex thin films and nanomaterials
- Scanning probe techniques for high resolution characterisation of organic, hybrid and inorganic semiconductors
- X-Ray diffraction, tomography, scattering and spectrometry-based applications on advanced materials and in nanoscience
- Advanced optical techniques, including spectroscopic, ultramicroscopy, interferometric and non-interferometric methods
- Metrology for energy materials, including energy conversion and storage
- Metrology for compound semiconductors materials and devices
- Recent developments of ion beam techniques for characterisation of lateral and vertical thin films
- Analytical techniques for characterisation of surface chemistry and of functionalised surfaces
- Nanometrology: ex-situ, in-situ and operando measurement methods, reference materials and calibration samples
- Methods for measurement of nanomaterials in complex matrices, including health and environmental safety assessment

ALTECH 2024 - Analytical techniques for accurate nanoscale characterization of advanced materials symposium

Consultative Committee for Ionizing Radiation online seminar: X-ray imaging dosimetry challenge

28 May 2024, online event

The Consultative Committee for Ionizing Radiation (CCRI) and the consortium of Metrology Partnership project Traceability in medical X-ray imaging dosimetry (22NRM01, TraMeXI) will organise this online seminar. It will offer an overview of the existing landscape in X-ray imaging dosimetry and proposes necessary updates to enhance accuracy and align with predefined objectives.
Medical X-ray imaging constitutes the most significant source of exposure to artificial ionising radiation. Accurate quantification of radiation exposure, facilitated by calibrated dosimetry equipment, is imperative for ensuring patient safety and adherence to fundamental safety protocols. Calibration laboratories adhere to established standards and international protocols in their procedures. However,

these protocols may not fully integrate recent advancements in technology and evolving clinical practices in X-ray imaging. Consequently, there is a pressing need for a critical evaluation of current calibration and measurement methodologies, as well as an update of relevant standards and protocols.

Full details including registration

Symposium: Biomarkers in Neurodegenerative Diseases

Thursday 6 & Friday 7 June 2024, Montpellier cedex 5-France & online

Metrology Partnership project Standardisation of measurements of neurodegenerative disease biomarkers (22HLT07, NEuroBioStand) and the French Centre of Excellence in Neurodegenerative Diseases will jointly organise this symposium.
The workshop is primarily intended for clinicians, metrologists, academics, in vitro medical device providers, and patient associations. It aims to present the latest advancements and perspectives on biomarkers in neurodegenerative diseases. The official language of the workshop will be English. Presentations from the NEuroBioStand consortium will be included.

Full information, including Programme and Registration (free of charge)

Passive radiative cooling characterisation and applications

7 June 2024, PTB Berlin, Germany and online

The consortium of Metrology Partnership project Metrological framework for passive radiative cooling technologies will organise this workshop.
Programme:

- Standardisation challenges for passive radiative cooling technologies
- Environmentally friendly radiative cooling coatings with static and self-adaptive functionality
- Figures of merit and practices for constructive PDRC measurements comparison
- Accurate and traceable approaches for determining the emissivity and reflectivity of PRC materials
- Demonstration/ Laboratory visit
- Setups for reproducible in-field performance testing of PRC materials
- Integration strategies and modelling of radiative cooling for buildings
- Numerical modeling of environmental conditions during testing of PRC materials

Full details and registration (Registration is free of charge but mandatory)

Joint MetSuperCap - EMPHASIS Workshop

12 June 2024, online event

An overview of supercapacitor technology, testing and applications

The Metrology Partnership project 'Metrology for static and dynamic characterisation of supercapacitors' (23IND04, MetSuperCap) is hosting a joint workshop with the Horizon Europe project 'Efficient materials and processes for high-energy supercapacitors for smart textiles and electromobility applications' (EMPHASIS). The aim of the workshop is to provide a broad overview of

the supercapacitor technology and testing. There will be 14 different pitch talks discussing various areas of supercapacitor technology.

Please view the agenda and register here >>

Workshop: Sustainable advanced flow meter calibration for the transport sector

20 August– 21 August, Online event

This workshop will be run by the consortium of European Partnership on Metrology project Sustainable advanced flow meter calibration for the transport sector (20IND13, SAFEST). The overarching aim of the project was to provide the foundation for advanced flow metrology in the transport sector ensuring reliable fuel consumption measurements as needed in road and maritime transport. By enabling characterisations of flow meters closer to operational conditions and a better consideration of the impact of the fuel properties on the flow measurement, innovation in the transport sector will be fostered and the increased deployment of sustainable alternative transport fuels supported. Moreover, the results will contribute to appropriate emission calculations. At the dissemination workshop findings and outputs of the project will be presented.
Workshop topics will include:

- Technologies for realising and measuring dynamic flow changes
- Effect of transport properties on flow meter performance
- Simulation of interaction between test liquid and flow meters
- Density/viscosity/speed of sound of selected alternative and synthetic fuels at a broad pressure and temperature range
- Evaluation of commercial inline viscometers/densimeters

Computing in Cardiology conference

8 – 11 September 2024, Karlsruhe, Germany

Members of the consortium of Metrology Partnership project Uncertainty quantification for machine learning models applied to photoplethysmography signals (22HLT01, QUMPHY) are participating in a special session entitled ‘Open questions in open research in cardiovascular data science’ at this conference.
Computing in Cardiology (formerly Computers in Cardiology) is an international scientific conference that has been held annually since 1974. CinC provides a forum for scientists and professionals from the fields of medicine, physics, engineering and computer science to discuss their current research in topics pertaining to computing in clinical cardiology and cardiovascular physiology.
Attendees present and learn about leading-edge work at the interface of clinical practice, engineering, and basic research during three days of plenary, parallel, and poster sessions. The 400+ papers presented every year at CinC meetings are published in Computing in Cardiology, available freely here.
Programme Please see session S41 for details of the agenda for the special session.
Full details of conference, including registration (Early bird registration deadline 31 July 2024).

Passive Radiative Cooling special conference session

10 Sept 2024, 11:45 – 15:45 CEST. Naples, Italy and Online

Partnership project 'Metrological framework for passive radiative cooling technologies' (21GRD03, PaRaMetriC) is developing metrology for new passive radiative cooling (PRC) materials.
The project will present a special session, chaired by project coordinator Lorenzo Pattelli, at the Annual Meeting of the European Optical Society, dedicated to the topic of passive radiative cooling.
The session takes place on the 10th anniversary of the publishing of 'Passive radiative cooling below ambient air temperature under direct sunlight' – the landmark Nature paper that launched the field of PRC study – and will be opened by the first author of the paper, Prof. Aaswath Raman (UCLA).
Topics covered in the session will include:

- Passive radiative cooling
- Thermal emissivity
- Selective and switchable emitters
- Optical materials for thermal regulation
- Radiative cooling for photovoltaics
- Design of photonic structures

Learn more

Metrology to support standardisation of hydrogen fuel sampling for heavy duty hydrogen transport

12 November 2024, VSL, Delft, The Netherlands

The consortium of Metrology Partnership project Metrology to support standardisation of hydrogen fuel sampling for heavy duty hydrogen transport (22NRM03, MetHyTrucks) will be holding a one day workshop.
Agenda

Time (CET)	Subject	Speaker
9:30	Reception with coffee/tea	
10:00	Opening of workshop	VSL director/ programme manager
10:05	Introduction to the MetHytrucks Project & aims of the workshop	Oliver Büker (RISE)
10:20	tbd	
10:45	ISO 19880-9 Gaseous Hydrogen - Fuelling Stations - Part 9: Sampling For Fuel Quality Analysis	Thor Aarhaug (ISO TC 197/WG 33)
11:10	Progress from HyQuality Europe	Thor Aarhaug

11:35	Progress and Prospects for International Standardization of Hydrogen Quality	Hidenori Tomioka (HySUT Japan / ISO TC197)
13:00	Working together with the EMN for Energy Gases	Annarita Baldan (EMN Energy Gases)
13:20	Towards traceable flow standards for HD hydrogen refuelling	Marcel Workamp (VSL)
13:45	tbd	
14:10	Adapting sampling systems for HD	ZBT / ENGIE
14:35	The latest results on sampling for hydrogen quality	Thomas Bacquart (NPL)
15:00	Interactive session ”Towards a sampling protocol for HD”	Stefan Persijn (VSL) Thomas Bacquart (NPL) Oliver Büker (RISE) Thor Aarhaug (SINTEF)
15:30	Tour laboratories of Chemistry, Flow and Humidity	All

Registration (free of charge)

Workshop on X-ray imaging dosimetry

20 - 22 November 2024, Helsinki, Finland

The consortium of Metrology Partnership project Traceability in medical X-ray imaging dosimetry (22NRM01, TraMeXI) will organise this workshop on clinical dosimetry measurements for X-ray imaging.
Topics covered will include:

- X-ray dosimetry equipment and procedures
- Uncertainties
- Patient specific dosimetry
- Practical demonstrations
- Experimental and computational dosimetry

This workshop will be relevant to medical physicists, engineers and researchers in the field.

Full details including registration

Extending quality control from light duty to heavy duty hydrogen transport conditions

10 December 2024, online event

The consortium of Metrology Partnership project Metrology to support standardisation of hydrogen fuel sampling for heavy duty hydrogen transport (22NRM03, MetHyTrucks) will be holding a half day webinar.

Agenda

10:00 – 10:45	**SAB meeting** *Meeting leader, RI.SE?*
10:45 – 11:00	**Break**
11:00 – 11:10	**Introduction of MetHyTrucks** *Name of presenter, RISE*
11:10 – 11:35	**HRS parameters influencing sampling: similarity/differences between light-duty and heavy-duty** *Thomas Bacquart, NPL*
11:35 – 12:00	**Novel sampling systems for heavy duty HRS (particles and gaseous species** *Ole Kjos, Sintef*
12:00 – 12:25	**On the road to standardization: A sampling protocol specific for HD or LD/HD** *Stefan Persijn, VSL*
12:00 – 12:25	**Closing remarks** *Karine or Oliver, RI.SE*

PARTNERSHIP GOOD NEWS STORIES in 2024 (highlighting engagement with stakeholders) included the following:

Partnership Call 2023: Finalisation of evaluation process

Date published: 9 January 2024

The evaluation process for Stage 2 of the 2023 Partnership Call has been finalised

Following the Review Conference held in November 2023, where external independent referees evaluated and ranked the proposals, the Partnership Committee recommended, and Board of Directors agreed, on a final list of selected projects to fund.

The following proposals have been selected and will be invited for contract negotiation:

Fundamental:

- Photonic and quantum sensors for practical integrated primary thermometry
- Controlled confinement to reduce the inaccuracy of clocks based on optical lattices
- High-accuracy ion-based optical clocks
- Fundamental physical metrology with cold molecules
- Advanced quantum technology for metrology of electrical currents
- Fundamental protein metrology to support the definition of measurands, analytical targets, and their associated measurement uncertainty
- Quantum anomalous Hall effect materials and devices for metrology
- Metrology for superconducting qubits

Industry:

- Electric energy and supply reliability
- Manufacturing of commutable calibrators and quality control materials for standardisation and post-market surveillance of IVD tests
- RF key quantities for 6G development
- Metrology for static and dynamic characterisation of supercapacitors
- Flow measurement traceability for hydrogen in gas networks
- Metrology for electric vehicle charging systems
- Radon metrology: Sensor networks for big buildings and future cities
- Traceable machine vision systems for digital industrial applications
- Metrology for green maritime shipping: Emission control through traceable measurements and machine learning approach
- On-wafer microwave metrology for future industrial applications
- Thermometry with embedded SI traceability for industrial applications
- Application of digital metrological twins for emerging measurement technology in advanced manufacturing
- Metrology for food safety in the circular economy: targeted and screening methods for contaminants in food and recycled packaging
- Multidimensional optical diffusion for the measurement of appearance

Normative:

- Support for standardisation of sample-by-sample waveform uncertainty computation
- Standardised measurements of surface functionalities on nanoparticles
- Standardisation of bioaerosol monitoring for air quality and climate modelling
- Normating colour-centre-based quantum sensing technology towards industrial application and standards

- Advanced detail sensitivity monitoring by new concepts to improve the reliability of safety relevant products using industrial computed tomography

Research Potential:

- Wideband AC quantum traceability
- Establishing European traceability for medical measuring devices through liquid absorbance filters
- Metrology for standardised moisture content measurements in plant-origin bulk materials in support of International and European food safety and trade

Capacity Building Coordination:

- Capacity building coordination (2023)

The referees consisted of 68 men (74 %), 23 women (26 %) and represented 28 different nationalities.

Metrology Partnership Call 2024: Stage 1 OPEN

Date published: 10 January 2024

Stage 1 of the 2024 Call under the European Partnership on Metrology is open to submit potential research ideas

Metrology Partnership

The EURAMET European Partnership on Metrology funds cutting-edge research projects which help provide effective metrological solutions to technological and societal challenges, as well as increase collaborative research between industry and academia. These advances in the field of metrology will help to support European goals such as the European Green Deal and digital transformation, and ensure that the European metrology system is internationally competitive.

Applications for Stage 1 of the 2024 Call are now open for potential research ideas.

Background

EURAMET has operated a number of funding programmes which, since 2007, have contributed 1 billion euro to innovative metrology research. Previous programmes include the European Metrology Research programme (EMRP) and the European Metrology Programme for innovation and Research (EMPIR), which together funded 362 joint research projects (JRPs).

Building on previous success, the European Partnership on Metrology was formed as part of Horizon Europe, a funding programme for research and innovation from the European Union. The Metrology Partnership will run from 2021 to 2027 and has an expected budget of 690 million euro that is co-funded by the European Union and the participating states.

Participating in the 2024 Call

Stage 1:

Anyone can submit a potential research topic (PRT) corresponding to one of the four themes for Call 2024, which are listed below. Submissions can also be put forward in collaboration with National Metrology Institutes.

Applications are now open and will close on **19 February 2024.**

A proportion of these PRTs will then proceed as selected research topics (SRTs).

Themes for Stage 1 Call 2024:

PRTs for the following themes can be submitted for Call 2024 Stage 1:

Green Deal

Digital

Normative

Research Potential

Stage 1 for the 2024 Call is now open and research groups can submit their research ideas on the Partnership website.

Stage 2:

Consortia form and submit proposals to receive funding for joint research projects (JRPs) against these selected research topics via the Partnership website. For groups who wish to collaborate and join consortia for certain SRTs, contact information will be made available on the website in advance of the second call stage being open. Stage 2 will **open on 26 June 2024 and will close on 30 September 2024.**

In addition, there will be a Call for Coordination for Support Action projects on Communication and Impact Coordination, which will also **open on 26 June 2024 and will close on 30 September 2024.**

Click here for further information.

Supporting improved electromagnetic compatibility measurements in harsh environments and real time

Date published: 21 February 2024

Metrology Partnership project is developing the standardised measurements required to protect modern electronics from radio-interference

The project

All electronic devices sold in the European Market are required to meet the essential criteria outlined in European EMC Directive 2014/30/EU. Compliance with this directive is demonstrated through the use of standardised electromagnetic compatibility measures. However, the rapid growth of radio services and cutting-edge technologies like smart grids, internet of things, and electromobility has created new scenarios where existing standards fall short of addressing interference issues effectively. Consequently, there is a need for validated and traceable methods to assess electromagnetic emissions in complex situations, including in-situ testing of large and high-powered equipment and interference in wireless communications.

Metrology Partnership project Metrology for emerging electromagnetic compatibility standards (21NRM06, EMC-STD) is working to address this problem, developing new electromagnetic emissions test methods for harsh environments, such as factory premises and photovoltaic installations, covering the emission testing frequency ranges 30 Hz – 150 kHz, 150 kHz – 30 MHz and 30 MHz – 6 GHz.

Project developments

Early project developments include:

- Project participant EMC Barcelona (EMC Electromagnetic BCN, S.L.) (Spain) developed a software solution to automate emissions measurements in time-domain using oscilloscopes called emiGO®. Using such technology, they performed a time-domain in-situ measurement rapid emissions checks of a large photovoltaic system and have also collaborated with project chief stakeholder Fuji Electric Europe in measurement campaigns intended to support standardisation projects. This method allows industry to acquire short-duration/transient interference and worst-case emission measurements in harsh environments in real time. The results have been published in three papers: "Efficient In situ Assessment of Radiated Emissions using Time-Domain Measurements" at EMC Europe 2023 Conference (nominated as Best Student Paper) and "Strategies Using Time-Domain Measurements for Radiated Emissions Testing in Harsh Environments" at the IEEE Open Journal of Instrumentation and Measurement and "Rapid Emission Check of Photovoltaic Installations Using Time Domain Measurements" at the IEEE Electromagnetic Compatibility Magazine . As part of this project, emiGO® has been calibrated by CMI showing compliance with CISPR 16-1-1 standard core parameters.
- A free software tool has been developed which calculates the uncertainty contribution of an Artificial Mains Network (AMN). This tool provides a more confident uncertainty calculation for the component values of AMNs and is actively being used by the EMC laboratory of project partner TUBITAK-UME. A paper titled as Investigation of AMN Impedance Uncertainty Contribution in Conducted Emission Tests has been accepted by IEEE EMC Magazine to be published in 2024.
- A new method for measuring conducted emission in the 30 Hz – 10 kHz frequency range has been developed by live impedance measurement. This was presented at EMC Europe 2023 Conference as "Improvement in Low Frequency Emission Test Method by Live Impedance Measurement". Besides it is envisaged that this method may extend to in-situ harmonic esmission measurements of electrical/electronic equipment.
- TUBITAK developed a compact impedance measurement device. This device will enable in-situ grid impedance masurements to utilize the collected impedance data for in-situ conducted emission measurement.
- Investigations have been carried out to improve the definition of the Amplitude Probability Distribution function and its application as part of emissions assessment and interference impact on digital communication systems. Such improvements have been applied to wireless LAN as a key use case. Early results can be found in the "Redefinition of the Amplitude Probability Distribution Measuring Function for Electromagnetic Emissions Assessment" article included in the proceedings of the 2023 Photonics & Electromagnetics Research Symposium (PIERS) (https://zenodo.org/records/8375638) and also in the "Electromagnetic Interference in Wireless Communications based on Software Defined Radio Platforms" final bachelor's Thesis from Marc García-Bermudez, R&D engineer at EMC Barcelona, defended on July 2023 at Universitat Politècnica de Catalunya.
- All papers are available for free download at https://zenodo.org/communities/21nrm06-emc-std

Project Coordinator Serdar Büyük from UME said

'The EMC-STD project is effectively supporting the development of the target standardisation projects through the necessary research in metrology to develop and validate emissions test methods, mainly those required for in-situ testing and harsh electromagnetic environments. The evidence provided by our investigations allows for high confidence in the proposed methodologies so they can be embraced by the different stakeholders coexisting in the corresponding standards committees and working groups. We expect to continue and increase our contribution in that domain.'

Partnership project makes progress towards supporting new generation mobile phone networks

Date published: 12 March 2024

Developing a measurement framework for performance and radio exposure in wireless networks

Complex wireless technologies underpin the Internet of Things (IoT) and fifth and sixth generation (5G and 6G) mobile networks. These ‘new radio’ technologies require improved underpinning normative wireless standards for their radio signals, systems, and the transmission environments used, and for the radio frequency exposures created. Current telecommunications sector challenges include a lack of accurate, fast, low-cost, and traceable methods for manufacturers to demonstrate that 5G/6G product verifications match customer specifications.

Metrology Partnership project Metrology for emerging wireless standards (21NRM03, MEWS) is working towards developing the practical and efficient measurement methods required to enable normative standards for wireless channels up to sub-THz, and for radio frequency exposure assessment to better match rapidly emerging radio technologies for 5G/6G products and system over-the-air testing.

Recent progress

The project has designed and implemented a new traceable calibration concept for Absorbed Power Density (APD) probes for 24 GHz – 36 GHz and produced a new generation of APD probes for near-field measurements for the 24 GHz – 34 GHz range that will pave the way to future uptake by manufacturers and testing laboratories in the telecommunications field.

The APD is the new metric introduced in the 2020 release of the International Commission on Non-Ionizing Radiation Protection guidelines for limiting exposure to electromagnetic fields from 6 GHz to 300 GHz. As with the specific absorption rate (SAR), for which international standards are well established, normative work is being carried out to produce an international standard for field exposure assessment above 6 GHz based on APD measurement. Establishing a traceable calibration of APD is an important achievement because it ensures reliability in measurements, which is essential for both manufacturers and testing laboratories in the telecommunications field. The near-field probe developed in the project will facilitate the implementation of APD measurements by simply extending existing exposure measurement systems already available for SAR assessment.

The results of this project will enable efficient and traceable measurements for wireless networks. This will accelerate the uptake and development of 5G/6G technology and improve human and environmental safety through improved understanding of RF exposure from wireless systems.

Project Coordinator Djamel Allal from LNE said

‘This development is directly linked to the preparation of a new international standard on procedures for measuring absorbed power density to assess human exposure to radio frequency fields from wireless communication devices operating between 6 GHz and 300 GHz, and gains particular significance in light of the rapid advancements of 5G technology and its applications, coupled with the future introduction of 6G technology’.

Partnership project helps improve the thermal comfort of public buildings in Rwanda and South Africa

Date published: 11 April 2024

Working with external project Cool White to test and suggest improvements on the locally available white paints

Background

A major challenge in dealing with climate change is the heat accumulated in buildings - for example in factories or schools and especially in the hot areas of Africa. Heat impairs the ability to concentrate and leads to a lower level of well-being. In addition, air conditioning systems require a lot of electricity

to cool. Cooling systems are responsible for almost 20 % of electricity consumption and 10 % of greenhouse gas emissions worldwide - and the trend is rising.

Recently, a new class of materials has emerged, which can generate sub-ambient cooling when exposed to the sky, even under direct solar illumination. To achieve this effect, these coatings reflect all solar radiation while emitting thermal infrared radiation in a wavelength range where the Earth atmosphere is transparent. This allows them to dissipate their heat directly to the cold outer space which acts as a renewable heat sink, without any consumption of energy.

Despite a growing interest in developing these materials, there is still a lack of established techniques to evaluate and compare their cooling performance under real-world conditions - a key factor in fostering their adoption and market uptake.

Supporting public buildings in Africa with accurate temperature measurement

Metrology Partnership project Metrological framework for passive radiative cooling technologies (21GRD03, PaRaMetriC) is supporting a development cooperation project in Rwanda and South Africa called *Cool White*. This project aims to demonstrate the clear cooling effect of white roofs. By white painting the roofs of public buildings such as schools and factories and by advising on suitable paints, room temperatures should be reduced with positive implications for well-being and productivity.

The expertise of the PaRaMetriC consortium has been exploited to measure the optical properties of different Passive Radiative Cooling (PRC) white coatings available on the local market and to train the local Rwandan metrology institute to optimise the measurement of temperature and humidity inside the buildings.

This included assisting the local contacts to select suitable sensors to log ambient conditions, and to position them within the monitored buildings, as well as to provide guidelines on how to communicate the idea of passive radiative cooling more effectively to a non-specialist audience.

To quantitatively investigate the cooling effect of these white colours on the roofs, scientists from the Metrology Partnership project worked with colleagues from Rwanda and South Africa to record temperature and humidity data over a longer period of time, including different seasons and longer rainy seasons - before and after the coating.

The measurements, which are based on the average values of the individual sensors in the period from January 2023 to today, showed a significant drop in temperature after the roofs were painted white. Daytime temperatures observed in a factory building during the warmest six hours decreased by 9.2 °C under the roof (averaged over 4 months) and by 2.3 °C indoors.

This has a doubly positive effect on working conditions. It's not just the actual room temperature that is crucial, but also the significant reduction in infrared heat radiation from the ceiling. It has a positive effect on the subjective feeling of temperature.

PaRaMetriC project participant Dr. Albert Adibekyan, from PTB, Germany’s National Metrology Institute (NMI), explains the cooling effect of white colours in sunshine:

‘Passive Radiative Cooling (PRC) materials ideally allow for temperatures below the ambient temperature without additional air conditioning, even in direct sunlight. This is due to their optical properties, which reflect solar radiation very effectively and at the same time dissipate heat through the infrared transparency window of the Earth's atmosphere.’

For example, on August 7, 2023, an improvement of 20.4 °C was achieved under the roof: While the temperatures under the unpainted school roof were 50.2 °C, the thermometer under the painted school roof showed a temperature of 29.7 °C.

Dr. Christian Monte, also part of the PaRaMetriC project and from PTB, confirms:

'By applying white paint to roofs, the conditions for schoolchildren and workers in developing and emerging countries are significantly improved. In addition, the resulting cooling effect creates a high potential for energy savings through not required air conditioning within buildings.'

The monitoring campaign is currently in progress.

Project Coordinator Lorenzo Pattelli from INRIM, Italy's NMI, said

'The idea that white materials heat up less than darker ones under the sun is part of our everyday experience. However, visible light is only a small fraction of solar irradiance: a material may look white to our eyes and still heat up due to absorbed radiation at different wavelengths. Part of this heat is inevitably re-emitted in the infrared spectrum, but the final heat balance is not trivial to predict due to the varying infrared transparency of the atmospheric window. For these reasons, understanding which paint may be most advantageous is not a simple task, and I was glad to see that the experience matured during the PaRaMetriC project allowed us to identify a promising solution based on the locally available products. The preliminary results coming from the test sites are extremely encouraging, showing major temperature reductions both inside and on the external surfaces of the buildings without any electricity consumption.'

The vision for *Cool White* is to scale the project, which will include developing a training programme for specialists from developing and emerging countries in order to paint as many roofs and surfaces as possible white using locally available paint.

As regards PaRaMetriC, an important task going forward will be to evaluate the potential energy savings deriving by the application of radiative cooling paints, as well as their stability against weathering agents. The long-term application scenario provided by our collaboration with *Cool White* provides an excellent opportunity to see these materials tested in the field over a prolonged time span.

Presentation describing work of Metrology Partnership biomethane project wins best lecture award

Date published: 25 April 2024

Creating a metrological infrastructure to monitor biomethane for use in transportation and gas networks

The project

Metrology Partnership project Protocol for SI-traceable validation of methods for biomethane conformity assessment (21NRM04, BiometCAP) is working to develop techniques for producing static and dynamic reference gasses containing different common impurities, suitable for validating instruments and measurement methods.

It will also develop a protocol for validating and evaluating the performance of commonly-used instruments and measurement methods. This protocol will be used to evaluate commercially available gas analysers used in both the lab and the field, and an accompanying good practice guide for its implementation will also be created.

The project's outcomes will accelerate the uptake of biomethane as a fuel source, increasing the safety and efficiency of its use through more widely applicable and cost-effective monitoring techniques.

The project will also contribute to ongoing standards development through collaboration with the ISO/TC193/SC1 "Biomethane" technical committee.

Best lecture in metrology

The ‘best lecture in metrology prize’ at the international Gas Analysis Workshop 2024 was awarded to Lucy Culleton of NPL for her presentation describing the work in this Metrology Partnership project.

The scientific research and standardisation work Lucy is leading within the project is supporting biomethane measurement infrastructure worldwide. She is working with other members of the consortium to deliver real impact to industrial stakeholders via an internationally standardised protocol for instrument performance benchmarking.

Lucy said

‘It’s excellent that the metrology work we are doing in the BiometCAP project has been recognised for its importance to the energy industry. Having a standardised protocol for evaluating measurement systems for biomethane will provide much needed quality infrastructure for stakeholders, and allow for equipment in homes and businesses to be protected from damage caused by impurities’.

Industrial stakeholders praised the work the project is doing, as it will give them confidence in the quality of the gas delivered to end users throughout European gas grids.

Metrology Partnership project on energy storage materials develops new cell designs

Date published: 13 May 2024

Developing improved energy storage materials that will help Europe become climate-neutral

Metrology Partnership project Operando metrology for energy storage materials (21GRD01, OpMetBat) is working to establish traceable, validated and quantitative operando methodology for energy storage materials suitable for use in battery systems. The term ‘operando’ refers to studying electrode material in a working cell while the system changes under an external influence, as opposed to ‘in situ’ where the cell is in a static condition.

Advanced spectroscopy techniques are being used, improving upon current approaches in terms of sensitivity, accuracy and spatial resolution. New hybrid methods will be developed, allowing multiple measurements to be made on batteries during operation, establishing the links between material properties and cell performance. The project will also publish the first good practice guide on how to improve repeatability and accuracy of measurements on energy materials. The work is being performed in conjunction with battery and car manufacturers to ensure results are translatable to real-world applications.

Recent project developments include:

- Two new cell designs for operando spectroscopy of energy storage materials were successfully manufactured by HZB (Germany) and NPL (UK) and have now been distributed to project partners for testing. Once validated, the designs will be made available for widespread adoption by scientists across industry and the research and metrology communities.
- CEA-LNHB (France) determined new experimental values of x-ray fundamental quantities (attenuation coefficients) for manganese, a component used for high-capacity energy storage materials. These basic quantities are widely used among the x-ray fluorescence techniques communities in applications such as chemical analysis of materials.

MDPI Journal Special Issue

Manuscript submissions are invited for the forthcoming special issue of *Batteries Journal* entitled Mechanistic Understanding of Electrochemical and Chemical Reactions in Batteries

with Operando and In-Situ Methods offers the opportunity to explore the complex reactions and processes in different battery systems.

The special issue contains several studies that apply operando or in situ methods to the analysis of half or whole cells, providing valuable insights into cell chemistry and degradation mechanisms. The methods presented range from X-ray diffraction to impedance spectroscopy and various forms of spectroscopy. The battery systems studied include Li-ion batteries, metal/sulphur batteries, alloy anodes and redox flow batteries.

Project participant Dr. Sebastian Risse from HZB acts as guest editor for this special issue, underlining the commitment to deepening knowledge in the field of battery research.

Deadline for manuscript submissions to the journal special issue: 1 July 2024

Project Coordinator Burkhard Beckhoff from PTB said

'The OpMetBat project got off to a very good start: novel battery cells were designed and manufactured, basic procedures for the operando EIS were developed and extensive experimental work on pristine and post-mortem materials was successfully carried out. Furthermore, the foundations for operando good practice guides were laid and long-term quantitative x-ray spectroscopic experiments under operando conditions on novel LiS materials performed successfully. These topics shall be addressed in the articles in the upcoming special edition of the journal.'

Workshop on standards and measurements for alpha-emitting radionuclides in nuclear medicine

Date published: 4 June 2024

Developing a metrological network to help implement targeted alpha therapy across European health institutes

The project

Targeted alpha therapy is a cancer treatment method utilising radioactive substances that undergo alpha decay. Alpha particles deposit a high energy within a short radius, ensuring that targeted alpha therapy can selectively target cancerous cells and minimise damage to the surrounding healthy tissue.

Within the Metrology Partnership project Metrology for emerging targeted alpha therapies (22HLT03, AlphaMet), a European consortium of metrology institutes and hospitals is working on creating the metrological network needed for safe administration of targeted alpha therapies to support the introduction of these therapies in health care institutes across Europe.

Project objectives include the development of primary and secondary radioactivity standards for alpha emitters and methods to improve the accuracy of activity and dosimetry calculations. In addition, a new bone site phantom made of tissue-like materials is being developed to ensure the accuracy of activity measurements in the red bone marrow, one of the main organs at risk. Finally, the accuracy of dosimetric calculations will be enhanced by multimodal imaging.

These advancements will help generate the metrological network needed for efficient and safe targeted administration of alpha therapies, improve comparability between multi-centre studies, and open up new routes for the treatment of cancer.

Successful international workshop

The European 22HLT03 AlphaMet project, funded by the European Partnership on Metrology held its first stakeholder workshop in collaboration with the BIPM CCRI RTQI Working Group.

The International Workshop on Standards and Measurements for Alpha Emitting Nuclides in Therapeutic Nuclear Medicine was hosted by BIPM in February 2024. The comprehensive scientific programme was organised by Dr Ana Denis-Bacelar (NPL, AlphaMet impact WP leader), Dr Jan Rusnak (CMI, AlphaMet's coordinator) and Dr Brian Zimmerman (NIST, RTQI WG chair).

A total of 444 participants from 67 countries worldwide registered to attend the workshop, with 60 in-person attendees and 235 people joining online, illustrating the recognised requirement to improve traceability in this field, and the need for the work of the AlphaMet project.

The workshop spanned two days of intensive discussions, bringing together global experts from the fields of radionuclide metrology, industry (such as pharmaceutical, radionuclide producers, scanner manufacturers), clinical nuclear medicine, medical physics, and radiochemistry, united in their commitment to advancing measurement standards and practices for alpha-emitting radionuclides and alpha therapies.

The agenda covered a wide range of topics critical to the field of targeted alpha therapy, and included discussions on:

- metrology
- current and future clinical applications
- dosimetry-based treatment planning
- quantitative imaging
- radionuclide production and supply
- radiopharmaceutical research and development
- radiation safety

The insights gathered from the event will provide input for the development of guidance documents aimed at improving measurements for targeted alpha therapy applications.

The unprecedented levels of engagement in the workshop represent a pivotal moment in the advancement of measurement standards and traceability for targeted alpha therapies, highlighting the interest in collaborative efforts between the metrology community and stakeholders to improve the safety and efficacy of targeted alpha therapies.

Workshop presentations

Workshop participant and AlphaMet's collaborator Ben Fongenie from Blue Earth Therapeutics said 'It was a great pleasure to participate in the first AlphaMet workshop as a collaborator. The workshop showcased the many areas of fantastic progress being made in measurement and detection of alpha emitters, such as in the critical area of radiochemical purity testing, dosimetry and QC. These are incredibly important keystones and will make a huge difference to the work of bringing therapeutic radiopharmaceuticals into the clinic. We look forward to continuing contributing to this excellent consortium going forward'.

Partnership project develops new analysis software for wearable light loggers

Date published: 25 June 2024

The open-source software streamlines analysis and visualisation of light exposure data measured using wearable devices

Light has a profound effect on human physiology and health. With the prevalence of electric lighting in buildings, on streets and from devices like computers and smartphones, the average level and character of light exposure has changed. These artificial sources have a different spectral

composition compared to daylight which is important as blue wavelengths interact with melanopsin in the eye, a photopigment involved in the body's physiological responses to light. These responses can impact a person's alertness during the day or how restfully they sleep at night. Over long time periods, light exposure at the wrong hours can lead to mental health issues and can even affect the risk of more severe physical health problems like heart disease, metabolic issues and cancer.

To monitor light exposure, wearable light loggers have been used by researchers, providing light exposure data across the day which can then be compared to physiological outcomes like heart rate or melatonin levels. However, the design of commercial light loggers often means that technical aspects, like sensor type and data processing methods being used, are not specified. This can lead to inaccuracies, unknown errors or incomplete data, making it difficult to draw accurate conclusions or compare data measured using different devices. Therefore, there is an urgent need to develop a unified approach to collecting and analysing data from wearable light loggers. The International Commission on Illumination (CIE) has also identified a need for light quantities related to the physiological response to light to be harmonised and in 2018 published the International Standard CIE S 026.

Partnership project 'Metrology for wearable light loggers and optical radiation dosimeters' (22NRM05, MeLiDos) is developing measurement and data analysis methods to characterise and validate wearable light loggers, responding to needs raised by CIE. The project will also define quality indices for light loggers and light exposure data, analyse use cases and evaluate the performance of new devices. The ambitions of the project were recently described in an overview article in the journal Measurement.

New software

As part of its work, the project is developing LightLogR, a new, open-source software package for analysing light exposure data.

The package has been created by a team of researchers at the Technical University of Munich (TUM) and the Max-Planck-Institute for Biological Cybernetics (MPI) Translational Sensory and Circadian Neuroscience Unit (MPS/TUM/TUMCREATE), in collaboration with EPFL. It provides tools to import, generate, and validate data and metadata files, calculate common parameters, and provide semi-automated analysis and visualisation. In particular, LightLogR aims to ensure the FAIRness (Findability, Accessibility, Interoperability, Reusability) of data to increase ease of use and improve the suitability of results for use in meta-analyses and other approaches aggregating data.

"LightLogR will facilitate the reproducible analysis of light exposure data, thereby ensuring that research groups around the world are not reinventing the wheel when they are dealing with light exposure data," says Prof. Dr. Manuel Spitschan (TUM), PI of the Translational Sensory and Circadian Neuroscience Unit.

An early version of the software, which is being regularly extended and updated, is available to download with operating instructions from the software's website. Dr. Johannes Zauner (TUM), lead developer of the software, has emphasised the community-driven approach:

"We aim to build LightLogR as a software that is useful for the community to maximise its utility. We are therefore keen to incorporate the views and experiences of users into the development process."

"Field measurement has always been challenging due to the numerous environmental factors", says project coordinator Dr. Fabien Eloi (LNE)*. "The software developed in our project provides scientific teams with tools to validate and analyse their light dosimetry data, and to compare it to different data sets from other teams, dates, or places. That will make light dosimetry studies and results a lot more reliable and lead to improved health and well-being."*

Metrology Partnership Call 2024: Stage 2 now OPEN

Date published: 26 June 2024

Call for proposals is now open – deadline for submission is 23:59 CEST on 30 September 2024

EURAMET is announcing the launch of Stage 2 of the 2024 Call, for joint research projects under the following topic areas within the European Partnership on Metrology:

- Metrology for Green Deal
- Metrology support for Digital Transformation
- Metrology for Pre- and Co-normative research
- Metrology for Research Potential

EURAMET also announces the launch of Call for coordination and support projects on impact and communication.

The deadline for the submission of proposals for joint research projects and coordination and support projects is 23:59 CEST on 30 September 2024.

Further information is available at the Partnership Participant Portal >>

New videos introduce work of Biosphere project: Cosmic rays, UV radiation and the ozone shield

Date published: 17 July 2024

Developing the first metrological framework to assess the impact of cosmic rays and human activity on the ozone layer

One of the most significant − yet unexplored − ecological challenges facing EU member states and beyond is the impact on human and environmental health of the increasing atmospheric ionisation caused by extra-terrestrial radiation (cosmic rays and solar UV radiation) boosted by anthropogenic emissions.

To address this, Metrology Partnership project Metrology for Earth Biosphere: Cosmic rays, ultraviolet radiation and fragility of ozone shield (21GRD02, BIOSPHERE) aims to develop the necessary tools, methodologies and measurement infrastructure needed to evaluate the mutual impact of cosmic rays and biologically active UV radiation on the Earth's biosphere, and to support EU policy makers with scientific assessments and information that have the potential to substantially improve policies on climate, health and anthropogenic emission activities.

The project consortium has produced six videos, which give an overview of the project and explain each area of work.

Available on YouTube, the videos are:

- Project overview: Studying the impact of extraterrestrial radiation on Earth's atmosphere
- Improving cosmic ray detectors for BIOSPHERE
- Ensuring accurate measurements of extraterrestrial radiation
- Studying collisions of cosmic rays and atmospheric gases in the lab
- How does radiation from space damage human cells?
- How do solar eruptions, UV and cosmic radiation impact life and the Earth?

Project coordinator Faton Krasniqi from PTB said

‘The BIOSPHERE consortium has conducted a series of measurement campaigns and experiments to decipher how the influx of high-energy particles and solar UV radiation will affect atmospheric ionisation and human health. We recently completed our third measurement campaign, which was carried out at urban Spacepole site in Brussels, where we measured both secondary cosmic rays and solar radiation simultaneously with more than nine instruments to explore how atmospheric ionisation and its effects are encoded in these radiation fields. We have also conducted a series of experiments to investigate how these radiation fields affect cells (e.g. DNA damage and chromosome breaks) and how electrons ionise and fragment atmospheric molecules (both natural and anthropogenic). The results of these experiments are currently being analysed and papers and reports are being prepared.

However, understanding the findings of this research requires a certain amount of expertise in radiation physics, atmospheric chemistry, and biology. With these videos, we attempted to bring the core of our research closer to the general public. Here, we explain in simple terms the significance and impact of extraterrestrial radiation on the Earth's biosphere. These videos may be useful to health and environmental regulatory bodies, governmental and intergovernmental panels on climate and environmental change, and experts working in the fields of environment, climate, medicine, biology, and radiation protection.’

Metrology Partnership project wins best poster award

Date published: 31/7/24

The poster was presented as part of the 2024 GAS Analysis event

There is an urgent need to decarbonise the European energy grid through the development and uptake of renewable, carbon-neutral energy sources. One of the pillars of the EU Green Deal is the phased replacement of natural gas with hydrogen in areas like transport, electricity generation and industry. While hydrogen can be integrated into the existing gas network, this requires the development of new infrastructure, sensors for monitoring and traceable measurements for leak detection.

Metrology Partnership project “Metrology for the hydrogen supply chain” (21GRD05 Met4H2) is providing novel and improved measurement methods and standards for the safe application of hydrogen flow measurement, quality assessment and custody transfer.

Poster Award

As part of the GAS Analysis 2024 event, project member Roel Beelen (VSL) presented a poster entitled “Matrix influence on the analysis of sulfur-containing compounds in hydrogen enriched natural gas and hydrogen with GC-SCD” which won the event’s Best Poster Award. This poster showcased the work of the Met4H2 project, in particular the first results of work on the sensitivity of sulfur analysis with respect to the gas matrix (methane, methane/hydrogen and hydrogen). This work has concluded that the effect on sulfur analysis is great enough to affect reference material production and certification but is not significant to measurements made in the field.

Project coordinator Adriaan van der Veen (VSL) has said about the work of the project,

“The insensitivity of the sulfur analysis method of natural gas, hydrogen and blends is encouraging for industrial applications, as it shows that with current equipment and methods odorant levels can be monitored in these gases, enabling the safe distribution and use in built areas.”

Presentations from metrology for digital substations workshop now available

Date published: 12/9/24

Partnership project holds successful workshop with videos and presentations now available to view online

Renewable energy sources such as solar, wind and hydroelectricity are a key tool to decarbonise Europe's energy grid, reducing the emissions that cause climate change. However, these renewable sources are more variable than fossil fuel-burning power stations and so there is an increased need for real-time monitoring and control of energy networks. To achieve this real-time control, analogue instruments that are coming to the end of their lives are more and more often replaced with digital substation technology.

Building on the work of EMPIR project FutureGrid II (17IND06), Partnership project 'Metrology for digital substation instrumentation' (21NRM02, Digital-IT) is developing reference systems for the calibration of digital substation equipment. This includes new hardware and software for sampling, data processing methods and traceable communication networks to transfer timing data.

Successful workshop

The project held a joint workshop titled 'Measurements and metering in digital substations' with industry-funded project DigIT.

The online workshop, which saw 85 attendees, covered topics including digital substation measurements, stand-alone merging unit (SAMU) performance and precision time protocol (PTP) calibrations. It also featured a review of results from both projects as well as contributions from stakeholders.

Selected presentations and recordings from the workshop are available to view online, covering:

- Digital substation measurements
- Digital-IT
- An overview of the DigIT project
- Evaluation of metering
- SAMU performance
- Meter calibration
- PTPv2 traceability
- SV software

"I was positively surprised by the interest to our workshop and projects," says project coordinator Jari Hällström (VTT MIKES). "We are also happy that we can provide precision measurement solutions for digital substation instrumentation manufacturers and users."

Metrology Partnership project adapts equipment for heavy duty hydrogen refuelling stations

Date published: 24/9/24

Hydrogen refuelling station sampling systems were adapted for heavy-duty use to support the employment of hydrogen powered trucks across Europe

As part of the European Green Deal the EU has pledged to have no net emissions of greenhouse gases by 2050. In 2020, 24% of the EU's total emissions of carbon dioxide (CO_2), one of the main greenhouse gases, was caused by road transport. Sustainable transport options are needed to reach the European Green Deal objectives and reduce CO_2 emissions.

The Metrology Partnership project Metrology to support standardisation of hydrogen fuel sampling for heavy duty hydrogen transport (22NRM03, MetHyTrucks) is developing the underlying metrological framework to increase the use of hydrogen fuel cells for heavy-duty road transport.

This project is building on the EMPIR projects Metrology for hydrogen vehicles (16ENG01, MetroHyVe) and Metrology for hydrogen vehicles 2 (19ENG04, MetroHyVe 2), which mostly focused on developing the technologies needed to use hydrogen fuel cells in light-duty vehicles. However, by 2030 approximately 60,000 hydrogen powered trucks will be used across Europe which require an extensive infrastructure of hydrogen refuelling stations for heavy-duty vehicles.

Project partners have adapted three light-duty sampling devices for heavy-duty conditions and started trialling the devices in the field. This work will support the future development of heavy-duty sampling systems and provide guidance on the metrological testing and validation needed for heavy-duty hydrogen refuelling station sampling systems.

ENGIE device

ENGIE is a French engineering company and project partner for MetHy Trucks. The ENGIE device was easily adapted for heavy-duty use by fitting a receptacle compatible with a 350 bar HDV nozzle since the device was originally qualified for pressure of up to 875 bar and the tank and valves supported a flow rate of up to 120 g/s. However, the ENGIE device requires the temperature of the hydrogen fuel to be between -40 to +80 °C. For the refuelling process, hydrogen must be cooled down to -40 °C to prevent overheating in the vehicle so ideally hydrogen sampling occurs at a similar temperature.

Hy-SaM device

The Hy-SaM device was developed by Zentrum für BrennstoffzellenTechnik (ZBT) and is a parallel sampling system that has been adapted for heavy-duty use by fitting a new high flow line, which has a flow rate of up to 120 g/s, and a receptacle and a high flow nozzle for sampling at 350 bar. Hy-SaM functions at minimum hydrogen temperatures of -20°C and can be used to fill up to three sample cylinders simultaneously during a fuelling.

DirSam device

The NPL Hydrogen direct sampling apparatus (DirSam) was developed to follow a direct sampling strategy according to ASTM D7606-17. The device can be used under heavy-duty conditions and is able to supply hydrogen at 350 and 700 bar, with a flow rate suitable for heavy-duty use of up to 120 g/s.

Additionally, the project consortium published the following reports:

- Selection of hydrogen sampling strategies for HD-HRS
- Review of the current sampling systems that are used for the quality control sampling of hydrogen at HD-HRS
- Review of the safety and venting requirements for the different hydrogen sampling strategies (direct, parallel)
- Review of existing protocols and guidelines related to the validation of the hydrogen sampling systems that are used for off-line quality control at HRS.
- Literature review of the methodologies used for assessing the representativeness of sampling for both gaseous species and particulates at HD HRS
- Review to identify the current refuelling protocol specifications and operational parameters that are in place at HD-HRS and questionnaire to investigate the potential evolution of HD-HRS
- Literature review of material compatibility studies undertaken in previous projects and their experimental conditions

Further information can be found on the MeHyTrucks project website and on the MetHyTrucks LinkedIn page.

The project coordinator Karine Arrhenius (RISE) comments on the early success of the project:

'Hydrogen buses and heavy-duty vehicles improve air quality and provide health benefits. Sampling systems for HD-HRS are urgently needed. Without them, standardisation documents for HD-HRS applications cannot be progressed. They are a key tool for the hydrogen quality assessment chain.'

Proceedings from workshop about commercially available CO_2 conditioning technologies

Date published: 1/10/24

Creating metrology frameworks for carbon capture, utilisation and storage to help Europe reach carbon neutrality

The project

In order to meet stringent reduction targets related to global warming, Europe must make reductions in CO_2 emissions. Carbon capture utilisation and storage (CCUS) can be used to permanently remove the CO_2 produced by industrial processes for storage either underground or locked in an alternative material. It is versatile, in the sense that the CO_2 removal step can complement any process such as the production of power, fuels, chemicals and heating.

Metrology Partnership project Metrology Support for Carbon Capture Utilisation and Storage (21GRD06, MetCCUS) is working to facilitate efficient and safe usage of this technology across Europe by addressing key measurement challenges.

This project will produce facilities for CO_2 flow monitoring, as well as primary standards for evaluating flow meters. Primary reference materials with impurities in CO_2, analysers and on-line sensors for real-time monitoring of the CO_2 composition and purity will also be developed. The project will validate leak monitors for both pipelines and storage sites and will produce good practice guides for measurement and sampling methods. It will also test the suitability of long- and short-term storage materials. These outcomes will improve measurement accuracy across the CO_2 lifecycle and improve confidence in available monitoring devices. This will encourage faster uptake of CCUS methods which will be crucial in meeting the targets of the Green Deal.

Proceedings available

Project coordinator Iris de Krom from VSL gave a presentation about the importance of metrology at the IEAGHG workshop 'Comparative Techno-economic Assessment of Commercially Available CO_2 Conditioning Technologies'. The workshop aimed to facilitate the exchange of knowledge and insights among a panel of international experts on CO_2 conditioning, with the goal of informing the scope of a technical specification for a comprehensive IEAGHG report.

The proceedings from the workshop are now available:

IEAGHG workshop on comparative technoeconomic assessment of commercially available CO_2 conditioning technologies - IEAGHG.

Project coordinator Iris de Krom said

'It was a great opportunity to join the IEAGHG workshop and talk about the crucial role of metrology in addressing the measurement challenges associated with CCUS technologies. The discussions underscored the necessity of the development of a universal CO_2 specification, and the strategic selection of conditioning technologies to meet multifaceted challenges presented by impurities in CO_2 streams. The expertise, and experiences shared during the workshop are important to overcome these challenges.'

Partnership project helping to advance carbon capture utilisation and storage techniques

Date published: 10/10/24

To reach carbon neutrality not only do we need to reduce the burning of fossil fuels but also find ways of utilising and storing CO_2

Europe aims to reduce greenhouse gas emissions by 55 % by 2030 and to become carbon neutral by 2050. To aid this the EU launched the Green Deal which, amongst other things, has identified “energy storage and carbon capture, storage and utilisation” as a key priority.

To accurately assess the amount of CO_2 being captured, transported, utilised and stored requires meters and analysers to monitor the CO_2 flow and quality in the delivery systems. No independent, primary, flow calibration facilities are available for calibrating flow meters with CO_2 across the full range of conditions which could occur during carbon capture, transport and storage.
In addition, primary reference materials with low-level impurities in CO_2 and sampling methods to determine the material compatibility of key impurities in CO_2 are needed to determine the CO_2 quality. However, available information on cylinders and surface passivation treatments for impurities in CO_2 are limited.

The Metrology Partnership project Creating metrology frameworks for carbon capture, utilisation and storage (CCUS) to help Europe reach carbon neutrality (21GRD06, MetCCUS) is addressing these issues.

Reviewing the state of the art

- An early output of the project was a study about the current state of the art for the traceable measurement of liquid CO_2 and the requirements for a liquid CO_2 flow meter calibration facility.
- The consortium published two literature reviews on the project’s website, one on the material compatibility of vessels for the sampling of CO_2 and the other on commercially available cylinders for the preparation of primary reference materials.

The project has so far disseminated its results at 17 conferences for industrial, metrology, and scientific communities and a presentation was recently given by the coordinator of the project Iris de Krom (VSL) at the IEA Greenhouse (IEAGHG) workshop on comparative technoeconomic assessment of commercially available CO_2 conditioning technologies.

The information on improved measurement accuracy across the CO_2 lifecycle will increase confidence in available monitoring devices and sampling methodologies. In turn this will encourage faster uptake of carbon capture and storage methods which will be crucial in meeting the targets of the Green Deal.

The coordinator of the project Iris de Krom (VSL) said about the work:

“MetCCUS is the first project EURAMET fully dedicated to carbon capture utilisation and storage (CCUS). The project participants are making great process in setting up a metrological sound measurement infrastructure for the CCUS industry focusing on urgent measurement challenges related to CO_2 flow metering, CO_2 emission monitoring, CO_2 composition and purity and CO_2 physical properties.”

Webinar on X-ray imaging dosimetry challenges attracts record numbers

Date published: 15/10/24

Providing the metrology required to ensure patient safety during medical x-rays

X-ray imaging is an important technique used in medicine, however its use forms the largest component of exposure to artificial ionising radiation. Consistent quantification of a patient's exposure to radiation with calibrated dosimetry equipment is essential to comply with EC Directive 2013/59/Euratom as well as to ensure patient safety.

Currently, the procedures used by calibration laboratories, based on relevant standards and international protocols, do not fully consider the recent technical developments in X-ray imaging.

Metrology Partnership project Traceability in medical X-ray imaging dosimetry (22NRM01, TraMeXI) will perform a critical assessment of conditions applied in calibrations and study the performance of different dosimeters. Updated measurement and calibration procedures will be proposed for inclusion into standards and protocols.

Record breaking webinar

The project consortium recently organised a webinar entitled X-ray imaging dosimetry challenges within the frame of BIPM's Consultative Committee for Ionising Radiation (CCRI) .

This webinar was attended by 378 people online, a record for CCRI webinars.

The webinar video and slides are freely available.

Project coordinator Paula Toroi from STUK said

'The webinar brought together all the main stakeholders of our project and they explained why the TraMeXI project is so important for them. We got excellent feedback, and this gives us a strong motivation to successfully complete the project to support the medical X-ray imaging community'.

Partnership project delivering first reference materials for stable isotope ratios in seawater

Date published: 17/10/24

Developing certified reference materials for mass spectroscopy to monitor radioactive pollution in the environment

The European Green Deal's goal of a "toxic-free environment" and "reducing air, water and soil pollution" requires highly sensitive state-of-the-art detection techniques for monitoring both radioactive and stable environmental pollutants. The isotopic compositions of elements vary in the environment due to natural processes, but for certain elements, processes such as radioactive decay, the interaction of cosmic rays with the atmosphere, industrial activities, and nuclear weapon testing and accidents. In either case, variation in isotopic compositions is a powerful tool for identifying the origins of materials.

Radiometric determination is well-established for detecting short-lived (< 10 years) radionuclides and mass spectrometry, including Inductively Coupled Plasma Mass Spectrometry (ICP-MS), allows the rapid determination of multiple elemental pollutants at a high throughput. Recent advances in ICP-MS have significantly enhanced sensitivity and precision, enabling the reliable detection of even minute variations in the isotopic composition of elements with more than one natural isotope.

However, mass spectrometers require validation using traceable reference materials (RMs) since known mass biases within the technique must be accounted for and quantified. A significant analytical challenge remains due to the vast number of analyte/matrix combinations, matrix effects, spectral interferences, and instrumental isotopic fractionation that must be characterised before and during the

measurements. Multi-element RMs are often unavailable and single-element RMs exist only for a limited number of species and matrices.

New liquid and solid radionuclide refence materials

This lack is being addressed by the Partnership project Metrology for the harmonisation of measurements of environmental pollutants in Europe (21GRD09, MetroPOEM), which is producing both liquid and solid radioactive certified reference materials for the calibration of mass spectrometers.

For the development of the liquid materials 250 litres of water was collected in May 2023 from the North Sea. This was performed as part of the regular monitoring research cruise of the RV ATAIR operated by the German Bundesamt für Seeschifffahrt und Hydrographie (BSH). After treatment to stabilise the water, it was processed by project partners Helmholtz-Zentrum Hereon and TÜBİTAK UME, the National Metrology Institute (NMI) of Turkey for stable isotopes and CMI, the NMI of Czechia where it is used to generate the first liquid refence materials containing actinide nuclides (^{234}U, ^{235}U, ^{236}U, ^{238}U, ^{237}Np, ^{239}Pu, ^{240}Pu and ^{241}Am).

In addition, MetroPOEM is producing a solid radioactive reference material. This is done by synthesising a silicate matrix from liquid precursors including radioactive ones. This gives the new material two main advantages – the first is it allows radioactivity to be bound within the silicate matrix and not only at the surface of the material – and the second is that synthesising the material enables control over its composition and thus better traceability of the material.

LNE-LNHB, one of the Designated Institutes (DIs) of France, has produced the first 20 batches of inactive solid reference material and the next step is to spike the material with ^{241}Am to estimate its homogeneity by γ-spectrometry directly or after dissolution.
Details of the collection and production of these new refence materials can be found in the project's second newsletter.

New BIPM task group

In recognition of the importance of the role of mass spectroscopy the Bureau international des poids et mesures (BIPM) established a new Task Group on Mass Spectrometry (CCRI(II)-MS-TG). Supported by Consultative Committee for (i) Amount of Substance: Metrology in Chemistry and Biology (CCQM) and (ii) Ionising radiation (CCRI), it includes three scientists from the MetroPOEM consortium.

The project's aim of bridging the gap between radiometric techniques and mass spectrometry will accelerate the uptake of the latter technique for detecting environmental contaminants, helping to reduce the detection limits and improving response times for pollution incidents. This will reduce human and environmental exposure to radiation and toxins and provide support for the goals of the Green Deal.

Dirk Arnold (PTB) said about the project:

"The project will go beyond the state of the art with the development of two radioactive reference materials (RM), respectively liquid and solid, containing the radioactive pollutants U, Np, Pu, Am for use in an inter-laboratory comparison employing techniques used for the measurement of the activity standards solutions, which will demonstrate the variations in parameters including detection limits, sample preparation requirements, sample introduction."

World first calibration service will support the use of renewable energy resources

Date published: 22/10/24

Developing calibration methods for ‘substations of the future’ in digitised energy networks

Due to the wider use of decentralised renewable energy resources, future electrical power grids require real-time control and monitoring to ensure their stability under more challenging conditions. Digital substation solutions are increasingly replacing analogue instrumentation which are approaching the end of their useful lifespan.

To support the European electrical power industry, Metrology Partnership project Metrology for digital substation instrumentation (21NRM02, Digital-IT) is working to provide the previously missing solutions for the calibration and timing of new types of digital substation instrumentation.

World first

As part of this work, the project consortium is working towards introducing a traceable timing calibration service for Precision Timing Protocol (PTPv2 – a protocol for clock synchronisation throughout a computer network) based substation devices, which will be the first in the world for this kind of calibration. Relevant standards published by IEC TC 38 require that intelligent electronic devices (IEDs) support PTPv2 as a primary means of time stamping measurement data. This means that the reported phase of grid signals is affected by the timing quality received through the PTPv2 protocol, which necessitates traceable calibration of PTPv2 timing as received by an IED. In practice, the consortium are working on establishing a link between a physical 1-pulse-per-second (1PPS) timing signal and PTPv2 link between a device under calibration and its master clock.

Acceptance of the digital substation as a key enabler of a smarter electricity grid of the future is strongly reliant on whether the technology can truly be relied on. Here metrology plays an important role, laying the foundation for reliability of data used for grid control and protection. This has been recognised by the project stakeholder community, including industry and standardisation bodies. IEC TC 38, the projects key stakeholder, has expressed significant interest towards the methodology the consortium is working on.

Once a traceable link between a physical timing standard and PTPv2 has been established, the findings will be reported to TC 38 as a recommendation for amending existing standards. A widely accepted and standardised method for IED phase displacement calibration will accelerate the uptake of digital substation technology and will benefit the European industry. In the EU and beyond, many companies already have large product portfolios and solutions for digital substations with customers lined up, unsure if the technology can truly deliver on the great promise it holds.

Project Coordinator Jari Hällström from MIKES said

‘Accurate timing in digital substations allows for precise time-stamping of events and data. This synchronisation helps in better coordination and control of the grid’.

Partnership project contributes to first commercially available absorbed power density test system

Date published: 30/10/24

Developing a measurement framework for performance and safe radio exposure in wireless networks

The project

Complex wireless technologies underpin the Internet of Things (IoT) and fifth and sixth generation (5G and 6G) mobile networks. These ‘new radio’ technologies require improved normative wireless standards for their radio signals, systems, and the transmission environments used, as well as for the radio frequency exposures created. Current telecommunications sector challenges include a lack of

accurate, fast, low-cost, and traceable methods for manufacturers to demonstrate that 5G/6G products match customer requirements.

The Metrology Partnership project Metrology for emerging wireless standards (21NRM03, MEWS) is working to develop practical and efficient measurement methods to enable normative standards for wireless channels up to sub-THz and for radio frequency human exposure assessment to match the rapidly emerging radio technologies for 5G/6G product and system over-the-air testing.

First commercially available absorbed power density test system

The project contributed to the release of the absorbed power density test system, the DASY8 Module APD, which is the first commercial system worldwide for demonstration of compliance with absorbed power density limits in humans, at frequencies from 10 – 45 GHz in full accordance with all national and international standards and regulations.

Traceability is key for type approval test systems such as DASY8 Module APD, and the calibration technology and methods were developed in collaboration with this project.

Input to standards

The APD calibration and validation solutions developed in this project contributed to the IEC/IEEE TR 63572 ED1 "Evaluation of Absorbed Power Density Related to Human Exposure to Radio Frequency Fields from Wireless Communication Devices Operating between 6 GHz and 300 GHz."

An international product test standard is currently being developed based on the content of this technical report. International standardisation and harmonisation are crucial requirements for billions of wireless device users, national regulators and the wireless industry.

The research in this project directly ensures the safety of billions of wireless device user around the globe.

Project coordinator Djamel Allal from LNE said

'With the development of the DASY8 Module APD and the contributions to international standards, we are confident that we have taken a significant step towards ensuring the safety and reliability of 5G and 6G technologies. Our research has paved the way for safer and more reliable wireless technologies, potentially benefiting billions of users worldwide'.

Partnership project presents early results at prestigious industry fair

The project presented their results at Hannover Messe 2024 and also featured in an article in c't magazine

Date published: 13/11/24

Magnetic resonance imaging (MRI) is a medical imaging technique that uses radio waves and large magnetic fields to create anatomical images to support the diagnosis of various diseases such as cancer.

However, MRI scans are not easily available across all of Europe due to their size and cost. 'Low-field MRI' can be used with portable scanners that could help bridge these supply gaps, however this method currently lacks metrological traceability.

The Partnership project Affordable low-field MRI reference system (22HLT02, A4IM) is working on developing an open-source, fully-characterised, traceable low-field MRI system that is portable and low-cost to increase accessibility of MRI scans across Europe and globally.

Hannover Messe and c't Magazin

Results from the project were presented at Hannover Messe 2024 in Hannover, Germany under the theme 'Energising a sustainable industry'. The fair is one of the world's largest trade fairs with around 4000 exhibitors and 130.000 visitors in 2024. The project consortium showcased an early functional prototype of a portable MRI scanner at the stand of the German Federal Ministry for Economic Affairs and Climate Action and was able to hold a presentation to introduce the A4IM vision of an accessible open-source MRI scanner using AI-based image reconstruction algorithm.

Additionally, the project was also featured in c't Magazin, a bi-weekly magazine focused on new technologies and innovations with the most subscribers in Europe and print numbers of around 320,000 per issue. Through these high-stake dissemination activities the project was able to connect with scientists across Europe and publicise their ideas for a portable, low-field MRI scanner.

For more information, please visit the project website.

The project coordinator Christoph Kolbitsch (PTB) comments on the early success of the project:

"Hannover Messe 2024 was an excellent opportunity to tell a wide audience about our project. People showed great interest and we received very positive feedback especially about the open-source aspect of our project. This is great motivation for the entire consortium."

Partnership project on operando analysis of battery storage technologies publishes videos

Date published: 3/12/24

Live insights into the operation of batteries under metrological aspects for developing energy storage systems that meet Green Deal targets

The European Green Deal targets net zero CO_2 emissions of greenhouse gases in Europe by 2050, specifying zero emissions from new cars by 2035. To meet this ambitious target, improvements in such things as battery performance and lifetime must be improved.

However, innovations in new battery materials and technologies are hampered by the inability of industry to reliably characterise a battery's structure or chemistry in an operating environment ('operando'). Most battery degradation studies are performed *post-mortem*, using ex-situ methods where the cell is disassembled, leading to chemical modification which can distort the result.

The European Metrology Partnership project Operando metrology for energy storage materials (21GRD01, OpMetBat) is working to address this problem by establishing traceable, validated and quantitative operando methodology for energy storage materials suitable for use in battery systems.

The project has released four short videos outlining the work being performed in the project.

- Traceable ex situ characterisation of high-capacity energy storage materials (1.13 min).
- Establishing good practice guide for current operando spectroscopy and diffraction methods (4.09 min).
- Development of novel dynamic electrochemical analysis approaches for combination with operando spectroscopy and dimensional metrology (3.00 min).
- Development of novel operando instrumentation and hybrid methodologies for multi-parameter characterisation (4.10 min).

Due to finish in 2025 the project has already produced two new cell designs for operando spectroscopy which have been tested electrochemically using benchmark lithium-ion battery materials and have been shown to exhibit excellent cycling performance and repeatability.

The methodologies, instruments and greater knowledge of energy storage materials being developed in OpMetBat will, amongst other things, aid the transition to hybrid or electric vehicles, helping to underpin Europe's energy transition.

The coordinator of the project Burkhard Beckhoff (PTB) said about the project:

"In various activities, the OpMetBat project aims to develop foundations for standardization via best practice guides so that analytical and dimensional information from various characterization methods can contribute to the quantitative recording of transport and conversion processes in batteries in order to correlate them with electrochemical data. Effective measures against degradation processes require knowledge of the composition and chemical bonding states at battery interfaces, preferably under operando conditions, which requires further qualification of the characterization techniques capable of this."

Successful Metrology Partnership project workshop on X-ray imaging dosimetry

Date published: 18/12/24

Providing the metrology required to ensure patient safety during medical X-rays

Metrology Partnership project Traceability in medical X-ray imaging dosimetry (22NRM01, TraMeXI) is working to review a range of radiation conditions relevant in medical imaging and produce a proposal to update the procedures used for dosimeter calibrations and clinical measurements.

In November 2024, project partners HUS (Helsinki University Hospital) and STUK (Finnish Radiation and Nuclear Safety Authority) hosted a Workshop on X-ray Imaging Dosimetry at the Bridge Hospital in Helsinki, Finland.

The workshop brought together 70 professionals in medical physics and metrology from 16 countries. It coincided with the halfway point of the TraMeXI project and offered a useful forum to discuss project developments and proposed updates in dosimetry practices, as well as to receive feedback from the main stakeholders.

The event was endorsed by EFOMP (European Federation of Organisations for Medical Physics) and organised in collaboration with NACP-RPC (Nordic Association for Clinical Physics Radiological Physics Committee).

The purpose of the workshop was to bridge the gap between the more theoretical knowledge of the metrologists and the practical reality of the clinical medical physicists with support from dosimeter manufacturers, whose contributions were an integral part of the workshop. Metrologists, manufacturers, and clinical professionals were invited, and the topics addressed included dosimetry equipment principles and operation, imaging modality specific measurement procedures and patient specific dosimetry, uncertainties (theory and practical exercises) and the use of AI in dosimetry.

The workshop included a live-streamed practical session during which some of the participants were invited to assist in carrying out measurements in three different modalities of X-ray imaging (conventional projection, mammography and interventional C-arm systems).

Feedback from participants indicated that the ambitious programme of talks and practical exercises offered something for everyone. Most importantly, the participants agreed that the main goal was achieved: the workshop helped bridge the gap between theory and clinical reality by providing both

metrologists and clinical medical physicists a common platform to learn about and discuss topics related to X-ray imaging dosimetry. The project consortium received valuable feedback on the project, which will be used to guide the remaining activities of the TraMeXI-project.

Workshop presentations