

**The 15<sup>th</sup> APMP NMI Directors' Workshop**

**“Hydrogen Technologies for a Sustainable Future”**

*- Strategies and the Role of Metrology in the Green Energy Transition -*

**ASIA PACIFIC METROLOGY PROGRAMME**

# The 15<sup>th</sup> APMP NMI Directors' Workshop

## “Hydrogen Technologies for a Sustainable Future”

- *Strategies and the Role of Metrology in the Green Energy Transition* -

### Introduction

As the world shifts toward a green, highly efficient energy structure, hydrogen is emerging as a promising next-generation energy source due to its ability to generate electricity and heat without emitting greenhouse gases like carbon dioxide. Metrology is expected to play a critical role at every stage of hydrogen utilization—from supply and storage to transportation and application. In today's interconnected world, understanding the backgrounds and strategies of various organizations is essential. This workshop will begin with an overview of hydrogen utilization, followed by strategic presentations from participating NMIs and stakeholders.

### Event Details

- Date: 27 November 2024
- Time: UTC 03:30 - 06:30 (IST 09:00- 12:00)
- Platform: In-Person & Online

### Participants

The Workshop is open to (panelists):

- Directors or their designates of APMP Full and Associate Member Institutes (one person per institute)
- APMP EC members, TC/DEC/FG/WG Chairs and Chair-elects, Secretariat - Invited speakers and panelists
- Invited CIPM members from the region and the BIPM Director
- Invited representatives from other RMOs and SRBs

APMP also welcomes the following colleagues to attend as “Observers”:

- Other members from APMP and its stakeholder organizations

### Zoom Webinar Link

**Panelists** must join the workshop through a specific link sent by Zoom by email.

**Observers** can join it using the following ID and passcode:

Webinar ID & passcode: To be provided by the meeting organizers

<p>9:00-9:05 (5min.)</p>	<p><b>Welcome and introductions:</b>  <i>Dr. Hyun-Min Park, KRISS / APMP Chairperson</i></p> <p><b>Workshop Overview:</b>  <i>Dr. Morioka Takehiro, National Metrology Institute of Japan, AIST</i></p>
<p>9:05 – 9:45 (40 min.)</p>	<p><b>Keynote Presentation</b></p>
	<p>1. <b>Title: “Research and development of hydrogen technology aiming for carbon neutrality”</b>  <i>Dr. FURUTANI Hirohide, Fukushima Renewable Energy Institute (FREA), AIST, Japan</i></p> <p><b>Abstract</b> In recent years, the scale of disasters has grown dramatically, and the damage has become enormous. The cause of these disasters is thought to be global warming. To prevent global warming, the world is working to move toward carbon neutrality. Hydrogen is one of the key technologies for carbon neutrality. In this presentation, the role of hydrogen in carbon neutrality and the current status of technological development for carbon neutral focusing on the results of AIST will be introduced.</p> <p><b>Speaker</b> Dr. Hirohide Furutani is a distinguished researcher with over 30 years of experience in the field of hydrogen energy systems. He is currently serving as the Deputy Director of the Fukushima Renewable Energy Institute (FREA) at the National Institute of Advanced Industrial Science and Technology (AIST). Dr. Furutani’s career spans various leadership roles within AIST, including Director of the Renewable Energy Research Center (RENRC) and Deputy Director of the Research Strategy Planning Department. His expertise lies in the development of advanced technologies for hydrogen systems that contribute to renewable energy solutions.</p> <p><b>Academic Background and Career:</b></p> <ul style="list-style-type: none"> <li>• 1992: Doctor of Philosophy in Engineering, University of Tsukuba</li> <li>• 1992–2001: Researcher, Mechanical Engineering Laboratory (MEL), Agency of Industrial Science and Technology, Ministry of International Trade and Industry (MITI)</li> <li>• 2001–2007: Senior Researcher, National Institute of Advanced Industrial Science and Technology (AIST)</li> <li>• 2012–2013: Director, Research Planning Office of Environment and Energy, AIST</li> <li>• 2013–2017: Deputy Director, Renewable Energy Research Center (RENRC), AIST</li> <li>• 2017–2022: Director, Renewable Energy Research Center (RENRC), AIST</li> <li>• 2022–2024: Deputy Director, Research Strategy Planning Department, AIST</li> </ul>

	<ul style="list-style-type: none"> <li>• 2024–present: Deputy Director, Fukushima Renewable Energy Institute (FREA), AIST</li> </ul> <p>Dr. Furutani's research activities have focused on the advancement of hydrogen energy technologies, with a particular emphasis on their integration into renewable energy systems. His pioneering work continues to play a vital role in the development of sustainable energy solutions.</p>
<p>9:45 – 10:45 (60 min.)</p>	<p><b>NMIs' Strategy I</b></p>
	<p><b>2. Title: “Development of Hydrogen Field Test Standard for HRS in Korea”</b>  <i>Dr. Kang Woong, Korea Research Institute of Standards and Science (KRISS), Korea</i></p> <p><b>Abstract</b> As interest in developing eco-friendly cars grew due to global warming and air pollution problems, the Korean government has formulated and implemented various policies to build 3 million hydrogen fuel cell electric vehicles and 1,200 hydrogen refueling stations in the 2040 year according to the national roadmap for revitalizing the hydrogen economy. Hydrogen fuel cell electric vehicles are typically refueled with a wide range of temperatures (-40 °C to 85 °C) and high pressure (up to 875 bar) in accordance with the worldwide accepted standard SAE 2601. The metrological and technical requirements stipulated in OIML R 139-1 and SAE J2601 should be followed, with a target accuracy of 2 - 4%. However, it is difficult to measure the flow rate accurately with conventional flow rate measurement methods. Currently, a mass flow meter (Coriolis-type) is used inside the hydrogen dispenser in the station, but the calibration of the flow meter for verification of measurement accuracy is carried out in the water as a different medium other than hydrogen, not high pressure when injecting hydrogen in Korea.</p> <p>To develop the necessary methodologies and calibration facilities to allow hydrogen refueling stations, we have developed a KRISS Hydrogen Field Test Standard (HFTS). KRISS HFTS is based on the gravimetric principle with three 52 L pressure cylinder tanks (type IV) and a 300 kg-weighing system. In 2022, for the first time in Korea, an on-site test for field verifications and calibrations of the measurement accuracy was carried out at the Naepo hydrogen station located in Korea using KRISS HFTS. It was confirmed that the maximum allowable error in type evaluation on OIML R 139 was sufficiently satisfied from 2% to 4%. Since the first on-site test of hydrogen station in Korea from 2022, the KRISS HFTS has been used to select more stations in four regions in Korea and conduct verification tests.</p> <p><b>Speaker</b> Woong Kang is the head of thermometry and fluid flow metrology group at KRISS. He received a Ph.D in mechanical engineering from KAIST, Korea in 2009. He joined the division of physical metrology of KRISS in 2011. His research interests are hydrogen flow metering, greenhouse gas flow measurement and</p>



natural gas flow measurement. He is currently working as APMP TCFF Chair since 2023.

3. **Title: “Metrology for Hydrogen technology in China: challenges, solutions and prospects”**

*Dr. Ping YANG, National Institute of Metrology (NIM), China*

**Abstract** This report highlights the research activities of the National Institute of Metrology (NIM), China in hydrogen metrology. They include the development of CRMs and standard testing methods for hydrogen fuel cell industry, the establishment of flow measurement standards and traceability chain for hydrogen dispensers, and the development of standard testing device and specifications for measurements of key parameters in water-electrolytic hydrogen production.

**Speaker** Dr Ping YANG is the Vice Director of National Institute of Metrology (NIM), China, a senior researcher and quality manager of NIM. He has profound research experience in ultrasound metrology and quality management. He currently supervises the overall work of quality management and metrological services, digital transformation, as well as infrastructure construction. He served as the APMP TCQS Chair from 2019 to 2022 and was elected as the Deputy Chair of the Digitalization Task Group (DTG) of the International Organization for Legal Metrology (OIML) in October 2022.



4. **Title: “NMIA metrology activities and plans supporting the growth of the Hydrogen economy in Australia.”**

*Dr. Mark Ballico, National Measurement Institute (NMI), Australia*

**Abstract** Australia has committed to decarbonise the Australian economy and transition to net-zero CO<sub>2</sub> emissions by 2050. While the adoption of renewable energy sources such as wind, solar, hydro and biomass will play a key part in decarbonising the energy sector, hydrogen generated from renewable sources is seen as critical to achieve an equivalent transition in the transport, agriculture, and emerging “green-metal” sectors. Given Australia’s abundant renewable energy resources, Australia also seeks to become a major exporter of hydrogen by 2050. Accurate measurement is critical in supporting the growth and adoption of transformative new technologies, such as generating hydrogen from

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renewable sources, ensuring trust in custody transfer and fuel quality, and enhancing safety and efficiency through reliable process engineering measurements.

Australia's hydrogen strategy, and the status of several hydrogen-metrology projects underway at NMIA will be discussed, including:

- Reference gases for hydrogen purity and natural-gas/hydrogen co-injection.
- Development of international standards for the use of hydrogen as a fuel.
- Verification of high-capacity flowmeters for liquid anhydrous ammonia.
- Verification of automotive hydrogen dispersers.
- Calibration of flowmeters for large-scale electrolyzers.
- Supporting metrology: e.g. trace-moisture, 100 MPa gas pressure standards.

The emerging hydrogen economy poses a wide range of metrology challenges to NMIs, and NMIA is keen to work with our international partners to accelerate progress in this key sector.

**Speaker** Dr Mark Ballico heads the Mechanical, Thermal and Optical standards section of the NMI, responsible for the development and dissemination of Australia's physical standards of measurement across a range of physical quantities. He is the Australian delegate to the BIPM's digital metrology forum (Forum-MD), and APMP-Medical Metrology Focus Group and has represented Australia at the Consultative Committees for Mass (CCM), Temperature (CCT) and Photometry and Radiometry (CCPR). He has served several terms as APMP TCT chair and is the recipient of both the APMP Iizuka and Technical awards. Current research interests include the establishment optical-based thermodynamic temperature and the development of practical metal-carbide fixed points, flow measurement standards to support the hydrogen economy, hyperspectral and laser power standards, and development of new standards for dynamic force and pressure.


##### 5. Title: "Green hydrogen related activities in India"

*Dr. Venu Gopal Achanta, National Physical Laboratory (NPL), India*



**Abstract** For sustainable future, circular economy is the only way forward. To leave less of waste and recycle and reuse of byproducts is essential. Hydrogen as a fuel is pursued as a viable alternate fuel for future. Metrology plays a critical role in the future hydrogen based economy as one would need standards to test and certify the origin and the purity of hydrogen, storage facilities, transport containers, pressure, to materials employed in all these. Under the national green hydrogen mission, government of India is encouraging research and active

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	<p>deployment of hydrogen based technologies. In this talk, I will present the ongoing work and the role being played by NPLI.</p> <p><b>Speaker</b> Prof. Venu Gopal Achanta obtained his Ph.D. (Physics) from TIFR, Mumbai and Ph.D. (Electronics) from Tokyo University. He is currently the Director of CSIR-National Physical Laboratory. He is on lien from Tata Institute of Fundamental Research, Mumbai where he is a Professor. His research interests are in the application of nanophotonics, and single photon metrology. He has over 150 journal publications. He is a fellow of the Indian National Science Academy (INSA) and an honorary fellow of the Metrology Society of India (MSI). He is elected to the International Committee for Weights and Measures (CIPM) in 2022 and to the executive committee of Asia Pacific Metrology Program (APMP). He is currently President of Optical Society of India (OSI), and Vice president of Indian Laser Association (ILA), and is on the EC of IEEE Photonics Mumbai Chapter. He is a senate member of Indian Institute of Technology (IIT), Delhi and Jawaharlal Nehru University (JNU), New Delhi.</p>
<p>10:45 – 11:10 (25 min.)</p>	<p><b>Tea and Coffee Break</b></p>
<p>11:10 – 11:40 (30 min.)</p>	<p><b>NMIs' Strategy II</b></p>
	<p><b>6. Tilt: “Metrology Supporting Clean Hydrogen Technologies”</b> <i>Dr. JT Janssen, National Physical Laboratory (NPL), UK</i></p> <p><b>Abstract</b> The National Physical Laboratory has been solving measurement challenges in the clean hydrogen sector for almost 20 years. We perform pre-normative research and development, advise on best practice, and provide accredited measurement services that accelerate the development and deployment of clean hydrogen technologies. Following publication of the UK’s Hydrogen Strategy we’ve worked closely with our UK stakeholders throughout 2023/4 to assess the sector’s priority needs. NPL’s work now focuses on four main areas: electrochemical hydrogen technologies such as fuel cells and electrolyzers, hydrogen gas quality, hydrogen emissions from infrastructure, and assurance of materials compatibility with liquid and gaseous hydrogen. This presentation will highlight the priority measurement challenges in each of these areas and provide examples of the work NPL is undertaking to address these.</p> <p><b>Speaker</b> Jan-Theodoor (JT) Janssen is the Chief Scientist at the National Physical Laboratory (NPL) and a member of the executive team. JT joined NPL in 1998 and is distinguished for the application of quantum technologies and an NPL Fellow in Quantum Electrical Metrology. His research involves a wide range of topics in solid-state physics applied to metrology applications such as single electron transport, Josephson effect and quantum Hall effect.</p>





JT is a Chartered Physicist and Chartered Engineer and a Fellow of NPL, the Institute of Physics (IOP) and the Institute of Engineering and Technology (IET). In 2021 JT was elected a Fellow of the Royal Academy of Engineering. He's a visiting professor at the University of Lancaster.  
 In 2022 JT was elected on the International Committee for Weights and Measures (CIPM) and appointed President of the Consultative Committee for Ionising Radiation (CCRI).

**7. Title – “Measurements for the Hydrogen Economy in the US”**  
*Dr. Jim Olthoff, National Institute of Standards and Technology (NIST), US*

**Abstract** The viability of hydrogen as a possible alternative energy system depends on the development of new technologies and measurement capabilities. NIST is involved in several areas of importance to advancing the hydrogen economy and I will briefly describe the goals and progress of these activities.

**Speaker** Dr. Olthoff is NIST’s first Chief Metrologist, and as such serves as the primary representative both nationally and internationally of NIST’s role as the national metrology institute of the United States, and works with NIST leadership to ensure that NIST’s core measurement capabilities remain amongst the best in the world.

Prior to becoming NIST Chief Metrologist, he was the Associate Director for Laboratory Programs where he provided direction and operational guidance for all of NIST's scientific and technical laboratory programs, and served as principal deputy to the Under Secretary of Commerce for Standards and Technology and NIST Director, among other duties. He held that position starting in 2018. Dr. Olthoff served as acting NIST Director from January 2021 to March 2022.

<p>11:40 – 11:55 (15 min.)</p>	<p><b>Open Discussion on Hydrogen Technologies and Strategies</b></p> <ul style="list-style-type: none"> <li>• Exploring areas where APMP can contribute</li> <li>• Cooperation with stakeholder organizations</li> <li>• Discussion on DEN interest</li> </ul>
<p>11:55 – 12:00 (5 min.)</p>	<p><b>Synthesis</b>  <i>Dr. Morioka Takehiro, National Metrology Institute of Japan, AIST</i></p>
<p>12:00</p>	<p><b>Closing Remarks</b>  <i>Dr. Hyun-Min Park, KRISS / APMP Chairperson</i></p>