2025 APEC Symposium on Energy Transition: Batteries, Fuel Cells & Electric Vehicles

Project Report

APEC Energy Working Group

April 2026

Asia-Pacific
Economic Cooperation

Asia-Pacific
Economic Cooperation

2025 APEC Symposium on Energy Transition: Batteries, Fuel Cells & Electric Vehicles

Project Report

APEC Energy Working Group

April 2026

APEC Project: EWG 201 2024A

Produced by
Associate Professor Dr Joash Tan Ban Lee
School of Science, Monash University Malaysia

Professor Dr Eric Chan Wei Chiang
International Institute of Science Diplomacy and Sustainability, UCSI University

Assistant Professor Dr Nurliyana Binti Abdul Razak
Faculty of Applied Sciences, UCSI University

Assistant Professor Kavita A/P Chirara
Faculty of Applied Sciences, UCSI University

Dr Lim Wern Han
School of Engineering, Monash University Malaysia

Azmil Zakri
Atri Advisory

Hawa Fitriah Binti Hamuzan
International Institute of Science Diplomacy and Sustainability, UCSI University

For
Asia-Pacific Economic Cooperation Secretariat
35 Heng Mui Keng Terrace
Singapore 119616
Tel: (65) 68919 600
Fax: (65) 68919 690
Email: info@apec.org
Website: www.apec.org

APEC#226-RE-04.3

Table of Contents

Organizing Committee

Professor Dr Eric Chan Wei Chiang
International Institute of Science Diplomacy and Sustainability, UCSI University

Associate Professor Dr Joash Tan Ban Lee
School of Science, Monash University Malaysia

Assistant Professor Dr Nurliyana Binti Abdul Razak
Faculty of Applied Sciences, UCSI University

Assistant Professor Kavita A/P Chirara
Faculty of Applied Sciences, UCSI University

Dr Lim Wern Han
School of Engineering, Monash University Malaysia

Azmil Zakri
Atri Advisory

Hawa Fitriah Binti Hamuzan
International Institute of Science Diplomacy and Sustainability, UCSI University

Advisory Board

Distinguished Professor Tan Sri Dr Zakri Bin Abdul Hamid, FASc
International Institute of Science Diplomacy and Sustainability, UCSI University

Ts Rushdi Abdul Rahim
Malaysian Industry-Government Group for High Technology (MIGHT)

Distinguished Professor Dr Phang Siew Moi, FASc, FMBA (UK)
Office of the Deputy Vice-Chancellor (Research and Postgraduate), UCSI University

Professor Dr Paul Arthur Berkman
Program on Negotiation, Harvard Law School (Harvard–MIT Public Disputes Program)

Associate Professor Dr Wong Chen Wai
Faculty of Applied Sciences, UCSI University

Symposium Speakers and Moderators

Opening Ceremony

Distinguished Professor. Tan Sri Dr. Zakri Bin Abdul Hamid
(UCSI University, Malaysia)

Distinguished Professor Dr Phang Siew Moi, FASc, FMBA (UK) (UCSI University, Malaysia)

Professor. Dr. Eric Chan Wei Chiang
(UCSI University, Malaysia)

Keynote Address

Ts. Rushdi Abdul Rahim,
(President & CEO, MIGHT)

Forum 1 – Automotive Policy and Urban Infrastructure trends for EV Transition

Professor. Ts. Dr. Nangkula Utaberta
(UCSI University)

Ms. Shafinaz on behalf of
Ts. Mohd. Sharulnizam bin Sarip
(MARii Malaysia Automotive Robotics)

Shi Hong Yu
(Senior Economist, CNPC)

TPr. Ts. Norliza Hashim
(Urbanice Malaysia)

Assistant Professor. Ts. Sr. Dr. Nadzirah Zainordin (UCSI University)

Forum 2 – Fuel Cells & Battery Storage Innovation Speakers

Professor. Dr. Mohd Razman Bin Salim
(UCSI University, Malaysia)

Associate Professor. ChM. Dr. Siti Aminah Mohd Noor (UPNM)

Dr. Nurul Akmaliah Dzulkurnain
(CEO, IBC)

Professor. Ts. Dr. Juhana Jaafar
(UTM, AMTEC)

Dr. Tan Wen Shan
(Monash University, Malaysia)

Forum 3 – Hydrogen & Energy Generation Systems Speakers

Professor. Dr. Eric Chan Wei Chiang
(UCSI University, Malaysia)

Professor. Ir. Dr. Suzana Yusup
(Sunway University)

Assistant Professor. Dr. Teng Kah Hou
(UCSI University)

Dr. Muhammad Shakeel Ahmad
(UMPEDAC)

Focus Group Discussion

Associate Professor. Dr. Joash Tan Ban Lee
(Monash University, Malaysia)

Forum 4 – Energy Policy, Carbon Offsets & Autonomous EV Ecosystem

Professor Dr Mohamad Osman
(UCSI University, Malaysia)

Associate Professor. Dr. Liew Chee Yoong (UCSI University, Malaysia)

Dr. Mohammad Zulhilmi Paiz Ismadi
(Monash University, Malaysia)

Mr. Mohd Hazwan Bin Abdul Rahman
(Energy Commission, Malaysia)

Dr. Lim Wern Han
(Monash University, Malaysia)

Forum 5 – UCSI Initiatives in Energy Transition and Invitation to Collaborate

Professor. Dr. Eric Chan Wei Chiang
(UCSI University, Malaysia)

Assistant Professor. Dr. Ramani Bai Varadharajan
(UCSI University, Malaysia)

Closing Ceremony

Professor. Dr. Eric Chan Wei Chiang
(UCSI University, Malaysia)

Symposium Activities

The APEC Symposium on Energy Transition: Batteries, Fuel Cells, and Electric Vehicles was convened under APEC Project EWG_201_2024A to support regional efforts in advancing low-carbon, energy-efficient, and resilient transport systems across the Asia-Pacific. Implemented through the Energy Working Group (EWG) and supported by the APEC Support Fund – Energy Efficiency, Low Carbon and Energy Resiliency Measures (ASF-EELCER) sub-fund, the symposium responded to the growing need for coordinated policy, technology development, and capacity building as economies transition away from internal combustion engines.

Held over three days in Kuala Lumpur, Malaysia, the symposium brought together policymakers, regulators, industry representatives, researchers, and academic institutions from APEC economies. The programme facilitated structured dialogue on electric vehicles (EVs), fuel cell vehicles (FCVs), batteries, hydrogen systems, and supporting energy and mobility infrastructure, recognising that these technologies operate within interconnected policy, industrial, and research ecosystems.

This Project Summary Report documents the symposium's objectives, structure, discussions, and key outcomes. It complements the accompanying Policy Recommendation Report, titled Transport Decarbonisation Pathways in APEC: Electric Vehicles, Fuel Cell Vehicles, and Informed Decision-making, which synthesises expert insights from the symposium and focus group discussions into an analytical framework and policy-relevant considerations for APEC economies. Together, the two reports serve distinct but complementary purposes: the Project Summary Report provides an account of the symposium activities and proceedings, while the Policy Recommendation Report supports informed decision-making through deeper analysis and structured policy reflection.

The symposium activities were organised around an opening ceremony, a keynote address, a series of thematic forums, and a focused group discussion. Collectively, these sessions examined the technical, policy, and socioeconomic dimensions of the energy transition. Topics included automotive policy and urban infrastructure readiness, battery and fuel-cell innovation, hydrogen production and energy generation systems, carbon markets and grid regulation, autonomous and digital mobility ecosystems, and institutional initiatives supporting low-carbon transition.

Across the thematic forums, discussions highlighted the complementary roles of battery-electric and hydrogen-based technologies across different transport segments and economy contexts. Participants examined challenges related to infrastructure deployment, grid integration, supply-chain resilience, safety standards, regulatory coordination, and public confidence, while also identifying opportunities for innovation, investment, and regional cooperation. Emphasis was placed on practical considerations for APEC economies at different stages of readiness, including developing economies facing infrastructure, fiscal, or institutional constraints.

A dedicated Focus Group Discussion formed a central component of the symposium activities. This session synthesised insights from the preceding discussions and enabled participants to reflect collectively on transition pathways, technology trade-offs, policy sequencing, and system constraints. The outputs of this discussion directly informed the expert analysis and options-based approach presented in the Policy Recommendation Report.

Universities and research institutions played an important role throughout the symposium by contributing scientific evidence, applied research perspectives, and insights on postgraduate training and talent development. Their participation reinforced the importance of research–policy–industry linkages in supporting evidence-based decision-making and long-term capacity building. The symposium also highlighted the role of Malaysia and ASEAN within the wider APEC context, particularly in relation to semiconductor value chains, electric vehicle manufacturing, and applied energy research.

Overall, the symposium activities strengthened regional understanding of the opportunities and challenges associated with energy transition in the transport sector. By fostering dialogue, sharing experience, and generating structured inputs for APEC publications, the symposium supported APEC's broader objectives of promoting sustainable, inclusive, and resilient growth across the Asia-Pacific region.

Opening Ceremony

Welcoming remarks from the Project Overseer

Professor. Dr. Eric Chan Wei Chiang
(UCSI University, Malaysia)

It is a pleasure to open this APEC Symposium on Energy Transition. Our focus on batteries, fuel cells, and electric vehicles comes at a moment when economies are accelerating the shift away from internal combustion engines. This shift shapes trade, supply chains, and the structures of cooperation that support stability and growth throughout the region.

Science diplomacy provides a useful backdrop for this discussion. It reminds us that technology transition depends on informed, cooperative decision-making that balances short-term pressures with long-term sustainability. In the energy transition, this balance is evident in the way our economies manage fiscal stimulus, semiconductor ecosystems, charging networks, and emerging hydrogen supply chains. No economy can advance these systems alone. The quality of our trade, growth, research partnerships, and technical standards will determine whether the transition is resilient and affordable.

Debates often present battery-electric systems and fuel-cell technologies as competing pathways. In reality, the transition benefits from a more complementary approach. Batteries serve dense urban mobility and distributed energy storage, while hydrogen and fuel cells meet the needs of heavy transport, long-distance travel, and industrial applications. Developing these systems together strengthens security, diversifies pathways, and expands opportunities for cooperation.

This is where APEC can demonstrate real value through integrated value chains, shared standards, open trade, and joint research that support both competition and collaboration. Universities and research institutions contribute by providing evidence, informing policy with new knowledge, and maintaining dialogue across sectors and borders. Their role reflects a core principle in science-policy-informed decision-making, which emerges when diverse actors share data, question methods, and help guide how the energy transition evolves. These linkages will keep the transition on a stable, cooperative trajectory.

Malaysia and ASEAN illustrate how regional ecosystems can contribute to these larger efforts. Expanding semiconductor capabilities, growing renewable energy deployment, and increasing participation in EV and battery supply chains show how institutions across the region are

adapting and innovating. Expanded assembly, testing, and design complement the broader APEC mission to scale electric mobility technologies.

These developments reaffirm a simple point: no technology transition succeeds without cooperation. The transition succeeds through shared capacity. APEC economies already possess deep strengths in manufacturing, renewable energy, and research. Strengthening this collaboration will hasten EV and future mobility requirements. Together, we can support a transition that is inclusive, resilient, and aligned with our shared interests in sustainability and long-term stability.

With that, I thank you and look forward to our discussions.

Opening remarks by Founding Director of International Institute of Science Diplomacy & Sustainability (IISDS), UCSI University Malaysia

Distinguished Professor
Tan Sri Dr Zakri Bin Abdul Hamid, FASc
(UCSI University, Malaysia)

I am not sure how much you know about APEC. I know it quite well, because I was part of the process very early on. It is a very good example of what is now known as science diplomacy.

APEC was established by 12 economies in the region. Today, the membership stands at 21. Do you know that APEC economies comprise about 60 percent of the world's GDP? You can imagine the significance. Around 48 percent of total trade in goods and services also takes place within the APEC region. Today we talk about the Asian G20 or the G7, but APEC has a special place because it focuses on three pillars.

What you are here for today, beyond being scientists or technocrats, is something I hope you will take away from your participation over these three days, the interface between science, technology, and policy. In other words, researchers conduct rigorous work, such as in batteries and fuel cells, through hard research and development. However, the results of that work should eventually translate into products that benefit individual economies or groups of economies within APEC.

Let me stress that this is not an isolated phenomenon. It must be a continuous interaction between knowledge providers, academics in universities and research institutions, and policymakers, particularly political leaders. I would also like to recognise that this meeting itself is an example of collaboration between UCSI and MIGHT. For those outside Malaysia, this reflects a public and private partnership, the three Ps. Here, we are in the business of walking the talk. In that context, I look forward to the keynote to be delivered by Encik Rushdi today, on the role of MIGHT in technology advancement in Malaysia, in ASEAN, and eventually within the broader APEC constellation.

I say I have some knowledge about APEC because I was involved in the first APEC science policy meeting in Indonesia, held in Medan, North Sumatra, convened by Sir Peter Gluckman. There is a great deal of hope invested in APEC, and just seeing the participants gathered here today is part of that hope.

When we talk today about sustainability, renewable energy, and the green economy, the discussions over these three days are extremely relevant. You hold the key to a progressive

and technologically rich future, one that is viewed with great hope by populations across the region. Let me also remind you that the APEC region is home to nearly three billion people. That is enormous.

I hope all of this can be internalised by the participants.

Once again, on behalf of the UCSI International Institute of Science Diplomacy and Sustainability, and MIGHT, where I also serve as joint chair, let me warmly welcome you to this meeting. Just to add a small announcement, UCSI IISDS is the first think tank in the Global South focused on science diplomacy. At UCSI, we offer training through short courses in science diplomacy, as well as Master's programmes, and we are developing PhD programmes. Those of you who are interested are most welcome to contact us.

Once again, welcome to this three day event, and terima kasih.

Opening remarks by Deputy Vice-Chancellor, Research and Postgraduate, UCSI University Malaysia

Distinguished Professor
Dr Phang Siew Moi, FASc, FMBA (UK)
(UCSI University, Malaysia)

It is my pleasure to join you at this APEC Symposium on Energy Transition, which brings together policymakers, researchers, industry leaders, and academic institutions to reflect on one of the most consequential transformations facing our economies today. The focus on batteries, fuel cells, and electric mobility is timely. Across the APEC region, the transition away from internal combustion engines is accelerating, reshaping trade patterns, industrial strategies, and the forms of cooperation that underpin long-term growth and stability.

Energy transition is not only a technological challenge. It is a coordination challenge. It requires decisions that balance short-term economic pressures with long-term sustainability, resilience, and inclusiveness. In this context, science diplomacy and science-informed policymaking play a critical role. They provide the mechanisms through which evidence, standards, and shared knowledge can guide collective action across borders, sectors, and disciplines.

In electric mobility, this balance is visible in how economies manage interdependent systems: critical minerals, semiconductor supply chains, charging infrastructure, grid stability, and emerging hydrogen ecosystems. No economy can advance these systems in isolation. The affordability, security, and scalability of electric mobility will depend on the quality of our cooperation in trade, research, technical standards, and regulatory alignment.

Discussions on energy transition are often framed as choices between competing technological pathways. In practice, progress depends on complementarity. Battery-electric technologies are well suited to urban mobility and distributed energy storage, while hydrogen and fuel-cell solutions address heavy transport, long-distance travel, and industrial applications. Developing these pathways together reduces risk, strengthens energy security, and broadens opportunities for collaboration across the region.

APEC provides an important platform to support this integrated approach. Through shared standards, open trade, coordinated value chains, and joint research initiatives, APEC economies can foster both healthy competition and practical collaboration. These efforts are essential to ensuring that the energy transition remains resilient, cost-effective, and accessible to economies at different stages of development.

Universities and research institutions have a distinct responsibility within this landscape. As centres of research and postgraduate training, we contribute by generating evidence, advancing new knowledge, and preparing talent capable of working across complex systems. We also serve as neutral spaces where policymakers, industry, and researchers can engage in sustained dialogue. This role becomes increasingly important as innovation shifts from standalone breakthroughs to ecosystem-based development, where progress depends on coordination across multiple actors.

Malaysia and ASEAN illustrate how regional ecosystems can contribute meaningfully to these wider efforts. Ongoing investments in semiconductor capabilities, expanding renewable energy deployment, and deeper participation in electric vehicle and battery supply chains reflect a strategic response to global technological change. Strengths in assembly, testing, design, and advanced manufacturing complement APEC's broader ambition to scale electric mobility technologies in a reliable and affordable manner.

At the same time, the nature of innovation itself has evolved. Earlier generations of technologies could often develop independently. Today, even the most promising innovations depend on supportive ecosystems. Electric mobility solutions rely on secure semiconductor supply, advanced software, precision manufacturing, stable energy systems, and clear regulatory frameworks. Success increasingly depends on how well these elements are aligned.

For universities, this evolution sets a clear mandate. We must strengthen interdisciplinary research, expand international collaboration, and ensure that postgraduate education equips researchers with systems-level understanding. At UCSI University, we are committed to advancing research that supports electric mobility, strengthens semiconductor-related capabilities, and contributes to Malaysia's and ASEAN's role within the APEC innovation ecosystem.

In closing, the energy transition reminds us of a simple but essential point. No technology scales without cooperation, and no transition succeeds without shared capacity. By working together across APEC economies, through research, policy coordination, and open exchange, we can support an energy transition that is inclusive, resilient, and aligned with our shared interests in sustainability and long-term stability.

I thank you and look forward to the discussions ahead.

Symposium Keynote Address and Forums

Keynote Address – Malaysian Foresighting and the Future Energy Landscape: Navigating the EV Transition

Summary of Keynote Address by Ts. Rushdi Abdul Rahim (President & CEO, MIGHT)

Good morning, and thank you for having me. Before I begin, I should mention that I am an EV user myself. I have been driving an EV for the past two years, so while I may not speak from a technical engineering standpoint, I can share genuine user experience. Many assumptions about EV usability, reliability, and cost do not always match real-world experience. For example, over two years of ownership, my total maintenance cost has been only MYR 25.

Let me briefly introduce MIGHT. We are a think tank under the Ministry of Science, Technology and Innovation, established in 1993 to provide strategic advice to the government on high-technology sectors such as aerospace, E&E, automotive and energy. In the past two days, we also organised a symposium on rare earth elements—a topic increasingly relevant to the EV ecosystem, as around 80% of EV motors and components rely on rare earth materials.

I would like to begin with a key statement: Electric, hydrogen-powered and data-driven mobility is redefining how economies connect and compete. This is not merely a slogan—global trends are clearly moving in this direction. While Malaysia may not yet match the EV adoption seen in China, momentum is growing. Proton's recently launched EV has already secured 10,000 bookings, and Perodua is preparing to launch theirs soon. EVs will become a common sight on our roads.

Where We Are Now

Across Asia, the energy transition is progressing, though unevenly. Many economies face financing gaps and varying levels of readiness. According to the 2024 Energy Transition Index, most economies fall within the mid-range, including advanced economies. The full Malaysian score is not yet published, but within ASEAN, Malaysia currently ranks first in energy transition readiness, ahead of Singapore; Thailand; Viet Nam.

Malaysia's direction is supported by several domestic policies:

- National Transport Policy – emphasises EV infrastructure, charging networks, electrified public transport and integrated transport planning.
- National Automotive Policy (NAP) – shifts the sector toward Energy Efficient Vehicles (EEV), local EV assembly, supply chain development and R&D. The BYD and Proton assembly expansions in Tanjung Malim align with this.
- National Energy Transition Roadmap (NETR) – focuses on increasing renewable energy share and catalytic projects for clean energy.
- Low Carbon Mobility Blueprint – supports EV adoption, alternative fuels and micromobility.

EVs and Sustainability

EVs and fuel-cell vehicles redefine clean mobility. However, sustainability extends beyond tailpipe emissions. EVs coupled with renewable energy—such as home solar systems—maximize energy savings and environmental benefits.

Globally, passenger vehicles contribute about 45% of transport-related CO_2 emissions, making them a major focus for decarbonisation. EV market growth reflects this shift, with rising demand for batteries and fuel-cell technologies.

Malaysia's EV demand is increasing steadily. However, as seen in Germany in 2023, the removal of incentives can cause sales to drop abruptly. Malaysia's incentive system differs because tax exemptions for completely knocked-down (CKD) units remain, encouraging local assembly.

Consumer surveys show that cost remains the top concern for potential EV buyers. Environmental motivation ranks only around fifth, indicating that price competitiveness is crucial for broader adoption.

Challenges in the EV Transition

The EV transition is not only about vehicles—it is a socioeconomic and policy challenge requiring coordination across sectors.

Social barriers:

- Range anxiety remains a common concern, especially for long-distance and rural travel.
- Trust in charging availability is still inconsistent—drivers worry about reaching a charger only to find it full or offline.

Technological barriers:

- Malaysia currently has about 5,000 chargers. Another 3,000–4,000 are planned, but most existing chargers are slow AC units. Europe, by contrast, is deploying 400 kW chargers.
- Battery technology continues to evolve, including LFP improvements and 800-volt architectures that allow ultra-fast charging in 10–15 minutes.
- Interoperability challenges exist, particularly with proprietary systems such as Tesla's charging network.

Environmental considerations:

- Battery recycling and "urban mining" must be established before large-scale battery retirement occurs 8–10 years from now.
- Most chargers still rely on grid electricity; integrating solar-powered charging would enhance overall sustainability.

Economic barriers:

- EV prices still depend heavily on incentives.
- Geopolitical trade barriers—particularly involving China, the dominant EV and battery producer—may affect global prices and supply chains.

Policy considerations:

- Many policies are evolving; EV policy remains in a "perpetual beta" state as we learn and adjust.
- Malaysia's National EV Task Force continues addressing gaps, standards and consumer concerns.

Where We Want to Be

Global energy demand will continue rising, and cleaner transport will become essential to achieving net-zero goals.

Key global targets include:

- 2030: 60% of global car sales to be electric
- 2035: 50% of heavy truck sales electric, and a reduction in new ICE vehicle sales
- 2040: At least 50% of aviation fuel to be low-emission alternatives

China currently leads in batteries, producing nearly 80% of global cells. Europe, meanwhile, is imposing strong policies to reduce dependency on China and achieve zero emissions. The US is enforcing domestic EV-related standards, including wider adoption of Tesla's charging technology. Japan continues to push hydrogen strategies, especially for heavy-duty mobility.

These examples show how major economies are shaping their industrial strategies around the EV future.

How Do We Get There?

Several forces will drive the transport energy transition:

- Technological Advancement – scaling hydrogen fuel cells, improving long-range mobility, and advancing battery density and charging speeds.
- Investment Flows – incentives, private capital, green financing, carbon markets and transition credits must support the sector.

Forum 1 – Automotive Policy and Urban Infrastructure trends for EV Transition

Focus: Policy for the automotive industry and its integration with low-carbon urban frameworks, smart-city mobility, and EV infrastructure.

Moderator
Professor. Ts. Dr. Nangkula Utaberta
(UCSI University)
Abstracts & Affiliations

Speaker: Ts. Mohd. Sharulnizam bin Sarip
Affiliation: Malaysia Automotive, Robotics and IoT Institute (MARii), MITI, Malaysia
Presentation Title: Malaysian Automotive Ecosystem and EV Enhancement Policy

Abstract

Professional Technologist Mohd Sharulnizam bin Sarip serves as the Chief Operating Officer at the Malaysia Automotive, Robotics and Internet of Things Institute (MARii). He has extensive experience in the automotive sector, particularly in vehicle construction, standards and regulations, testing, road vehicle acts, and policy development. He holds a Master of Engineering from Universiti Putra Malaysia, a Bachelor in Electrical, Electronics and System Engineering from Saitama University, Japan, and a Certificate of Excellence in Data Science and Analytics from the University of California, Berkeley.

In Malaysia, his expertise includes vehicle construction, regulatory standards, testing, and policy development, particularly the National Automotive Policy (NAP). He also leads key domestic facilities such as the Malaysia National Emission Testing Centre (NETC) and the Centre of Excellence for Future Industry (CoEFI).

This presentation explores Malaysia's policy landscape for automotive and EV transition, focusing on the National Automotive Policy 2020 (NAP 2020) and the New Industrial Master Plan 2030 (NIMP 2030). Both policies emphasise carbon neutrality and outline strategies to reduce economy-wide carbon intensity by 2030 while accelerating EV adoption. MARii supports this domestic agenda through initiatives including the Vendor Development Programme, the development of specialised National Occupational Skills Standards (NOSS) for EV-related jobs, technical evaluations for charging infrastructure, and contributions to regional initiatives such as the ASEAN EV Implementation Roadmap and Battery Passport guidelines.

Keywords: Automotive policy; National Automotive Policy; EV ecosystem; regulatory frameworks; Malaysia; MARii.

Speaker: Shi Hong Yu
Affiliation: Senior Economist, CNPC, China
Presentation Title: Development of New Energy Vehicles and Charging Infrastructure in China

Abstract

This presentation provides an overview of the development, policy evolution, and future direction of New Energy Vehicles (NEVs) and charging infrastructure in China. NEV adoption has accelerated rapidly, reaching more than 30 million vehicles by 2024, with passenger vehicle penetration surpassing 50%. Key trends include shifts in ownership patterns, increased dominance of plug-in hybrid electric vehicles (PHEVs), and the economic contribution of NEV exports.

The presentation outlines the policy framework enabling large-scale NEV deployment and the growth of charging and battery-swapping networks. It also discusses long-term projections indicating that NEVs are expected to dominate vehicle sales and ownership between 2035 and 2040. Challenges related to hydrogen refuelling infrastructure and the complementary roles of electric and hydrogen energy systems in supporting China's dual carbon objectives are highlighted.

Keywords: New Energy Vehicles; charging infrastructure; PHEVs; hydrogen energy; carbon neutrality; China.

Speaker: TPr. Ts. Norliza Hashim
Affiliation: Urbanice Malaysia, KPKT, Malaysia
Presentation Title: Low Carbon and Sustainable Urbanisation for Malaysia

Abstract

Malaysia's transition toward low-carbon and sustainable urban development is essential for meeting Net-Zero 2050 commitments and improving city resilience, competitiveness, and liveability. With nearly 78% of the population residing in urban areas, cities must lead the transformation through clean energy adoption, efficient mobility systems, green building practices, and climate-adaptive planning.

Integrated strategies involving renewable energy deployment, low-carbon mobility expansion, energy-efficient development, and strengthened city-level climate action can create healthier and more inclusive urban environments. Low-carbon urbanisation ultimately enhances domestic growth by making sustainability a driver of long-term economic and social well-being.

Keywords: Low-carbon cities; sustainable urbanisation; energy transition; climate action; mobility planning; Malaysia.

Speaker: Assistant Professor. Ts. Sr. Dr. Nadzirah Zainordin
Affiliation: UCSI University, Malaysia
Presentation Title: EV-Ready Cities: Bridging Urban Design, Sustainability, and the Digital Transition

Abstract

As cities progress toward low-carbon and technology-driven futures, the integration of electric vehicle (EV) infrastructure within urban planning frameworks has become essential for sustainable mobility. This presentation examines the role of strategic urban design, smart city principles, and sustainable construction in creating EV-ready environments.

Drawing from interdisciplinary insights in smart development and digital innovation, the session outlines practical frameworks for incorporating EV infrastructure into master planning, land use policies, and built environment projects. It also explores the application of digital tools such as Building Information Modelling (BIM), Geographic Information System (GIS), and digital twins for improving spatial planning, operational efficiency, and cost management.

By linking policy, design, and technology, the presentation encourages planners, engineers, and built environment professionals to rethink how cities function, positioning mobility infrastructure as a catalyst for resilient, smart, and people-centred urban futures.

Keywords: EV-ready cities; urban planning; smart city design; digital tools; sustainability; mobility transition.

Summary of Forum 1

Forum 1 explored how automotive policy, EV ecosystem development, and urban infrastructure must evolve in an integrated manner to support a sustainable electric vehicle transition across the APEC region. The forum brought together perspectives from government, industry, and academia, highlighting the importance of coordinated standards, planning, and regional cooperation.

Malaysia’s automotive policy and EV ecosystem, presented by Ms Nurul Shafinas on behalf of Ts. Mohd. Sharulnizam bin Sarip (MARii), outlined Malaysia’s ambitions under the New Industrial Master Plan 2030 to become an EV manufacturing hub. Key initiatives included xEV adoption targets, expansion of charging infrastructure, human

capital development, and local value chain strengthening. MARii's work on EV safety standards, including UNR 100, MS 7840 for emergency responders, and the newly approved battery passport framework, was highlighted. Malaysia's leadership within ASEAN on EV standards harmonisation and battery passport guidelines was also emphasised.

China's EV market and infrastructure development, presented by Mr Shi Hong Yu, Senior Economist, CNPC, highlighted China's transition from policy-driven to market-driven EV growth, with new energy vehicles accounting for over half of new passenger vehicle sales. The presentation outlined rapid expansion of charging infrastructure, diverse operator models, and strong industrial concentration in batteries and vehicle manufacturing. Hydrogen fuel cell vehicles were noted as promising for long-distance and heavy transport, though currently constrained by cost and infrastructure readiness.

Urban infrastructure and climate resilience, presented by TPr. Ts. Norliza Hashim, Urbanice Malaysia, focused on the role of cities in emissions reduction and climate adaptation. Rapid urbanisation has intensified transport demand and climate risks such as heat stress and flooding. The presentation highlighted the need for low-carbon city planning, climate adaptation strategies, and digital tools to support data-driven urban decision-making.

EV-ready cities and integrated planning, presented by Asst. Prof. Ts. Sr. Dr. Nadzirah Zainordin, UCSI University, emphasised that EV readiness depends on integrated urban design rather than charger deployment alone. Transit-oriented development, EV-ready building codes, grid planning, and the use of digital tools such as GIS, BIM, and digital twins were identified as key enablers. Regional examples illustrated how early planning and coordinated governance can support scalable EV adoption.

Forum 2 – Fuel Cells & Battery Storage Innovation

Focus: Battery and fuel-cell technology advancements, safety standards, and circular design for EV ecosystems.

Moderator
Professor. Dr. Mohd Razman Bin Salim
(UCSI University, Malaysia)

Abstracts & Affiliations

Speaker: Associate Professor. ChM. Dr. Siti Aminah Mohd Noor
Affiliation: Universiti Pertahanan Nasional Malaysia (UPNM), Malaysia

Presentation Title: Advancing Green Energy Storage: Malaysian Palm Oil Biomass-Derived Hard Carbon Anodes for Sodium-Ion Batteries

Abstract

The increasing demand for sustainable energy solutions has intensified interest in efficient electrochemical energy storage systems. While lithium-ion batteries dominate the current market due to high energy density and technological maturity, concerns regarding cost, material scarcity, and environmental impact have encouraged exploration of alternatives such as sodium-ion batteries (SIBs). Sodium-ion systems offer advantages including resource abundance, wide geographical distribution, lower toxicity, and reduced cost, making them suitable for large-scale energy storage applications.

A key challenge in SIB development is the design of high-performance anode materials. This work focuses on hard carbon derived from Malaysian oil palm biomass as a sustainable anode material. Bio-derived hard carbon demonstrates favourable structural properties and porosity for sodium storage, combining environmental sustainability with promising electrochemical performance. Hard carbon is recognised as a leading anode candidate due to its high reversible capacity, strong electrical conductivity, and stable cycling performance.

The use of biomass feedstocks supports circular-economy practices and provides an environmentally responsible route for battery material production. Oil palm biomass, a widely available by-product of Malaysia's palm oil sector, serves as a renewable and reliable precursor for hard carbon, contributing to waste minimisation and sustainable industrial practices. This work highlights how bio-derived materials and advanced electrode design can accelerate the development of sustainable sodium-ion batteries and support the transition toward greener energy storage solutions.

Keywords: Sodium-ion batteries; hard carbon; palm oil biomass; sustainable energy storage; anode materials; circular economy.

Speaker: Dr. Nurul Akmaliah Dzulkurnain
Affiliation: CEO, International Battery Center Sdn. Bhd, Malaysia
Presentation Title: Battery Safety and Circular Design: Cell-Level Strategies for Sustainable EVs

Abstract

The rapid growth of electric mobility requires batteries that are both high-performance and intrinsically safe, while aligning with long-term sustainability goals. This presentation examines three fundamental pillars shaping next-generation EV battery development: international safety standards, safety-by-design principles at the cell level, and circular manufacturing pathways.

Key cell-level standards such as UN 38.3, IEC 62133, IEC 62619, and UL 2580 are used to illustrate regulatory requirements for thermal, mechanical, and electrical safety. Safety-by-design strategies are explored, including advanced separator technologies, engineered electrode architectures, material-based thermal mitigation, and diagnostic approaches for minimising internal short circuits and thermal runaway.

The presentation also highlights circular-economy pathways that begin at the design stage, integrating recyclable materials, closed-loop recovery processes, and reintegration of recovered resources into new cell fabrication. By combining strong safety frameworks with sustainable manufacturing practices, the session emphasises the importance of developing EV batteries that are safer, more durable, and aligned with circular-economy principles.

Keywords: Battery safety; safety standards; circular design; EV batteries; thermal management; cell engineering.

Speaker: Professor. Ts. Dr. Juhana Jaafar
Affiliation: Advanced Membrane Technology Research Centre (AMTEC), Universiti Teknologi Malaysia, Malaysia

Presentation Title: Innovation in Membrane Formation and Design for Fuel Cells
Other Contributors: Juhana Jaafar*, Nuor Sariyan Suhaimin, Nurul Natasha Mohammad Jafri

Abstract

“My approach in transforming traditional membranes into new-generation membranes that are smart, flexible, tolerable, and versatile in facing the unprecedented circumstances and changes of our time symbolizes the integration of Artificial Intelligence (AI) in membrane research and development. This approach embodies originality in my research journey at UTM. From ideas to translational applications, this transformation reflects a comprehensive evolution of innovation and purpose.” – Prof. Ts. Dr. Juhana Jaafar

For more than two decades, the Advanced Membrane Technology Research Centre (AMTEC) at UTM has pursued a research direction that transforms traditional membrane technologies into new-generation intelligent membrane systems. This approach integrates adaptability, resilience, and multifunctionality, reflecting a paradigm shift from static membrane materials to dynamic systems capable of responding to environmental and operational stimuli.

Hybrid membranes incorporating nanostructured fillers—such as metal nanoparticles, carbon nanotubes, and graphene oxide—demonstrate enhanced capabilities in selective separation, catalytic functions, and tolerance to harsh conditions. These adaptive behaviours mirror core principles of artificial intelligence, where hybrid and responsive systems can self-optimise based on external inputs.

A key achievement is the development of a Malaysian-made polymer electrolyte membrane based on sulfonated poly(ether ether ketone) (SPEEK), which demonstrates performance comparable to the commercial Nafion® membrane. Its successful deployment in a working fuel cell prototype highlights Malaysia’s capability in advancing membrane technology from fundamental research to translational application. Through advanced modification strategies and circular-economy approaches using locally sourced materials, the research demonstrates strong performance, long-term stability, and the potential to support sustainable energy solutions.

Keywords: Fuel cells; membrane technology; SPEEK; nanostructured materials; adaptive membranes; energy materials.

Speaker: Dr. Tan Wen Shan
Affiliation: Monash University Malaysia, Malaysia
Presentation Title: Solar-plus-Storage Synergy: Preparing Energy Management Systems for the Electric Vehicle Future

Abstract

The rapid growth of electric vehicle (EV) adoption is reshaping Malaysia’s energy landscape, introducing new requirements for solar photovoltaic (PV) systems and

energy storage solutions. As distributed solar generation continues to expand, energy management strategies must evolve to address fluctuating EV charging demand, bidirectional power flows, and grid stability constraints.

This presentation examines how solar-plus-storage systems can be optimised to support increased EV penetration. Key topics include optimisation algorithms for solar-storage integration, forecasting methods for improving reliability, and the impact of large-scale EV adoption on demand profiles and peak loads. The role of vehicle-to-grid (V2G) technologies is also discussed, emphasising how EV batteries can serve as distributed storage assets to complement variable renewable generation.

A Malaysia-based case study is used to contextualise these concepts, offering regional insights and practical lessons for broader application in developing flexible, resilient energy systems.

Keywords: Solar-plus-storage; energy management; EV charging; V2G; distributed energy systems; grid flexibility.

Summary of Forum 2

This forum focused on advancements in battery and fuel-cell technologies, circular manufacturing, and energy management for electric vehicles (EVs). Prof. Ts. Dr. Juhana Jaafar (UTM) highlighted the evolution of fuel-cell membranes from basic designs to smart, self-healing membranes and sustainable fabrication using advanced materials like graphene and nanocellulose. Her group also demonstrated microbial fuel cells using palm oil effluent, producing electricity and hydrogen with membranes comparable to commercial systems.

Assoc. Prof. Dr. Siti Aminah Mohd Noor (UPNM) presented sodium-ion batteries as a cost-effective, sustainable alternative to lithium-ion systems. Her team developed compatible electrolytes, sodium vanadium phosphate cathodes, and biomass-derived hard carbon anodes, showing reliable performance using abundant, low-cost materials.

Dr. Nurul Akmaliah Dzulkurnain (IBC) highlighted the rapid growth of lithium-ion batteries for EVs and outlined a circular manufacturing pathway with second-life use and recycling. She showcased the HEBATT pilot facility producing graphene-enhanced lithium-ion, aluminium-ion, and sodium-ion batteries with improved safety, thermal stability, and cycle life, and shared plans for a mega-factory in Sepang.

Dr. Tan Wen Shan (Monash University Malaysia) discussed integrating solar energy with battery storage to manage peak electricity demand under Malaysia's new industrial tariffs. Energy storage, combined with smart EV charging and Vehicle-to-

Grid technology, can reduce costs while providing flexibility and revenue for industrial and commercial users.

Overall, the forum emphasized sustainable materials, circular design, and intelligent energy management as key drivers for advancing battery and fuel-cell technologies in Malaysia’s EV and renewable energy sectors.

Forum 3 – Hydrogen & Energy Generation Systems

Focus: Hydrogen production via plasma and bio-catalytic methods, green hydro-pyrolysis, and renewable energy integration.

Moderator
Professor. Dr. Eric Chan Wei Chiang
(UCSI University, Malaysia)

Abstracts & Affiliations

Speaker: Professor. Ir. Dr. Suzana Yusup (Sunway University)
Affiliation: Sunway University, Malaysia
Presentation Title: Hydrogen Production Technologies and Ecosystem

Abstract

Climate change impacts demand urgent action to transition toward cleaner and greener energy systems. This transformation is driven by decarbonisation, electrification, and long-term sustainability goals. Hydrogen presents a promising alternative energy carrier, offering high energy density and the potential for low-emission applications. As an energy vector, hydrogen supports renewable integration, transportation systems, and industrial operations.

Hydrogen can be produced via thermochemical, electrochemical, and biological pathways. This presentation highlights comparative hydrogen production technologies and discusses the broader hydrogen ecosystem required to support energy transition strategies.

Keywords: Hydrogen production; decarbonisation; energy transition; energy systems; renewable integration.

Speaker: Assistant Professor. Dr. Teng Kah Hou (UCSI University)
Affiliation: UCSI University, Malaysia
Presentation Title: Green Hydrogen Production Enhancement by Incorporating Ultrasound Technology in Alkaline Water Electrolysis
Other Contributors: Wenya Wong; Yu Shem Goh; Kah Hou Teng; Kiat Moon Lee; Wah Yen Tey; Leong Sim Teh; Yeah Hui Loh

Abstract

The global energy crisis has elevated the urgency of transitioning toward green energy alternatives to mitigate the worsening effects of global warming. Green hydrogen

production, combining solar energy with alkaline water electrolysis (AWE), has been widely adopted; however, efficiency limitations remain a key challenge.

This study investigates the enhancement of AWE efficiency through the application of ultrasonic energy to improve the hydrogen evolution reaction. The experimental work examines the influence of temperature and ultrasonic power, supported by mathematical modelling. Results indicate that heat generated by the sonotrode reduces activation energy for both hydrogen and oxygen evolution reactions, increasing overall system efficiency. The ultrasound-induced cavitation effect further accelerates bubble detachment from the electrode surface, reducing interfacial resistance and significantly boosting hydrogen production.

The findings demonstrate that ultrasound-assisted electrolysis has strong potential for commercial application, offering a promising pathway toward efficient green hydrogen production.

Keywords: Green hydrogen; ultrasound; alkaline water electrolysis; localized heat; cavitation effect; hydrogen evolution reaction.

Speaker: Dr. Muhammad Shakeel Ahmad (UMPEDAC)
Affiliation: Higher Institution Centre of Excellence (HICoE), UM Power Energy Dedicated Advanced Centre (UMPEDAC), Universiti Malaya, Malaysia
Presentation Title: Reframing Hydrogen Narrative for Emerging Economies Centred on Green Hydro-Pyrolysis

Abstract

Green hydrogen and electric mobility are often positioned as central pillars of global decarbonisation strategies. However, both Battery Electric Vehicles (BEVs) and Fuel-Cell Electric Vehicles (FCEVs) face fundamental constraints when applied universally. BEVs require substantial electricity generation and large-scale charging infrastructure; electrifying Malaysia's 24 million vehicles with 45 kWh battery packs would necessitate more than 1 TWh/day of additional generation. FCEVs, while offering faster refuelling and longer range, remain hindered by high production costs and limited refuelling infrastructure. Solar-based electrolysis in Malaysia currently cannot achieve hydrogen production costs below USD2/kg, with more realistic projections near USD3/kg.

Hydro-pyrolysis presents a more pragmatic alternative for emerging economies. Rather than using hydrogen directly as a transport fuel, hydrogen serves as a chemical agent for converting biomass and plastic waste into drop-in liquid fuels. This method can achieve comparable decarbonisation outcomes while requiring four to five times less electricity than direct hydrogen mobility pathways. The approach leverages existing fuel infrastructure, reduces hydrogen storage and distribution challenges, and supports circular-economy integration. For regions with moderate solar potential and

abundant waste resources, such as Malaysia, hydrogen-enabled hydro-pyrolysis offers a feasible and economically competitive route to sustainable fuels and meaningful carbon reduction.

Keywords: Green hydrogen; hydro-pyrolysis; emerging economies; decarbonisation; sustainable fuels; circular carbon systems.

Summary of Forum 3

Forum 3 focused on hydrogen and energy generation systems, exploring production methods, green hydro-pyrolysis, and renewable energy integration. Prof. Suzana Yusup highlighted hydrogen's potential in Malaysia's energy transition, noting its role in clean energy, EV adoption, and net-zero goals. She emphasized the challenges of low energy density, hydrogen embrittlement, high production costs, and limited infrastructure, while advocating for green hydrogen produced from local renewable resources. Advancing Malaysia's hydrogen agenda requires coordinated ecosystem development, including scaling pilot projects, establishing regulatory frameworks, expanding distribution and storage, creating demand, training skilled workers, and sustained R&D investment.

Dr. Teng Kah Hou presented ultrasonication-assisted electrolysis as a method to improve hydrogen production efficiency. By using ultrasonic vibrations at the electrode, gas bubbles detach faster, the boundary layer is broken, and mass transport is enhanced, resulting in a 25–30% increase in hydrogen output and Faradaic efficiency. His team is working toward Internet of Things (IoT)-integrated monitoring to optimize electrolysis and invited collaboration for pilot demonstrations.

Dr. Muhammad Shakeel Ahmad showcased UMPEDAC's innovations in hydrogen applications, including membraneless alkaline electrolyzers, hydrogen-fired waste management systems, hydrogen-powered appliances, Stirling engines, and pipeline coatings to prevent embrittlement. He emphasized using hydrogen as an enabler rather than a primary fuel, integrating local resources like biomass for green liquid fuels and decarbonizing industrial and transport applications. He concluded that Malaysia's sustainable hydrogen economy relies on strategic local innovation, infrastructure alignment, and resource-focused solutions rather than replicating foreign models.

Focus Group Discussion

Focus: Contributing to an APEC publication on policy recommendations.

Moderator
Associate Professor. Dr. Joash Tan Ban Lee
(Monash University, Malaysia)

Summary of the Focus Group Discussion

The discussion emphasized that the transition from internal combustion engines (ICEs) to electric and hydrogen vehicles must be gradual to avoid disrupting economies and livelihoods, with incentives for EVs and hydrogen vehicles preferred over sudden policy changes. Historical examples, such as the UK's gas-to-electric street lamp transition, illustrate that such shifts take decades, and life cycle assessments suggest that EVs may initially be more polluting than ICE vehicles, reinforcing the need for gradual normalization. Opportunities with EVs and fuel cell vehicles (FCVs) include short-distance personal transport for EVs, and long-distance or heavy-duty use for hydrogen or hybrid vehicles. Adoption of these technologies also opens business prospects in battery reuse, maintenance, and local supply chains, while a concurrent coexistence of ICE, EVs, and hydrogen vehicles is likely due to the entrenched niches of ICEs.

Challenges to adoption include public perception, safety concerns, and negative online coverage, as well as market oversaturation from low-cost EVs affecting quality, resale value, and supply chains. Technical limitations such as battery range, degradation, heavy-duty adaptation, and infrastructure gaps also pose barriers, while hydrogen production remains energy-intensive and requires a cost-effective ecosystem. Technical and infrastructure readiness is further constrained by bottlenecks in battery technology, charging stations, and hydrogen ecosystem alignment. Modular and easily maintainable EV designs, such as hot-swappable batteries, and hybrid solutions can help address adoption barriers, and modelling tools—including simulation platforms or even games like City Skyline—can assist in planning infrastructure.

Regulation and standards were highlighted as critical, needing to balance safety with innovation, harmonize EV regulations, and ensure modularity and lifecycle part availability. International collaboration is essential for securing rare earth supply chains and technology sharing. APEC's role includes sharing best practices, offering technical assistance adapted to local contexts, supporting hybrid approaches rather than single-technology adoption, and promoting regional cooperation, capacity building, and equitable technology deployment. The group concluded that successful EV and FCV adoption depends on a combination of gradual transition, hybrid solutions, infrastructure readiness, public perception management, standardization, and regional collaboration.

Forum 4 – Energy Policy, Carbon Offsets & Autonomous EV Ecosystem

Focus: Policy transitions for EV and energy markets, carbon credit frameworks, and autonomous mobility ecosystems.

Moderator
Professor Dr Mohamad Osman
(UCSI University, Malaysia)

Speaker: Assoc. Prof. Dr. Liew Chee Yoong
Affiliation: UCSI University, Malaysia
Presentation Title: Carbon Markets as the Catalyst: Powering APEC's Clean Energy Transformation

Abstract

Advanced batteries, fuel cells, and electric vehicles (EVs) are reshaping the Asia–Pacific energy landscape, but technological progress alone is insufficient to achieve rapid decarbonisation. A credible carbon market, using tradable credits to place an economic value on emissions reduction, is a crucial mechanism for aligning financial incentives with climate goals. Carbon credits convert environmental benefits into economic returns, encouraging businesses to adopt low-carbon solutions proactively.

This presentation provides a strategic outlook for APEC's energy transition by integrating data-driven charts, conceptual diagrams, and comparative tables to illustrate how interconnected carbon markets can accelerate innovation while maintaining environmental integrity. The session highlights how market-based mechanisms can bridge ambition gaps, strengthen policy implementation, and stimulate investment in clean technologies across the region.

Keywords: Carbon markets; energy transition; APEC; carbon credits; clean technology; economic instruments.

Speaker: Dr. Mohammad Zulhilmi Paiz Ismadi
Affiliation: Monash University Malaysia, Malaysia
Presentation Title: Talent Development: A Critical Driver for the Autonomous EV Ecosystem

Abstract

The ASEAN autonomous EV ecosystem is evolving rapidly, supported by government incentives, regional coordination, and a growing supply chain that links raw material

sources in Indonesia, semiconductor packaging in Malaysia, and large-scale EV assembly in Thailand and Viet Nam. Regional energy policies prioritise renewable integration and smart grid development, both essential for decentralised and intelligent EV charging infrastructure aligned with carbon reduction targets.

Emerging carbon offset mechanisms in the region further strengthen EV adoption by incorporating digital monitoring and tokenised carbon credit systems. Human capital development is central to this transition, with initiatives spanning artificial intelligence, battery engineering, energy management, and data science. These efforts are supported by cross-border education programmes, research collaborations, and upskilling frameworks.

Cities such as Singapore and Kuala Lumpur are leading smart mobility deployment and infrastructure pilots, though challenges remain in regulatory harmonisation and infrastructure readiness. With sustained cooperation, ASEAN is positioned to become a global centre for clean mobility innovation by 2030, balancing growth, sustainability, and technological leadership.

Keyword: Autonomous EVs; talent development; ASEAN; smart mobility; energy policy; supply chain.

Speaker: Mr. Mohd Hazwan Bin Abdul Rahman
Affiliation: Energy Commission (METWT), Malaysia
Presentation Title: The Backbone of the Energy Transition: Modernising the Grid Code

Abstract

Malaysia’s electricity sector is undergoing rapid transformation driven by the increasing integration of variable renewable energy (VRE) and emerging technologies such as battery energy storage systems (BESS). In response, the Grid Code for Peninsular Malaysia—first issued in 2010—has been comprehensively reviewed to ensure continued relevance, clarity, and system security in a high-renewables future.

The revised Grid Code strengthens technical, operational, and planning frameworks by improving transparency, defining clearer roles and responsibilities for grid users, and aligning generation and transmission planning processes. It also addresses legacy gaps such as undocumented procedures and outdated requirements. A major focus of the updated code is to support the reliable integration of large-scale VRE, projected to exceed 8,000 MW by 2030. Provisions include frameworks for managing variability, reduced system inertia, duck-curve effects, and limited visibility of embedded solar generation.

The new structure, consisting of a Main Code and Additional Codes, is designed to be future-proof by streamlining amendment processes and accommodating new

technologies, demand response, and ancillary services. The modernised Grid Code provides a robust regulatory foundation for Malaysia's energy transition.

Keywords: Grid Code; renewable energy integration; system security; BESS; energy policy; Malaysia.

Speaker: Dr. Lim Wern Han
Affiliation: Monash University Malaysia, Malaysia
Presentation Title: Trust and Confidence: Hearing the Right Stakeholder Voice

Abstract

EV adoption in the region is increasing, though progress remains uneven, particularly in emerging economies. While supportive policies have accelerated growth in some markets, rapid technological development, especially in autonomous mobility, has introduced new uncertainties. At this stage, it is critical to incorporate perspectives from diverse stakeholder groups, especially consumers, who represent the largest and most influential segment.

Consumers today are more vocal due to widespread social media use. Online discussions, votes, resharing patterns, and threaded dialogues provide rich data sources for policymakers seeking to understand public sentiment. However, the same platforms also give rise to misinformation, amplified by the increasing use of artificial intelligence to manipulate narratives that undermine EV adoption. The presentation discusses two key priorities:

1. Current best practices for analysing consumer sentiment on social media. Rather than just exploring sentiment in isolation, platform features such as threaded discussions should be maintained to perform emotion recognition in conversations. Other techniques include user profiles with personality types, user rating through votes / likes-dislikes, and agreement measures with that of other users.
2. Navigating through misinformation using fact-checking approaches, with an emphasis on explainability or reasoning beyond just misinformation classifications that varies based on the users' profile.

The session highlights how accurate sentiment analysis, transparent communication, and stakeholder engagement can strengthen public confidence and support smoother EV transitions.

Keywords: EV adoption; stakeholder engagement; consumer sentiment; social media analysis; misinformation; autonomous mobility.

Summary of Forum 4

Forum 4 explored energy policy, carbon offsets, and the autonomous EV ecosystem, highlighting the interplay between technology, policy, and public perception. Dr.

Mohammad Zulhilmi Paiz Ismadi from Monash University Malaysia emphasized the critical role of talent development in the rapid transition to electric and autonomous vehicles. He highlighted that modern vehicles are highly software-driven, creating a fast-moving 10–15 year transition that has produced a talent gap in STEM, IT, and energy sectors. Hands-on experience, multidisciplinary training, international exposure, and government support are essential to equip the workforce and ensure successful EV and autonomous vehicle adoption.

Assoc. Prof. Dr. Liew Chee Yoong from UCSI University discussed carbon markets as a key driver for clean energy adoption in the Asia-Pacific. He explained how tradable carbon credits incentivize low-carbon practices and support renewable electricity, green batteries, and hydrogen. Highlighting challenges such as fraud and fragmented regulations, he proposed a three-phase roadmap for regional integration: aligned standards by 2025, linked pilot markets by 2030, and full integration with unified carbon pricing by 2035.

Mr. Mohd Hazwan Abdul Rahman from Malaysia's Energy Commission presented updates to the domestic grid code to support renewable integration, digitalization, and emerging technologies while maintaining stability. He highlighted the shift to bidirectional power flow, provisions for battery storage, and pilot projects such as a 100 MW / 400 MWh lithium-ion BESS at Santong substation. These updates are crucial to achieving Malaysia's renewable energy targets and enabling reliable, future-ready grid operation.

Dr. Lim Wern Han from Monash University Malaysia focused on social media, misinformation, and sentiment analysis in shaping public perception of EVs and renewable energy. He noted that young populations rely on online sources, making them vulnerable to false claims about EV safety and infrastructure. By analyzing sentiment and specific concerns, policymakers and manufacturers can design targeted campaigns, behavioral strategies, and narratives to improve technology adoption while ensuring ethical communication.

Forum 5 – UCSI Initiatives in Energy Transition and Invitation to Collaborate

Moderator and Speaker
Professor. Dr. Eric Chan Wei Chiang
(UCSI University, Malaysia)
Affiliation: UCSI University, Malaysia
Presentation Title: Establishing Connections in Today's Multipolar World

Speaker: Assistant Professor. Dr. Ramani Bai Varadharajan
Affiliation: UCSI University, Malaysia
Presentation Title: UCSI-Cheras Low Carbon Innovation Hub

Summary of Forum 5

Assistant Professor Dr. Ramani Bai Varadharajan from UCSI-Cheras Low Carbon Innovation Hub presented the Hub's initiatives in low-carbon innovation, sustainability, and energy transition, highlighting its vision to contribute to a greener Kuala Lumpur by 2030. Launched in 2022, the consortium focuses on four research clusters—Renewable Energy, Environmental Sciences, Chemicals, and Electronics—and conducts projects on green hydrogen, bioenergy, solar kits for schools, biodiesel from used cooking oil, waste recycling, and smart sensors. The Hub has secured domestic and international grants, established labs for IoT and energy projects, and achieved regional recognition, ranking 57th in Asia for sustainability. Dr. Ramani Bai emphasized collaboration opportunities with universities, industry partners, and researchers through MOAs, MOUs, student engagement, lab access, and small grants, inviting participation to drive sustainable solutions, knowledge transfer, and community impact.

Prof. Dr. Eric Chan Wei Chiang from UCSI-IISDS highlighted the role of science diplomacy in promoting sustainability and regional cooperation. The International Institute of Science Diplomacy and Sustainability (UCSI-IISDS) is a centre of excellence at UCSI University that connects scientists, policymakers, and leaders to advance science-informed decision-making and sustainable development through research, education, and dialogue on global challenges such as environmental diplomacy, health, food security, and international cooperation.

He explained that science diplomacy links science, policy, and diplomacy to address global challenges collaboratively, emphasizing mutual benefit and continuity before, during, and after crises. IISDS, Malaysia's first institute connecting science diplomacy with sustainability, offers academic programs, short courses for diplomats and professionals, and engages with the ASEAN Centre for Science Diplomacy. Prof. Eric also discussed research collaboration opportunities, including EV and fuel cell grid integration, fuel cell efficiency improvements, and hydrogen system development. He

described science diplomacy as the “language of hope,” encouraging shared prosperity, capacity building, and sustainable regional development.

ANNEX – Event Photos