# 8th APEC Energy Efficiency Policy (EEP) Workshop Report

# Energy Management: Standards, Policies, and Best Practices

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**APEC Energy Working Group**

**May 2025**

Asia-Pacific
Economic Cooperation

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## Workshop Objectives

The 8th Energy Efficiency Policy (EEP) Workshop took place in person on 5 November 2024, in Tianjin, the People's Republic of China. Organized by the Asia-Pacific Energy Research Centre (APERC), the event was held alongside the 63rd Meeting of the APEC Expert Group on Energy Efficiency & Conservation (EGEEC 63) and the 10th anniversary celebration of the APEC Sustainable Energy Center (APSEC).

The workshop brought together APEC member economies and international experts to discuss key topics, including:

- International standards in energy management systems and audits
- The current policy landscape for energy management systems and audits in APEC economies
- Policies, regulations, and initiatives related to energy management systems and audits in APEC economies
- Best practices and lessons learned in energy management and audits
- The economic and environmental benefits of effective energy management and audits

The event provided an opportunity for participants to exchange insights and best practices, enhancing their expertise and practical skills in energy management and audits.


Photo: The experts and participants of the 8th Energy Efficiency Policy (EEP) Workshop

The workshop's theme, "Energy Management: Standards, Policies, and Best Practices," aimed to:

1. Introduce energy management and audit standards and their application in APEC economies
2. Explore the implementation of international standards for energy management systems (EnMS) and energy audits

3. Examine best practices in energy management systems and audit policies across APEC economies

## Opening Remarks

APERC Vice President Mr Munehisa Yamashiro delivered opening remarks. He expressed his gratitude to the government of the People's Republic of China for hosting the workshop in Tianjin. Mr Yamashiro also expressed his appreciation to the speakers and participants for their thorough preparations. Lastly, he expressed gratitude to the APEC Secretariat for their support.

Mr Yamashiro noted that this workshop was in its eighth iteration, focusing this time on energy management standards and best practices. He explained that the theme reflected an approach to energy efficiency that encompasses both a project basis and an operational basis. He emphasized that operational improvements play a significant role, and integrating such improvements into energy management systems is a crucial step. He also highlighted that high-quality energy audits serve as an essential foundation for effective energy management.

Based on these concepts, Mr Yamashiro outlined the workshop's structure. The morning session would concentrate on energy management systems, and the afternoon session would focus on energy audits. He expressed his hope that the workshop would provide a platform for meaningful discussions and valuable lessons related to energy technology development as well as energy system and audit management.

## Session 1 - Energy Management, Standards, and Policy Practices

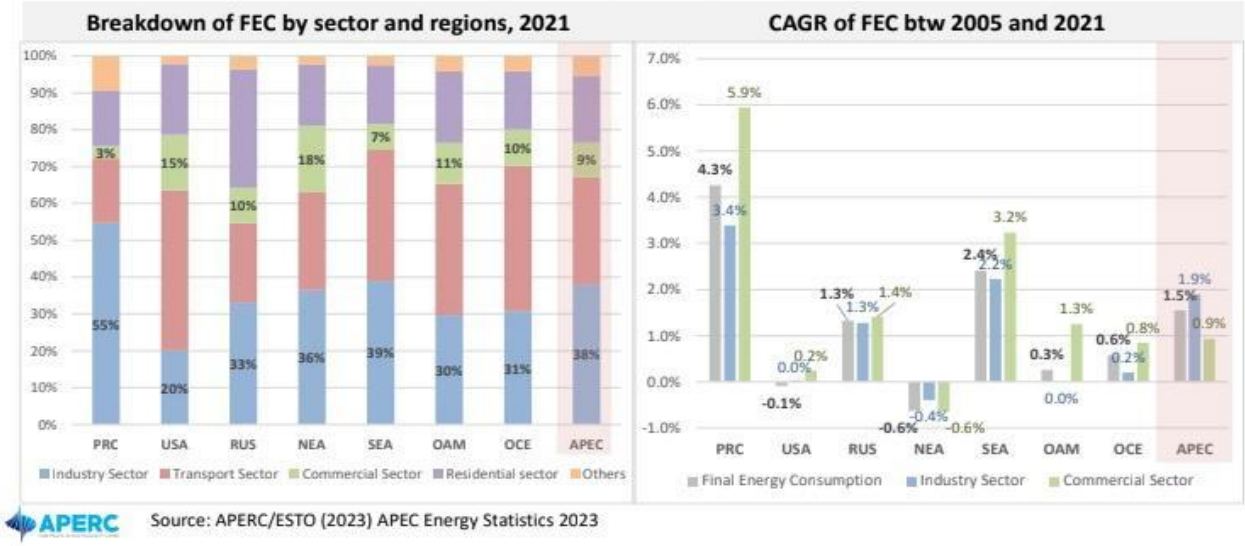
Panel Presentation #1 – Energy efficiency policy on energy management systems in the APEC region

**Ting-Jui Sun**, *Senior Researcher, Asia Pacific Energy Research Centre (APERC)*

The first presentation was by Ting-Jui Sun, who is a visiting senior researcher at APERC. His presentation provided an overview of energy management systems and their effect on energy efficiency with a focus on policies in the APEC region. Mr Sun outlined the structure of the presentation, explaining that it would begin with an examination of energy consumption trends within the APEC region. Following this, he planned to provide a detailed explanation of what constitutes an energy management system. He then described the next part of the presentation, which would focus on discussing the importance of implementing energy management systems and their role in addressing energy challenges. Additionally, he mentioned that he would present a roadmap to guide governments in the development and adoption of energy management systems. To provide a practical perspective, the speaker indicated that he would include an example of a specific case study before bringing the presentation to a close.

The speaker began by discussing sectoral energy consumption trends in the APEC region. He emphasized that while the industrial sector remains the largest energy consumer in the APEC region, the commercial sector's final energy consumption is increasing at a faster rate in many areas. To illustrate these points, the speaker introduced two graphs. The first graph displayed the Compound Annual Growth Rate (CAGR) of Final Energy Consumption across various regions from 2005 to 2021, highlighting trends over time. The second graph provided a detailed breakdown of Final Energy Consumption by sector and region in 2021, offering a comprehensive snapshot of energy use distribution. The speaker further noted that the PRC (People's Republic of China) and RUS (The Russian Federation) were analyzed as separate regions due to significant differences in their energy consumption patterns, ensuring a more precise representation of regional trends.

The speaker introduced the definition of an energy management system as defined by ISO 50001. An energy management system is a management system to establish an energy policy, objectives, energy targets, action plans and processes to achieve the objectives and energy targets. An energy management information system is a broad and rapidly evolving family of software tools that monitor, analyze, and control energy use and system performances. This is a software tool that enables energy management systems.




There are several elements of the energy management system, and its contents can be broadly divided into two categories: management and technical. Under the management category, the elements include planning for a policy, goal, target, role, etc.; taking actions for risk and opportunities to ensure legal and other requirements; compliance with legal requirements and internal audits; and finally, a management review. Under the technical category, the elements include energy review and data collection plan; operational planning and control along with design and procurement; monitoring, measuring and analysis of energy performance; and evaluation of energy performance. It is under the technical category of monitoring, measuring, and analysis of energy performance where the energy management information system is utilized significantly.

The speaker explained that within the APEC region, there are currently 17 economies that have published standards aligned with ISO 50001, while five economies have directly adopted ISO 50001 without modifications. For those economies using standards aligned with ISO 50001, the standards often incorporate slightly modified language or include additional requirements beyond the core ISO 50001 framework. The speaker further highlighted that, in addition to the international standard of ISO 50001, there are several regional standards in use, such as the ASEAN Energy Management Golden System (EMGS) and ASHRAE Standard 100. He pointed out that while there are notable similarities between the regional and international standards, there are also distinct differences that reflect the specific needs and priorities of different regions. To provide greater clarity, the speaker shared the figure below as a chart that explains the differences.

The speaker shared the ecosystem of how ISO 50001 certification works in the world. There are several key stakeholders in this ecosystem. ISO and IAF are the key stakeholders. IAF is the International Accreditation Forum. IAFs ensure that Accreditation Bodies (AB) follow the same rules and guidelines while maintaining global standards for conformity. Accreditation Bodies ensure that certification bodies operate competently and impartially. Certification bodies are audit organizations seeking ISO certification including ISO 50001. Certified organizations establish energy management systems while maintaining ISO 50001 certification. Some organizations from governments provide technical support and financial support funding. Canada and Chinese Taipei provide financial support for certifications of ISO 50001. 19 economies in the APEC region have established accreditation bodies.

**Varied scope of EnMS related standards**

| | Key Requirements | ISO 50001: 2018 | ASEAN: EMGS | ASHRAE std. 100: 2024 |
|---|---|---|---|---|
| Simplified EnMS | Energy policy (HLM Pledge) | √ | √ | |
| | Energy goal/ target | √ | √ | Detailed EUI calc. |
| | Role & resps (appointed energy manger) | √ | AEMAS CEM | |
| | Conduct energy review / energy audit (identify ECM) | √ | Detailed EA | ASHRAE std.211 |
| | Establishing EnPI and Energy Baseline(EnB) | √ | √ | Detailed EUI calc. |
| | Establishing energy data collection plan | √ | √ | |
| Key imp. details | Operation and maintenance (O&M) | √ | √ | Detailed req. |
| | Design and procurement | √ | √ | |
| | Monitoring, measuring and analysis of EnPI and ECM | √ | Quantified req. | Quantified EUI |
| | Internal audit | √ | Incl. Night audit | |
| | Management review | √ | √ | |
| | Compliance form template | | Star1/2/3/rec. | √ |

The speaker emphasized the importance of energy management systems by first highlighting a key challenge: Many organizations struggle to integrate energy management into their existing management processes. He explained that an ad hoc approach to energy management often results in cycles of high costs followed by budget cuts, which can lead to inefficiencies and instability. In contrast, adopting a systematic energy management process has been shown to provide organizations with sustainable and maintainable cost reductions over time. The speaker elaborated on the multiple benefits that energy management systems offer to organizations. These include streamlined decision-making processes within management, reduced risks related to compliance with regulatory requirements, enhanced marketability to environmentally conscious clients, optimized operational efficiency, and significant reductions in energy costs. He also noted the additional advantage of mitigating the financial impact of potential carbon taxes or fees, further underlining the value of implementing structured energy management practices.

The roadmap of developing energy management systems policy for governments includes several actions. The first step is referred to as “standards”, and it includes the developing the standard for energy management systems aligned with ISO 50001 and related standards. 17 economies have published their domestic energy management system standards. The second step is “training and capacity building”. This step provides different training for stakeholders such as auditors, consultants, and operators. For example, the AEE develops different certification programs: auditor, professional, and practitioner. The third step is called, “public sector leadership step”, where public-owned organizations should take a leadership role in applying energy management systems. For example, the US Federal government and other economies have energy management system initiatives for the public sector. The fourth step is called “voluntary program”, and this step provides financial and technical support for supporting the company to establish an energy management system. Canada; Japan; Chinese Taipei; and the United States are examples of economies with this step. The final step is “mandatory measures”, which mandates that significant energy users implement energy management systems aligned with ISO 50001.

In the APEC region, the progress of energy management system policy shows that six economies have adopted mandatory measures with ISO 50001 standards and eight economies have launched voluntary programs with ISO 50001 standards. The industry sector still dominates the market of ISO 50001 certification, as shown from the chart that the speaker

shared which illustrates 2022 statistics of ISO 50001 valid certificates in APEC regions. 2023 data is available but there were data issues, so 2022 data was utilized.

The speaker shared a case study of a mandatory policy for energy management system in Chile as part of the Energy Efficiency Law 21.035, Article 2, Energy Management of large consumers. The designated parties were the consumers with energy management capacity that consume over 50 tera-calories. The type of energy management systems includes certified and not certified. Certification submission is around 68%. The requirements in Chile include implementing an energy management system, reporting their energy management system annually, energy management system must cover at least 80% of energy consumption, and energy management system requirements include energy policy, energy objectives and targets, energy action plan updated, Energy Performance indicators, energy manager (not exclusive), operational control, and M&V plan for defined improvements.

The speaker concluded the presentation by addressing one of the primary challenges in improving energy efficiency: the fact that many energy-saving efforts tend to be project-based, which makes it difficult to achieve continuous and sustained improvements in organizational energy efficiency. He highlighted that an energy management system serves as an effective tool for overcoming this challenge by raising overall organizational awareness and seamlessly integrating energy management into daily management processes. The speaker also discussed the progress being made in the APEC region. He noted that 17 APEC economies have established internal standards that are based on ISO 50001. Furthermore, six APEC economies have integrated ISO 50001 into their mandatory measures, demonstrating a stronger regulatory commitment to energy management. Additionally, eight APEC economies have combined ISO 50001 with voluntary measures, reflecting a flexible approach to encouraging systematic energy management practices across the region.

## Panel Presentation #2 – International Standards on Energy Management: Concepts and Application

**Deann Desai**, *Chair Elect, ISO/TC 301*

The second presentation was delivered by Deann Desai, the Chair-elect for ISO/TC 301. This presentation focused on ISO 50001, the international standard for energy management systems. ISO/TC 301 is the organization responsible for developing and managing energy management systems and related documents focused on energy savings. ISO/TC 301 is interested in gaining feedback on how they can enhance their support for organizations and stakeholders in implementing and improving energy management systems.

ISO/TC 301 is actively engaged in a wide range of projects. There is a dedicated working group focusing on ISO 50001, along with additional working groups addressing Energy Audits under the ISO 50002-X series. Another working group, led by French experts, is concentrating on the development of a Data Measurement Plan.

The first working group responsible for ISO 50001 is also developing ISO 50100, which focuses on decarbonization strategies. Several other documents have been created to support various aspects of energy management—ISO 50003 is designed to assist auditors, while ISO 50006 provides detailed guidance on energy performance indicators and energy baselines for organizations seeking more in-depth information. Others are more technical topics such as measurement and verification, including predictive modeling and modeling tailored for specific regions and cities. There are many experts focused on verification of data. There are also vocabulary standards on energy and renewable energy.

The value proposition for management systems is relatively straightforward. The management systems help with reducing costs and supporting economic growth. One of the other things that ISO is hearing about is the benefits that management systems can have on energy security and energy reliability. This has become a greater issue as the grid becomes more strained. Electrification is a significant driver of decarbonization, but it also presents substantial challenges for utilities, who are key proponents within TC 301. There are also significant values around normalized data as well as verifiability of the data. In energy efficiency, normalized data is especially important to help with understanding of the energy management system. Validating and verifying that new technologies are performing as intended is another important value proposition. Additionally, there are challenges related to climate change, particularly concerning energy scopes 1 and 2, with some impact on scope 3. Key themes in this context include circularity and environmental, social, and governance (ESG) considerations.

ISO conducts an annual survey to gather insights and data. Additionally, the Clean Energy Ministerial was recommended as another group to follow for relevant developments and initiatives. The presentation included ISO survey data, which highlighted significant energy consumption in sectors such as transportation, food, construction, chemicals, and recycling. It was also noted that the adoption of management systems is steadily increasing across many basic industries.

There are a number of Clean Energy Ministerial winners that are showing increased application of energy management systems. One particular case was in Indonesia, where a footwear company has seen a 13% improvement over three years as a fairly small company. Another example is a military base. Military bases in the USA present unique challenges due to leadership changes every two years. Despite this, one specific Air Force logistics base demonstrated the effectiveness of a management system approach, achieving a 35% improvement in energy performance over an 8-year period. Energy management also works in commercial buildings. For example, a JW Marriott hotel sought certification, and over three years, it achieved a 7.8% improvement in energy performance. The fourth case highlighted the success of a grocery store chain in Denmark. Coop Danmark demonstrated a 24% improvement in energy performance over six years through initiatives focused on lighting, temperature regulation, and building envelop enhancements.

The United States has a program called 50001 Ready, which is particularly relevant given that the majority of domestic businesses are small to medium-sized enterprises (SMEs), accounting for 80% of all businesses. These businesses are often evaluated based on their “energy spend,” or the amount they spend annually on energy. The speaker shared a graph illustrating this distribution among businesses participating in the 50001 Ready program. According to the data, 47% of these businesses spend over USD1 million annually on energy, 16% spend between USD500,000 and USD1 million, and 37% spend less than USD500,000 annually.

Smaller companies often lack dedicated energy experts, making them reliant on energy auditors and external energy guidance. These businesses require energy management systems and education on how to use them effectively, as energy management is not their primary focus. The goal of the 50001 Ready program is to train staff and foster a basic understanding of energy system management within these organizations. Under the US Department of Energy, there are 147 federal sites enrolled, 40 federal sites recognized, and 200 federal staff trained. ISO has a number of programs in the United States, and one of them is called Better Plants, which is a project-based approach. This targets a 2.5% improvement over a certain time frame. What ISO found from taking data from 50001 certified manufacturing facilities is that the ISO50001 approach allows for an approximation of 4% improvement against the project based Better Plants program, and the ISO 50001 benefits can be

maintained over 12 years. Management based approaches such as ISO show much stronger impacts than project-based approaches.

There are a number of economies around the world that have implemented some kind of energy legislation. Many of these economies have directly engaged with ISO 50001 including Australia; Brazil; Canada; the EU; the People's Republic of China; India; Japan; the Republic of Korea; Mexico; the Russian Federation; United Arab Emirates (UAE); South Africa; the United Kingdom, and the United States.

1. The European Union has introduced the Energy Efficiency Directive (EED) where the EU encourages the implementation of ISO 50001 through this EED. Large enterprises are required to undergo energy audits every four years. These companies can be exempted from audits if they have implemented an energy management system like ISO 50001. The EU has also introduced the Energy Performance of Buildings Directive (EPBD) which supports the adoption of energy management systems in buildings to improve energy performance. Many EU member states have incorporated ISO 50001 in their domestic energy legislation, and places such as Germany, Italy, and France offer incentives such as tax reductions, subsidies, or compliance benefits for adopting ISO 50001. In Germany, there is an Energy Services Act where large companies in Germany are required to conduct energy audits, but if they adopt ISO 50001 or other energy management systems, they can be exempt from this requirement. Additionally, Germany has an Energy and Electricity Tax Law that allows for companies implementing ISO 50001 to qualify for tax refunds on energy consumption. Furthermore, there is a German Federal Office for Economic Affairs and Export Control (BAFA) that provides financial support for companies to implement ISO 50001.

2. India has implemented a Perform, Achieve, and Trade (PAT) Scheme, where India's Bureau of Energy Efficiency (BEE) promotes ISO 50001 as a voluntary mechanism under the PAT scheme. The scheme sets energy efficiency targets for industries, and ISO 50001 is recognized as a way to achieve these targets.

3. The Republic of Korea has an Energy Use Rationalization Act where the Republic of Korea has encouraged the adoption of ISO 50001 through energy efficiency legislation. Large industrial companies must implement energy management systems, and ISO 50001 is a recognized way to fulfill these requirements. Furthermore, the Republic of Korea also has a Green Energy Certification where companies that implement energy management systems like ISO 50001 are recognized and incentivized through domestic certification schemes.

4. The People's Republic of China has an Energy Conservation Law where the People's Republic of China encourages enterprises, especially those in energy-intensive industries, to adopt energy management systems like ISO 50001 to comply with domestic efficiency targets. The People's Republic of China has also implemented a Top-10,000 Enterprises Program. This initiative targets large energy-consuming enterprises, requiring them to adopt energy management systems to achieve efficiency targets.

5. Japan has an Energy Conservation Law that mandates that large energy-consuming businesses adopt measures for energy efficiency including the implementation of energy management systems. This law promotes the use of management systems like ISO 50001 to achieve domestic energy efficiency goals. Japan also has a Top Runner Program that encourages the adoption of energy management systems in energy-intensive sectors to improve energy performance.

6. United Arab Emirates (UAE) has an Energy Efficiency Policy. The UAE's various energy efficiency frameworks, particularly in Dubai and Abu Dhabi, promote the adoption of energy management systems to achieve energy and sustainability targets.

7. South Africa has an Energy Efficiency Strategy that encourages the adoption of energy management systems, particularly in energy-intensive sectors, to help meet domestic energy efficiency goals.

8. The Russian Federation has a Federal Law on Energy Saving and Increasing Energy Efficiency. This law encourages companies to adopt energy management systems such as ISO 50001 to meet mandatory energy saving requirements for large companies.

9. Brazil has a National Energy Efficiency Program (PROCEL). Brazil promotes energy management systems for industries to improve energy performance and reduce consumption, though this is primarily through volunteer programs rather than mandatory requirements.

10. Mexico has a National Energy Efficiency Law under which Mexico promotes the use of Energy Management Systems including ISO 50001 as part of its domestic energy efficiency efforts. The government provides support and incentives for companies to implement energy management systems to improve industrial energy efficiency.

11. Australia has concluded its Energy Efficiency Opportunities (EEO) Program. Although this specific program has ended, many states and organizations in Australia continue to promote the use of energy management systems such as ISO 50001 to improve energy efficiency in industries and buildings. Additionally, Australia has the National Australian Built Environmental Rating System (NABERS) which promotes energy management in commercial buildings, encouraging the use of energy management systems.

12. Canada has the Canadian Industry Program for Energy Conservation (CIPEC). This encourages the adoption of energy management systems including ISO 50001 as part of energy efficiency efforts in industry. The ISO 50001 Energy Management System Program provides financial incentives to industries for adopting energy management systems. Additionally, various provinces in Canada offer incentives and recognition programs for organizations that adopt energy management systems.

13. The United Kingdom has an Energy Savings Opportunity Scheme (ESOS). Under ESOS, large companies must conduct energy audits or implement ISO 50001. Organizations with ISO 50001 certification are exempt from mandatory energy audits, as the system demonstrates continuous energy improvement. Furthermore, Climate Change Agreements (CCAs) enable UK companies in energy-intensive sectors that adopt energy management systems such as ISO 50001 to receive discounts on their Climate Change Levy (CCL).

14. The United States has the 50001 Ready Program. While ISO 50001 is not a regulatory requirement in the United States, the US Department of Energy promotes its adoption through the 50001 Ready Program. This voluntary initiative helps companies develop and implement energy management systems to improve energy performance. Furthermore, the United States has the Superior Energy Performance Program, which includes both ISO 50001 and energy performance requirements using a defined protocol to demonstrate performance. Some states like California have state-level

programs that encourage the use of energy management systems to meet energy efficiency goals and receive incentives.

ESG is a significant topic today, and both ISO and TC301 have committees dedicated to ESG and climate change coordination. A challenge with ESG in the energy sector defines its meaning. For example, while purchase agreements are common, not all economies have equal access to alternative energy sources. This disparity affects energy efficiency and decarbonization efforts, highlighting the central issue of ESG: unequal availability of resources. This presents a major dilemma in striving for equality in energy access, which is currently unachievable globally. Another concern is social issues. The energy sector supports many jobs, creating substantial social and governance responsibilities within this field.

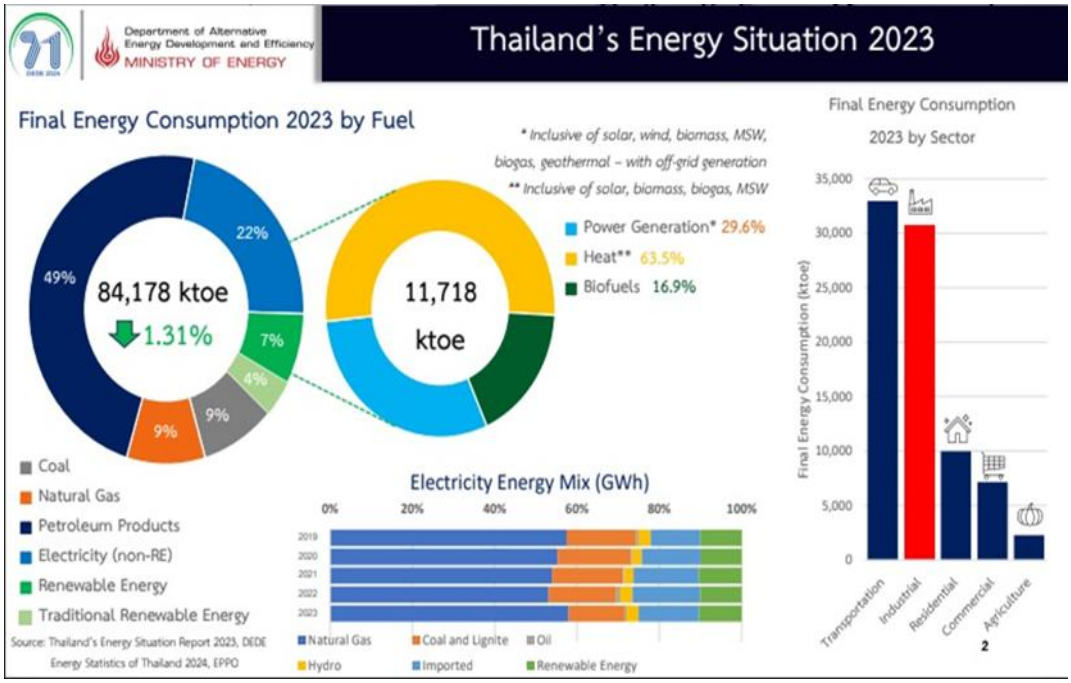
## Panel Presentation #3 – Thailand's Energy Management Standards, and Policy Practices

**Wisaruth Maethasith**, *Engineer, Ministry of Energy, Thailand*

The third presentation was delivered by Mr Wisaruth Maethasith, a professional-level engineer with the Department of Alternative Energy Development and Efficiency (DEDE) under Thailand's Ministry of Energy. His presentation highlighted Thailand's energy efficiency plan and the Energy Conservation Act.

The speaker began by introducing the experience of energy management standards and policy. In 2023, Thailand consumed approximately 84,000ktoe of energy, which is a 1.31% decrease from the previous year. Most of this power comes from fossil fuels such as coal, natural gas, petroleum products, etc. 7% of the energy mix is from renewable energy, which comprises about 11,000ktoe of energy. Final energy consumption is largely dominated by two main sectors, the transportation sector and the industrial sector. Combined, these represent 75% of the total energy consumption. Transportation and industrial sectors are the main sectors in which Thailand is trying to address the energy conservation efforts. The graphs and charts can be seen below.

Thailand passed the Energy Efficiency Plan of 2018, which is currently in place. The goal is to reduce the energy intensity by 30% by 2037, which is approximately 49,064ktoe from the base year of 2010. There are a variety of measures in place including compulsory, voluntary, and complement measures. Under the compulsory measures, there are energy management standards, energy codes (industrial, buildings, residential), energy efficiency resource standards (EERS), demand response, and excise tax. Under the voluntary measures, there are equipment standards and labeling, financial supports (grants and subsidies, soft loans, tax incentives, credit guarantees), and innovations (IOT, smart buildings, big data). Under complementary measures, there are Human Resources Development (HRD) (energy manager, energy auditor, and technologies), public relations and awareness, and research and development. The final energy consumption projection takes into consideration average estimated GDP growth of 3.8% with an average estimated population growth of -0.02%. The final energy consumption projection hopes to see 31% electricity consumption (15,379ktoe) and 69% heat consumption (33,685ktoe). Energy savings by sector show that the industrial sector will save 43% and the transportation sector will save 36% making up most of the savings with commercial (13%), residential (7%) and agricultural (1%) representing the remainder of savings.




The speaker also shared the regulation framework in Thailand. In Thailand, the most powerful law on energy is the Energy Conservation and Promotion Act. This act allows the government to command energy savings and energy management measures. The government is enabled to force mandatory energy management on buildings and designated factories. Furthermore, it creates a requirement for Person Responsible for Energy (PRE) and Energy Management Auditors. These are all aspects of the energy management system. In addition to these regulation frameworks, there are also regulations on building energy codes and high energy performance standards for equipment and machinery.

The speaker then further explained the energy management system by focusing on factories and buildings. There are two classifications of designated factories and buildings, which are based on the installed electric meter, installed transformers, and total annual energy consumption.

1. Group 1 includes factories and buildings with installed electric meters installing between 1000-3000kW, installed transformers totaling between 1,175-3,530kVA, and total annual energy consumption between 20-60TJ per year.
2. Group 2 includes factories and buildings with installed electric meters totaling over 3000kW, installed transformers totaling over 3,530kVA, and total annual energy consumption totaling over 60TJ per year.

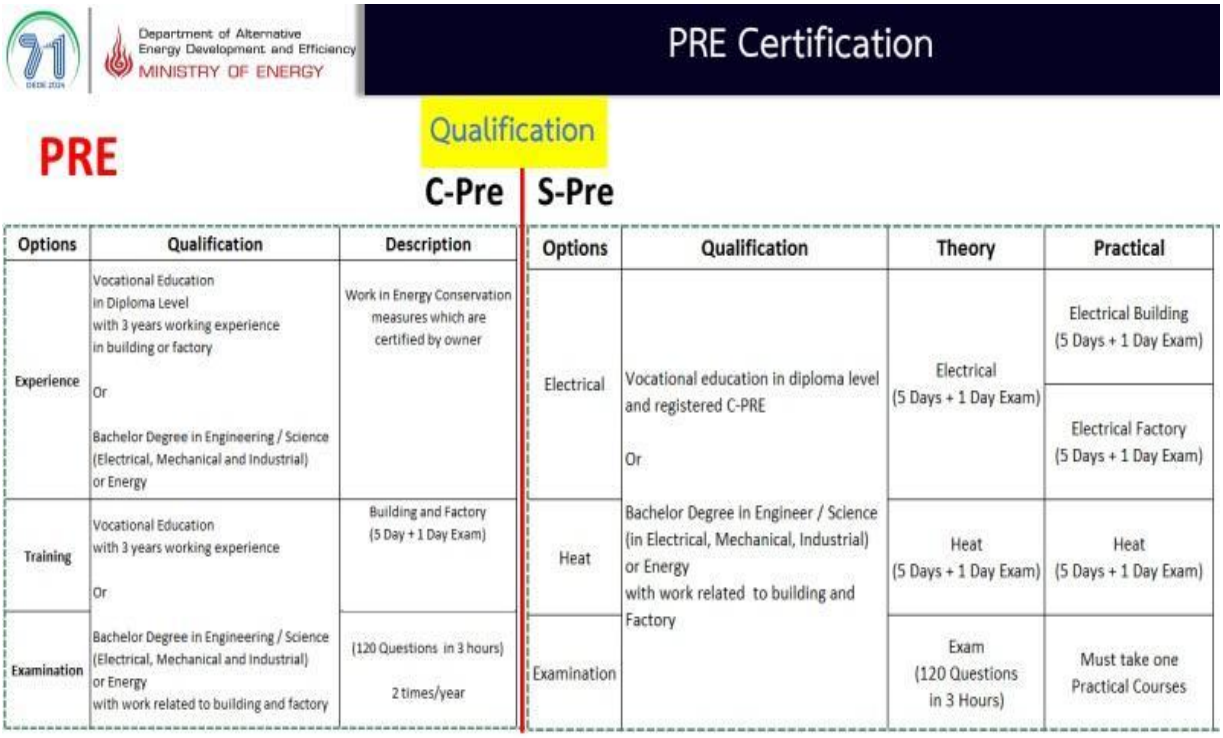
As of 17 October 2024, there were 6,616 designated factories and 3,381 designated buildings. The legal responsibilities of the designated factories and buildings include appointing a Person Responsible for Energy (PRE), which is similar to an energy manager, as well as conducting energy management systems as described in regulation and submit an annual report to the Department of Alternative Energy Development and Efficiency (DEDE) every year in March. There must be at least one Person Responsible for Energy in Group 1, and at least two Persons Responsible for Energy in Group 2.

The speaker then further explained the concept of the Person Responsible for Energy. In Thailand, the Person Responsible for Energy has certain duties including maintaining and monitoring efficiency of machines and equipment periodically, improving energy use following energy conservation measures, helping the owner to conduct energy management systems,

and helping the owner to follow the order of Director General of DEDE. There are two types of Persons Responsible for Energy: conventional (C-PRE) and senior (S-PRE). There are five ways to become a registered PRE. The first way is vocational education with a diploma plus three years of work experience in factories or buildings plus work experience on energy conservation measures which are certified by the owner. The second is a bachelor's degree in engineering or science (electrical, mechanical, industrial, or energy) plus work experience on energy conservation measures which are certified by the owner. The third is to pass C-PRE training. The fourth is to pass S-PRE training, and the final way is to pass examination. The distribution of PREs by type and location is shown in the chart below.

| Types of PREs | Factories | Buildings |
|---|---|---|
| C-PREs | 9,066 | 6,271 |
| S-PREs | 4,107 | 1,208 |

The speaker outlined the qualifications required for both conventional and senior Persons Responsible for Energy (PREs). Both roles necessitate relevant experience, specialized training, and passing an examination. The specific distinctions between the qualifications for conventional and senior PREs were detailed in the accompanying chart.




The Energy Management System in Thailand based on the ISO 50001 has eight steps:

1. The first step is the establishment of the energy management team.
2. The second step is the preliminary assessment of the energy management situation.
3. The third step is the formulation of energy efficiency and conservation policy.
4. The fourth step is the evaluation of energy saving potential.
5. The fifth step is the setting of targets and plans for energy efficiency and conservation. Measures include prioritization, time frame, responsible person, and budget.
6. The sixth step is implementing and monitoring.
7. The seventh step is an internal audit.
8. The eighth and final step is management review for improvement.

Conventional and senior Persons Responsible for Energy are involved in all the steps.

The speaker explained the auditing process, noting that 328 energy auditor licenses have been issued so far. The process begins with the factory or building owner appointing PREs. Next, energy management is carried out. In the third step, the energy report is submitted, during which the energy auditor is employed. The auditor reviews and certifies the energy report, creates the energy audit report, and submits it to the client. In the fourth step, the energy audit report is certified, and both the energy report and the energy audit report are submitted to the DEDE annually.

The energy management system requires data submissions annually by March to the DEDE in Thailand. This individual data is confidential and may include sensitive information.

- For factory and building data: Name, Location, Contact information, Type of factories or buildings, Products (name and amount/area), Operating hours
- For energy data: Monthly energy consumption by type/fuel/system, Specific energy consumption, Details on machinery with significant energy consumption, Self-produced energy
- For energy conservation data: Overall target, Measures conducted (plan and result), Amount of power or energy saved, Payback period, Capacity building programs to promote energy conservation

In Thailand, energy management is a legal requirement for designated factories and buildings. However, several challenges remain, along with proposed solutions to address them. There are four primary challenges:

1. **Lack of Technical Expertise**: Factories and buildings often consume significant energy but lack personnel with adequate technical knowledge. To address this, the government has proposed providing consultancy services and implementing training programs to build expertise.
2. **High Costs for SMEs**: Establishing an energy management system can be expensive, particularly for small and medium-sized enterprises (SMEs). Proposed solutions include financial incentive programs such as subsidies, soft loans, and exemption schemes to ease the financial burden.
3. **Increased Workloads for Employees**: Energy management duties are often assigned to existing employees, adding to their workloads with minimal benefits. To resolve this, free training for certification and capacity building programs have been proposed, along with initiatives like the Thailand Energy Awards to recognize and motivate employees.
4. **Non-Compliance with Regulations**: Instances of non-compliance, such as failing to assign Persons Responsible for Energy (PREs) or neglecting to submit energy management reports, remain a challenge. Proposed solutions include imposing fines for violations and revoking eligibility for government-provided incentives to enforce compliance.

## Panel Presentation #4 – Energy Management System and Policy in ASEAN

**Zulfikar Yurnaidi,** *Head of Energy Modeling and Policy Planning (MPP) and Energy Efficiency and Conservation (CEE) Department, ASEAN Centre for Energy*

The fourth presentation was presented by Dr Zulfikar Yurnaidi, who is the head of energy modeling and policy planning (MPP) and energy efficiency and conservation (CEE) department at the ASEAN Centre for Energy (ACE).

The presenter began by introducing ACE, which was established in January 1999 as an intergovernmental organization within the ASEAN framework. ACE represents the energy interests of the 10 ASEAN Member States. The center plays three key roles: a think tank, an energy data and knowledge hub, and a catalyst for cooperation. As a think tank, ACE identifies and promotes innovative solutions, develops reports, and conducts dissemination activities while providing advisory support to member states. As an energy data and knowledge hub, ACE serves as a central repository for energy-related information for the ASEAN Member States. In its role as a catalyst, ACE fosters greater unity and strengthens cooperation and integration within the region.

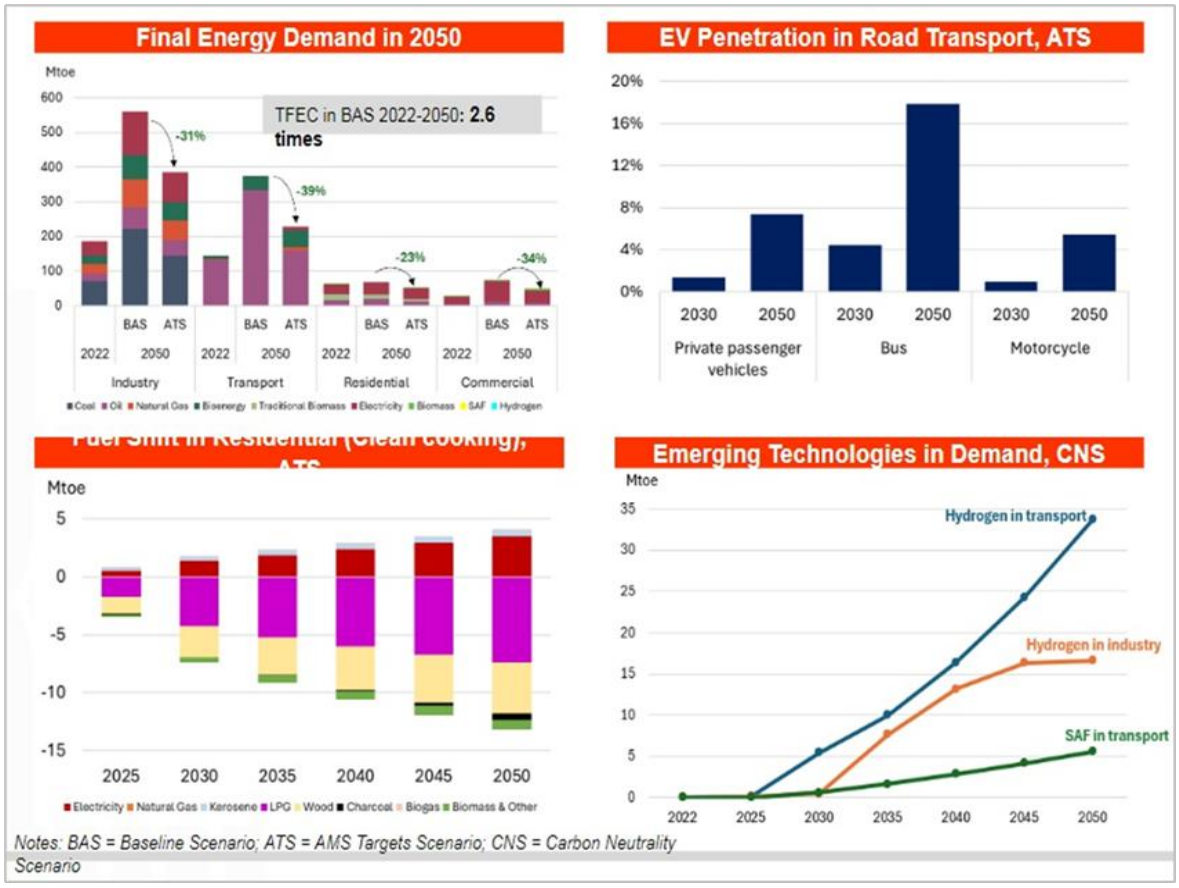
The speaker introduced the ASEAN Plan of Action for Energy Cooperation (APAEC). The goal of the plan is to enhance energy connectivity and market integration within ASEAN to achieve energy security, accessibility, affordability, and sustainability for all. Additionally, it seeks to accelerate the energy transition and strengthen energy resilience through innovation and cooperation.

The APAEC covers several program areas, including the ASEAN power grid, trans-ASEAN gas pipeline, coal and clean coal technology, energy efficiency and conservation, renewable energy, regional energy policy and planning, and civilian nuclear energy. The goal is to reduce energy intensity by 32% by 2025, with a particular focus on energy efficiency and conservation (EE&C) efforts in the transportation and industrial sectors. Currently, the APAEC is in its second phase, which will last until 2025.

The APAEC has five outcome-based strategies:
1. Expanding, harmonizing, and promoting energy efficiency standards and labeling
2. Enhancing participation from the private sector, financial institutions, and clusters
3. Strengthening the sustainability of energy efficiency in buildings
4. Pursuing energy efficiency in the transport sector
5. Advancing energy efficiency and energy management in the industry

The speaker shared that ASEAN has energy demand targets to reduce energy intensity, and he shared a number of graphs that illustrate these targets, as seen below. Energy demand in 2050 is 2.6 higher than in 2022 (baseline scenario). Industry and transport are the highest energy-consuming sectors, dominated by oil and coal. Potential reductions of 33% (AMS targets scenario) are driven by efficient appliances and fuel economy. The need to transition to cleaner energy sources, including electricity, bioenergy, and hydrogen, is also recognized. In road transport, buses are leading the EV penetration in road transport (AMS targets scenario). In residential areas, there is a target to phase out of traditional biomass and LPG to electricity by 2050. Another target is to see hydrogen usage in transport grow exponentially.

The Mandatory Energy Management System serves as a standard policy for promoting energy efficiency and conservation practices across ASEAN Member States. Key measures include the appointment of certified energy managers, the development and implementation of energy management programs, regular energy audits, and the submission of periodic reports.




The speaker outlined the legislative framework governing the implementation of energy management training across the various ASEAN Member States, as shown in the figure below.

| | Indonesia | Malaysia | Philippines | Singapore | Thailand | Vietnam |
|---|---|---|---|---|---|---|
| **EC Law/Act, decree & related regulation** | • **The Law No.30/2007** on Energy<br>• **The Government Regulation No.70/2009** on Energy Conservation<br>• **Minister of Labor Decree No.80/2015** on National Competence of Energy Manager for Industry and Building.<br>• **SKKNI No. 80/2015** on the Stipulation of Indonesian National Work Competency Standards for the Work Position of Energy Manager in Industry and Buildings (**under review and seek for approval : status as of November 2022**)<br>• **SKKNI No. 53 of 2018** on the Stipulation of Indonesian National Work Competency Standards for Work Positions in the Energy Audit Sector | • **Electricity Supply Act: 1990**<br>• **Electricity Regulations: 1994,** amendment 2013.<br>• **Energy Commission Act: 2001**<br>• **License Supply Regulations: 1990**<br>• **Electricity Supply** (Exemption) Notification: 1994<br>• **Efficient Management of Electrical Energy Regulations: 2008**<br>• **Energy Efficient Conservation (under the drafting process and expected to be approved by 2023).** | • **Republic Act No. 11285** on Energy Efficiency and Conservation (EE&C) Act<br>• **Memorandum Circular No. MC2020-05-0001:** Directing All Designated Establishments (DEs) under Commercial, Industrial and Transport Sectors to Submit Energy Consumption Reports<br>• **Department Circular No. DC2022-03-0008** on the Adoption of Training Regulations and Prescribing Certification Process for Training Institutions and Energy Managers (EMs) | • **EC Act (ECA) 2012** (amended on 2 July 2017)<br>• **Mandatory Energy Management (MEM) Practices** under ECA: 2013 & 2014<br>• **Subsidiary Legislation (SL)** on Energy Manager: 2014 | • **EC Promotion and Act:1992** ECP Act rev.:2007<br>• **Decree on designated building: 1995**<br>• **Decree on designated factory: 1997**<br>• **Ministerial Regulations (MR) on Energy Management (EM)** in designated buildings and factories: 2009<br>• **MR on PRE: 2009**<br>• **MR on EM Auditors**: 2012<br>• **MR on Building Energy Code: 2009**<br>• **MR on High Energy Efficiency Standard for Equipment and Machinery: 2009** | • **Law No.50/2010** on Energy Efficiency and Conservation<br>• **Government Decree No. 21/2011** on Details and measures for the implementation of the Law on Energy Efficiency and Conservation<br>• **Prime Minister Decision No. 1294/2011** on Issuing the list of Designated energy-using units<br>• **MOIT Circular No. 39/2011** on Regulation of training, certification for energy manager and energy auditor<br>• **MOIT Circular No. 09/2012** on Regulating planning, reporting implementation of energy saving and efficient using; energy audit implementation |

(Note: Slide submitted by presenter. Economy names should read as The Philippines and Viet Nam.)

The Energy Manager Training Programme is channeled through multiple accredited training providers, as shown in the figures below.

| | Indonesia | Malaysia | Philippines | Singapore | Thailand | Vietnam |
|---|---|---|---|---|---|---|
| Target Sector | Industry, Building, Transport | Industry and Building | Industry, Building, and Transport | Industry and Building | Industry and Building | Industry, Building, and Transport |
| Certification Body | BNSP (licensing authority)<br>LSP - HAKE<br>LSP - Energi<br>LSP - BPSDM KESDM | Energy Commission | Department of Energy (DOE) | National Environment Agency & IES | Department of Alternative Energy Development and Efficiency (DEDE) | Ministry of Industry and Trade (MOIT) |
| Training Provider | PPSDM KEBTKE<br>Benefita<br>Enercoss<br>Kensi<br>Etc. | - Interview<br>- Training Programme<br>- Higher Education | DOE - Recognised Training Institutions | - IES Academy<br>- Sustainable Energy Association of Singapore<br>- Polytechnic (Associate) | Department of Alternative Energy Development and Efficiency (DEDE) | Accredited Training Agencies |

(Note: Slide submitted by presenter. Economy names should read as The Philippines and Viet Nam.)

The Energy Manager Core Competency in AMS mainly covers energy management modules and functional/technical modules. In the generic module, there are elements of National Policy and Regulations as well as the Energy Management System. Under the functional module, there are elements of the Energy Conservation for Electrical System and the Energy Conservation for Thermal Systems. The supplementary module includes a combined heat-power system, sustainability and climate change, best practices and success stories, digitalization, and renewable energy, and more. All ASEAN member states have covered the elements of energy management as well as their respective domestic regulations as their core modules. While energy conservation for electrical systems is mainly included in most ASEAN member states, some are yet to cover measures for thermal systems.

Economies with an established energy management system have a surplus of energy managers. Five economies that have established mandatory energy management systems policy have an increasing trend of the number of energy managers. Indonesia; Singapore; and Thailand have a significant surplus of energy managers, compared to the required number from designated entities. Malaysia required around 150 additional energy managers to fulfill the mandatory requirement under their proposed Energy Conservation Act. The Philippines, which just established the energy management certification system in 2022, required more than 2,000 energy managers.

An estimated additional 1,000 new energy managers are required, especially for the CLM economies to implement energy management systems. Over 1,000 new energy managers can be expected if there is a mechanism to allow for the flexible mobility and recognition of the energy management professional in ASEAN, especially in Cambodia, Lao PDR, and Myanmar. This can create opportunities to fill in supply-demand gaps in energy management jobs and provide opportunities for cooperation and capacity building across ASEAN member states.

The ASEAN Energy Management Scheme (AEMAS) exists in ASEAN. The regional energy manager certification system is complementary to domestic certification schemes by focusing on the energy management policy formulation and implementation, defining appropriate lines

of command relevant with the ASEAN business culture. There are two aspects to this scheme: certification of energy managers and energy management gold standard.

## Session 1: Questions and Answers

**Q**: *I found it very interesting when you emphasized that EMS is not an environmental management information system, and you explained about the concept. One thing I found interesting is that the uptick rate for EMS was not as high in certain sectors as others. Can you explain the sectoral differences?*

**Ting-Jui Sun**: I want to share two different things. EMS is a useful tool to enhance assistance in organizations. We have adopted a similar approach, which is a new system. It does have some challenges, and there is some reluctance in adoption. It is hard to compare each economy. We do have some best practices in commercial buildings. Many hospitals, hotels, and similar commercial buildings do not have ISO 50001, so we have to prepare the documents. For commercial buildings, they rely on outsourcing. This can explain why commercial buildings have lower case numbers than others.

**Q**: *I was interested in the US ISO 50001 Ready program. Would you recommend that program as a stepstone to economies where energy management systems are not yet sufficient or well received?*

**Deann Desai**: With 50001 Ready, we aim that at small businesses, and some of those organizations have five people with others having 200 people. One common denominator is that they do not have energy experts. This program is designed to have bite-sized pieces. There are 25 steps, and they can select which steps are most valuable to them. They do get some consulting, and they can join other companies in group participation. We found that providing small companies with bite-sized pieces is helpful for organizations that are resource challenged. The program also connects them to specific energy resources. There is an industrial assessment center, and there are energy experts that can perform technical energy audits. The SEP program runs, but we would not consider that hugely successful. 50001 Ready program is growing at a rate of 40% per year. It is easier for the small to mid-size base which is 80% of the companies in the United States.

**Q**: *For the energy law that requires mandatory energy management systems, you shared that there are some challenges related to the compliance of the program. You mentioned that there is also significant financial assistance. What is the reason for noncompliance?*

**Wisaruth Maethasith**: The first thing of course is that maybe we are having difficulty imposing the fine because we have to go through the police, and the police do not want to deal with this issue. Factories also do not see much benefit in complying with the law. They conduct an energy management system that is good for the factory itself, but what is the motivation to send the report to us? That is the problem. Normally they will take energy conservation actions, but they do not see the benefit of sending us the report. Some economies such as Japan published that certain factories and buildings are conducting energy management, where they can receive feedback. This is not a big thing in Thailand. Thailand does not provide feedback on the reception of the energy conservation reports.

**Q**: *I was curious about your point about additionality. Why do you think that creating two different standards is an effective way of moving forward given the existence of the*

*international standards of 50001. Can you also discuss the concept of the energy managers pool that will allow for mobility for different economies? Is this idea feasible?*

**Zulfikar Yurnaidi**: This is the challenge we have now. The idea is that we can help economies that do not have a proper system for energy management. It is not the intention to compete with the international and domestic certification systems. ISO will always be the base for everything. However, in our region, we have some additional considerations. The idea of energy manager mobility is to allow for a type of certification that covers common principles between the ASEAN member states.

**Q**: *Does your economy have domestic standards for energy management systems? What is the current situation regarding mandatory measures for energy management systems if your economy requires an energy management system?*

**Wisaruth Maethasith**: I would like to talk about energy management systems. I think we have discussed this morning that we are focusing on large industries and large buildings. This makes sense because they are high energy consumers with high potential. One of the things in Thailand we are considering is focusing on small businesses that are part of big chains such as convenience stores. All of them together would comprise a lot of energy consumption. There is no energy management system mandated for them. I am looking for any best practices for economies that are tackling this situation.

**Japan Participant**: In the case of Japan, there is a regulation to report the consumption and conservation of energy for industries and buildings. There is the next step of evaluation by the government. In Japan, according to the data, the government will classify the situation. These groups may receive benefits or subsidies from the government, and the information will be disclosed to the public. Under the average group, there will be some guidance or some management steps included by the government. To increase compliance, this is particularly important. Now in Japan, there is a new step of disclosure of information. Usually, the energy data of companies is classified or sensitive, so this is usually not open to the public. Some companies want to disclose their excellent performance data, so in Japan, we are introducing some kind of voluntary disclosure program using the reported data.

**Indonesia Participant**: For the energy management system in Indonesia, there are some mandatory energy management systems for industries and buildings. We have a new law for the energy management system.

**Indonesia Participant**: We are working with our ministries. The situation in Indonesia is good to combine ESG and energy efficiency. My background is in buildings and green building certifications. There is a long-term mandatory clean buildings focus. There are also energy management and measurement initiatives.

## Session 2 - Energy Audits, Standards, and Policy Practices

Panel Presentation #1 – Energy Audits in the APEC region

**Mohd Shah Hambali Arifin**, *Senior Researcher, Asia Pacific Energy Research Centre (APERC)*

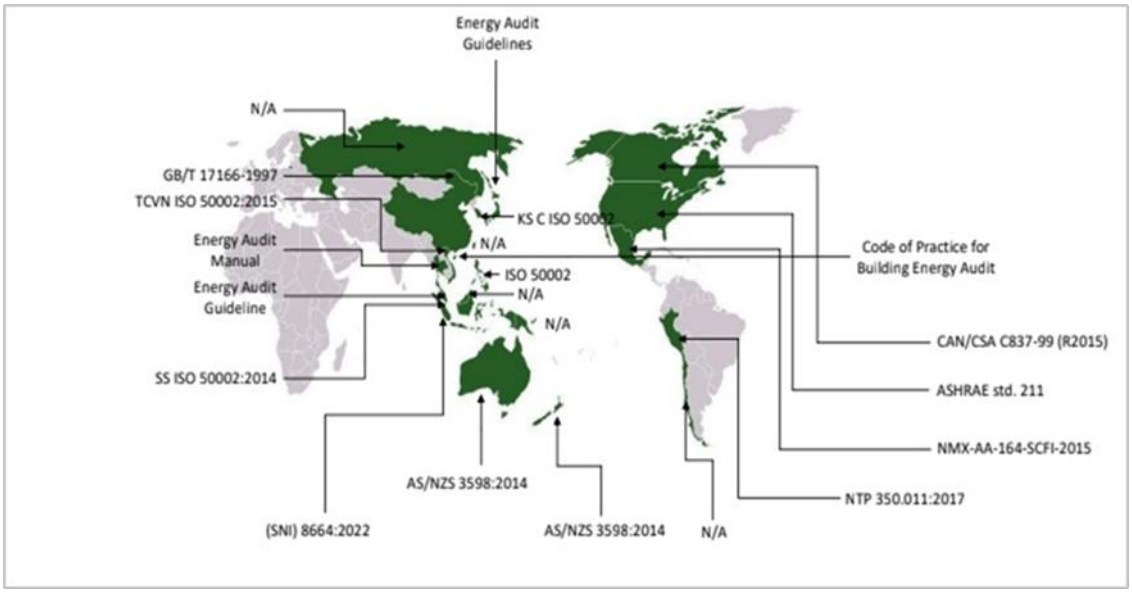
The first presentation in the second session was delivered by Mohd Shah Hambali Arifin, a senior researcher at the Asia Pacific Energy Research Centre (APERC). His presentation focused on energy efficiency policy and energy audits within the APEC region. He began by thanking the moderator for the introduction and providing a brief overview of the APEC region's vital role in energy efficiency and conservation efforts. Mr Arifin emphasized the benefits of energy audits in reducing emissions, optimizing energy consumption, cost reduction and supporting energy policies.

He outlined his presentation, starting with an overview of energy consumption by sectors and regions. Next, he planned to cover energy audit standards and guidelines, including international standards (ISO 50002:2014 Energy Audit), regional standards (European Energy Audit Standard EN 16247), and domestic standards. Mr Arifin also discussed the importance of energy audits within the APEC context and shared a case study from the Republic of Korea. He concluded by summarizing the key points of his presentation.

The speaker began by showing graphs of the sector energy consumption trends in the APEC region, which showed that the commercial and industrial sectors' final energy consumption is growing faster in emerging regions (PRC and Southeast Asia). The PRC and USA contribute more than 50% in all sectors largely because of the size of the economies and their populations.

The speaker moved on to the topic of energy audit standards, guidelines and elements. The speaker noted that the definition of energy audits as defined by the ISO 50002 international standards is: the detailed analysis of the energy performance of an organization, equipment, system(s), or process(es), which is based on appropriate measurement and observation of energy use, energy efficiency, and consumption. Under the international standards of ISO 50002, the energy audit planning is followed by an opening meeting and data collection. After these steps, the measurement plan is developed, and a site visit is conducted. Data analysis then occurs, which helps inform the energy audit reporting followed by a closing meeting. Under the regional standards of the European Energy Audit Standard EN 16247, energy audits are defined as systematic inspection and analysis of energy use and energy consumption of a site, building, system, or organization with the objective of identifying energy flows and the potential for energy efficiency improvements and then reporting the results. In this regional standard, preliminary contact is followed by a startup meeting, which flows into data collection. Data collection includes information requests, review of data, and preliminary data analysis. After collecting data, a measurement plan is created followed by sampling and field work which includes the aim, conduct, and site visit. Analysis is the next step which includes energy breakdown, EPI, and EPIA, and the final stage is the report and final meeting.

The speaker shared a figure that illustrates the use of energy audit standards and guidelines in APEC. This figure can be seen below.




ISO and ASHRAE provide excellent frameworks for expanding energy audits. ASHRAE outlines a four-level approach to energy auditing: Levels 0, 1, 2, and 3.

**Level 0:** Preliminary Energy Use Analysis (PEA)
This initial stage involves analyzing and evaluating energy bills, calculating the Energy Use Intensity (EUI) and Energy Cost Index (ECI), benchmarking performance, and identifying opportunities for no-cost or low-cost energy-saving measures.

**Level 1**: Walkthrough Assessment
This stage includes a qualitative evaluation of potential Energy Conservation Measure (ECM) costs, expected energy savings, and return on investment (ROI). It also identifies opportunities for capital-intensive projects.

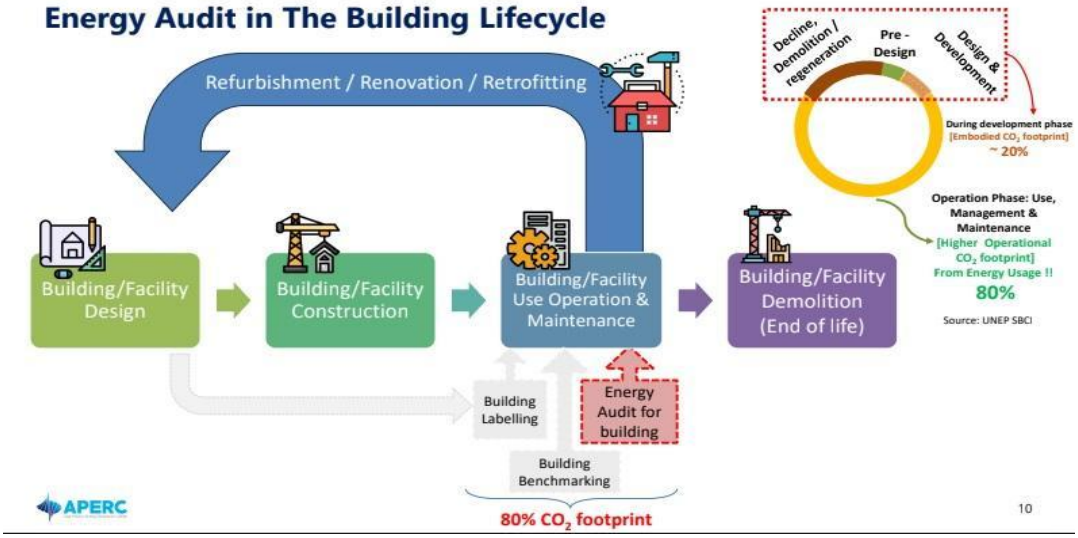
**Level 2**: Energy Survey and Analysis
At this level, auditors conduct a more detailed examination, including end-use energy breakdowns, cost and savings estimates for Energy Efficiency Measures (EEMs), Energy Savings Measures (ESMs), and ECMs, as well as recommendations for operations and maintenance (O&M) improvements.

**Level 3**: Detailed Survey and Analysis
This advanced stage features a refined and comprehensive analysis, ROI calculations, additional data acquisition, and the use of hourly simulations to ensure precise energy modeling.

Each level builds upon the previous one, offering increasingly detailed insights to support strategic energy management and optimization.

Energy audits are important for several reasons, including understanding energy usage in an organization, identifying energy-saving opportunities, reducing energy costs, improving energy efficiency, enhancing environmental sustainability, and promoting corporate social responsibility.

The speaker shared the energy audit in a building's lifecycle, and the figure is illustrated below.




The speaker then shared the current progress of energy audit policy in the APEC region. One economy has adopted mandatory measures with ISO 50002 standards, and another 10 economies have adopted mandatory measures with domestic standards and guidelines. Two economies have adopted mandatory measures without any standard, and no economies have adopted voluntary standards with ISO standards. 11 economies have developed voluntary measures with domestic standards, five economies have developed voluntary measures without any standard, and three economies have unclear or no measures.

The speaker then shared a case study for the Korea Energy Diagnosis System, Korea Energy Efficiency Partnership (KEEP 30) and Energy Efficiency Innovation Leading Project (KEEP+). The economy under focus is the Republic of Korea, and the type of measures included both mandatory and voluntary measures. The sector in focus is the industry sector which is energy-intensive with an annual energy usage of 2,000toe or more. In this case, the purpose was to promote rational energy use in businesses by requiring energy-intensive businesses to undergo a mandatory diagnosis every three years or more. Technical support for this included comprehensive support (energy assessment, investment, and management), establishing the target for reducing energy consumption, and the latest information on the latest trends and on-site consulting services. Financial support and alternatives included financial support to SMEs to establish energy management systems and set up goals, long-term low-interest loans to businesses for energy efficiency initiatives, and financing for worn-out (old) equipment. The achievement from the mandatory energy diagnosis system found 10,521 businesses with potential savings of 9,257,000toe/ year. The achievement from the energy diagnosis business showed 242 businesses with savings of 3,542toe/ year.

The speaker ended the presentation with conclusion remarks: Energy audits help identify inefficiencies and propose measures to improve energy efficiency in facilities and transport. The energy audit process should be standardized, straightforward, and flexible enough to be tailored to specific cases. Audit methodology is described by the International Organization for Standardization (ISO) and European National Standards. Legislative mandates are not the only factor encouraging demand for energy audits. Voluntary approaches are equally encouraging. Under the progress of the APEC region, there are 13 APEC economies with embedded energy audits in their energy efficiency laws/regulations/programs. 1 APEC economy has integrated ISO 50002 into its mandatory measures. In contrast, no APEC economy has combined ISO 50002 with its voluntary measures and another 10 economies have adopted mandatory measures with domestic standards and guidelines. All APEC economies except three have their energy audit standards/guidelines/manuals.

## Panel Presentation #2 – International Standards on Energy Audits: Concepts and Applications

**Kit Loong Oung**, *Principal Consultant, OurWorld Solutions*

The second speaker presenting in this session is Kit Loong Oung who is the principal consultant at OurWorld Solutions and is also affiliated with ISO. The speaker began the presentation by introducing himself and asking two questions: 1) The first question he asked was whether the policy is about applying energy management and energy auditing; 2) The second question is whether the policy is about prescribing what people should be doing or showing them where their benefits may be. The speaker shared that he will not only discuss the energy audits but also introduce how the UK designed energy audits and how they operate in the UK.

The speaker noted, as part of energy audits, asking the right questions is crucial. With the current techniques and technology, energy intensity can be reduced by up to 73%. Notably, about 25% of energy consumption can be reduced through low-cost or no-cost measures without significant operational changes. Currently, the global real-term year-on-year energy reduction is 1.2%; however, to limit climate change to 1.5 degrees Celsius, an 8% reduction in energy consumption is needed each year until 2050. In reality, the year-on-year energy consumption increase is 2.6%.

Global research on energy consumption in buildings, transport, and industry reveals that maintaining similar building comfort requires 83% less energy than current consumption. For transportation and industry, energy consumption is 68% and 62% higher than the minimum required, respectively.

To maximize value at minimal cost, the following pathways are recommended: Remove, Reduce, Refrain, Reuse in-situ, Recover, Reuse elsewhere, Resource productivity, Green Chemistry, Circular economy, Renewables, Energy storage, CO2-to-X, Restoring ecosystems, & Offset.

A survey revealed the top reasons why companies are not saving energy. These reasons from most to least concerning are: lack of leadership by policy makers, energy providers wanting to maintain status quo, failure of assessing the side effects or consequences, uncertainty over the viability, leadership attitudes towards avoiding new costs, insufficient collaboration among stakeholders, inadequate R&D and funding by governments, corporate cultural resistance to new ideas, financial constraints e.g. high hurdle rates, and poor innovation by suppliers and business partners. Additional reasons included inadequate or unavailable resources, poorly communicated strategies, actions required to execute not clearly defined, unclear accountabilities for execution, organizational silos and culture blocking execution, inadequate performance monitoring, inadequate consequences for inaction, poor senior leadership, uncommitted leadership, unapproved strategy, other obstacles.

To effectively resolve challenges, several essential steps are necessary:

Develop a High-Level Strategy: This step involves understanding the organization and its context, identifying the needs and expectations of interested parties, determining the scope and boundaries, securing leadership commitment and alignment, defining high-level energy policies, and assigning high-level responsibilities and authorities.

Develop Detailed Implementation Plans: This includes determining legal and other requirements, analyzing the energy baseline, identifying relevant energy performance indicators, pinpointing opportunities to improve energy performance, and agreeing on objectives and action plans to achieve them.

Align Plans with Operating Requirements: This step focuses on communicating with all stakeholders, resolving conflicting interests, increasing workforce competence, integrating plans into operational planning and control, design specifications, and procurement processes.

Execute the Plans: Implementation of the agreed plans, gathering and analyzing energy performance data, and documenting the results of monitoring and analysis are crucial here.

Monitor the Effectiveness of the Plan: This involves assessing the conformity of operations to the plan, evaluating the plan's effectiveness in achieving intended outcomes, and applying corrections and corrective actions as needed.

Test, Adapt, and Renew Strategy and Plan: Finally, this step includes reviewing the current strategy's applicability and suitability, assessing the efficiency and effectiveness of current plans, and revising and adapting to operational changes and requirements.

The UK has made significant actions and efforts in climate change and environmental sustainability. In 2013, the UK made mandatory GHG reporting where large companies must publish a non-financial report no more than six months after its financial report. In 2014, the UK passed the ESOS and Lead Assessors which states that large companies must carry out an energy assessment every four years or implement a certified ISO 50001 covering 90% of their total energy consumption. In 2015, the UK focused on minimum energy efficiency legislation.

The speaker ended his presentation by sharing some conclusions: If your energy policy is about mandating energy saving actions, companies find loopholes to avoid compliance. If your energy policy is about applying a method, companies often apply the method blindly and ignore energy savings. If your policy addresses the source of cognitive biases achieving energy savings, policy design must be about achieving the big picture - demand reduction and/or decarbonization. A one size fits all approach does not work for every organization.

## Panel Presentation #3 – Policies and Practices for Optimizing Building Energy Efficiency in Hong Kong, China

**Jovian Cheung**, *Senior Engineer, Electrical and Mechanical Services Department, Hong Kong, China*

The third speaker in the second session was Jovian Cheung, a senior engineer in the electrical and mechanical services department in Hong Kong, China. She was introduced as a key figure in energy efficiency and conservation in new technologies and will be sharing policies and practices for optimizing building energy efficiency in Hong Kong, China.

Hong Kong, China has developed a climate action plan for 2050, and there are four decarbonization strategies under this action plan: 1) net-zero electricity generation, 2) energy savings and green buildings, 3) green transport, and 4) waste reduction. Green buildings are a central focus of this plan. To meet its goal of a 45% reduction in energy intensity, the government is prioritizing energy efficiency. Hong Kong, China is committed to advancing sustainability through its green building initiative and taking careful steps to improve environmental performance.

Hong Kong, China has approximately 50,000 buildings, with about 80% of the buildings being residential buildings. Buildings in Hong Kong, China represent 90% of the total electricity consumption and accounts for approximately 60% of the total carbon emissions. By 2035, commercial building electricity consumption is targeted for a 15-20% decrease, with a 10-15%

decrease in residential buildings. By 2050, the hope is to reduce commercial building energy consumption by 30-40% and residential building consumption by 20-30%.

The Climate Action Plan 2050 is a comprehensive strategy that includes buildings' energy efficiency ordinance, green government buildings, energy efficiency registration scheme, promoting innovation and technologies, fostering support in the community, energy efficiency labeling scheme, regulating OTTV of buildings, district cooling systems, data transparency and benchmarks, and subsidy and incentive schemes. The building energy efficiency ordinance enacted in 2012 has resulted in over 4,000 energy audit reports, over 1,100 registered energy assessors, over 15,000 major retrofitting works in existing buildings, and over 2,300 new buildings.

The Mandatory Energy Audit in Hong Kong, China states that it is mandatory for commercial buildings to conduct an energy audit every 10 years. There will be a legislative amendment planned for 2025. This amendment aims to include additional building types, reduce the audit interval to five years, and require the disclosure of technical information in energy audit reports. In the building's main lobby, the energy utilization index (EUI) is displayed.

Hong Kong, China is using smart power meters to enhance energy audits. Power companies started installing smart meters for all customers, and this is expected to be completed by 2025. Data readings for the past 14 months and hourly data for the last 90 days are included with the smart power meters.

Hong Kong, China has achieved significant milestones: Over 80% of buildings reported a reduction in the Energy Use Intensity (EUI) of central building services installations during the second round of energy audits. Additionally, from 2015 to 2023, the average EUI of commercial buildings was reduced by 15%.

## Panel Presentation #4 – Policies on Energy Audit in Malaysia

**Muhammad Khoiri bin Abdul Aziz**, Assistant Director, Energy Efficiency & Conservation Department, Energy Commission Malaysia

The fourth and final presentation of the session was delivered by Muhammad Khoiri bin Abdul Aziz, Assistant Director at the Energy Efficiency & Conservation Department of the Energy Commission Malaysia. His presentation centered on energy audit policies in Malaysia.

He began by outlining his discussion points, which included: energy efficiency initiatives in Malaysia, energy audit policies, the domestic energy efficiency action plan, the Efficient Management of Electrical Energy Regulation 2008, the energy audit conditional grant, and the Energy Efficiency and Conservation Bill 2023.

Energy efficiency initiatives in Malaysia started in 1996 with the Seventh Malaysia Plan. In 2008, Malaysia introduced the Efficient Management of Electrical Regulations. In 2016, Malaysia implemented the National Energy Efficiency Action Plan and implemented EE projects during the 11th Malaysia Plan. In 2021, Malaysia launched the Sustainability Achieved via Energy Efficiency (SAVE) 2.0 programme as well as the Energy Audit Conditional Grants (EACG) 2.0. In 2023, Malaysia implemented the Energy Efficiency Conservation Act (EECA) and the NEEAP 2.0.

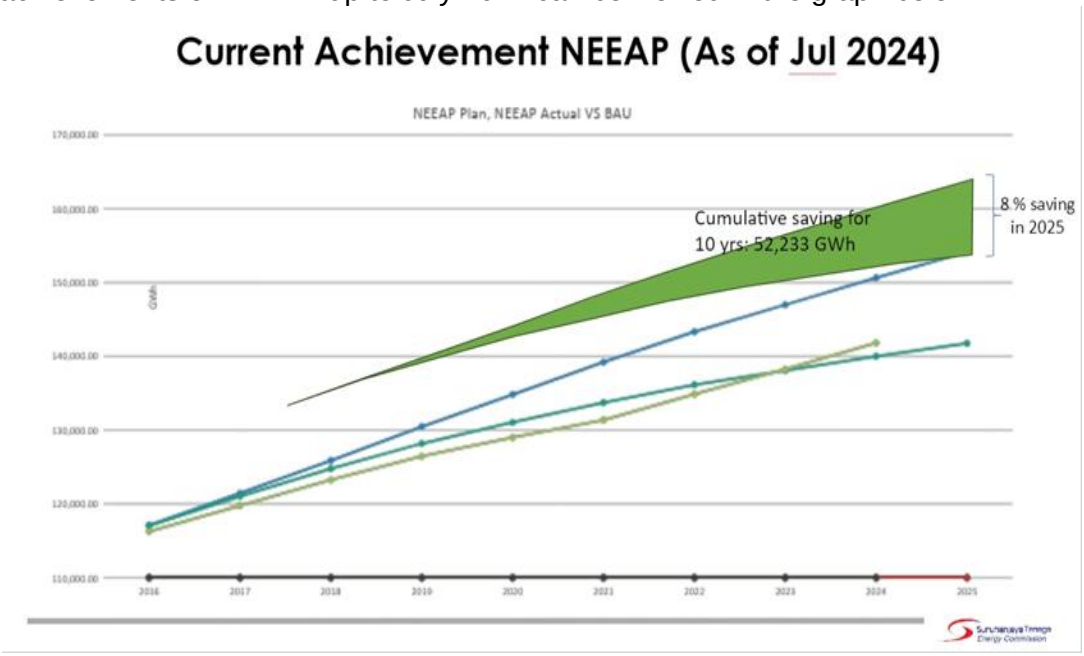
The speaker discussed Malaysia's National Energy Efficiency Action Plan (NEEAP), which spans from 2016 to 2025. The plan includes four strategic thrusts:

1. Implementation of energy efficiency initiatives
2. Strengthening the institutional framework, along with capacity development and training for energy efficiency initiatives
3. Establishing sustainable funding mechanisms to support these initiatives
4. Promoting private sector investments in energy efficiency initiatives

Key initiatives under NEEAP include:

- **Equipment Programme Initiative**: Promoting 5-star rated appliances and Minimum Energy Performance Standards (MEPS)
- **Industrial Programme Initiative**: Conducting energy audits and managing energy in industries, alongside promoting co-generation
- **Buildings Programme Initiative**: Conducting energy audits and managing energy in buildings, as well as promoting energy-efficient building design

The achievements of NEEAP up to July 2024 can be viewed in the graph below.




The speaker then shared the National Energy Transition Roadmap (NETR), which is aimed at driving energy transition and socio-economic advancement. One of the energy transition levers is to optimize energy efficiency. Prioritization criteria include emission reduction potential, economic opportunities, cost effectiveness, and social inclusiveness. There are a number of different EEC activities under NETR including improving energy efficiency awareness, improving existing Minimum Energy Performance Standards (MEPS) and 5-star rating bands, enforcing mandatory audits for large commercial and industrial buildings, establishing green building codes for energy-intensive residential and commercial buildings, establishing an ESCO platform, and launching a major energy efficiency retrofit initiative amongst government buildings.

The speaker highlighted the current regulations on energy efficiency and conservation, focusing on the Efficient Management of Electrical Energy Regulation 2008 (EMEER 2008). This regulation applies to consumers and generators, including any installation that receives electrical energy from a license or supply authority and consumes equal to or exceeds 3,000,000kWh in any period of six consecutive months, or any installation operated by a private installation licensee that generates equal to or exceeds 3,000,000kWh in any period of six consecutive months.

The duties and responsibilities for these installations include:

- Appointing or designating a registered electrical energy manager
- Submitting a written confirmation of such appointment or designation, including the name, particulars, and date of expiry of registration
- Providing information such as the statement of policy for efficient management of electrical energy, objectives for efficient management of electrical energy, and the accounts and documents pertaining to efficient management of electrical energy
- Submitting regular reports

In order to qualify to be a Registered Electrical Energy Managers (REEM), the applicant must be a Malaysian citizen aged 23 and above; professional engineer with at least six months experience in electrical energy efficiency or degree in science/engineering/architecture with at least one year working experience in electrical energy efficiency or hold a certificate of competency as an electrical services engineer or as a competent electrical engineer with at least nine months working experience in electrical energy efficiency; and demonstrate knowledge of the requirements of the act and these regulations that satisfies the commission. The functions and duties of a REEM include auditing and analyzing the total electrical energy consumption, advising in developing and implementing measures to ensure efficient management of electrical energy at the installation, monitoring effective implementation of the measures, supervising the keeping of records on efficient electrical management at the installation, and ensuring timely submission of information and reports under the regulations.

The speaker then outlined the energy efficiency program under the 11th Malaysia Plan, which includes energy audits and energy management for the industrial, commercial, and government sectors. The government sector aims to lead by example, focusing on government offices and hospitals, and implementing retrofit measures such as improving lighting and air conditioning. The industrial and commercial sectors are eligible for energy audit conditional grants, available to companies with monthly energy consumption of 100,000kWh or more. Applications are submitted through implementation agencies: SEDA (for the commercial sector) and MGTC (for the industrial sector). Applicants must appoint an Energy Service Company (ESCO) registered with the Energy Commission (EC) to conduct the energy audit. Successful applicants of the Energy Audit Conditional Grant (EACG) are required to implement the recommended measures within three years, with the implementation cost meeting or exceeding the grant amount.

The speaker then provided an overview of the Energy Efficiency and Conservation Act (EECA) 2024. The objectives of the EECA include the creation of comprehensive energy legislation to drive energy efficiency, enhance energy efficiency initiatives, and help achieve a 45% reduction in carbon emissions by 2030, based on 2005 levels, as pledged in COP21. The act also supports the government's goal of carbon neutrality by 2050 and aims to effectively manage energy demand while promoting efficient and sustainable energy consumption practices.

## Session 2: Questions and Answers

**Q**: *You mentioned there were few financial incentives for the energy audits? Do you know why that is, and is that specific to the UK?*

**Kit Oung**: There is a specific reason. In the UK, what businesses tend to do is self-funded mechanism, instead of taking the grant and paying interest. That is why there is a low uptick in grants.

**Arifin**: Malaysia faced the same problem. To overcome this, the government provided an interactive package of grants that includes capacity building and monitoring and verification.

**Q**: *You mentioned that in the energy audits, you identified potential savings for industry as 12%. What are the potential industries in the audits, and which industries have less potential? Did you do audits only for electrical energy consumption, or electrical plus thermal? The potential savings from each energy audit are 19% for the building sector. What are the key findings in this 19%? What sectors have the most potential for building audits?*

**Muhammad Khoiri bin Abdul Aziz**: As you can see in my slide, I am generalizing average savings for the industry and commercial sectors. For the exact number, you can find it on our website and our energy commission website. They have very detailed explanations for every category. From the audit conducted in Malaysia, we are a manufacturing industry where foreign companies come to invest in Malaysia for manufacturing. We are focusing on electrical energy consumption only. We will later include thermal energy.

**Q**: *Beside energy outreach, there is also terminology of retro commissioning, and it is related to green buildings. How is regulation related to commissioning?*

**Jovian Cheung**: Hong Kong, China is looking into retro commissioning, and we believe we can achieve energy savings through retro commissioning. We are looking to have an engineering professional conduct the retro commissioning examination and we support the use of AI and advanced sensors. We already set the certification for the pre-levels of retro commissioning. We hope we can establish a platform. In Hong Kong, China, we have already created a retro commissioning hub that includes information from other places. We hope this platform can be used to encourage others to investigate retro commissioning.

**Kit Oung**: In the UK, building codes dictate this. Unfortunately, the UK's building code is not as stringent as others. The UK has been doing many demonstration projects to encourage others to choose this. Would they revise the current building codes in the future? We do not know.

**Deann Desai**: In the United States, we have two different programs, one for buildings and one for industry. The industry program is the industrial assessment centers, and they are run by DOE. All of these findings are in the IAC database, and they are available online through the DOE website. It is a government website, so do not try to search it through DOE, use your favorite search engine. All of the audit findings are in the IAC database, which is publicly available. The second database is for buildings, and that database is for comparative purposes. You have to know what kind of building it is to search for because it is categorized by building type. The rules for buildings are set by the states and territories, so there are over 50 different rules on buildings. California's data is readily available publicly as well as New York's and Oregon's, but other states have this without making the data publicly available. If you are getting an incentive from the state, they have to meet one set of requirements.

**Q**: *There is type 1-3 and there is a quick overview for ISO 50001. Can you share about the different types of auditing and which ones are required for which case?*

**Kit Oung**: You see type 1-3, and this refers to the size and capability of the company. Type 1 is when a company does the first-time audit to identify main opportunities. From then on, you want to do a type 2, where you pick the project size and evaluate risks. Type 3 takes you to very high risks and very high costs. If you are a smaller sized company, type 1 is probably

what you would choose. Your technology is simpler, and your savings probably do not require a significant level of accuracy. Type 2 is a little more detailed, and it is not pure guesswork.

**Q**: *Can you share any best practices that you have from conducting energy audits?*

**Kit Oung**: I've seen a lot of auditors who do not go on the site and they do the audits based on the documents and software. I prioritize what the operational and maintenance changes are. Have they installed everything correctly? Probably about 15-20% of the time I perform an audit, it is because someone installed something incorrectly.

**Q**: *It is fascinating to learn about 90% of the buildings representing 60% of emissions. You said that the interval of energy audits is 10 years, and you are looking to shorten it to five years. Do you think five years is enough to provide assurance about the energy management system and the audits?*

**Jovian Cheung**: Normally we encourage commercial sectors to perform audits, and it takes about six months for them to collect the data. Some of them are quick, and some take a longer time. Right now, there is a lot of innovative technology that can help them speed up the time, so we are shortening it to five years. However, we have to be mindful of the economic factors that go into energy audits and management when thinking about shortening it more than five years.

**Q**: *Do you also require mandatory energy audits every five years? Is that periodic energy report different from the actual energy audit updated by five years as compared to the annual report?*

**Muhammad Khoiri bin Abdul Aziz:** One of the most important things that we did was that in developed economies, we saw that the big question is the cost. If you reduce the interval of the energy audit to every three years, the cost will be very high. Learning from our neighbors, we saw that five years was an appropriate interval for energy audits.

**Q**: *Are there any engagements with outside data to improve buildings data?*

**Jovian Cheung**: We collect data from energy audits and put it into an index without disclosing the building name. We only disclose the building type. We also created a hotline to encourage others to contact us so we can share our advice on how to conduct the energy audits and energy saving measures.

**Q**: *What are some of the major challenges associated with maintaining and establishing energy audits? How can policies be adjusted to address those challenges?*

**The Russian Federation Representative**: There are some standards in the Russian Federation are similar to international standards. The main focus were the industrial areas in the Russian Federation. Many industries in the Russian Federation have established energy management systems and energy audits.

**Chinese Taipei Representatives**: We have several different energy audit programs. For type 1 audits, it's a half day progress where we send a couple of professionals, and we assess

without metering. For type 2, it's a 3-5 day process where we bring electrical devices to collect different data such as temperature and pressure.

**Republic of Korea Representative**: I will provide some additional information to the case that Mohd Shah Hambali Arifin presented in his presentation. There is a requirement for energy audits, but there is no requirement to implement the audit results, and the implementation rate is only 50%. The Republic of Korea offers support programs to improve energy efficiency. Implementation data of 50% means that only half of the recommended measures recommended in energy audits are carried out.

**Q***: A few days ago, I read a newspaper article about the performance of the KEEP30 program and there was tremendous progress with companies achieving beyond the required targets. What is the driving force of the participant companies who are doing more than the required improvement targets?*

**Republic of Korea Representative**: Recently, the electric cost has increased, so that is why.

**Q**: *Can you elaborate more on energy management systems and energy auditing, and how those two are related?*

**Deann Desai**: There are a lot of pieces to it. The first is the history behind energy management system standards. In ISO, there were 57 different energy management system standards with many more being developed. The only performance-based management system standard is 50001. There were discussions on whether it would be a management system standard or a verification standard. A lot of auditors are not used to looking for performance, and the number one feedback we receive is the surprise that they have to include performance data in the audit.

**Kit Oung**: I can attest that what she said is correct. If you do not have an energy background, you will fail.

## Moderator Wrap Up and Closing Remarks

The moderator concluded the panel by expressing gratitude to the speakers for their insightful presentations and highlighting the unique experiences and perspectives they brought to the discussion on energy management systems and auditing.

The moderator shared two key takeaways:

1. **Energy Management**: It is a comprehensive system designed to reduce energy consumption and improve efficiency across an organization. It involves an integrated approach, extending beyond the use of a single software tool.
2. **Energy Auditing**: Far from being a mere paper-based exercise, auditing serves as a dynamic process to enhance and optimize energy savings within an organization.

Following these remarks, Dr Kim handed the floor to Dr Liu Meng for his concluding statements.
Dr Liu Meng concluded the workshop by expressing his gratitude to the speakers and the audience for their participation, emphasizing that their involvement was crucial to the event's success. He highlighted that the insights shared on energy management systems and energy audits would greatly benefit APEC member economies in shaping their energy policies. He also underscored the importance of senior experts' participation in capacity building, hoping that the workshop would positively influence policymaking in the APEC region.

## Workshop Conclusions

The workshop aimed to achieve three main objectives: to introduce energy management and energy audit standards in APEC economies, to explain the concepts and application of international standards in energy management systems (EnMS) and energy audits, and to explore best practices in energy management and auditing policies and initiatives within APEC economies.

Session 1 - Energy Management, Standards, and Policy Practices

An energy management system (EnMS) consists of two main components: management and technical elements.

***Management Category***

- Planning: Establishing policies, goals, targets, and roles
- Risk and Opportunity Actions: Ensuring that legal and other requirements are met
- Compliance and Audits: Adhering to legal requirements and conducting internal audits
- Management Review: Regularly reviewing management practices

***Technical Category***

- Energy Review and Data Collection Plan: Conducting energy assessments and creating plans for data collection
- Operational Planning and Control: Integrating energy management into operational planning, control, design, and procurement processes
- Monitoring, Measuring, and Analysis: Tracking and analyzing energy performance, where energy management information systems play a significant role
- Evaluation: Assessing energy performance to identify areas for improvement

The value of management systems is evident: They help reduce costs and foster economic growth. One key benefit is their positive impact on energy security and reliability, especially as grids face increasing challenges. Electrification is essential for decarbonization but presents significant challenges for utilities, making the support of TC 301 critical. These

systems also offer value through normalized, verifiable data, which is essential for assessing energy management systems. Moreover, validating the performance of new technologies is a key advantage. These systems also help address climate change challenges, particularly in Scope 1 and Scope 2 emissions (with some impact on Scope 3), while incorporating themes such as circularity and ESG (Environmental, Social, and Governance).

Thailand's Energy Efficiency Plan, launched in 2018, aims to reduce energy intensity by 30% by 2037, equivalent to approximately 49,064ktoe from the 2010 baseline. The plan includes a mix of mandatory, voluntary, and complementary measures:

- **Compulsory measures**: Energy management standards, energy codes for industries, buildings, and residential sectors, energy efficiency resource standards (EERS), demand response programs, and excise taxes
- **Voluntary measures**: Equipment standards and labeling, financial incentives such as grants, subsidies, soft loans, tax breaks, and credit guarantees, and innovations like IoT, smart buildings, and big data
- **Complementary measures**: Human resources development, including training for energy managers, auditors, and technology experts, as well as public awareness campaigns and research initiatives

The Mandatory Energy Management System is widely implemented across ASEAN member states. Policies typically include the appointment of certified energy managers, the development and execution of energy management programs, conducting regular energy audits, and submitting periodic reports.

Session 2 – Energy Audits, Standards, and Policy Practices

An energy audit, as defined by ISO 50002, is a detailed analysis of the energy performance of an organization, system(s), or processes. It involves the measurement and observation of energy use, efficiency, and consumption. The audit process, in accordance with ISO 50002, includes planning, an opening meeting, data collection, the development of a measurement plan, a site visit, data analysis, energy audit reporting, and a closing meeting.

The UK has made significant strides in tackling climate change and advancing environmental sustainability. In 2013, it introduced mandatory greenhouse gas (GHG) reporting, requiring large companies to publish a non-financial report within six months of their financial report. In 2014, the UK enacted the Energy Savings Opportunity Scheme (ESOS) and Lead Assessors regulations, mandating large companies to conduct energy assessments every four years or implement an ISO 50001 system covering at least 90% of their energy consumption. By 2015, the UK focused on establishing minimum energy efficiency legislation.

Hong Kong, China developed a 2050 climate action plan centered on four decarbonization strategies: net-zero electricity generation, energy savings, green buildings, green transport, and waste reduction. Energy efficiency, particularly in green buildings, is a primary focus of the plan. The government is committed to a 45% reduction in energy intensity by 2030 and prioritizes energy efficiency initiatives in its green building efforts.

Malaysia's National Energy Efficiency Action Plan (NEEAP) covers the period from 2016 to 2025 and focuses on four strategic areas: implementation of the energy efficiency plan, strengthening institutional frameworks and capacity development, establishing sustainable funding mechanisms, and encouraging private sector investment. Key initiatives under NEEAP include the equipment, industry, and buildings program initiatives.

# AGENDA

# PREE 13: 8th APEC Energy Efficiency Policy Workshop

# (EWG 202 2023A)

# Energy Management: Standards, Policies, and Best Practices

The **workshop** is a full-day event that provides a capacity-building opportunity to design an effective energy efficiency program through presentations and discussions from prominent experts in the field. The workshop will focus on **"Energy Management: Standards, Policies, and Best Practices,"** as effective energy management is crucial for integrating proactive handling of an organization's daily systems and procedures. The main goals for the workshop are as follows:

1) Introduction to energy management and energy audit standards application policies in APEC economies;
2) Concepts and application of international standards in energy management system (EnMS) and energy audits;
3) Exploring the best practices in energy management systems (EnMS) and energy audit policies and initiatives in APEC economies.

**Organizer:** APERC (Asia Pacific Energy Research Centre)
**Co-organizer:** EGEEC (Expert Group on Energy Efficiency and Conservation)
**Location:** Tianjin, People's Republic of China
**Date:** 5 November 2024
**Venue:** St. Regis Tianjin, 3rd floor (Jinyu Room荊豫厅)
**Time:** 09:30 to 17:00

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| 09:00 to 09:30 | **Registration** |

## Part 1 - Energy Management, Standards and Policies Practices

| Time | Session |
|---|---|
| 09:30 to 09:35 | **Opening Remarks**<br>Mr Munehisa YAMASHIRO, Vice President, Asia Pacific Energy Research Centre |

| Time | Session |
|---|---|
| 09:35 to 09:40 | **Group Photo**<br><br>**Introduction to the Agenda of Part 1 by Moderator**<br><br>Moderator: Professor Younsung KIM from George Mason University |
| 09:40 to 12:15 | 1. **Energy Management System in the APEC Region**<br>Mr Ting-Jui SUN, Senior Researcher<br>Asia Pacific Energy Research Centre (APERC)<br><br>2. **International Standards on Energy Management: Concepts and Applications**<br>Mrs Deann DESAI, Chair-Elect<br>Technical Committee 301,<br>International Organization for Standardization (ISO) |
| | Coffee Break |
| | 3. **Thailand's Energy Management, Standards and Policy Practices**<br>Mr Wisaruth MAETHASITH, Engineer<br>Department of Alternative Energy Development and Efficiency,<br>Ministry of Energy, Thailand<br><br>4. **Policies on Energy Management Systems (EnMS) in ASEAN**<br>Dr Zulfikar YURNAIDI, Head of Energy Modelling and Acting Head of Energy Efficiency and Conservation Department, ASEAN Centre for Energy (ACE)<br><br>5. **Knowledge-Sharing by Economies and Discussion** |
| 12:15 to 14:00 | Lunch Break |

## Part 2 – Energy Audits, Standards and Policies Practices

| Time | Session |
|---|---|
| 14:00 to 14:05 | **Introduction to the Agenda of Part 2 by Moderator**<br><br>Moderator: Professor. Younsung KIM from George Mason University |
| 14:05 to 16:40 | 1. **Energy Audits in the APEC region**<br>Mr Mohd Shah Hambali ARIFIN, Senior Researcher<br>Asia Pacific Energy Research Centre (APERC)<br><br>2. **International Standards on Energy Audits: Concepts and Application**<br>Mr Kit OUNG, Convenor<br>Technical Committee 301/WG17,<br>International Organization for Standardization (ISO) |
| | Coffee Break |

| Time | Session |
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| | **3. Policies and Practices for Optimizing Building Energy Efficiency in Hong Kong, China**<br>Ms Man-chit (Jovian) CHEUNG, Senior Engineer<br>Electrical and Mechanical Services Department, Hong Kong, China<br><br>**4. Policies on Energy Audit in Malaysia**<br>Mr Muhammad Khoiri bin ABDUL AZIZ, Assistant Director<br>Energy Efficiency & Conservation Unit<br>Department of Industrial Operations, Energy Commission Malaysia<br><br>**5. Knowledge-Sharing by Economies and Discussion** |
| 16:40 to 16:50 | **Post-Evaluation Survey** |
| 16:50 to 16:55 | **Summary by Moderator** |
| 16:55 to 17:00 | **Closing Remarks by EGEEC**<br><br>Dr Meng LIU, Chair, APEC Expert Group on Energy Efficiency and Conservation |

## Speaker Bios

| Speaker | Bio |
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| **Yasmin Fouladi**<br>*Emcee*<br>  | Yasmin Fouladi is a researcher at the Asia Pacific Energy Research Centre (APERC). At APERC, she works on research projects to assist Asia-Pacific Economic Cooperation (APEC) members achieve their energy and climate goals.<br><br>Prior to joining APERC, Ms Fouladi worked for the U.S. Department of Energy (DOE) in various roles, such as a Senior Asia Researcher and a DOE Attaché abroad. Before DOE, Ms Fouladi gained experience in U.S.-Asia relations at various organizations, such as The Asia Group (TAG), the U.S. Department of State, the Carnegie-Tsinghua Center for Global Policy, the National Committee on United States-China Relations (NCUSCR), and the U.S.-Asia Institute (USAI).<br><br>Ms Fouladi has a Bachelor's degree with honors in Asian Studies and English from Cornell University and a Master's degree in Asian Studies with a focus on Politics & Security and Energy & Environment from Georgetown University's School of Foreign Service. |
| **Munehisa Yamashiro**<br>*Opening Remarks*<br>  | Munehisa Yamashiro is the Vice President of the Asia Pacific Energy Research Centre (APERC). Mr Yamashiro joined APERC in 2018. Previously, he had worked for Japan's Ministry of Economy, Trade and Industry for 32 years.<br><br>When he was in charge of international energy issues in mid-1990s, he was involved with the establishment of APERC. He holds a Bachelor of Engineering from the University of Tokyo and a Master of Arts in International Relations from Yale University. |
| **Younsung Kim**<br>*Moderator*<br>  | Younsung Kim is Professor and Associate Department Chair in the Department of Environmental Science and Policy at George Mason University. Her research lies in collaborative governance and self-regulatory policy tools designed to address today's complex environmental and sustainability challenges. Focusing on the private sector's role in environmental governance, she has investigated such topics as whether Environmental Management Systems (EMSs) are effective, why some companies are more receptive to regulatory environmental policy, and which type of firms would be most likely to form cross-sector partnerships for sustainability solutions. Her recent research interests cover sustainable packages and waste management and recycling policy. |

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| | In 2016, her co-authored research article “Business as a Collaborative Partner: Understanding Firms’ Sociopolitical Support for Policy Formation” received the Best Article Award from the Public and Nonprofit Management Division of the Academy of Management.<br><br>Prior to her career in academia, Dr. Kim worked for the Ministry of Environment in the Republic of Korea as Deputy Director of the Public Information Office and served on the World Bank’s Carbon Finance Assist Team. Recently, she served as an external reviewer of the US Environment Protection Agency’s Pathfinder Innovation Projects. She holds a PhD from George Mason University, Environmental Science and Public Polic program. |
| **Ting-Jui Sun**<br>*Speaker*<br><br>  | Ting-Jui (Ray) SUN is a visiting researcher from Chinese Taipei at the Asia Pacific Energy Research Centre (APERC) in Tokyo, Japan. Prior to this role, he served as a building energy efficiency consultant and building energy consumption survey program manager at the Industrial Technology Research Institute (ITRI). His expertise lies in various areas including building energy auditing, ISO 50001 EnM, and LEED O+M certification consulting projects. Additionally, Ting-Jui volunteered as the Government Affairs Committee (GAC) Chair for the ASHRAE Chinese Taipei Chapter.<br><br>Ting-Jui holds a Bachelor’s degree in international business from I-SOU University and a Master’s degree in Natural Resource Management from National Taipei University. |
| **Presentation: Energy Management Systems in the APEC Region: Standards and Policies**<br><br>This presentation offers an overview of energy management systems (EnMS) and their impact on energy efficiency, with a focus on the policy situation in the APEC region. It explains what EnMS is and its importance for organizations seeking to improve energy performance and reduce costs. Key international standards such as ISO 5000:2018 and ASHRAE Standard 100:2024, along with related economy-level standards, will be highlighted.<br><br>The presentation explores the energy efficiency policy landscape in the APEC region, where several economies have developed EnMS programs supported by government-led training, public sector leadership, and voluntary initiatives for private sector adoption. Additionally, it discusses the adoption of mandatory regulatory measures in some APEC economies, scope, and compliance requirements.<br><br>The presentation addresses challenges in implementing EnMS across the APEC region and proposes solutions, offering recommendations for policy improvements. This presentation provides a comprehensive understanding of EnMS in promoting energy efficiency within APEC economies. | |
| **Deann Desai**<br>*Speaker* | Ms Desai has extensive experience in the service and manufacturing sectors with implementation and auditing of |

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|  | various management system standards. She has extensive experience in multiple sectors, including Personnel Services, Banking, Electronics, Textiles, Construction, Mining, Chemical, Metal, Paper, Defense, Aerospace, Printing, Foods, Pharmaceuticals, Automotive and Aerospace suppliers, Consumer Commodities, Corrections, Ports, Shipping and logistics, Airports, occupational health and safety as well as experience in FSMA (Food Safety Management), Hospitals and Local Government entities. Ms Desai is experienced in implementation strategies, innovation management, tools and materials development for implementation and maintenance of management systems and integration with existing systems. In addition, she has worked with organizations in the development of design systems developing applications of the Stage-Gate® system and other related creativity idea generation-based development programs such as EurekaTM, measuring and monitoring and statistical methods development as well as general process development and evaluation. Ms Desai's responsibilities have also included developing and providing courses related to management system standards and auditing.<br><br>Ms Desai has been working in the Standards sector for the past 14 years and has developed a good reputation not only for sector knowledge but also for her leadership skills in building consensus. She is currently the Convenor of TC 301/WG 1, TG 3, TG 5, as well as various ad hocs in TC 301. She also contributes to a number of other ISO groups including but not limited to ISO TC 207/SC1, TC 207/SC7, ISO/PC 302, ISO CASCO, ISO/TMB_ESG, ISO/TMB_JTCG and IAF. She also works with domestic standardization activities such as the US Superior Energy Performance Program (SEP). Ms Desai is the Chair elect for ISO/TC 301. |

**Presentation: International Standards on Energy Management: Concepts and Application**

In this presentation, we delve into the key concepts of ISO 50001, the energy management standard applicable across various sectors. ISO 50001 is versatile—it can benefit organizations of any size and industry. Its primary goal? To help organizations reduce energy consumption and the resulting greenhouse gas emissions. By establishing robust systems and processes, ISO 50001 empowers users to improve energy performance. Policymakers can leverage these concepts to incentivize organizations and influence energy consumption at regional, domestic, or global levels. Throughout the presentation, we will explore implementation success stories in service, industrial, and government sectors, including insights from programs like U.S. Superior Energy Performance and 50001 Ready. Additionally, we will touch on ongoing activities within ISO TC 301 related to energy management, savings, and emissions reduction.

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| **Wisaruth Maethasith**<br>*Speaker* | Wisaruth Maethasith is an engineer from Department of Alternative Energy Development and Efficiency (DEDE), Ministry of Energy (Thailand). Over the past years, he has overseen numerous projects implemented by DEDE on domestic mandatory energy management system and energy |

efficiency indicators in factories and buildings. He has given numerous talks on energy management systems to audiences from both public and private sector.

He graduated from Northwestern University, USA, with a master's degree in Material Science Engineering from the same university.

**Presentation: Thailand's Energy Management, Standards, and Policy Practices**

Thailand has developed policies aligned with global trends to reduce dependency on fossil fuels and enhance energy efficiency - Thailand's Energy Efficiency Plan (EEP2024), which sets long-term strategies to promote energy efficiency in all sectors. Mandatory energy management system is one of the key policies for the success of this plan.

The Energy Conservation Promotion Act plays a key role in supporting these initiatives, making energy audits and management mandatory for designated factories and buildings. Energy management, similar to ISO50001, requires factories and buildings to recognize their energy usage, implement energy efficiency measures, and review the process. Following these Plan-Do-Check-Act cycle (PDCA Cycle) allows factories and buildings to improve their efficiency over time – with added benefits of the government being able to use the data for informed policymaking and measures tailored to energy users.

**Zulfikar Yurnaidi**
*Speaker*

Dr Zulfikar Yurnaidi is the Head of Energy Modeling, Policy and Planning (MPP) Department and Acting Head of Energy Efficiency and Conservation (CEE) Department of ASEAN Centre for Energy (ACE).

MPP department leads the energy research and cooperation activities in ASEAN, especially to implement the Regional Energy Policy and Planning (REPP), including cross-sectoral issues, and support other programme areas of the ASEAN Plan of Action for Energy Cooperation (APAEC). Among others, the department is responsible for the development of the ASEAN Energy Outlook (AEO) and ASEAN Energy Database System (AEDS).

CEE Department is responsible for the implementation of EE&C programme area of APAEC, including through project implementations, such as those of AsBuilT with GGGI/IKI, PEEB ASEAN with AFD, EE Financing in Industry with KDB/GCF, AJEEP with ECCJ/METI, CEFIA with BCG/METI, also with partners such as USAID, UNEP U4E and UN ESCAP.

Previously, he was Project Manager of the 7th ASEAN Energy Outlook (AEO7), Senior Officer of Renewable Energy and Energy Efficiency (REE) Department, and Senior Research Analyst of ASEAN Climate Change and Energy Project (ACCEPT).

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| | He holds a Doctoral Degree from the Department of Energy Studies, Ajou University. Prior to ACE, he was a researcher in Green Technology Center (GTC) Republic of Korea, focusing on green technology cooperation with partner economies, such as on waste-to-energy, climate smart agriculture, water monitoring system, and AI-based disaster response, in Indonesia and Bhutan. Prior to that, he was a post-doctoral researcher and lecturer at Ajou University, working in energy modelling and energy economics. |

**Presentation: Energy Management System Policy in ASEAN**

ASEAN energy cooperation is guided by the ASEAN Plan of Action for Energy Cooperation (APAEC). One of the Programme Areas of APAEC is on Energy Efficiency & Conservation (EE&C). In this Programme Area, one of the key activities is the development of the regional energy manager certification system, which is called the ASEAN Energy Management Scheme (AEMAS). The presentation will review energy efficiency, focusing on management systems and policies in ASEAN member states. It will then highlight the status and plans of the AEMAS development.

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| **Mohd Shah Hambali Arifin**<br>*Speaker*<br>  | Shah Hambali is a visiting researcher from Malaysia at the Asia Pacific Energy Research Centre (APERC) in Tokyo, Japan. Prior to this role, he was the Deputy Director of Technical Development and Facilitation (TECH) at the Sustainable Energy Development Authority (SEDA), Malaysia, where he oversaw energy efficiency (EE), low-carbon building, low-carbon city and climate change initiatives. He was involved in the development of SEDA's Voluntary Sustainable Low Carbon Building GreenPASS Assessment System and Building Energy Data Online System (BEDOS) used to access the performance of Low EE Carbon Building, the extended version of Common Carbon Metric (CCM) by UNEP SBCI.<br><br>Shah Hambali is an environmental engineer and a certified Energy Manager. He holds a Master's degree in Environmental Engineering from University of Malaya (UM) and a Bachelor's Degree in Technology (Majoring in Environment) from Universiti Sains Malaysia (USM). |

**Presentation: Energy Efficiency Policy on Energy Audit in the APEC region**

This presentation provides an overview of energy audits, highlighting their significance in enhancing energy efficiency. It begins by explaining the concept of energy audits, followed by a discussion of key international standards such as ISO 50002:2014 and ASHRAE Standard 211:2018, as well as regional standards like the European Energy Audit Standard (EN 16247) and economy-specific standards.

The importance of energy audits within the APEC context is emphasized, particularly in relation to the breakdown of energy consumption in the APEC region and current energy efficiency policies for energy audits. The presentation will cover both mandatory and voluntary regulatory measures, public sector leadership, training programs, and incentives to promote energy audits.

Selected case studies from APEC economies will showcase successful implementations in various sectors. Lastly, the presentation addresses challenges, and proposes solutions for further improvement. The session concludes with recommendations for strengthening energy audit adoption in APEC economies.

**Kit Loong Oung**
*Speaker*

Kit Loong Oung is a principal consultant, trainer, and author with a focus on Energy management, Environmental management, Greenhouse Gases (GHG) and Net Zero, Occupational Health and Safety (OH&S) management, and Environment, Social, and Governance (ESG). For more than 25 years, Kit Loong Oung has developed a unique skill set that allows him to tackle technical and managerial challenges, collaborate with various stakeholders, oversee multi-disciplinary projects, pinpoint areas for enhancement, address performance issues, and effectively communicate complex topics in a clear and straightforward manner.

Kit Loong Oung's consulting work spans across commercial and industrial sectors on five continents, while his training and coaching activities are conducted in partnership with the British Standards Institution (BSI). Some of his notable projects include assisting stock exchanges and major financial institutions, major sports clubs, and the film industries in reporting energy and GHG emissions, contributing to the development of energy and climate change regulations in the UK, UAE, and Singapore, as well as producing guidebooks on integrated management systems, energy efficiency, and ISO 50001. Kit Loong Oung has also been involved in promoting good governance practices in energy, environment, health and safety, and GHG/Net Zero initiatives in various places worldwide.

Kit Loong Oung's educational background includes a M.Sc. (Eng.) in Environmental and Energy Engineering, a B.Eng. in Chemical and Process Engineering with Fuel Technology, and a General Management Programme certificate from Judge Business School, The University of Cambridge. Additionally, he has actively participated in various professional organizations such as IChemE, UNIDO, and ISO, where he has contributed to the development of industry standards and serve on judging panels for sustainability, water, and energy management awards.

**Presentation: ISO 50002: International Standards on Energy Audits: Concepts and Applications**

This presentation provides an overview of the ISO 50002 energy audit standard and its application in the formulation of UK policies aimed at promoting the identification and execution of energy-saving initiatives. It commences by outlining the current landscape of global energy consumption and the imperative for reduction. The discussion emphasizes the reasons behind the ongoing increase in energy consumption rather than a decrease. Building upon the earlier session focused on the ISO 50001 energy management system, this presentation details the fundamental structure and requirements associated with ISO 50002 energy audits. It concludes with an examination of how the UK integrates both ISO 50001 and

ISO 50002 standards into its policy frameworks, along with an assessment of the outcomes achieved over 12 years of implementation, and a preview of future developments.

**Jovian Cheung**
*Speaker*

Ir Jovian M.C. Cheung is the Senior Engineer at the Electrical and Mechanical Services Department in Hong Kong, China where she plays a pivotal role in promoting energy efficiency, conservation, and the application of new and renewable energy technologies.

With over 20 years of experience in government service, Ir Cheung has held various professional and managerial positions, focusing on engineering services and project management. She earned her Bachelor of Engineering degree in Building Services Engineering from the University of Manchester and a Master of Science degree in Computer and Information Technology from the University of Hong Kong. Currently, she is pursuing a Master of Public Administration at Peking University.

From 2019 to 2023, Ir Cheung served as the Secretary of the APEC Energy Efficiency and Conservation Expert Group (EGEE&C). Since 2023, she has been the Vice-Chair of the EGEE&C. Additionally, she is the APEC Project Manager, leading collaboration among the engineering industry, academia, and organizations to implement seven APEC-funded and self-funded projects aimed at strengthening regional energy-related cooperation.

Ir Cheung has devoted her career to promoting sustainable energy practices in Hong Kong, China and the Asia-Pacific. Her exemplary expertise and leadership in this field are evident through her various roles and contributions to advancing sustainable energy practices in Hong Kong, China and the wider Asia-Pacific region.

**Presentation: Policies and Practices for Optimizing Building Energy Efficiency in Hong Kong**
**Hong Kong, China**

Hong Kong, China is committed to reducing energy intensity by 45% by 2035, aligning with APEC targets to combat climate change. The city's decarbonization strategies prioritize Net-zero Electricity Generation, Energy Saving and Green Buildings, Green Transport, and Waste Reduction. With over 50,000 buildings accounting for 90% of electricity consumption, enhancing energy efficiency is a critical objective.

This presentation will highlight initiatives aimed at improving energy efficiency across both commercial and residential sectors. The Buildings Energy Efficiency Ordinance (BEEO) mandates energy audits and establishes enhanced energy performance standards, with ongoing updates to codes and regulations driving energy conservation efforts.

Furthermore, Hong Kong, China plans to expand audit requirements, shorten audit cycles, and promote energy-efficient practices through education and technology. The presentation

will showcase collaborative efforts with NGOs, schools, and power companies, illustrating how data-driven evaluations support a comprehensive approach to achieving carbon neutrality and fostering a sustainable future. By emphasizing these initiatives, we aim to demonstrate Hong Kong, China's proactive stance in addressing climate change and enhancing energy efficiency in its built environment.

**Muhammad Khoiri bin Abdul Aziz**
*Speaker*

Muhammad Khoiri bin Abdul Aziz currently serve as Assistant Director in the Energy Efficiency & Conservation Unit, Department of Industrial Operations, Energy Commission Malaysia, headquarter in Putrajaya, Malaysia. His professional experience includes the development and implementation of several energy efficiency initiatives and regulatory frameworks, notably the Energy Efficiency and Conservation Act 2023, along with its associated regulations and guidelines.

He also has extensive experience in regulatory management under the Energy Supply Act 1990 and the Efficient Management of Electrical Energy Regulations 2008, ensuring adherence and compliance.

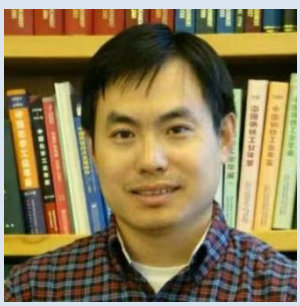
Muhammad Khoiri holds a Bachelor's degree in Electrical Engineering from National University of Malaysia (UKM).

**Presentation: Policies on Energy Audit in Malaysia**

Malaysia's energy audit policies have advanced notably, transitioning from the Efficient Management of Electrical Energy Regulations (EMEER) 2008 to the more expansive Energy Efficiency and Conservation Act (EECA) 2023. This evolution places a stronger emphasis on energy audits as a key mechanism for enhancing energy efficiency and supporting global net-zero goals. EMEER 2008 set the framework by requiring installations consuming over 3,000,000kWh in six months to manage energy usage efficiently by appointing Registered Electrical Energy Manager (REEM).

The newly passed EECA 2023 bill introduces mandatory energy audits for energy intensive buildings and consumers, incorporating energy management systems and Registered Energy Managers (REM). EECA further establishes comprehensive audit procedures and reporting guidelines, ensuring adherence to international standards**,** and improving the overall effectiveness of energy audits. This progression highlights Malaysia's growing reliance on energy audits as a cornerstone in its strategy to reduce carbon emissions and promote sustainable energy practices.

**Liu Meng**
*Closing Remarks*



Dr. LIU Meng, Ph.D., associate professor. He joined the China National Institute of Standardization in 2008 and has over 15 years experiences in energy conservation and renewable energy policies and standards. He is the APEC EGEEC chair, IEA 4E (Energy Efficient End-use Equipment) Executive Council member, the committee manager of the ISO Subcommittee on Solar Energy System Performance (ISO/TC180/SC4) by organizing the development of ISO standards on solar energy, the Chair Advisory Group member of the ISO technical committee on Energy Management and Energy Savings (ISO/TC301) , the convenor of

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| | ISO/TC301/WG19 on Integrated District Energy System, and he also worked as the convenor in leading the development of international standard of ISO 17741:2016 General technical rules for measurement, calculation and verification of energy savings of projects. He led the development of over 30 China domestic standards of energy efficiency, energy management system, energy system optimization, district energy, solar energy, energy savings evaluation, etc. He is the co-author of the Annual White Paper for Energy Efficiency of Appliances and Equipment in China. |
| **Florence Lowe-Lee**<br>*Conference Consultant*<br><br>  | Ms Florence Lowe-Lee is Founder and President of the Global America Business Institute (GABI) in Washington, DC. Since its founding, one of the primary organizational missions has been to act as a forum and platform for discussion on policy-relevant energy and technology issues, with a focus on technologies that facilitate an environmentally sustainable and low-carbon energy future. GABI approaches energy from various viewpoints — economics, security of supply, diversity, safety, technological development, and geopolitics. GABI regularly organizes seminars and workshops, and the primary audience has been the policy community in Washington, DC, which includes think tanks, NGOs, U.S. government agencies, congressional offices, embassies, academics, industries, etc.<br><br>Previously, Ms Lowe-Lee served as Treasurer, Director of Finance and Publications at the Korea Economic Institute of America (KEIA) in Washington, DC where she focused on issues impacting the Republic of Korea's macroeconomic development as well as security concern on the Republic of Korea's peninsula. She worked as Director of Operations at the Massachusetts Senate Ways and Means Committee and served as an advisor to the Massachusetts Office of Trade and Investment. Earlier, she was a research assistant at the Neuroanatomy and Neuroendocrinology laboratory at Rockefeller University in New York City.<br><br>Ms Lowe-Lee received a BA in Neuroscience from Mount Holyoke College and an MA in Industrial/Organizational Psychology from Columbia University. She is also an Adjunct professor at School of Global Entrepreneurship and ICT at the Handong Global University as well as distinguished Professor of Global Cooperation at the Busan University of Foreign Studies in the Republic of Korea. |

**Speaker Presentation Materials:**

For access to the Workshop's presentation materials, please click here.