

# Energy Management Action Network (EMAK) Task Group

EMAK 11 Workshop Report:

“Toward Net-Zero Energy Building”

Held on 9 February 2023 in Singapore





# The Ministry of Economy, Trade and Industry and The Energy Conservation Center, Japan

## July 2023

The Hub is a voluntary collaboration among 16 governments seeking to strengthen their effectiveness in deploying energy efficiency. Its Secretariat is hosted at the International Energy Agency (IEA) to foster coordination with the Agency and with other international organisations, the private sector, and other stakeholders.

The Energy Management Action Network (EMAK) is a Task Group of the Hub, established in 2009 and led by Japan. EMAK is a platform dedicated to policy information exchange to help improve energy efficiency and energy savings in industry and buildings. The goal of EMAK is to promote best practices by bringing together policy makers and energy managers to discuss solutions and develop public-private and private-private networks. To learn more about EMAK, please visit: <https://energyefficiencyhub.org/task-groups/emak/>

9 rue de la Fédération, 75015 Paris, France  
secretariat@energyefficiencyhub.org  
[www.energyefficiencyhub.org](http://www.energyefficiencyhub.org)

Energy Efficiency Hub 2023. All rights reserved.



# Table of Contents

List of Acronyms .....	4
Executive Summary.....	5
Introduction.....	7
<b>Opening Remarks &amp; Keynotes.....</b>	<b>9</b>
<b>Session 1: Effective Policy Packages for Sustainable and Energy Efficient Building – Pathway to Net-Zero Energy Building.....</b>	<b>12</b>
1.Japan's Policy and Strategy in the Building Sector Toward Carbon Neutrality .....	12
2.Toward Net-Zero Buildings in Canada .....	12
3.Toward Carbon Neutrality in the Building sector in ASEAN .....	13
4.Transitioning to Net-Zero Commercial Buildings in Australia.....	13
Q&A .....	14
<b>Session 2: The Best Practice Examples Toward Net-Zero Carbon goals in the Building Sector .....</b>	<b>15</b>
1.Singapore's Sustainability Drive Toward Zero Energy .....	15
2.ZEB Conversion Retrofit of Existing Building in Malaysia.....	15
3.The Best Practice Examples Toward Carbon Neutrality Goals in the Building Sector .....	16
4.Energy Saving Technology Toward ZEB and SLEB as a Private Construction Company in Singapore .....	16
5.Climate-Neutral Construction and Refurbishment – Best Practice Examples from Germany .....	17
Q&A .....	17
<b>Session 3: Panel Discussion on Promotion of EE&amp;C Toward Achievement of Net-Zero Energy Building .....</b>	<b>19</b>
Agenda 1: The Key Policy Issues to Enhance Awareness of Building Owners to Promote ZEB.....	19
Agenda 2: The Technical Challenge for the Promotion and Dissemination of ZEB.....	20
<b>Closing Remarks and Networking Dinner .....</b>	<b>22</b>
<b>Analysis of Workshop Themes .....</b>	<b>23</b>
<b>Conclusion .....</b>	<b>25</b>
<b>Appendix 1: Agenda .....</b>	<b>26</b>
<b>Appendix 2: Photos from the Workshop .....</b>	<b>29</b>

## List of Acronyms

ACE:	ASEAN Centre for Energy
AMS:	ASEAN Member States
ANRE:	Agency for Natural Resources and Energy (Japan)
BCA:	Building and Construction Authority (Singapore)
BMS:	Building Management System
BMWK:	Federal Ministry for Economic Affairs and Climate Action (Germany)
ECCJ:	The Energy Conservation Center, Japan
EE&C:	Energy Efficiency and Conservation
EMA:	Energy Market Authority (Singapore)
EMAK:	Energy Management Action Network
GHG:	Greenhouse Gas
HVAC:	Heating, Ventilation, and Air Conditioning
IEA:	The International Energy Agency
IoT:	Internet of Things
ISO:	International Organization for Standardization
KaTRIS:	Kajima Technical Research Institute Singapore
MTI:	Ministry of Trade and Industry (Singapore)
METI:	Ministry of Economy, Trade and Industry (Japan)
SEDA:	Sustainable Energy Development Authority (Malaysia)
ZEB:	net-Zero Energy Building

## Executive Summary

The Ministry of Economy, Trade and Industry of Japan (METI) and the Energy Conservation Center, Japan (ECCJ) in cooperation with the Energy Market Authority of Singapore (EMA) successfully conducted the 11<sup>th</sup> workshop of the Energy Management Action Network (EMAK), a Task Group of the Energy Efficiency Hub, on 9 February 2023, at the Grand Copthorne Waterfront Hotel in Singapore.

The theme of this workshop (EMAK11) is “Toward Net-Zero Energy Building”. It aims to highlight policies and best practices related to energy efficiency and conservation in the building sector. In addition to Singapore and Japan, the ASEAN Centre for Energy (ACE), Australia, Canada, China, Germany, and Malaysia delivered presentations. Almost 100 participants joined the workshop in person and online.

The workshop aimed to:

- provide best practices to improve energy efficiency in buildings including a step-by-step approach to constructing net-zero energy buildings,
- discuss common challenges in implementing energy efficiency policies in the building sector, overcoming barriers and achieving pragmatic targets toward the pathway to net-zero energy buildings,
- provide a networking opportunity to participants from the public and private sector.

Throughout the workshop, policies and case studies related to the transition toward net-zero energy buildings were presented and discussed.

In terms of policies, effective policy packages for sustainable and energy efficient buildings were presented from Japan, Canada, ACE, and Australia. The workshop reaffirmed the importance of developing regulatory frameworks to promote carbon emission reductions, including the development of energy efficiency building codes and standards and strengthening data disclosure. In addition, it was noted that policy measures need to be adapted for small and medium-sized businesses and tailored to regional context.

Excellent examples of energy efficient buildings from Singapore, Malaysia, China, Japan, and Germany were presented, confirming the importance of using digital technologies to capture a holistic view of energy consumption. In addition, participants discussed that the optimal application of technologies and their operation, including maintenance, are critical to achieving highly energy efficient buildings.

During the panel discussion, challenges and solutions for ZEB promotion were discussed, including raising ZEB awareness among building owners, the importance of implementing various policies (regulations, information, and incentives) as packages and enhancing their effectiveness by finding synergies between policies.

Regarding technical issues for the dissemination and promotion of ZEB, participants concluded that various technologies exist on the supply and demand sides and that it is important to develop the human resources that can appropriately combine and integrate these technologies.

The workshop and the reception helped develop and share knowledge about ZEB and how to overcome the challenges associated with their promotion. A public-private network including academia was additionally formed among the participants.

This report was prepared by ECCJ on behalf of METI to summarize the above outcomes and share them with more stakeholders, related organizations, and interested parties.

This report and the video recordings of the presentations will be available on the website of the Asia Energy Efficiency and Conservation Collaboration Center ([asiaeec-col.eccj.or.jp](http://asiaeec-col.eccj.or.jp)) to ensure that the workshop outcomes are widely shared through the EMAK and Energy Efficiency Hub networks.

## Introduction

This report provides a summary and analysis of the presentations and discussions that were conducted at the EMAK 11 workshop held on 9 February, 2023, at the Grand Copthorne Waterfront Hotel in Singapore, which was organized by The Ministry of Economy, Trade and Industry of Japan (METI) and the Energy Conservation Center, Japan (ECCJ) in cooperation with the Energy Market Authority of Singapore (EMA).

The “Energy Management Action Network” (EMAK) serves as a forum to discuss policy issues related to energy efficiency and energy management systems, to share best practices from participating countries and sectors, and to explore how to adapt such practices to the different conditions and systems prevailing in other countries.

EMAK is a Task Group under the Energy Efficiency Hub, a voluntary collaboration among 16 governments seeking to strengthen their effectiveness in deploying energy efficiency. Its Secretariat is hosted at the International Energy Agency (IEA). EMAK was originally established in 2009 as a Task Group under the International Partnership for Energy Efficiency Cooperation (IPEEC) and has been led by Japan since. It was featured in the G20 Energy Efficiency Leading Programme in 2016 as a key activity to reduce energy intensity in the industrial sector by establishing and enhancing energy management systems and related policy and legal frameworks.

EMAK facilitates public-private exchanges on systems for improving energy efficiency in industry and buildings and fosters the development of networks among policy makers and practitioners such as energy managers. Ten (10) workshops were held before the EMAK11 session, to share and discuss the best practices in energy management and energy efficiency including policy issues related to energy management in each country and region. The ten workshops held to date are as follows:

- 1<sup>st</sup>: Paris, France – 26-27 January, 2010
- 2<sup>nd</sup>: Washington, USA – 10 May, 2010
- 3<sup>rd</sup>: Guilin, China – 15 November, 2011
- 4<sup>th</sup>: Tokyo, Japan – 31 January, 2013
- 5<sup>th</sup>: Sydney, Australia – 27 February, 2014
- 6<sup>th</sup>: New Delhi, India – 25 February, 2015
- 7<sup>th</sup>: Moscow, Russia – 19 November, 2015
- 8<sup>th</sup>: Jakarta, Indonesia – 3 February, 2017
- 9<sup>th</sup>: Sao Paulo, Brazil – 21 November, 2018
- 10<sup>th</sup>: Hanoi, Vietnam – 4 December, 2020

Even as energy prices soar and stable energy supplies are threatened, climate change countermeasures are recognized as a global challenge, and ambitious goals toward carbon neutrality are being formulated and implemented around the world.

Correspondingly, there is a growing need to strengthen policies and measures to address climate change, including the promotion of energy efficiency. In particular, the building sector has great potential for improving energy efficiency, and energy conservation is becoming increasingly important.

Considering this situation, METI decided to hold a workshop in Singapore, an ASEAN country with a strong part to play in the global economy, on the topic of energy conservation in the building sector and the transition toward net-zero energy building. Singapore was chosen to host the workshop because of its strong interest in energy efficient buildings exemplified by the case studies that demonstrate applying energy-saving standards and benchmarks for building design and operations.

The theme of this workshop is “Toward Net-Zero Energy Building.” It aims to highlight policies related to energy efficiency and conservation in the building sector and best practices regarding realistic energy efficient buildings.

The workshop aimed to:

- provide best practices to improve energy efficiency in buildings including a step-by-step approach to constructing net-zero energy buildings,
- discuss common challenges in implementing energy efficiency policies in the building sector, overcoming barriers and achieving realistic targets toward the pathway to net-zero energy buildings,
- provide a networking opportunity to participants from the public and private sectors.

In addition to Singapore and Japan, ACE, Malaysia, Canada, Australia, China, and Germany delivered presentations. Almost 100 participants both in person and online joined the workshop.

Remarks, presentations and discussions can be found in the following sections.

## Opening Remarks & Keynotes

Opening remarks by the organizers and Energy Efficiency Hub representatives were followed by keynote presentations from academic experts from Singapore and Japan.

The session provided an overview of the EMAK Task Group, the objectives of the EMAK 11 workshop and highlighted trends in energy consumption and carbon emissions, as well as perspectives on human behavior and improving the quality of indoor environments. The presentations helped participants understand main approaches to improving energy efficiency in buildings and allowed for a smooth introduction to the panel discussion.

## Remarks from the Energy Efficiency Hub

Ms. Kristina Klimovich, Programme Officer of the Energy Efficiency Hub Secretariat, welcomed all participants to the workshop and explained that the Energy Management Action Network (EMAK) is a Japan-led Task Group of the Energy Efficiency Hub which aims to accelerate the uptake of energy management practices globally. She also explained that the Hub was established to foster global collaboration on energy efficiency and it is unique in providing a platform for government-to-government collaboration and exchanges on energy efficiency. The points of her remarks are as follows.

- (1) To promote energy efficiency and conservation in the industrial sector and buildings, EMAK organized 11 international conferences to bring together government and industry stakeholders to discuss practical implementation of policy issues and accelerate energy management practices worldwide.
- (2) The activities of the other four Task Groups of the Hub (from the Digitalisation Working Group (DWG), Energy Efficiency in Buildings (EEB), Super-Efficient Equipment and Appliances Deployment (SEAD), the Top 10 Energy Efficiency Best Available Technologies and Practices (TOP TENS)) could create synergies with the outcomes of the EMAK11 workshop on improving energy efficiency in the building sector.
- (3) The Hub provides an informal working process to facilitate a lively exchange of ideas, and opportunities to interact with energy efficiency practitioners to help Member governments learn from each other about how to design and implement energy efficiency policies and overcome common challenges.

## Remarks from Japan

Mr. Masashi Hoshino, Director of the International Affairs Office at the Agency for Natural Resources and Energy (ANRE), METI warmly welcomed the participants and provided opening remarks. Mr. Hoshino thanked the host country, Singapore, and all those involved for their tremendous efforts in organizing the workshop, which was held again in person after several years of that not being the case. Mr. Hoshino underscored the importance of energy efficiency in the building sector and the expectations for the practical promotion of ZEB with a step-by-step approach toward net-zero and introduced plans to provide US\$ 150 billion in support for Green Transformation (GX) to further accelerate decarbonization efforts. The points of his speech are as follows.

- (1) Japan promotes net-zero energy buildings as an approach to energy conservation, and ZEBs are classified based on the reduction of a building's standard energy consumption. This concept of ZEB is defined in ISO (TS 23764), an international standard, and contributes to the practical promotion of ZEB in a step-by-step manner, even when it is difficult to achieve net-zero in a single step.
- (2) To achieve both energy security and energy transformation, Japan will invest US\$ 150 billion to support rapid investment to realize more than US\$ 1 trillion in GX investments by the Japanese public and private sectors over the next decade to further accelerate decarbonisation and achieve a green transformation that shifts industrial and social structures toward a clean energy and energy efficient society.

## Keynote 1: The Human Dimension of Net-Zero Energy Buildings

Dr. Clayton Carl Miller, Assistant Professor at the National University of Singapore introduced the SDE4 Net-Zero Energy Building from the National University of Singapore and described research projects focused on human behavior in relation to the indoor environment.

- (1) The SDE4 building is designed with comfort and energy efficiency in mind. A hybrid system cools the entire building and accelerates air movement in response to temperature settings and natural ventilation.
- (2) The Cozie smartwatch data collection platform was deployed in the SDE4 building, which effectively measures environmental, physiological, psychological, and behavioral attributes of its occupants.
- (3) Research projects focused on the role of people's behaviour as building users were described. The National University of Singapore is looking to expand data collection across Singapore, with a vision to scale up to North America, Europe, and Japan. The concept of a digital twin was further elaborated on to better understand how people interact with the environment and evaluate flexible hybrid work.

## Keynote 2: Impact for GHG Reduction by ZEB

Dr. Masayuki Ichinose, Associate Professor at the Tokyo Metropolitan University provided a keynote address focusing on two points, namely, (1) the status of energy consumption and indoor environment quality for “Green Building” practice in Asia-Pacific urban centers and (2) the importance of monitoring and commissioning occupied building for the implementation of carbon neutrality with transparency. He explained the following.

- (1) The energy consumption of Asia will account for 50% of global energy consumption in 2030, and the main factor behind carbon emission in the building sector are a hot & humid climate and urbanization in the ASEAN region.
- (2) A full menu of zero energy building technologies, including measures to address energy consumption due to overcooling and efficient facades, can be applied in Tokyo with a reduction of almost 40% of energy consumption, while important cities in southern Asia could have a potential of 60% or more.
- (3) Existing building codes and ratings are not sufficient to assess building efficiency and carbon neutrality. Overall building performance needs to be transparently shared with building owners, managers, and users.

## Session 1: Effective Policy Packages for Sustainable and Energy Efficient Building – Pathway to Net-Zero Energy Building

Mr. Joji Koike, Managing Director of the ECCJ moderated session 1, in which presentations on effective policy packages were made by Japan, Canada, ASEAN, and Australia. He confirmed that regulatory frameworks are being prepared in various countries to promote carbon emission reductions, including through the establishment of codes and standards for energy efficiency and information disclosure. It was also noted that there is a need for providers to actually propose appropriate measures in accordance with regional context, especially for small and medium-scale businesses.

### 1. Japan's Policy and Strategy in the Building Sector Toward Carbon Neutrality

Mr. Haruto Shinoda, Assistant Director of the International Affairs Office, ANRE, METI introduced policies to promote ZEB, including subsidies, case studies, knowledge sharing, publicizing ZEB businesses, and raising awareness through the ZEB label, etc. His remarks included the following.

- (1) The Building Energy Efficiency Act requires new non-residential buildings to meet energy efficiency standards based on building scale. In 2022, Japan has amended the Building Energy Efficiency Act to make energy efficiency standards mandatory for all building scales.
- (2) METI aims to disseminate ZEB in large-scale buildings by demonstrating “unevaluated technologies - 15 technologies with high energy efficiency potential published by The Society of Heating, Air-Conditioning and Sanitary Engineers of Japan,” through subsidized projects.
- (3) Japan aims to improve awareness of ZEB through information tools such as ZEB Planner, ZEB Leading Owner registration system, ZEB Design Guideline and ZEB Brochure, and Labeling system related to ZEB.

### 2. Toward Net-Zero Buildings in Canada

Mr. Jérôme Bilodeau, Director of Office of Energy Efficiency described federal efforts to develop standards and financial support for net-zero buildings. His points were as follows.

- (1) The Canada Green Buildings Strategy, currently developed by the Government of Canada, focuses on net-zero and climate resilient new buildings, accelerating retrofits, and transforming heating systems.
- (2) The Government of Canada supports existing building retrofits in various ways, namely through the Greener Homes initiative, the Canada Infrastructure Bank, the Greener Neighbourhoods Pilot Program, and the Deep Retrofit Accelerator initiative.

### 3. Toward Carbon Neutrality in the Building sector in ASEAN

Dr. Nuki Agya Utama, Executive Director of the ASEAN Centre for Energy (ACE) introduced the widespread use of more energy efficient air conditioners and other energy efficiency measures, such as the use of efficient fans and improved building envelope efficiency. ASEAN Member States expect to reduce projected space cooling energy use by more than one-third by 2040. His comments included the following.

- (1) While policy and financing frameworks support low-carbon and sustainable building, regulations and standards can provide an effective means of forcing buildings to be equipped with higher efficiency technologies. Information programs to "lift the market" support regulations and incentives and inform consumer choices.
- (2) ACE and the IEA recently published the Roadmap for Energy Efficient Building and Construction in ASEAN to support policymakers in developing, adopting, and enforcing energy efficiency and low-carbon policies and programmes to improve energy efficiency in buildings.

### 4. Transitioning to Net-Zero Commercial Buildings in Australia

Mr. Stanford Harrison, Director of Commercial Building Policy, Department of Climate Change, Energy, the Environment and Water reported that Australia is moving toward a net-zero future, in line with a national plan ("The Trajectory for Low Energy Buildings") that aims to achieve cost-effective energy efficiency improvements in residential and commercial buildings. His remarks were as follows.

- (1) The National Construction Code (NCC) is a performance-based code that sets minimum required levels for sustainability, safety, and other aspects of a particular building, including energy efficiency. In addition to incremental updates of the NCC, the Trajectory for Low Energy Buildings includes a wide range of complementary measures, including rating updates and disclosures, and consumer guidance.
- (2) The Commercial Building Disclosure (CBD) Program was introduced in 2010 under the Building Energy Efficiency Disclosure Act to mandate disclosure of energy efficiency information after 10 years of voluntary ratings based on design standards.

## Q&A

During the Q&A session, the following was discussed.

About Canada as a federal state, a question was raised about the interrelationship between measures at the national and sub-national levels. The Federal Government is responsible for coordinating the development of national standards and harmonization among the states.

The means of connecting real estate companies and building owners with manufacturers of energy efficient equipment to find appropriate technologies to install in order to meet energy goals were addressed. It was further noted that incentives were put in place to facilitate these connections.

The importance of policy packages as a means to further accelerate the improvement of building energy efficiency were discussed. The need for further promotion of the policy packages through workshops and other means to explain the policies and packages was noted.

## Session 2: The Best Practice Examples Toward Net-Zero Carbon goals in the Building Sector

Mr. Masashi Hoshino, Director of International Affairs Office, ANRE, METI moderated the second session, which featured presentations from Singapore, Malaysia, China, Japan, and Germany on best practice examples of realistic energy efficient buildings.

He confirmed the importance of digitization to obtain a complete overview of energy consumption. In the second session, the optimal application of individual technologies and their operation, including maintenance, were also discussed as important for realizing highly efficient buildings.

### 1. Singapore's Sustainability Drive Toward Zero Energy

Ms. Farizan d'Avezac de Moran, Senior Partner of GreenA Consultants Pte Ltd presented examples of building energy reduction through Green Mark certification and the latest Positive Energy Buildings. His points were the following.

- (1) The BCA (Building and Construction Authority) Green Mark is a green building certification tailored to tropical climates and requires a 50% energy reduction. With a further 5% reduction in energy consumption, SLE (Super Low Energy) buildings can achieve zero energy by using the Local REC (Renewable Energy Certificates) credits offset.
- (2) In addition to the energy efficient design of the building envelope, Takeda Pharmaceutical's new energy positive building reduces energy consumption through a hybrid air conditioning system, a plug load management system, and BMS management of IoT devices, making energy consumption of the building smaller than that generated by its solar PV.

### 2. ZEB Conversion Retrofit of Existing Building in Malaysia

Mr. Steve Anthony Lojuntin, Director of the Sustainable Energy Development Authority (SEDA) presented a government-sponsored emissions reduction initiative: a low-cost sports center renovation. He made the following comments.

- (1) The Astaka Sports Complex is a showcase of the government to lead by example in reducing carbon emissions in buildings. Simple and affordable retrofits were done by the Petaling Jaya City Council.
- (2) Based on the results of an energy audit of a 40-year-old one-story multi-purpose building, retrofits (lighting and HVAC system, passive system improvements) resulted in approximately 64% of energy savings, excluding renewable energy use.

- (3) The building is qualified as a Zero Energy Building under the ZEB Ready category and has obtained ZEB voluntary certification by SEDA Malaysia in 2019.

### 3. The Best Practice Examples Toward Carbon Neutrality Goals in the Building Sector

Mr. Zhang Yigong, Project Engineer of the China Quality Certification Centre introduced the case of the Demonstration Building with Near-Zero Energy Consumption of the China Academy of Building Research, which contributed to the establishment of a standard for buildings with near-zero energy consumption, and the Passive House Experience Center at the Sino-German Eco Park. He noted the following.

- (1) The Demonstration Building with Near-Zero Energy Consumption located in Beijing integrated 28 world leading energy conservation and environmental control technologies, including building enclosure components, heating & refrigeration technology, end-of-pipe technology, renewable energy application and an intelligent control system that can save more than 80% of energy consumption.
- (2) The Passive House Technology Experience Center which was adapted with a series of passive technologies and green building technologies, including the design of the enclosure structures, renewable energy technology, air conditioning optimizations, and operation systems for energy resource and human management, is effective in disseminating passive house technologies in cold regions.

### 4. Energy Saving Technology Toward ZEB and SLEB as a Private Construction Company in Singapore

Dr. Takamasa Hasama, Senior Research Engineer of the Kajima Technical Research Institute Singapore (KaTRIS) introduced the case of a high efficiency building in Singapore that integrates design, work style, management, and renewable energy use. His comments were as follows.

- (1) Four types of technologies to realize ZEB were explained, showing that energy conscious design can have a significant effect prior to the optimization of energy-saving performance and renewable energy use. The importance of the design to lead occupants to energy-saving behaviors, including a passive designing and reduced wasted energy, as well as the design of efficient and comfortable workplaces, was demonstrated.
- (2) The six-story building in Singapore will serve as a testbed for R&D in global engineering, architecture, and real estate, with energy consumption estimated to be less than 45%, making it SLE (Super Low Energy Buildings) on Green Mark in Singapore. In addition to the radiant air-cooling system and photovoltaic system installed in the building, the project

aims to further reduce energy consumption by utilizing the semi-outdoor space as a workspace and data-driven control of energy consuming equipment using digital twin and machine learning technologies.

## 5. Climate-Neutral Construction and Refurbishment – Best Practice Examples from Germany

Mr. Manuel Palz from the Federal Ministry for Economic Affairs and Climate Action of Germany (BMWK) showed a comprehensive overview of current German projects of sustainable construction, including construction of buildings using recyclable materials, refurbishment of a residential block, and an entire neighborhood. He made the following remarks.

- (1) The Cradle, a hybrid wooden office building in Düsseldorf, where approximately 98% of the installed materials are recyclable, has eliminated 1,152 tons of carbon dioxide emissions by replacing reinforced concrete with wood.
- (2) The retrofit of an apartment block consisting of three two-story buildings demonstrated that continuous retrofitting according to the Energiesprong principle for multi-family dwellings is technically feasible, and that even the worst class of energy efficiency in existing buildings can be raised to net-zero standard with serial refurbishment.
- (3) Quartier, Rosenheim's largest timber construction housing project, combines sustainability and social aspects by integrating various technologies, such as heat supply through district heating, energy supply from on-site electricity generated by a photovoltaic system and battery storage, use of prefabricated wood panel elements to reduce construction time and numerous cooling green areas in the property and on-site rainwater retention, and meets the KfW 40 plus building standard.

### Q&A

During the Q&A session, the following was discussed.

Discussions revealed that building owners may be reluctant to invest in green building retrofit due to high investment costs and owners' prevailing focus on economic and financial factors in investment decisions. However, even without the obligation or compulsion to implement net-zero, an understanding of the environmental and social benefits can encourage building owners to make investment decisions that incorporate the triple bottom line, including return on investment, environmental aspects, and social aspects, leading to implementation of green building retrofits with the involvement of consulting firms.

The use of intelligent control and digitization was also discussed, and it was noted that it is important to keep systems in proper condition, including equipment maintenance, and that

these technologies can be very effective if used under the right circumstances and for the right purposes.

Questions were also asked about individual technologies, and the challenges of introducing outside air (latent heat, noise, dust) and the thermal comfort and recyclability of wood constructions were discussed.

## Session 3: Panel Discussion on Promotion of EE&C Toward Achievement of Net-Zero Energy Building

Dr. Yoshitaka Ushio, Senior Advisor of ECCJ moderated session 3, in which two agendas were selected to discuss by the moderator, namely (1) Agenda 1: the key policy issues to enhance awareness of building owners to promote ZEB, and (2) Agenda 2: the technical challenge for the promotion and dissemination of ZEB.

He pointed out that the global ZEB initiatives are in their early stages and cannot be realized immediately, and he invited four panelists to Agenda 1 (the key policy issues to enhance awareness of building owners to promote ZEB), which was chosen as the first challenge in promoting ZEB in a situation where ZEB is still not well understood and building owners are reluctant to promote ZEB due to the image of high construction costs and unfeasibility.

### Agenda 1: The Key Policy Issues to Enhance Awareness of Building Owners to Promote ZEB

The four panelists were Ms. Kristina Klimovich from the Energy Efficiency Hub, Dr. Nuki Agya Utama from ACE, Mr. Manuel Palz from BMWK, and Mr. Haruto Shinoda from METI, respectively.

Ms. Kristina Klimovich pointed out that the role of the public sector is to ensure a regulatory environment that attracts private capital to enter the market, provides the right incentives, the right subsidies, and sends a message to the market that we are aiming for net-zero. She introduced the "policy toolkit" (policy package approach) that the IEA's Energy Efficiency Hub is working on.

With regard to the first pillar of the package, "regulation," she noted that about 90 countries around the world already have energy building codes in place and cited the example of a Dutch office building with a minimum energy performance standard, where regulation stimulated the market.

As examples of the second pillar, "information," she cited the European Energy Performance Certificate and the Recovery Passport, in addition to NABERS and Green Mark, which were categorized as labels and branding. She also drew attention to the importance of information transparency, which was pointed out in the keynote speech.

Regarding the third pillar, "incentives," she introduced the use of debt against the building itself. She pointed out that these financing instruments, such as Property Assessed Clean Energy (PACE), which is tax-financed, and Power Purchase Agreements (PPAs), which are contracts for energy efficiency and supply, can accelerate the decision-making process for retrofits.

Dr. Nuki Agya Utama drew attention to the fact that building materials and appliances play a role in the energy efficiency of buildings, and pointed out that providing incentives to designers and users who choose these products is important for zero energy buildings. He introduced examples of regional banks investing in energy conservation and noted the need for global funds to be made available to regional banks. As an information area for the policy package approach, he indicated that Energy Efficiency and Conservation, a programme area of the ASEAN Action Plan on Energy Cooperation, is promoting Zero Energy Buildings through the ASEAN Energy Awards.

Mr. Manuel Palz indicated that within the policy framework of the European Green Deal, the German federal government is strengthening its regulatory framework with the aim of achieving climate neutrality by 2045. He pointed out that Germany has a huge building stock and that it is very important to start with appropriate renovation and refurbishment of apartment buildings. On the other hand, he showed that funding for renovation measures cannot continue to increase, and that the regulatory framework needs to be strengthened. He noted that one of the most important aspects of strengthening the regulatory framework is improving clarity, and that an effort should be made to make owners, tenants, and investors aware of policy packages and regulations through a massive public campaign.

Mr. Haruto Shinoda reiterated the importance of a policy package that includes regulations, information, and incentives, drawing attention to the importance of the combination and interaction of each of these instruments. He cited support measures for ZEB in Japan, for example, subsidies to replace inefficient equipment with more efficient equipment, such as for the installation of heat-pump water heaters, and explained a system in which businesses must make efforts to save energy in order to receive support.

## Agenda 2: The Technical Challenge for the Promotion and Dissemination of ZEB

Dr. Yoshitaka Ushio, then, invited four panelists to Agenda 2 (the technical challenge for the promotion and dissemination of ZEB) to discuss solutions to the challenges of ZEB promotion. The four panelists were Ms. Farizan d'Avezac de Moran from GreenA Consultants, Mr. Steve Anthony Lojuntin from SEDA, Dr. Takamasa Hasama from KaTRIS, and Mr. Manuel Palz from BMWK, respectively.

Ms. Farizan d’Avezac de Moran noted that cheap tariffs hinder the diffusion of technologies. She cited waste heat recovery, water reuse, and renewable energy from biomass fuels and solar power generation as technologies that can help realize a recycling-oriented society and expressed hope for heat pumps.

Mr. Steve Anthony Lojuntin cited the lack of appropriate constructors and designers as a technical challenge in the planning phase, including for the decision of design firms and contractors and the selection of materials and equipment. He mentioned that in Malaysia, capacity building and knowledge sharing has been progressing through a demonstration project that was promoted using energy consultants and a facility management who know how to manage buildings.

Dr. Takamasa Hasama pointed out that while there are many different measures to reduce energy use through air conditioning, the most efficient way is to take into account the climate conditions and people's mindsets. He explained that not only installing highly efficient HVAC systems, but also combining classic methods such as natural ventilation systems, can be very cost-effective, and drew attention to the role of construction companies which can offer a wide range of options. Regarding the diffusion of heating and cooling technologies, which is important for the promotion of ZEB, Mr. Patz again presented two issues based on the current situation in Germany. He explained that in Germany, about 80% of heating demand is met by gas and oil, and that there is an accelerating trend toward the widespread use of heat pumps for heating, and pointed out that many older buildings need to be retrofitted and that there is a shortage of skilled workers to do the retrofitting. He concluded that capacity building and knowledge sharing are also important in Southeast Asia, and that measures to educate constructors and workers are needed.

## Closing Remarks and Networking Dinner

Mr. Jonathan Goh of the Energy Market Authority, Singapore, and Mr. Masashi Hoshino of METI, Japan, provided the closing remarks for the workshop.

Mr. Jonathan Goh expressed his pleasure in organizing the EMAK11 workshop in collaboration with METI. He expressed his sincere gratitude to all the organizers, speakers, and participants who contributed to the success of the workshop. Mr. Goh introduced the fourth edition of the Singapore Green Building Master Plan, which aims to achieve a sustainably built environment with zero emissions by 2050. He expressed his great pleasure to invite many participants to Singapore for an in-depth exchange of views on the challenges and opportunities of a low-carbon future. He invited speakers and participants to the reception and networking dinner.

Mr. Masashi Hoshino expressed his gratitude to all those that had been involved in developing and delivering the workshop. He also thanked participants for their active involvement in the workshop.

He reiterated the importance of promoting international cooperation and gathering collective wisdom and announced that the results of the workshop would be shared in cooperation with the Energy Efficiency Hub.

Following the closing remarks, workshop participants attended a reception and networking dinner at the hotel. This provide an opportunity for networks to be further developed and perspectives to be shared among policymakers from governments and international organization, practitioners from the industrial sector and financial institutions, and researchers from academia.

## Analysis of Workshop Themes

The following is a summary of this workshop as an outcome of the presentations and questions from each session.

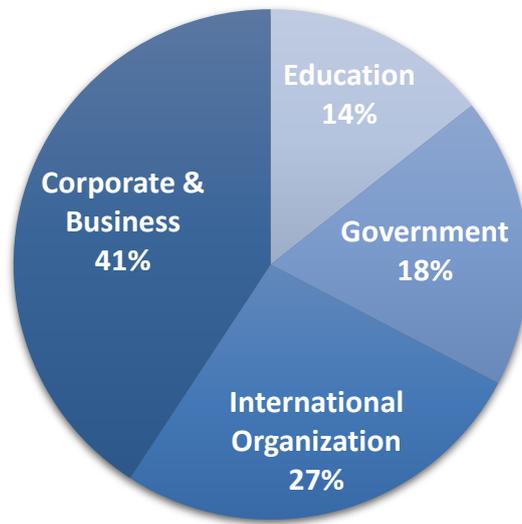
In Session 1, effective policy packages for sustainable and energy efficient buildings were presented by Japan, Canada, ASEAN, and Australia. The importance of developing a regulatory framework to promote carbon emission reductions, including the development of codes and standards for energy efficiency and information disclosure, was confirmed. In addition, it was noted that it is necessary to propose appropriate measures, especially for small and medium-sized businesses, according to regional context.

In Session 2, excellent examples of realistic energy efficient buildings in Singapore, Malaysia, China, Japan, and Germany were presented, confirming the importance of using digital technology to gain a holistic view of energy consumption. At the same time, China's policy of continuously raising energy efficiency standards for new buildings with the goal of peaking carbon dioxide emissions by 2030 and achieving carbon neutrality by 2060 was introduced. Also introduced was a policy package that mandates the creation of a so-called Immediate Action Program to close the gap if Germany fails to meet its objective and annual recommendation to be greenhouse gas neutral by 2045. In addition, participants discussed that the optimal application of individual technologies and their operation, including their maintenance, are critical to achieve highly energy efficient buildings.

During the panel discussion, issues and solutions for ZEB promotion were discussed. About raising ZEB awareness among building owners, the importance of implementing various policies (regulations, information, and incentives) as a package and enhancing their effectiveness through the synergistic effects of each policy was discussed. As for technical issues for the dissemination and promotion of ZEB, it was concluded that various technologies exist from the supply side to the demand side of energy, and that it is important to develop human resources to successfully combine and integrate these technologies.

Approximately 100 people attended EMAK11 workshop both in person and online. The affiliations of the in-person participants are shown in Figure 1. Networking took place through discussions and receptions.

## Affiliation



■ Education ■ Government ■ International Organization ■ Corporate & Business

Figure 1. Participant Affiliations

## Conclusion

In addition to reaffirming the effectiveness of ZEB in the building sector toward carbon neutrality, the following points were noted as important.

- (1) Each country has already introduced buildings that use high energy efficiency and renewable energy measures. Policy measures to promote ZEB ought to be flexible and take into account each country's local context.
- (2) As for implementation, various policies should be combined as a package to enhance the effectiveness of each policy through synergistic effects.
- (3) On the technical side, it is necessary to combine various technologies, and for this purpose, cooperation among the academia, the public and private sectors is needed. Furthermore, workforce development related to ZEB is required in various sectors, which involves the development of skills and competencies for net-zero building renovation.

EMAK enables information sharing and networking among participants from public and private sectors. Participants reaffirmed the value of in-person events and raised the potential of holding future local meetings to deepen exchanges on this topic.

## Appendix 1: Agenda

Time (SGT)	Agenda
09:30-10:00	Reception/Connection Test
10:00-11:00	<b>Opening Remarks &amp; Keynotes</b>
10:00-10:10	Remarks from the Energy Efficiency Hub Ms. Kristina Klimovich, Programme Officer, Energy Efficiency Hub
10:10-10:20	Remarks from Japan Mr. Masashi Hoshino, Director, International Affairs Office, ANRE, METI, Japan
10:20-10:40	Keynote 1: The Human Dimension of Net-Zero Energy Buildings Dr. Clayton Carl Miller, Assistant Professor, National University of Singapore
10:40-11:00	Keynote 2: Impact for GHG reduction by ZEB Dr. Masayuki Ichinose, Associate Professor, Tokyo Metropolitan University, Japan
11:00-11:30	Guest Introduction and Photo Session & Break
11:30-12:50	<b>Session 1: Effective Policy Packages for Sustainable and Energy Efficient Building – Pathway to net-ZERO Energy Buildings</b> <b>Chaired by Mr. Joji Koike, ECCJ</b>
11:30-11:45	S1 1 Japan's policy and strategy in the building sector toward Carbon Neutrality Mr. Haruto Shinoda, Assistant Director, International Affairs Office, ANRE, METI, Japan
11:45-12:00	S1 2 Toward Net-Zero Buildings in Canada Mr. Jérôme Bilodeau, Director, Office of Energy Efficiency, Canada (via online)
12:00-12:10	Q&A
12:10-12:25	S1 3 Toward Carbon Neutrality in Building sector in ASEAN Dr. Nuki Agya Utama, Executive Director, ASEAN Centre for Energy
12:25-12:40	S1 4 Transitioning to Net-Zero Commercial Buildings in Australia Mr. Stanford Harrison, Director, Commercial Building Policy, Department of Climate Change, Energy, the Environment and Water, Australia (via online)
12:40-12:50	Q&A
12:50-14:10	<i>Lunch</i>

14:10-15:45	<p><b>Session 2: The Best Practice examples toward Net-Zero Carbon goals in the Building sector</b></p> <p><b>Chaired by Mr. Masashi Hoshino, ANRE, METI</b></p>
14:10-14:25	S2 1 Singapore's Sustainability Drive Toward Zero Energy Ms. Farizan d'Avezac de Moran, Senior Partner, GreenA Consultants Pte Ltd, Singapore
14:25-14:40	S2 2 ZEB conversion retrofit of existing building in Malaysia Mr. Steve Anthony Lojuntin, Director, Sustainable Energy Development Authority, Malaysia
14:40-14:55	S2 3 The Best Practice examples toward carbon neutrality goals in the building sector Mr. Zhang Yigong, Project Engineer, China Quality Certification Centre, China (via online)
14:55-15:05	Q&A
15:05-15:20	S2 4 Energy Saving Technology Toward ZEB and SLEB as a Private Construction Company in Singapore Dr. Takamasa Hasama, Senior Research Engineer, Kajima Technical Research Institute Singapore
15:20-15:35	S2 5 Climate-neutral construction and refurbishment - best practice examples from Germany Mr. Manuel Palz, Federal Ministry for Economic Affairs and Climate Action (BMWK), Germany (via online)
15:35-15:45	Q&A
15:45-16:05	<i>Break</i>
16:05-17:35	<p><b>Session 3: Panel Discussion on Promotion of EE&amp;C toward achievement of Net-Zero Energy Building</b></p> <p><b>Moderated by Dr. Yoshitaka Ushio, ECCJ</b></p>
16:05-16:45	<p>Panel Discussion (Speakers and Representatives of Government / Private Sector) Panelist's opinion sharing (5min. each) and Discussion Agenda 1: Key policy issues to enhance awareness of building owners to promote ZEB ACE (Dr. Nuki Agya Utama), Energy Efficiency Hub (Ms. Kristina Klimovich), Germany (Mr. Manuel Palz via online), Japan (Mr. Haruto Shinoda) Discussion and Q&amp;A</p>
16:45-17:25	<p>Agenda 2: Technical challenges for promote and disseminate ZEB Singapore (Ms. Farizan d'Avezac de Moran), Malaysia (Mr. Steve Anthony Lojuntin), Germany (Mr. Manuel Palz via online), Japan (Dr. Takamasa Hasama) Discussion and Q&amp;A</p>

17:25-17:35	Wrap-up of Session 3 by Moderator
17:35-17:45	<b>Closing</b>
17:35-17:40	Closing Remarks (MTI, Singapore) Mr. Jonathan Goh, Director of External Relations, Energy Market Authority
17:40-17:45	Closing Remarks (METI, Japan) Mr. Masashi Hoshino, Director, International Affairs Office, ANRE, METI
	END of Workshop
18:00-19:30	Reception

## Appendix 2: Photos from the Workshop

Opening & Keynote Session, Assembly Photo of Speakers with Guests



### Presentations



Q&A, Discussion



Closing Remarks



*Reception & Networking*



