Asia-Pacific
Economic Cooperation

Advancing Free Trade
for Asia-Pacific Prosperity

The APEC LCMT Project Wrap-up Symposium

APEC Energy Working Group

October 2022

Asia-Pacific
Economic Cooperation

The APEC LCMT Project Wrap-up Symposium

SUMMARY REPORT

Tokyo, Japan (Online), 10 September 2021

APEC Energy Group

October 2022

APEC Project: EWG 01 2019A

Produced by
Asia Pacific Energy Research Centre (APERC)
11F, 1-13-1 Kachidoki, Chuo-ku, Tokyo 104-0054 Japan

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

APEC#222-RE-04.6

Table of Contents

Abbreviations

BAU	Business As Usual
CO_2-eq	Carbon dioxide equivalent
EV	Electric Vehicle
GHG	Greenhouse Gas
GW	Gigawatts
KPI	Key Performance Indicator
LCMT	Low-Carbon Model Town
LCT-I	Low-Carbon Town Indicator
LED	Light Emitting Diode
Mt	Million tonnes
$MtCO_2$	Million tonnes of carbon dioxide
$MtCO_2$-eq	Million tonnes of carbon dioxide equivalent
MW	Megawatt
PV	Photovoltaic
tCO_2	Tonnes of carbon dioxide
tCO_2-eq	Tonnes of carbon dioxide equivalent
TOD	Transit Oriented Development
TW	Terawatts

List of Figures

1. Background

The APEC Low-Carbon Model Town (LCMT) Project is a multi-year project that includes the LCMT Phases 1-7 and the LCMT Dissemination Phases 1-3.

It was launched in response to the declaration of the 9th APEC Energy Ministers Meeting in Fukui, Japan, in 2010. During the Phases 1-6 from 2011 to 2016, the Concept of the Low-Carbon Town in the APEC Region (Concept), which provides a basic idea of a low-carbon town and an effective approach to its development, was developed. In tandem with the Concept, the APEC Low-Carbon Town Indicator (LCT-I) System, which is a self-assessment tool to assess and monitor the progress of each low-carbon town development, was developed and published in 2016. Over the 2011-2017 period, full-scale feasibility studies and policy reviews for seven case towns in China, Thailand, Viet Nam, Peru, Indonesia, the Philippines and Russia were deployed. Additionally, the 1st LCMT symposium was held successfully in Indonesia in 2017.

Continuing the success of the LCMT Phases 1-7, the LCMT Dissemination Phases 1-3 based upon the instructions from the 12th APEC Energy Ministerial Meeting in Cebu, the Philippines, in 2015 were implemented. The main objective of the Dissemination Phase was to accelerate the dissemination of low-carbon towns to manage rapidly growing energy consumption in the APEC region. Although the Dissemination Phase was originally planned from 2018 to 2020, it was extended to the end of 2021 due to the spread of the Covid-19 pandemic. Eight focused feasibility studies were conducted at volunteer towns in six APEC economies (Indonesia, Malaysia, the Philippines, Viet Nam, Thailand and Peru). Furthermore, three other APEC LCMT symposiums were conducted during this period, including this wrap-up symposium.

2. Objectives

The main objectives of the APEC LCMT Project Wrap-up Symposium are to recognize the activities of the APEC LCMT project that have been conducted over the last ten years, share the lessons learnt on low-carbon town development with planners and policymakers, and reinforce the existing LCMT network in the APEC region.

3. Symposium Description

The APEC LCMT Project Wrap-up Symposium was hosted by Japan and virtually organized by the Asia Pacific Energy Research Centre (APERC) on 10 September 2021. The agenda of the symposium consisted of the following sessions:

1. **Opening**: Welcome remarks from the Ministry of Economy, Trade and Industry (METI) Japan and Chair of APEC Low-Carbon Model Town Taskforce (LCMT-TF), followed by the APERC presentation on the outline of the APEC LCMT project development.
2. **Reports of participating towns**: Speakers presented the current status of LCMT developments, advantages and disadvantages for each town. Subsequently, Japan shared its experience on the development of a low-carbon town and projects to reduce CO_2 emission.

3. **Reviews from the experts and Q&A**: Three experts presented the comments and suggestions for the participating towns, followed by Q&A.
4. **Closing**: Closing remarks.

The agenda is in Appendix and the slides used in the presentations are listed as Annex.

4. Symposium Sessions Summary

4.1 Opening

On behalf of the host economy, **Mr Tetsuro Ito**, Director for Natural Resources and Energy Research, International Affairs Division, Agency for Natural Resources and Energy, Ministry of Economy, Trade and Industry (METI) Japan and Chair of APEC Low-Carbon Model Town Taskforce (LCMT-TF) delivered the opening remarks. He regretted having this symposium online instead of in-person in Tokyo due to the ongoing pandemic. He expressed gratitude to the organizers and participants, especially **Dr Irie** and **Mr Yamashiro,** for organizing this symposium. He also pointed out that the natural disasters worldwide have made a low-carbon society "more realistic and urgent". He expressed his wish that this symposium be a fruitful one and promote a low-carbon society.

Subsequently, **Mr Diego Rivera Rivota**, a researcher from the Asia Pacific Energy Research Centre (APERC), introduced the APEC LCMT project development outline as follows: The Concept and the LCT-I System were developed by the APEC-LCMT Task Force and APERC beginning in 2011. Over the project period, 15 full-scale or focused feasibility studies were conducted in eight APEC economy members. Additionally, three LCMT symposiums were carried out successfully. He concluded his presentation by stating that this wrap-up symposium and its report marked an end to this ten-year project.

The Concept and the LCT-I system are available on the APERC website at

https://aperc.or.jp/publications/reports/lcmt.html

4.2 Reports of participating towns

4.2.1 Yujiapu CBD, Tianjin, China

Professor Li Zhu from the APEC Sustainable Energy Centre presented the low-carbon town development in China based on the experience of the APEC LCMT project in Yujiapu's Central Business District (CBD). The Yujiapu CBD was designated as the first APEC LCMT at the 9th APEC Energy Ministerial Meeting held in 2010 and a full-scale feasibility study was conducted in 2011.

The Yujiapu CBD is located in Tianjin city, the second-largest city in the north of China, with a total area of 2 270 km^2. Yujiapu CBD covers an area of 3.86 km^2 and is surrounded by water on the east, west, and south side. The district plans to build 120 buildings with a total construction area of 9.5 km^2, a comprehensive international central business district with business and financial functions, including commercial, exhibition, leisure, cultural and entertainment functions.

General measures were taken in the Yujiapu CBD, including the technical path of low-carbon city construction and the KPI low-carbon town index system. While the technical path of low-carbon city construction shows the sectors which are potential for low-carbon city target, KPI low-carbon town index system sets out the target for each index such as total carbon emissions and green ratio of built-up areas.

Five main specific measures have been applied in the Yujiapu CBD. They included green buildings, low carbon transportation, low carbon energy, underground space and low carbon landscape.

For the green building measure, all building in the area will qualify as green buildings and over 70% of the buildings receive the highest rating. In low carbon transportation, seven kinds of public transportation with Transit Oriented Development (TOD) complex functions were introduced in Yujiapu, including high-speed rail, metro, customized bus, regular bus line, inside shuttle bus, bicycle rental and sightseeing boat (Figure 1).

Regarding low carbon energy measures, it planned seven cooling supply centres in the Yujiapu CBD to provide high-quality cooling service to 120 plots, with a total service area of 6 900 000 m^2 (72.9% of the planned construction area).

The underground space within the boundary line of the building is nearly four million square meters and it is used for various functions such as transportation, commerce, culture, leisure, parking and disaster prevention.

Low carbon landscape measures take into account the river landscape, increase open space, establish a green belt for Central Avenue and install green roofs, with a green ratio of nearly 40%.

Applying all these measures is expected to reduce total CO_2 emissions by 30% by 2030 relative to the 2010 emissions level.

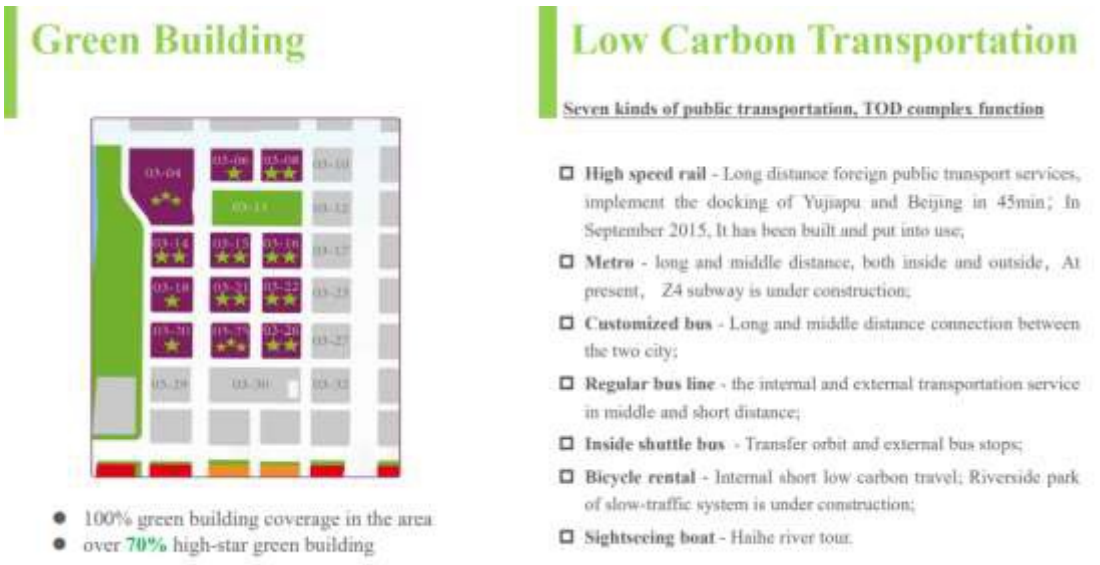

Figure 1: Selected measures for low-carbon development in Yujiapu CBD

4.2.2 Koh Samui, Thailand

On behalf of Koh Samui Municipality working group, **Mr Kamol TANPIPAT** from Bright Management Consulting Co., Ltd. presented the LCMT development in Koh Samui Municipality.

Koh Samui is in the east coast of Gulf of Thailand, and is the third-largest island in Thailand. This island is one of the tourism destinations in Thailand, with a total area of 227 km^2 and 68 894 people (2018 data).

A full-scale feasibility study for Koh Samui was conducted in 2012 in LCMT Phase 2. The objective was to plan, develop and implement the concrete roadmap to lower carbon emissions while the natural resources are effectively utilized and the economic growth continues. Nine potential categories were introduced to reduce the CO_2 emissions in the city. They included town structure planning, transportation, area energy planning, area energy management, renewables, untapped energy, low carbon building, eco-lifestyle and environment.

Specific measures for CO_2 emissions reductions in the short, medium and long term for Koh Samui city have been planned, which are expected to reduce emissions by 2.2 $MtCO_2$-eq by 2030.

In the short term, nine measures expected to be implemented during 2022 are: (1) LED replacement bulbs to increase lighting efficiency, (2) LED bulb installation on public roads, (3) public EV mini-buses promotion (whole-island route), (4) public EV mini-buses promotion (Airport – Chaweng route), (5) installation of organic waste compost bins in households, (6) establishment of waste management stations to produce compost, (7) forest restoration/rehabilitation, (8) mangrove forest plantation, and (9) increase of city green areas.

In the medium term, six measures will be conducted between 2023 and 2025. They include (1) replacement of all split type air conditioners with inverter type, (2) promotion of solar power generation system, (3) promotion of solar hot water generation system, (4) installation of solar floating power generation system, (5) promotion of the use of EV motorcycles so that its share will reach 10%, (6) increase the efficiency of waste treatment and conversion of RDF.

In the long term, a measure for increased energy efficiency by using a chiller system by 2030.

He also described notable achievements of this LCMT project, such as expansion of this initiative to additional CO_2 reduction projects, creation of new coordination framework among local stakeholders, expansion of renewable energy development projects, inspiration for other sectors regarding CO_2 reduction, creation of a new voluntary group to address organic waste issues at the household level leading to the reduction of waste sent to municipal landfills (Figure 2).

Figure 2: Notable achievements in the Koh Samui

4.2.3 Da Nang, Viet Nam

Mr Tran Minh Huy from Da Nang Department of Industry and Trade presented the LCMT development of Da Nang, one of the biggest cities in Viet Nam with a population of 1.2 million and 1 283 km^2. The key measures for CO_2 reduction include energy efficiency and renewable energy.

A full-scale feasibility study for Da Nang was conducted in 2013 in LCMT Phase 3. Application of LED lights in public lighting has been deployed since 2018, replacing sodium public lights with LED lights at 19 main streets with nearly 3000 light points, accounting for 5% of the total public lights. The People's Committee plans to replace around 10% of the total lights by 2030.

The technical potential map of rooftop solar power has been investigated and deployed since 2017. The installed capacity of rooftop solar power reached 75 MW in 2020. Rooftop solar power plan to 2025 with a vision to 2035 sets out the goals of 169.54 MW by 2025, reaching 293.92 MW and 402.24 MW in 2030 and 2035, respectively.

By applying such measures, Da Nang diminished its CO_2 emissions by 2% in 2015 and 5% in 2020 compared with the baseline (BAU scenario).

Up to 2020, there were notable achievements: (1) the Air Pollution Index (API) in urban areas was maintained at less than 100, (2) noise levels in residential areas were under 60 dB, on main roads under 75 dB, (3) average urban green area was 6 - 8 m^2/ person, (4) the percentage of households with access to clean water in the city centre and rural area were 97.83% and 76.81% respectively, (5) 100% of industrial wastewater met discharge requirements, (6) the proportion of domestic solid waste collected in urban areas was higher than 95%, in rural areas higher than 70%, (7) over 83% of domestic wastewater was collected, over 50% was properly treated in accordance with standards.

4.2.4 San Borja, Lima, Peru

Ms Leydith Valverde from the Municipality of San Borja presented the LCMT development in San Borja, highlighting its efforts since the full-scale feasibility study was conducted in 2014 in LCMT Phase 4.

The Municipality of San Borja assumes the goal of reducing carbon emissions by 85% by 2035. It has taken various measures, setting the target for 2035.

The Green San Borja program aims at implementing 12 urban bio-gardens in the district, benefiting 2 000 families. Up to 2021, five bio-gardens were implemented, accounting for 29.5% of the 2035 target (Figure 3). Besides, San Borja Urban Green program aims at achieving 100 000 trees in the district, accounting for 25% of the total tree coverage. This program is expected to reduce more than 100 000 tCO_2 per year. Currently, 38 600 tCO_2 was reduced, accounting for 38.5% of the total target.

Figure 3: Urban Biogardens Program in San Borja

In the sustainable mobility program, 53 km of bike lanes within San Borja and interdistrict connection among Surco, Surquillo and San Isidro were completed. This program is expected to reduce 4 025 Mt CO_2-eq by 2035. Up to 2021, about 1 039 Mt CO_2-eq was reduced, accounting for 25.8% of the total target.

An energy planning program aims to disseminate and promote the efficient use of alternative energies for 66 500 people. Around 20 000 people have participated, accounting for 30% of the 2035's target. One of the targets of this program is to produce annually 456 Mt of organic fertilizer. 268 tonnes of compost have been produced per year by 2021, accounting for 58.8% of the 2035's target.

San Borja Recycles program aims to invest 150 underground containers and make 80% of the collection recyclable material by 2035. Up to the present, while 110 underground containers have been set up, accounting for 73.3% of the target, the target for recyclable material has been already attained.

The urban planning program includes green streets and the San Borja river park projects. While the green streets project aims to construct small gardens and green roofs, the San Borja river park project aims to canalize the Surco river. Currently, 50% of the project has been completed.

Eco-efficient design and eco-efficient buildings programs aim to promote standards for sustainable construction to 2035. Three municipal ordinances and two mayoral resolutions have been implemented, accounting for 50% of the 2035's target.

Up to the present, San Borja has reduced GHG emissions by 15% since the beginning of participation in the LCMT project.

4.2.5 Bitung, North Sulawesi, Indonesia

Ms Jenny Karouw, Head of North Sulawesi Regional Planning and Development Board, presented the LCMT development in North Sulawesi province and Bitung City.

She mentioned the North Sulawesi target in renewable energy which contributed considerably to the CO_2 emissions reduction. The province plans to construct 832 MW of solar photovoltaics by 2025, in addition to existing renewable resources of 120 MW of geothermal power and 62 MW of hydroelectric power. In 2020, CO_2 emissions were 0.35 $MtCO_2$-eq less than expected under the BAU scenario.

The LCMT was deployed within 534 ha in the Bitung Special Economic Zone (SEZ), part of Bitung city with 33 008 hectares and 225 134 inhabitants. The full-scale feasibility study was conducted in 2015 in LCMT Phase 5.

In the coming years, Bitung SEZ will become a domestic and global model for sustainable, low carbon urban and industrial planning and contribute to the domestic goal of reducing GHG emissions by 29% by 2030 compared with the BAU scenario.

In terms of environment and resources, Bitung SEZ proposes an eco-friendly plan consisting of retaining sufficient green areas to minimize the adverse effect of commercial and industrial development (Figure 4).

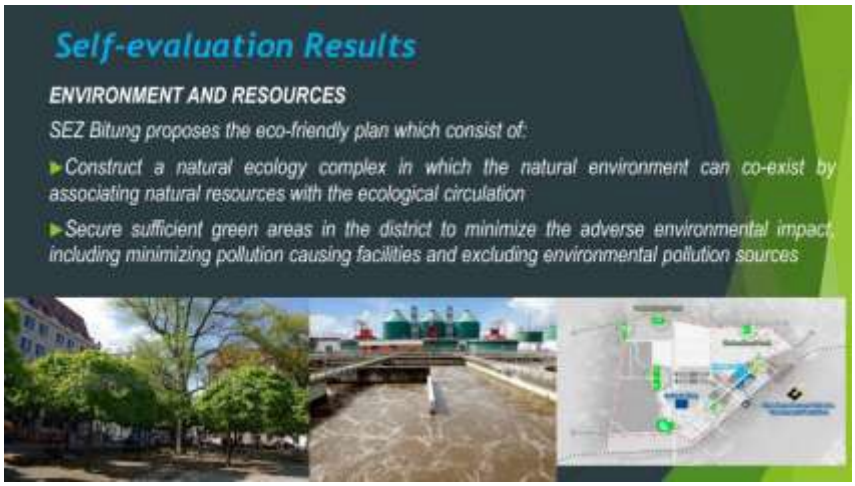

Figure 4: Self-evaluation result on environment and resources

In conclusion, Bitung SEZ development should be continuously encouraged to provide economic and social benefits for people. SEZ Bitung is expected to absorb as much as possible local workforce and needs a breakthrough concerning SEZ's land acquisition. As an industrial area, SEZ Bitung requires a large amount of energy. Therefore, the utilization of renewable energy resources is necessary. Furthermore, technological and financial supports are needed to promote renewable energy use.

4.2.6 Mandaue, Cebu, The Philippines

Ms Araceli Barlam from Local Government Unit Mandaue city presented the development of LCMT in Mandaue city. Mandaue is a coastal city situated in the central-eastern region of Cebu island with 32.85 km^2 and 364 116 people. The city's vision is to be a green city with sustainable economic development focused on high value manufactured consumer products for better living standards of its populace through inclusive governance.

A full-scale feasibility study for Mandaue was conducted in 2016 in LCMT Phase 6. The Mandaue City Green Building Code has been implemented by the city. There were eight applications for Green Building certifications, and two of these have been certified. Mandaue City's approved Local Public Transport Route Plan is now being implemented, specifically with fleet management and electric bus policy. Another policy regards the use of bicycles and other non-motorized transport modes in the city. With this, alternative active transport is encouraged, including the installation of associated facilities. Green corridors are being established at the Butuanon River, Mahiga River and other waterways in the city. Open and green spaces are also being implemented in other parts of Mandaue, like streets, city parks and wetlands.

a)

b)

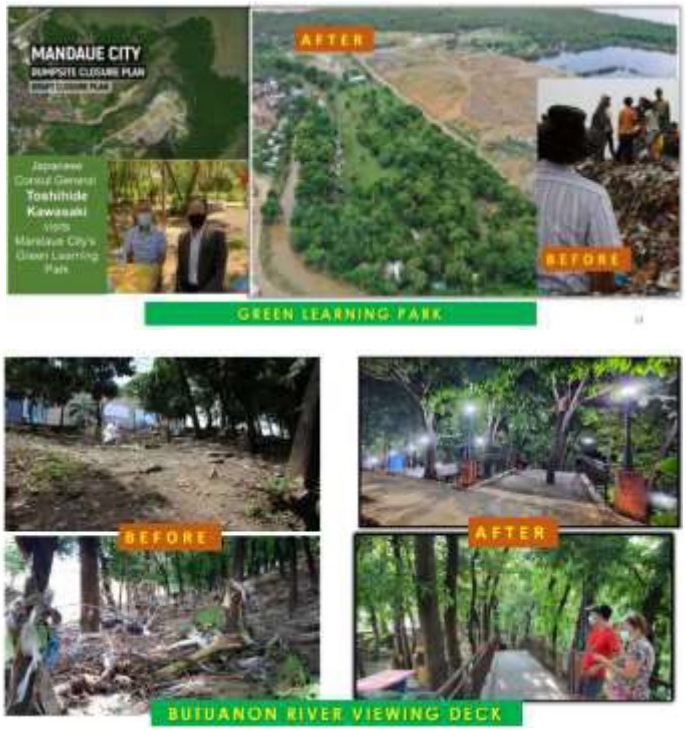

Figure 5: Notable achievements in Mandaue

Since starting of the LCMT project in conjunction with other projects, several infrastructure projects have been deployed. The former dumpsite of the city is now the Mandaue City Green Learning Park (Figure 5.a). In areas where the slope protection was already installed, linear parks were established. Some portion of the linear park features an eco-fence in order to prevent further environmental damage to the ecosystem. A section of the Butuanon River linear park also has a Viewing Deck facility at Barangay Ibabao-Estancia (Figure 5.b). Mangrove Eco-Park Development had also started like the installation of the bamboo boardwalk at the South Mangrove Patch. Bike lane network infrastructure like bollards, bike repair and bike rack facilities were already installed. An additional portion of these bike network facilities will be installed in the next years. The development of the Green Corridor along the Butuanon River, Mahiga River and other waterways has been ongoing. The General Services Office is installing energy-efficient lighting in the city every year.

4.2.7 Krasnoyarsk, Russia

Mr Roman Teleshun from the International Affairs Division of Mayor's Department presented the development of LCMT in Krasnoyarsk, a city situated in the Krasnoyarsk Region with 379.5 km^2 and 1 092 851 people (2021 data).

A full-scale feasibility study for Krasnoyarsk was conducted in 2017 in LCMT Phase 7 with five main sectors, including town structure, transport, area energy system, greenery and industry. Among these, several specific measures were deployed over the last three years to reduce greenhouse gas emissions.

In the transport and town structure sectors, energy-efficient lighting was used in the city streets - new generation "smart" lamps, which regulate energy consumption depending on ambient light and traffic intensity, were installed. The automated traffic control system was launched, to which 487 traffic-light objects were connected. In addition, 73 public transport units with an environmental class of at least Euro-4 and 26 new trolleybuses were purchased.

In the greenery sector, over 246 thousand hectares around Krasnoyarsk were allocated as a forest park green belt in 2019, with appropriate handling measures being implemented. Additionally, two automated posts for monitoring atmospheric air pollution were commissioned in the Kirovsky and Sverdlovsky districts of Krasnoyarsk and a specialized mobile group of round-the-clock duty of the environmental supervision was created.

The city plans to reduce the CO_2 emissions compared with the 2016 level by 27% by 2030 and 62% by 2050.

4.2.8 Banda Aceh, Indonesia

Mr Parmakope from the Urban Development Planning Agency of Banda Aceh presented the development of LCMT in Banda Aceh.

A focused feasibility study for Banda Aceh was conducted in 2018 in LCMT Dissemination Phase 1. With 61 km^2 and 252 890 inhabitants, Banda Aceh plans to be environmentally friendly, green, clean, resilient, and sustainable. The city has already adopted the Banda Aceh

city Greenhouse Gas Regional Action Plan 2013 to 2018 and 2020 to 2025, focusing on green transportation, green waste, green open space, and green energy sectors.

Five routes for the electric bus were constructed in the green transportation sector, which contributes to reducing emissions by 17.6 Kg to 34.8 Kg CO_2/km. Furthermore, public transport and bicycle to work programs are encouraged.

In the green waste sector, enhancing reuse and recycle rates by promoting the waste-collecting point method, communal waste treatment, 4R program, and the utilization of methane gas. Waste collecting points were installed in 11 villages and 34 schools (Figure 6.a).

The city targets to achieve 30% green open space in the total area, 20% in public and 10% in private spaces. Currently, 14.3% of the public are in green open spaces. In addition, E-Berindah, an application for monitoring and evaluating cleanliness based on community participants, is in operation.

In the green energy sector, the utilization of solar panels and LED lamps for street lighting and in government buildings helped dramatically reduce CO_2 emissions. The CO_2 emissions from this sector decreased from 58 751 tCO_2-eq in 2015 to 8467 tCO_2-eq in 2019 (Figure 6.b).

a)

b)

Figure 6: Green waste and green energy activities in Banda Aceh

4.2.9 Hang Tuah Jaya, Malaysia

Mr Rozaidi bin Mahat from Hang Tuah Jaya Municipal Council presented the development of LCMT in Hang Tuah Jaya, which has 144.6 km^2 in area and 190 529 people (in 2018).

A focused feasibility study for Hang Tuah Jaya was conducted in 2018 in LCMT Dissemination Phase 1. Regarding the mitigation target, the city manager committed reducing 665 000 tCO_2-eq by 2030 relative to the BAU scenario to achieve the level of 0.072 intensity Carbon per GDP (reduction of 45%) to support domestic vision and commitment. The city plans to be a Low - Carbon City by 2030 and Net-zero Carbon City by 2050.

The city has established its low-carbon development plan based on the LCT-I System, focusing on buildings and transportation, area energy system and renewable energy, policy framework and education and management (Figure 7).

Figure 7: Significant sectors applied in Hang Tuah Jaya

In buildings, green building rating and green incentives on green construction were applied.

In transportation, various measures have been applied, such as smart parking apps, parking rebate for electric vehicles, and mobility as a service. Additionally, the green bus network corridor is under study.

In area energy system, smart grid program has been deployed since 2019, while district cooling system in the Melaka International Trade Centre (MITC) is in early development.

In renewable energy, two solar farm projects with 58 MW in total capacity were completed in 2019. The city is implementing decarbonized community program and related policies to encourage the installation of solar panels through Net Energy Metering program.

In policy framework, as a high-level commitment on achieving Low Carbon City by 2030 and Net-zero Carbon City by 2050, integration and link-up with commitment on GHG reduction and environmental protection have been considered strictly.

In education and management, community awareness on mitigation and adaptation, a special program on Low Carbon Eco-Schools and Green Ambassador and climate financing and budgeting have been applied.

As a result, 2 532 tCO_2-eq was reduced in 2020 compared with the 2018 level. According to the City Roadmap GHG year 2030, GHG emission will decrease to 0.86 Mt by 2030 from 1.03 Mt in 2018.

Notable achievements include Smart Grid Project, Building Energy Online Data Monitoring System, Rainwater Harvesting Project for Schools and energy audit report implementation.

4.2.10 Shah Alam, Malaysia

Ms Annie Syazrin Ismail from Shah Alam City Council presented the LCMT development plan in Shah Alam. Shah Alam is located within the district of Petaling and a portion of the district of Klang in the state of Selangor with 303.1 km^2 and 671 200 people (2020 data).

A focused feasibility study for Shah Alam was conducted in 2018 in LCMT Dissemination Phase 1. Shah Alam Low Carbon City Action Plan 2030 was developed and launched in 2017 to transform Shah Alam into a green city with green technology practices by 2030. The plan aims to reduce carbon emission by 45% by 2030 from the baseline year of 2015. The Action Plan is now being revised in line with the domestic Low Carbon City Master Plan and the United Nation Habitat Guideline and will be launched at the end of 2021.

It will focus on developing GHG inventory and emission scenario analysis based on acceptable standards, setting ambitious targets (short, medium, long term, by sector), identifying strategies (based on GHG inventory) and developing implementation and monitoring plans. The city will actively participate in regional, domestic and international networks of cities that promote climate action, such as the global covenant of mayors for climate and energy (Figure 8).

Five core strategies of this revised Action Plan include an integrated building monitoring system, district cooling enhancement program, solar PV program, solar hybrid compound lighting program, and smart city.

The integrated building monitoring system is used to display the parameters from buildings such as voltage, current, power factor, temperature, energy consumption and energy demand via metering devices and sensors. Data collected from this system can be transferred to integrated data servers for statistical and energy management purposes.

The district cooling enhancement program utilizes a chiller system to enhance the cooling efficiency. The main chiller pipeline is directly connected to the multiple building Air Handling Unit.

The solar PV program encourages the usage of rooftop solar panel units in the markets, terminal sections and public halls. Solar panel units are used with an integrated building monitoring system for data collection.

The solar hybrid compound lighting program aims at replacing conventional bulbs with LED bulbs or substituting bulbs with the same price and better performance with lower energy consumption.

The smart city uses a source of data and information to monitor and control the activities in the city in real-time. Components of the smart city in this plan include the decision-making process, planning and cityscape, city management, total inventory, infrastructure and utility maintenance, revenue management and development approval records.

Figure 8: Shah Alam Low Carbon City Action Plan

4.2.11 Davao, the Philippines

Mr Romeo Lintapan from the Office of the City Planning and Development Coordinator, City Government of Davao, presented the development of LCMT in Davao. Davao is a highly urbanized city on the island of Mindanao, the Philippines, with a total land area of 2 443.61 km^2.

A focused feasibility study for Davao was conducted in 2019 in LCMT Dissemination Phase 2. Davao enacted various policies related to LCT development such as the Comprehensive Land Use Plan (2013-2022), Philippine Energy Efficiency Action Plan for 2016–2020, Power Development Plan 2016-2040, the Philippine Energy Plan 2016-2030, Renewable Energy Roadmap 2017-2040, Davao City Transport Roadmap, and Davao Regional Development Plan 2017-2022. Proposed measures included transportation, untapped energy, building efficiency, energy management system, waste management, policy framework and education and management with the target to reduce emissions by 0.38 $MtCO_2$-eq by 2030 (Figure 9).

The approved Local Climate Change Action Plan (LCCAP) helps in mainstreaming projects and policies into the government development plans that will address climate change. Ultimately, it was implemented by the City Government to focus on the GHG Inventory (GHGI),

mitigation, and adaptation. There are outlines of policies, projects, and activities (PPA) which are anchored to seven thematic areas/outcomes, namely: Food Security, Water Sufficiency, Ecological and Environmental Stability, Human Security, Climate-Smart Industries, Sustainable Energy, and Knowledge and Capacity Development. Although all of these thematic areas have outlined PPAs that will contribute to GHG emission reduction, the Climate-Smart Industries and Ecological Environmental Stability program highlights and proposes numerous PPAs that will target GHG emission reduction. Furthermore, through LCCAP and GHG inventory, the City Government of Davao aims to contribute to the Philippine's commitment to cut its emission to 70% by 2030, which was outlined to the submitted Intended Nationally Determined Contribution (INDC), now called Nationally Determined Contribution (NDC).

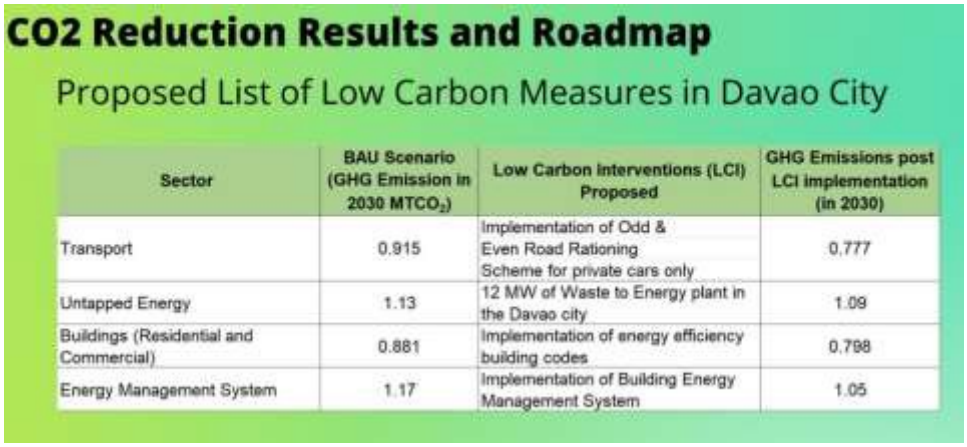

Figure 9: Davao city's CO_2 reduction results and roadmap

The City Government of Davao has implemented the "Conversion of Used Cooking Oil to Bio-Diesel Fuel Program" project along with the Biomass Japan, Inc. and Shinozaki Transport Warehouse Co., Ltd in cooperation with the Japanese government and Japan International Cooperating Agency (JICA). The facility converts used cooking oil to biodiesel fuel. Public utility jeepneys and the City Environmental and Natural Resources Office's (CENRO) trucks and vehicles use biodiesel fuel to operate. With this project, the City Government of Davao aims to reduce petroleum diesel as it significantly contributes to current GHG emissions.

Also, the City Government of Davao is implementing the High Priority Bus System (HPBS), a project under the Davao City Transport Roadmap, which aims to develop a transport system that is green, reliable, and efficient in serving the community. Meanwhile, solutions to solve the solid waste problem in the city have been considered through the 10-hectare Waste-To-Energy facility in Tugbok District.

Meanwhile, the Comprehensive Land Use Plan (CLUP) 2019 – 2028, a planning document has been prepared by the Local Government Units (LGUs) to rationalize allocation and proper use of land resources. It has inclusions of policies that will also help address the GHG emission in the city through the proposed zoning ordinance that limits entry of highly-pollutive and highly-hazardous industries. Among its regulations is the required 15% green space in all developments in the city.

Bicycle Ordinance of 2009 is the inauguration of the 54.7 km bike lane network that stretches across 14 road sections of the city. Cycling can reduce carbon footprint. Thus, more people are being encouraged to choose cycling to create a significant impact in the future.

4.2.12 Da Lat, Viet Nam

Mr Minh Tran from the Institute of Regional Sustainable Development (IRSD) presented the LCMT development in Da Lat. A focused feasibility study for Da Lat was conducted in 2019 in LCMT Dissemination Phase 2.

The city planned to introduce two-wheeler and four-wheeler electric vehicles and biofuel vehicles in the transportation sector, targeting 40% of total vehicle stock by 2030. It will contribute to reducing 0.13 $MtCO_2$-eq cumulatively by 2030 (Figure 10).

In the untapped energy, power generation through incineration of solid waste will consume approximately 185 Mt of solid waste by 2030, which will reduce 0.18 $MtCO_2$-eq cumulatively by 2030. Furthermore, 25% of entire buildings (commercial and residential buildings) will install ground source heat pumps for heating purposes.

Rooftop solar power generation in residential and commercial buildings reduces 0.165 $MtCO_2$-eq cumulatively by 2030, while integrated Building Energy Management Systems (BEMS) for monitoring and controlling energy-related building plant and equipment aims to reduce energy consumption by 20% in 2030.

For the town structure, the introduction of Transit Oriented Development (TOD), green city land-use planning, infill of vacant land and redevelopment of existing land use aim to reduce carbon emissions by 15% to 20% in 2030.

Sector	Intervention	Target (by 2030)	Cost (Million USD)	Cumulative CO_2 Savings ($MTCO_2$)
Transportation	Penetration of low emission fuel– 2W & 4W EV & Biofuel in goods vehicle	40% of total vehicle stock	0.5	0.131
	Modal shift - Establishment of non-motorized vehicle and pedestrian infrastructure	Shift of 5% vehicular passenger	0.6	0.082
	Aggregation of passenger occupancy in personal vehicles through ride sharing options[1]	-	-	-
Area Energy System	Aggregated heating/cooling supply units[2]	-	-	-
Untapped Energy	Waste to Energy – Power generation through incineration of solid waste.	Utilization of total solid waste generated (~185MT)	75.00	0.181
	Ground source heat pump - heating purpose in commercial and residential buildings	25% of total building stock	0.01	0.00001
Renewable Energy	Rooftop Solar Power Generation in residential and commercial buildings[3]	-	433	0.165
Multi Energy System	Cogen or CHP plants produce electricity along with heating which can be used for heating system	35% of commercial buildings	0.003	0.00003
Energy Management System	Integrated Building Energy Management Systems (BEMS) for monitoring and controlling energy-related building plant and equipment	-	Finance varies with project	20% of energy consumption
Town Structure	Town planning concepts to reduce vehicular (Transit Oriented Development) & increase carbon sequestration (Green Redevelopment) for new area[4]	-	-	-

Figure 10: Overview of interventions in Da Lat city

4.2.13 La Molina, Peru

Mr Fernando Magallanes Iberico from the Municipality of La Molina presented its LCMT development plan. A focused feasibility study for La Molina was conducted in 2021 in LCMT Dissemination Phase 3.

La Molina is a residential district with 178 200 people living within 65.75 km^2, which is now under redevelopment for existing areas with low carbon targets. La Molina plans to become a greener, more walkable and more accessible city that encourages healthier lifestyles, with meeting places that encourage respect and love for nature. The CO_2 emissions estimated for 2019 was 260 000 tCO_2-eq and they expected to decline to 228 000 tCO_2-eq by 2027.

Low carbon measures for the demand side include reducing the urban heat island effect by planting more trees, developing LED street lights, cycling pathways, energy-efficient home appliances, and green roofs. Low carbon measures for the supply side include solar photovoltaic systems, wind power and waste heat recovery. Several notable projects have been developed under a low-carbon town development in La Molina. They included the Carpull project (promoting car-sharing), the Molibus project (promoting the municipal public transport service), the Tech irrigation project (promoting technical irrigation system to reduce the amount of water used in the irrigation of parks and avenues), and the Recycling plant project (promoting recycling and waste-separation) (Figure 11).

Figure 11: Main projects for LCT development in La Molina

4.2.14 Khon Kaen, Thailand

Mr Padungsak Unontakarn from Bright Management Consulting Company presented the plan for LCMT development in the Khon Kaen Municipality. A focused feasibility study for Khon Kaen was conducted in 2021 in LCMT Dissemination Phase 3.

The district with a land area of 46 km^2 and about 120 000 people have adopted general strategies for green space, energy-saving, and sustainable development. The measures include enhancing energy efficiency, alternative energy, waste management, transportation management, agricultural and forestry management.

As for energy efficiency, the city plans to utilize LED bulbs to increase lighting efficiency, install new lighting equipment for public roads, and create a new implementation framework with the private sector to enhance future energy efficiency projects.

For alternative energy, measures such as installing new lighting equipment with a solar cell for public areas, biodiesel production, and energy production from solar energy (self-consumption) are considered.

In waste management, the city establishes waste management stations to produce compost, install composting bins at households, and promote 3Rs activity (Figure 12).

In transportation, the city promotes and enhances biodiesel for vehicles, establishes a Light Rail Transit (LRT) system, and promotes walking and cycling paths. In addition, private electric vehicles and electric vehicles for public transportation are considered in the development plan.

By applying those measures, the city is expected to reduce its emissions by 182 327 tCO_2-eq by 2030 compared with the BAU scenario.

Figure 12: Waste Management Station project in Khon Kaen

4.2.15 Phu Quoc, Viet Nam

Ms Loan Nguyen from Phu Quoc City People's Committee Office presented the LCMT development in Phu Quoc. A focused feasibility study for Phu Quoc was conducted in 2021 in LCMT Dissemination Phase 3.

Phu Quoc is located near the southern coast of Cambodia with forest covering 67% of its 574 km^2. It is the largest island in Viet Nam and is a hot spot for tourism.

Phu Quoc focuses on investments for domestic waste treatment plants, an electric bus system, renewable energy projects, and energy management models in buildings. In the residential sector, the city encourages households to invest in rooftop solar power to reduce fossil energy consumption (the number of households investing in rooftop solar panels was 239 by December 2020). Over 90% of the local household waste has been collected and treated (the total amount of household waste collected in 2020 was about 70 000 tonnes).

The city plans to develop itself sustainably with particular concern to conserving the environment and culture, eliminating 19 500 tCO_2-eq of emissions per year by saving 5% of

electricity consumption. Additionally, promoting the application of science and technology is also one of the top priorities of the city authorities.

The urban public transport system with 60.72 Km in length has been improved to connect the whole island. While electric cars have been used for tourists, public transport has been used by both residents and tourists. Additionally, a tree-lined road system has been developed in the city (Figure 13).

Figure 13: The urban public transport system in Phu Quoc

4.3 Introduction of a low-carbon town development in Japan

The organizer showed the Video of Keihanna, an eco-city project located across Osaka, Kyoto and Nara prefectures in Japan. The project has started in 2010 with four main aims, which were CO_2 reduction and energy saving, peak cut measures, balancing measures and surplus PV acceptance measures. The Community Energy Management System (CEMS) was introduced in this project, including Home Energy Management System (HEMS), Building Energy Management System (BEMS), electric power demand response, and electric vehicle management centre.

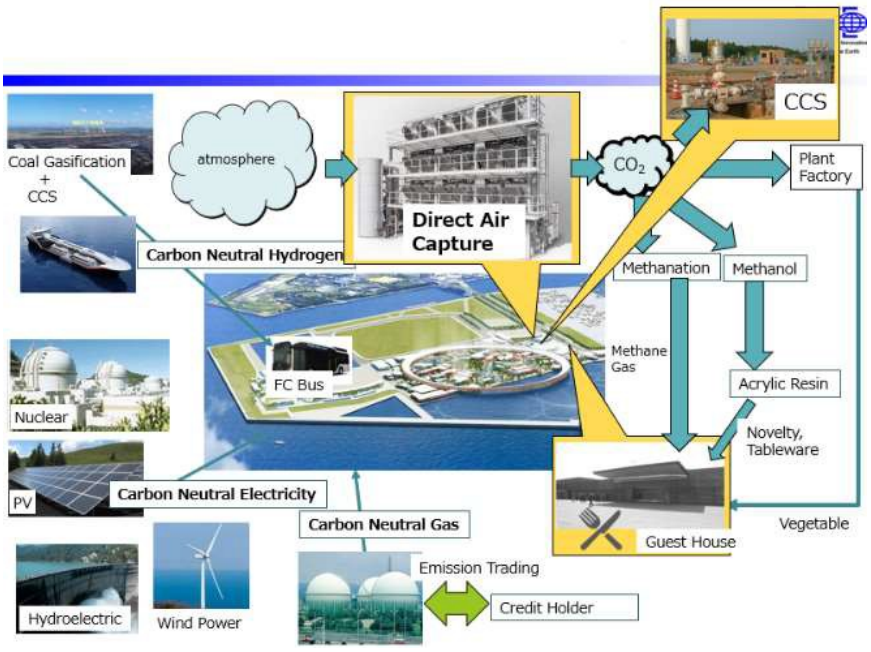

Figure 14: Beyond Zero at Osaka EXPO 2025

Subsequently, **Mr Takashi Honjo**, Senior Managing Director of Research Institute of Innovative Technology for the Earth (RITE), which is located in the Keihanna area, introduced its projects to reduce CO_2 emissions. They include developing scenarios for global warming mitigation, Carbon Capture and Storage (CCS) and bio-refinery. He also mentioned its initiative, which will be exhibited at Osaka EXPO 2025 (Figure 14).

4.4 Comments from experts and Q&A

Mr Michinaga Kohno from Michi Creative City Designers Inc. (Japan) reviewed five LCMTs in the project, including San Borja (Peru), Mandaue and Davao (the Philippines), Banda Ache (Indonesia) and Phu Quoc (Viet Nam). He summarised the achievements and difficulties in deploying the LCMT project those five cities.

All the participating cities recognized that the LCMT project and LCT-I are helpful. They have learned fact-finding methodologies, identified the priority areas, and introduced systematic planning from the LCMT project. However, the accuracy and transparency of the data and human resources with data analytical skills should be improved. He also suggested the reinforcement of policies, laws, regulations, and ordinances.

He suggested that all cities and towns on the earth shall have to become "Zero Carbon Towns" in the following decades (Figure 15). He stressed continuous values of APEC LCMT projects on the path to "Zero Carbon Towns", referring to opportunities for improvements in the Concept of the Low-Carbon Town in the APEC Region and LCT-I in line with technological development.

Figure 15: Change in the Landscapes of Low Carbon Towns

Dr Hung-Wen LIN from Industrial Technology Research Institute (Chinese Taipei) reviewed five LCMTs in the project, including Da Lat and Da Nang (Viet Nam), Hang Tuah Jaya and Shah Alam (Malaysia) and La Molina (Peru).

He reviewed the achieved results using the LCT indicator tiers such as demand, supply, environment and resources, and governance for each city. He also pointed out the main obstacles to achieving the low-carbon town: technology, budget, governmental policy, international investment, social culture, and political issues.

He proposed the ideas for the LCT development based on the Internet of Things (IoT), which can connect LCT's components such as low carbon energy, low carbon transportation, bio-environment, low carbon consumption, low carbon tour and green energy industry together over the internet (Figure 16). In the low carbon energy area, renewable energy, energy conservation and low burden measures can be applied. Modern transportation devices and smart mass-transportation systems will be potential measures for low carbon transportation. Bio-environment (ecological environment, recycling) and low carbon consumption (new consumption environment, low carbon culture) measures will assist in reducing carbon emissions. In addition, low carbon tour includes low carbon travelling and low carbon scene are new ideas for LCT development. Lastly, the green energy industry (rising green energy industry program, green EICT, employment in the green energy industry) can reduce CO_2 emissions.

He also addressed the idea of the LCT indicator system becoming an integral part of comprehensive approaches towards sustainable urbanization, including technology, spatial, regulatory, financial, legal, social and economic perspectives. Interaction and integration between buildings, the users and the regional energy, mobility and ICT system are considered. Additionally, the green building system, positive energy district, and GHGs emission management in the industry should be considered as new elements of the LCT-I system.

Figure 16: Expert's suggestion for LCT development

In conclusion, he insisted that "Net-zero carbon emission is the global target in 2050". In order to achieve a future net-zero society, we must break familiar or habitual thinking and make significant progress in the innovation of clean energy, energy conservation, and system integration technology. Low carbon model towns are important demonstration sites to achieve the target of net-zero carbon emission. Additionally, performance measure standards setting and regular performance verification are suitable methods to maintain the low carbon city.

Mr Alan Pears from RMIT University and Climate and Energy College University of Melbourne (Australia) reviewed five LCMTs in the project, including Tianjin (China), Koh Samui and Khon Kaen (Thailand), Bitung (Indonesia) and Krasnoyarsk (Russia).

He addressed the common issues for these five cities, including broad and detailed issues (Figure 17). Broad issues included complex interactions between municipality and governments, limited financial and human resources, diverted resources and funds due to COVID pandemic and natural disasters, changes in city leaders/staff, priority level and local factors. He also mentioned detail issues such as insufficient data, inconsistent indicators, irregular reporting, over-estimation of energy demand, under-estimation of benefits from energy efficiency improvement and digitalization, and falling energy efficiency and renewable energy costs.

Mr Pears identified success factors, including incorporating low carbon measures in high profile events, building a city's profile as a leader, governmental leadership and support, and international funding. Some detailed factors included linking to local issues and concerns; promoting achievements; rewarding innovators; voluntary action; incentives; visible improvements; effective communication; partnerships with research organizations, businesses, and city networks: and innovative financing.

In addition, he pointed out that regulations and institutions can be a two-edged sword for cities. They can block or support LCT development. He identified issues for the LCMT and LCT-I system. Benefits include engagement with international experts, feasibility studies, and LCT-I assessments, which build knowledge and support focused policies. More support for LCT-I assessment training and progress tracking would be beneficial. The LCT-I rating has a limited focus on progress, and self-assessment can be inconsistent. LCT-I rating faces competition from other sustainability rating systems.

For emerging issues, he suggested that cities should consider net-zero emissions targets, climate resilience, sustainable development, energy efficiency, smart energy management, zero-carbon and space-efficient transport modes, low carbon tourism and business travel, circular economy, and resilient supply chains in various areas.

Figure 17: Common issues for cities

The audience raised questions for experts related to the role of governments in implementing LCMT projects. **Mr Kohno** emphasized that the leadership from city governments play a fundamental role, which is more political than technical. In his opinion, this is a crucial departure point. **Mr Pears** said that some city governments play a crucial role in sectors like buildings. He mentioned efforts by cities in the state of Victoria in Australia as putting pressure on the governments. **Dr LIN** explained the strictness of building codes and rules to start construction in Chinese Taipei.

4.5 Closing

Dr Kazutomo Irie, President of APERC, delivered the closing remarks. He stressed that this event formally concludes this ten-year project but does not end low-carbon development in the APEC region. He proposed maintaining a network of the 15 participating towns of the LCMT project with APERC as its secretariat. He proposed that after several years the representatives of these towns could get together and share the development progress of each town. He then asked participants to let him know their thoughts on this proposal. Finally, he thanked everybody for their participation and contributions.

Appendix : Agenda

(JST)	*MC: Mr Munehisa Yamashiro, Vice President, APERC*
08:30-09:00	Registration
09:00-09:05	Opening remarks **Mr Tetsuro Ito**, Director for Natural Resources and Energy Research, International Affairs Division, Agency for Natural Resources and Energy, Ministry of Economy, Trade and Industry (METI) Japan and Chair of APEC Low-Carbon Model Town Taskforce (LCMT-TF)
09:05-09:15	- Presentation on the outline of the APEC LCMT project development **Mr Diego Rivera Rivota,** Researcher, APERC
Brief reports of 15 participating towns (seven full-scale FS and eight focused FS) with videos	
09:15-09:25	- 1. Yujiapu CBD, Tianjin, China Presentation by **Prof Li Zhu**, President, APEC Sustainable Energy Centre
09:25-09:35	- 2. Koh Samui, Thailand Presentation by **Ms Supinya SRITHONGKUL**, Deputy Mayor of Koh Samui Municipality, Koh Samui Municipality and **Mr Kamol TANPIPAT**, Deputy Managing Director, Bright Management Consulting Co., Ltd.
09:35-09:45	- 3. Da Nang, Viet Nam Presentation by **Mr Tran Minh Huy**, Officer, Energy Management Division - Department of Industry and Trade - Da Nang city
09:45-09:55	- 4. San Borja, Lima, Peru Presentation by **Ms Leydith Valverde**, Secretary General of the Municipality of San Borja
09:55-10:05	- 5. Bitung, North Sulawesi, Indonesia Presentation by **Ir. Jenny Karouw, M.Si**, Head of North Sulawesi Regional Planning and Development Board
10:05-10:15	- 6. Mandaue, Cebu, The Philippines Presentation by **EnP./Ar. Araceli Barlam**, Head of City Environment and Natural Resources Office (CENRO), Local Government Unit Mandaue City
10:15-10:25	- 7. Krasnoyarsk City, Russia Presentation by **Mr Roman Teleshun**, Consultant, International Affairs Division of Mayor's Department, Krasnoyarsk City, Russian Federation
10:25-10:30	- Break time
10:30-10:40	- 8. Banda Aceh, Indonesia Presentation by **Mr Parmakope**, Head of Economic and Natural resource Planning Division, Urban Development Planning Agency, Banda Aceh

10:40-10:50	- 9. Hang Tuah Jaya, Malaysia Presentation by **Mr (TPr) Rozaidi bin Mahat**, Head of Sustainability, Hang Tuah Jaya Municipal Council, Hang Tuah Jaya City
10:50-11:00	- 10. Shah Alam, Malaysia Presentation by **Ms Annie Syazrin Ismail**, Senior Assistant Director, Shah Alam City Council
11:00-11:10	- 11. Davao, The Philippines Presentation by **Mr Romeo Lintapan**, Statistician II, Office of the City Planning and Development Coordinator, City Government of Davao
11:10-11:20	- 12. Da Lat, Viet Nam Presentation by **Mr Minh Tran**, Vice Head of Environment Dept., Institute of Regional Sustainable Development (IRSD)
11:20-11:30	- 13. La Molina, Peru Presentation by **Mr Fernando Magallanes Iberico**, Forestal Engineer, Municipality of La Molina
11:30-11:40	- 14. Khon Kaen, Thailand Presentation by **Mr Boonyarit Phanichrungruong**, Deputy Mayor of Khon Kaen Municipality, and **Mr Padungsak Unontakarn**, Assistant Managing Director, Bright Management Consulting Co., Ltd.
11:40-11:50	- 15. Phu Quoc, Viet Nam Presentation by **Ms Loan Nguyen**, Head of Phu Quoc City People's Committee Office
11:50-11:55	- Group photo and break time
11:55-12:10	- Introduction video of low-carbon town development in Japan - Presentation by **Mr Takashi Honjo**, Senior Managing Director, Research Institute of Innovative Technology for the Earth (RITE)
12:10-12:40	Comments from experts - **Mr Michinaga Kohno**, President and Chief Executive Officer, Michi Creative City Designers Inc. - **Dr Hung-Wen Lin,** Manager, IndustrialTechnology Research Institute - **Mr Alan Kenneth Pears**, Senior Industry Fellow, RMIT University
12:40-12:55	Q&A for all presenters and discussion
12:55-13:00	Closing remarks **Dr Kazutomo Irie,** President, APERC