The Concept of the Low-Carbon Town in the APEC Region

(Part I)

Final Report

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The APEC Low Carbon Model Town Task Force
APEC Energy Working Group

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Part I

Contents

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Executive Summary

The “Concept of the APEC Low Carbon Town (LCT)” aims to provide a basic idea of what is a low-carbon town and an effective approach on how to develop it. The LCT Concept aims to promote the development of low-carbon towns in the APEC region by providing a basic principle that can assist the central and local government officials of the member economies in planning effective low-carbon policies and in formulating an appropriate combination of low-carbon measures while taking socio-economic conditions and city specific characteristics.

The APEC Low Carbon Town(LCT) means towns, cities and villages which seek to become low carbon with a quantitative CO_2 emissions reduction target and a concrete low carbon developing plan irrespective of its size, characteristics and type of development (greenfieild or brownfield development).

The overall planning to develop the LCT proceeds on a step by step basis. The first stage of the planning is to create a basic low carbon town development plan, which builds upon the existing town development plan and goals and backgrounds of the central and local government’s low carbon plan

The following stage is the formation of a low carbon town development strategy, two essential features of which are to 1) set quantitative low carbon reduction targets with a time frame to achieve them, and 2) select the most appropriate set of low carbon measures in a comprehensive manner. In this planning process, it is vital to completely grasp the characteristics of the town under consideration, because the characteristics of town makes a difference in selecting the most appropriate set of low carbon measures.

There are several different characteristics of towns including climate conditions, geography, industrial structure, town structure or intensity of land use and town infrastructure. Unlike the first two characteristics, industrial structure, town structure and town infrastructure are variable. Therefore, the government officials responsible for low carbon town development, especially in the developing economies where rapid growth of town is being observed, should look at the future picture of the town, or even think about guiding these changes from a view point of reducing CO_2 emissions in the town.

The LCMT project offers a very good opportunity for the central as well as local government officials in the APEC economies to refine and enhance their current low carbon town development plans based on the “Concept of the APEC Low Carbon Town”.

Introduction

At the 9th APEC Energy Ministers Meeting (EMM9), which was held in Fukui, Japan on 19 June 2010, focusing on the theme “Low Carbon Paths to Energy Security”, the Ministers observed that “Introduction of low-carbon technologies in city planning to boost energy efficiency and reduce fossil energy use is vital to manage rapidly growing energy consumption in urban areas of APEC”. Responding to this observation, they called for the APEC Energy Working Group (EWG) to implement an APEC Low-Carbon Model Town (LCMT) Project “to encourage creation of low-carbon communities in urban development plans, and share best practices for making such communities a reality”.

The APEC LCMT project consists of three activities, namely, i) development of the “Concept of the Low-Carbon Town ”, ii) feasibility studies（hereafter “F/S”） and iii) policy reviews of planned town and city development projects. The LCMT Project will be a multi-year project. The first phase of the LCMT Project will develop an initial version of the “Concept of the Low Carbon Town” and provide F/S and policy review for the Yujiapu CBD (Central Business District) Development Project in Tianjin, China.

To develop the “Concept of the Low-Carbon Town ”, Study Group A was formed, in which experts from interested APEC member economies participate as a task-shared activity. Over the next several years, the “Concept of the Low-Carbon Town” will be further refined into a useful guidebook for planners who wish to implement low-carbon urban design, building on the case studies of other Low Carbon Towns in the APEC as well as incorporating the practical methodologies for urban planning and design. In the similar way, Study Group B was formed to conduct policy review.

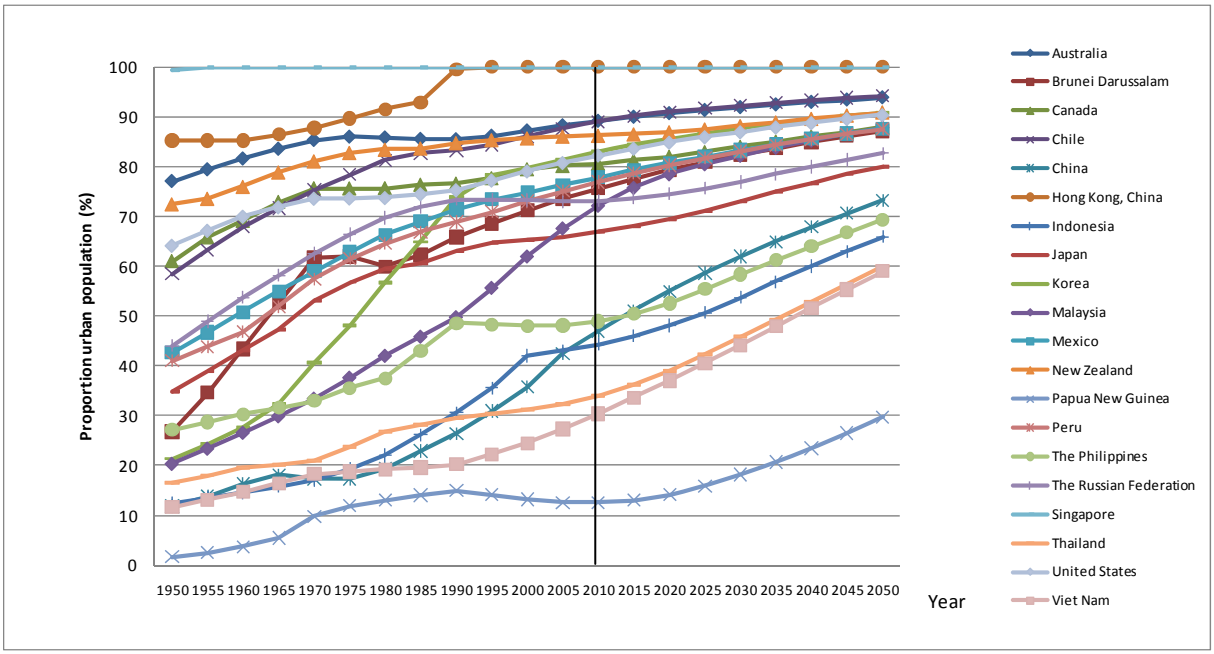
As the key advisory body for the APEC LCMT project, LCMT Task Force (TF) was established in response to the Energy Minister’s instructions in their Fukui Declaration. LCMT TF is responsible for supporting development of the “Concept of the Low Carbon Town”. The Asia-Pacific Energy Research Centre (APERC) coordinates the overall work of APEC LCMT project including the work of the Study Group A and B under the direction of the Agency for Natural Resources and Energy, METI Japan (Project Overseer).

Chapter 1 Background

1.1 Urbanization and the impact in the APEC region

The APEC region has increasingly been urbanized in recent years. In 2010, the average urbanization rate in all APEC economies was 68.5%. Urbanization is likely to increase in the future. In 2050, the average urbanization rate is predicted to be around at 80.9%. Especially in Asia, the increase in urbanization has been remarkable and has a strong possibility of increasing as represented by economies such as China, Indonesia, the Philippines, Thailand and Viet Nam, etc. (Figure 1).

Figure 1 APEC Economies Urbanization Outlook

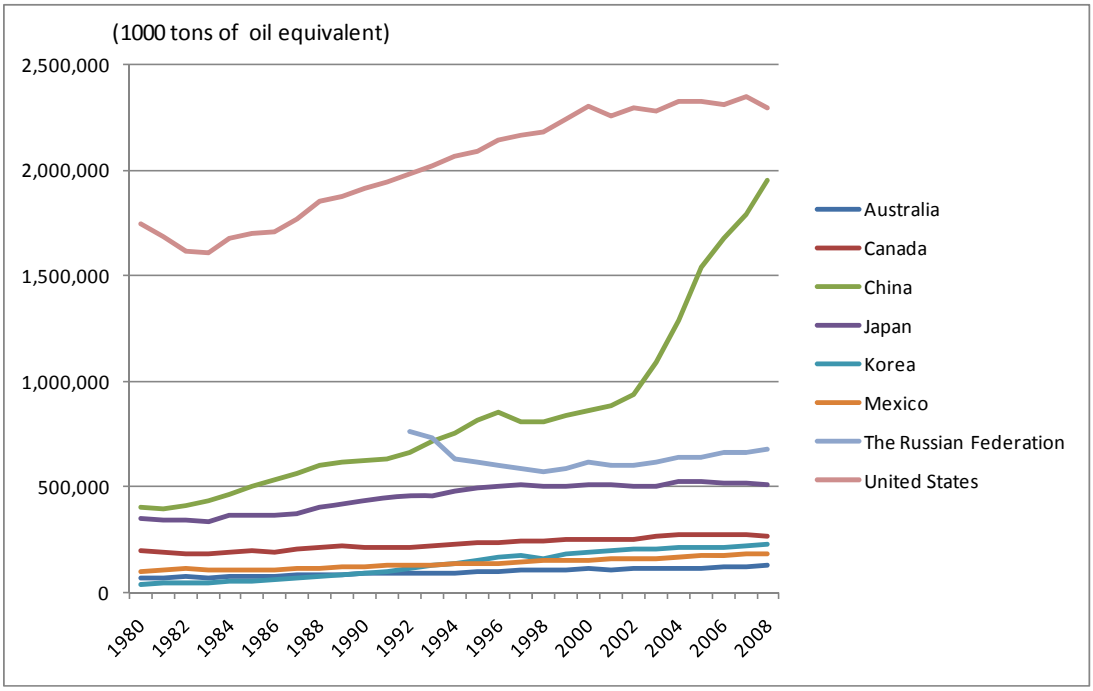


Source: World Urbanization Prospects 2009 (United Nations Development Program)

Energy consumption has also increased in responses to urbanization advances. The amount of primary energy consumption in the APEC region has increased at an annual average rate of 3.5% since 1990. In 2008, the consumption stood at approximately 6.8 billion toe (tons of oil equivalent), an 84.2% increase compared to year 1990 and a 26.2% increase compared to year 2000.

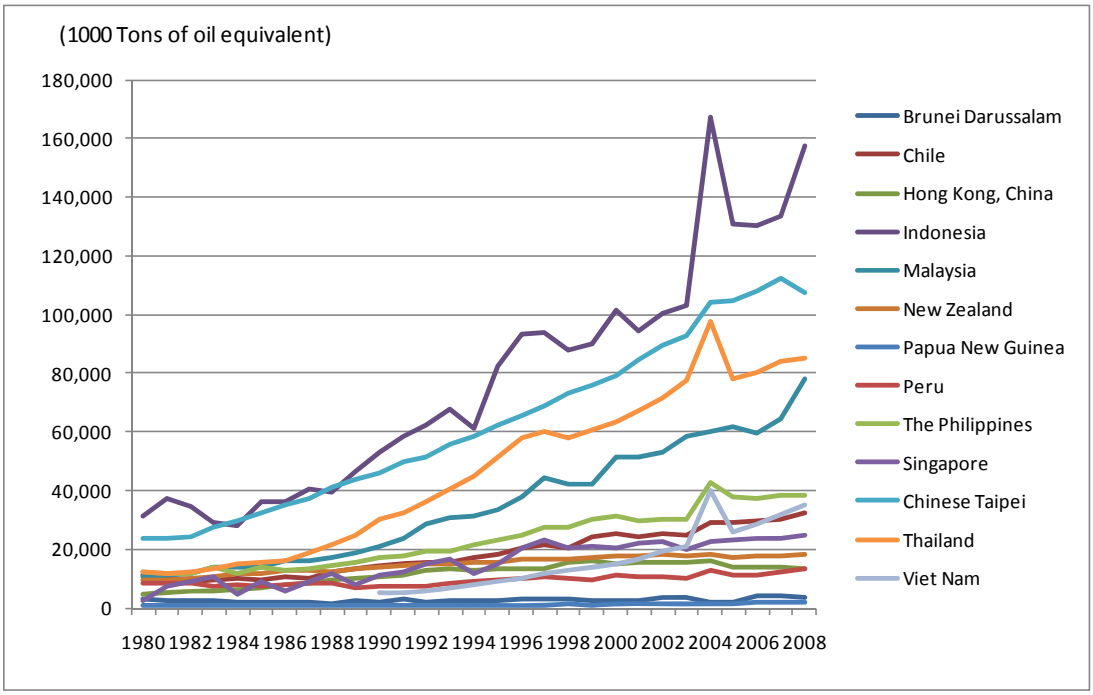
The increase in the energy consumption is remarkable especially in China where the consumption has more than doubled during the period from 2000 to 2008. China accounted for 76.9% of the total increase in energy consumption in the APEC region during the period (Figure 2). Energy consumption has also significantly increased in Indonesia, Chinese Taipei, Thailand and Malaysia (Figure 3). Energy consumption is expected to increase significantly as emerging economies especially in Asia achieve high economic growth.

Figure 2 Historical Trend of Primary Energy Supply for APEC Economies-1



Source: APEC Energy Statistics, 2000, 2004 and 2008

Figure 3 Historical Trend of Primary Energy Supply for APEC Economies-2



Source: APEC Energy Statistics, 2000, 2004 and 2008

The urbanization has led to the increase in energy consumption in the APEC region. Naturally, much of the energy is consumed in the urban areas. Reducing green house gas emissions in the area is important challenge for the APEC economies. Therefore, making the concept of low carbon model towns to help the implementation of low carbon town in the APEC region is significant in this respect.

1.2 Low carbon target for each APEC member economy

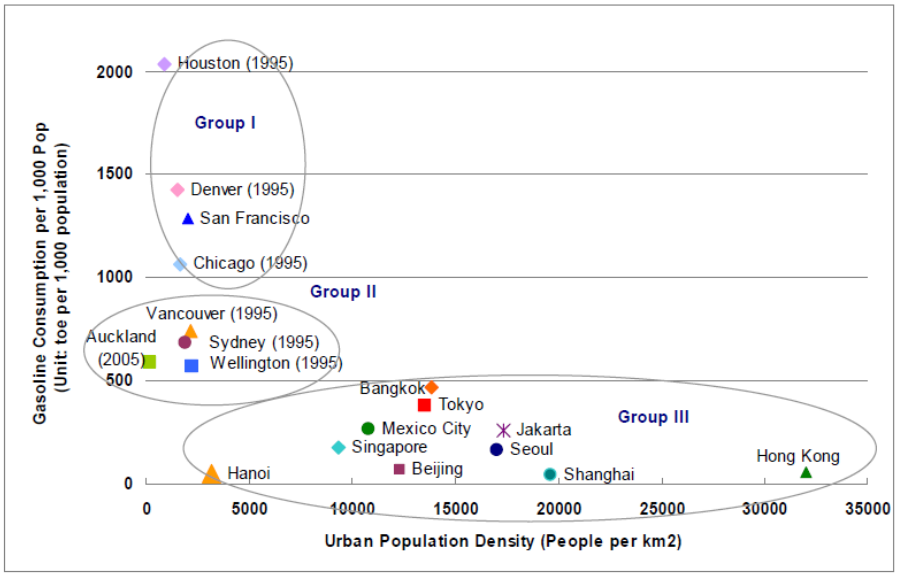
As discussed, the energy consumption in the APEC region, especially in Asia, has been increasing, resulting in increased greenhouse gas emissions. This has prompted APEC member economies to work on carbon reductions by developing their own low carbon targets (Appendix 1).

1.3 Trend of CO_2 emissions in cities

The increase in energy consumption and greenhouse gas emissions tends to be conspicuous in urban areas. Therefore, understanding the level of greenhouse gas emissions and absorptions in each city is important to define low carbon targets and enact methods to achieve set targets.

CO_2 emissions resulting from urbanization show that per capita gasoline consumption in cities in developing economies is currently lower than that in North American cities (Figure 4). However increasing dependency on private transport with improving per capita income is expected to increase per capita CO_2 emissions in the future.

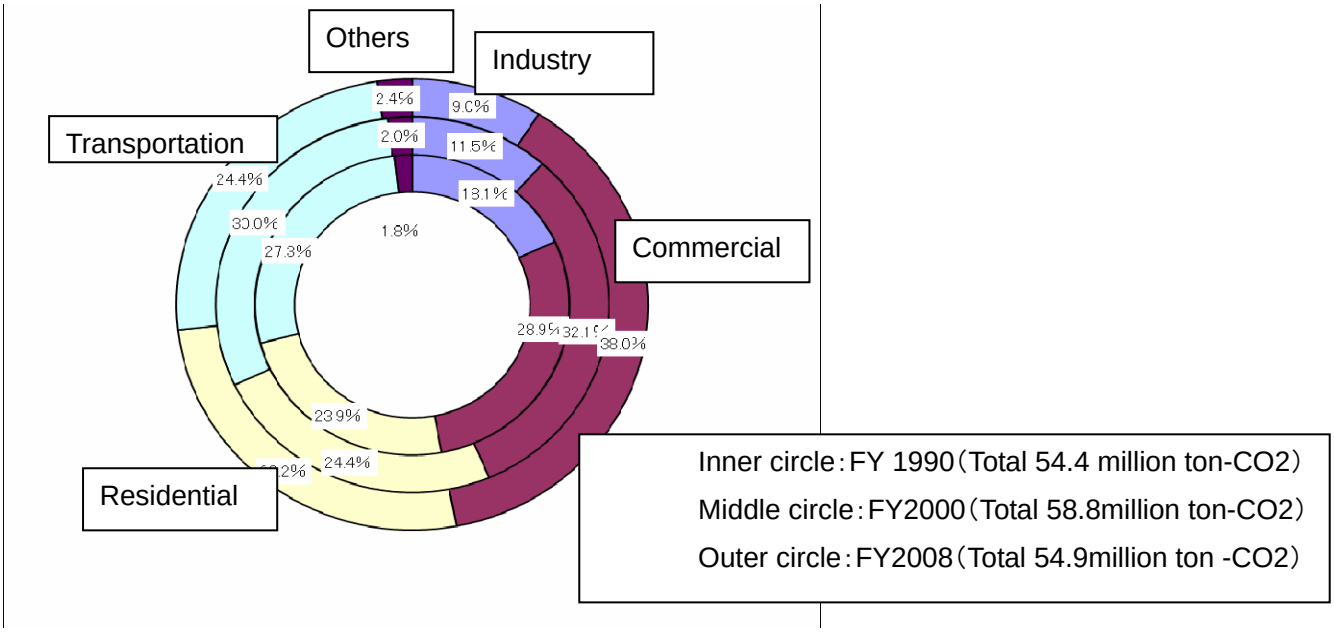
Figure 4 Urban Population Density and Gasoline Consumption per 1,000 Person



Source: Urban Transport Energy Use in The APEC Region

Changes in life styles resulting from economic growth will also change the energy demand and hence the percentages of CO_2 emission sources in cities. To put it differently, as the urbanization process changes the living habits, CO_2 emissions in residential, commercial and transportation sectors increase. For example in Tokyo, the percentage of CO2 emissions in industrial sector decreased from 18.1% to 9.0% during the period from 1990 to 2007. On the other hand, the percentage of CO2 emissions in residential and commercial sector increased from 23.9% to 26.3%, from 28.9% to 38.1% respectively during the same period (Figure 5).

Figure 5　CO2 Emissions in Tokyo



Chapter 3 describes the basic approach to develop Low-Carbon Town. When planning a low carbon town, it is important to study fully the current status and future changes in energy demand in cities as a low carbon town development spans long periods of time.

Urbanization could also lead to overpopulation, deteriorated sanitary conditions, traffic congestion, air and water pollution and decreased Quality of Life (QOL) for people. Efforts for reducing CO_2 emissions in cities where various life activities take place intensively and a large volume of energy is consumed could also help resolve such urban problems in cities. Working on and achieving low carbon towns is expected to create new values to them.

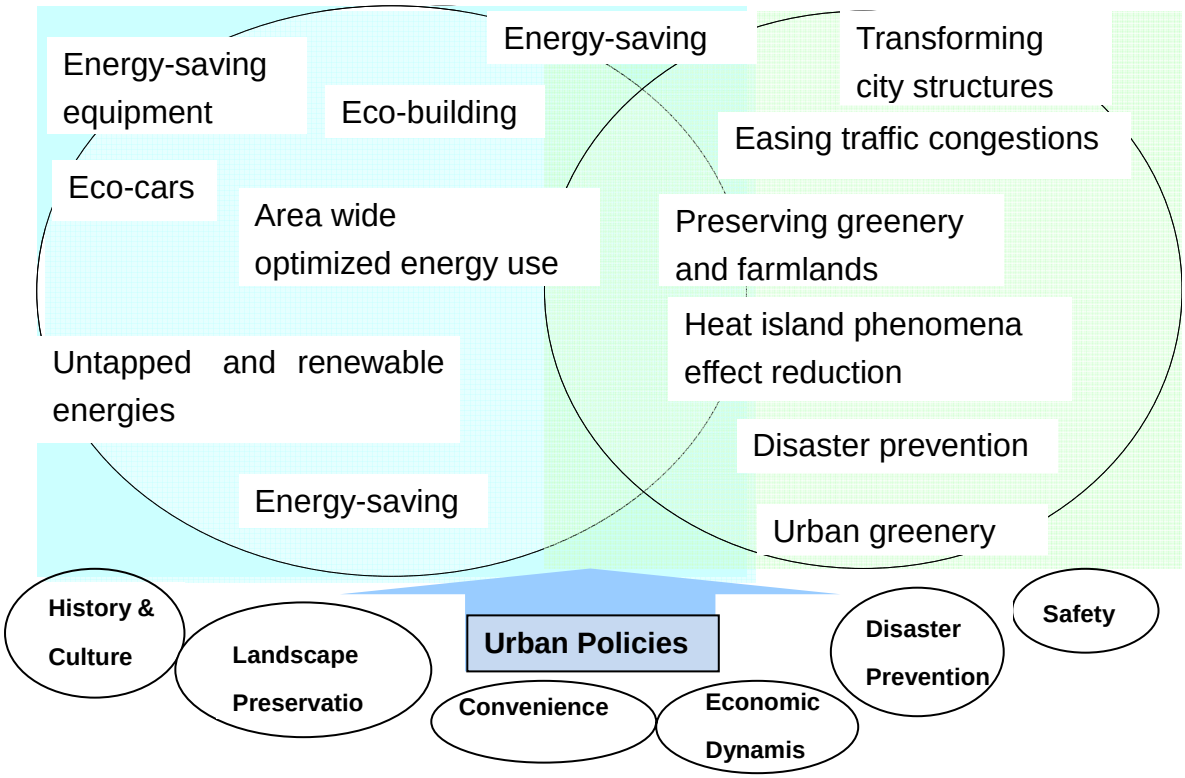
Chapter 2 The APEC Low Carbon Town (LCT) and Its Concept

2.1 What is the Concept of the APEC LCT?

The “Concept of the APEC LCT” aims to provide a basic idea of what is the APEC Low-Carbon Town and an effective approach on how to develop the APEC Low Carbon Town, considering the characteristics of the intended town. The target audience of this Concept is the central as well as local government officials responsible for low-carbon town policies and its development plans. The basic approach for low carbon town development, and characterization of towns and low carbon measures will be explained in detail in Chapter 3 and 4 respectively.

As is shown in Figure 6, there are many different types of measures to mitigate CO2 emissions. They are divided into different types of measures, namely, 1) energy related measures which directly result in CO2 emissions reductions such as introduction of energy efficient equipments/facilities, use of renewable energy, etc. (shown in the left-hand circle of the figure) and 2) other environment related measures which indirectly facilitate CO2 emissions reductions such as public transport, recycling, afforestation, etc. (shown in the right-hand circle of the figure). The “Concept of the APEC LCT” will be helpful for them to identify the appropriate set of low carbon measures for a town considered.

Figure 6 Measures for Low Carbon Measures



The APEC LCT sets CO_2 emissions reduction as a main goal and adopts energy and CO_2 related indicators. Other indicators like reduction of car traffic, reduction of waste, reuse of water, etc. are used as supplemental indicators of CO_2 emissions reduction. As these measures are interrelated, it is important to select the most appropriate set of measures when designing low carbon towns.

There are several sustainable urban development projects on going in the APEC region. Some have a broader objective of achieving a sustainable development through setting multiple goals, such as green society, recycle based society and mitigating heat island phenomenon. In these projects, there are several different indicators to measure the progress towards the targets.

For example, the Asian Green City Index, which is a research project conducted by the Economist Intelligence Unit, measures and assesses the environmental performance of 22 major Asian cities. It adopts 29 indicators which cover 8 different categories, namely, energy and CO_2, land use and buildings, transport, waste, water, sanitation, air quality and environmental governance.

2.2 What is the APEC LCT?

The APEC “Low-Carbon Town (LCT)” refers to towns in the APEC region that have a clear target of CO_2 emissions reduction and comprehensive measures to achieve it for sustainable development.
In this report, a town is defined as part of a city, while a city stands for any size of cities ranging from a small city to a big city and a greater city area. As per this report, a district is considered part of a town. A town also means a village as a village is deemed as a smaller agricultural/fishing/resort town/area.
There are two types of low carbon town development, namely, greenfield development and brownfield development. In the case of greenfield development, it will make sense to make a low carbon development plan covering a whole city. In the case of brownfield development, it is not practical to make a whole existing city low carbon at one time. Instead, a low carbon development will normally proceed on a step by step basis, for example, from one district to another, or from one part of city to another.
To summarize, the APEC LCT means towns, cities and villages which seek to become low carbon with a quantitative CO_2 emissions reduction target and a concrete low carbon developing plan irrespective of its size, characteristics and type of development.

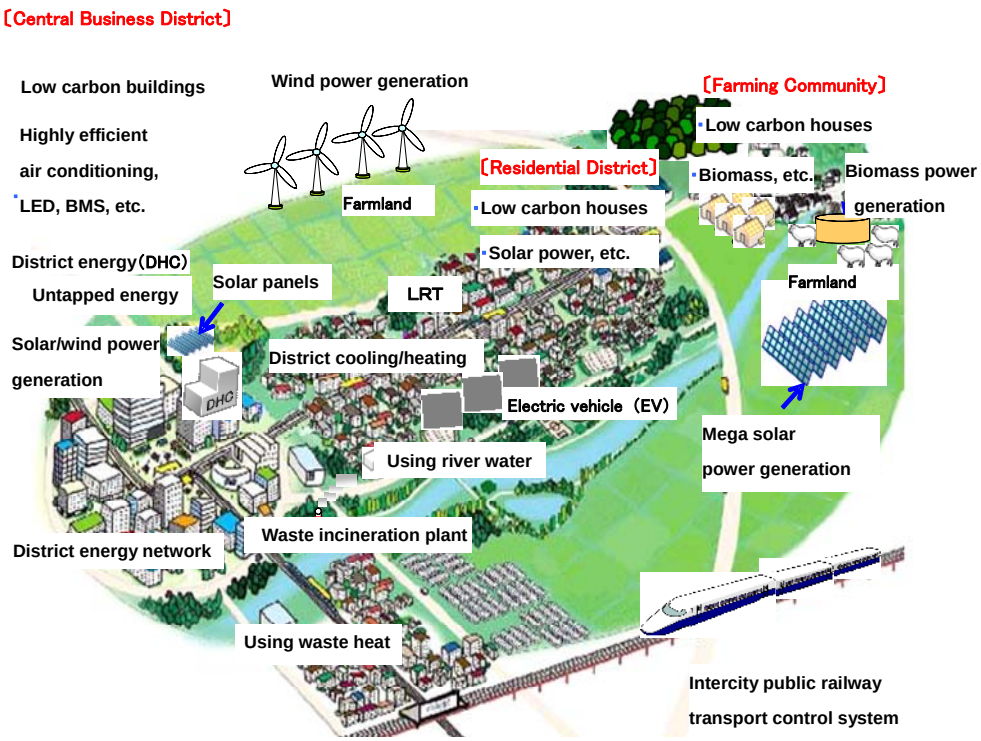
Figure 7 shows the image of the APEC LCT where the most suitable low carbon measures are applied to different districts of the “Town” in a comprehensive manner considering cost effectiveness, availability of resources and characteristics of each district.

Towns in the APEC region have varying degrees of population, population density, economic capability, climatic conditions, and level of basic infrastructure provision. There is also different land usage patterns observed in the towns, for example, one town may be comprised of mainly business and

commercial districts, while another town may be comprised of a primarily industrial manufacturing district, and another mainly comprised of residential districts, while another may be an agricultural town, etc.

An applicable combination of low-carbon measures and available non-fossil energy resources will be different according to the characteristics of the town for a low carbon development.

Figure 7 Image of a Low Carbon Town



2.3 The Criteria for the APEC Low Carbon Model Town Project

The low carbon town development project which will apply for the feasibility study of the APEC Low Carbon Town Project is selected by EWG as a model for planning or implementing the APEC LCT. The criteria for selecting the low carbon town development project are as follows.

- The low carbon development project is coordinated or supervised by a relevant government authority of the APEC member economy. It is ideal if the LCT is under cooperation with other member economies.

- Responsible entity for the low carbon town development project is identified, and the project is already on-going or has been committed to being implemented.

- The low carbon development project implementation plan has been developed. The plan should include major items, such as land use plan, transportation plan, energy plan, environment plan and area management plan.

- Organization and people responsible for the F/S have been identified, and committed to provide necessary information for the purpose of F/S. Member economy may need to prepare for necessary funding and human resources for internal use.

Any low carbon development projects are candidates for future APEC LCMT Project, and will not be excluded from the selection for the reason of its size, scale and characteristics.

The F/S, which is conducted under the LCMT Project, provides the local government officials, municipal officials and the developer with a clear assessment on the most appropriate low-carbon measures in a comprehensive manner. It will also provide the opportunity to test the viability of the low carbon development strategies they have taken. The F/S will proceed according to the process specified in the strategy to develop a low carbon town discussed in Chapter 3. An ordinary feasibility study is conducted to determine if and how a project can succeed with an emphasis on identifying potential problems before the actual project is initiated. In this sense, the F/S provided by APEC LCMT project is different from an ordinary feasibility study.

The Yujiapu CBD (Central Business District) project in Tianjin, China was selected as the first Low Carbon Model Town, as jointly proposed by Japan and China at the EMM9. It is located on the east coast of northern China and is about 40 km east of Tianjin City Center. Yujiapu is the largest CBD development plan in BINHAI new area, in Tianjin city where a variety of large development projects have been in progress. The district consists of 120 blocks and is expected to be a business center for finance and insurance in China. Land use of CBD is mainly office and commercial, but hotels and residential facilities will also be located in the district.

The project is already being undertaken by a local development company with the strong support from the Tianjin local government. It is planned that the site area is approximately 3,650,000 m^2, day time population is approximately 500,000, and a completion target year is 2020. The F/S is conducted by the urban design consultant selected by the APEC Central Secretariat.

Similar aspirations for large-scale urban developments are also on the rise in other APEC economies, especially in Asia. At the same time, there are different types of low carbon town projects on going or under planning, which vary in size and design approach according to their individual circumstances. An appropriate set of low carbon measures to be applied will be different depending on the size of the area and the characteristics of the town. However, the strategy to develop a low carbon town is basically the same irrespective of the magnitude and characteristics of the low carbon development. Therefore, it will

be valuable to undergo a feasibility study of the planned low carbon development project in various APEC member economies, where the overall planning process and strategy will be reviewed. It will also be valuable to have an assessment of policy issues by Study Group B. Policy issues include:

- What kinds of regulatory schemes are appropriate for land use, energy use, water quality, air quality, etc.?
- How should government be best organized for the town/city/region to promote low-carbon development?
- What kinds of economic incentives can be used?
- What kind of infrastructure investment is most suited?

Chapter 3 Basic Approach to Develop the Low-Carbon Town

There are cities and areas within the emerging economies in the APEC region that have quickly developed in recent years and have not gone through the systematic planning and assessment of low-carbon town development. Given these situations, the necessity of developing a low-carbon concept that defines an effective approach on how to develop the low carbon town in the APEC region is increasingly important.

3.1 Overall Planning to develop the Low Carbon Town

The procedure of overall planning to develop the low carbon town is shown in figure 8. First of all, when planning a low-carbon town development, a full and complete understanding of goals and backgrounds of the central and local government's low carbon plan is indispensable so as to confirm that the low carbon town development plan is consistent with the economy level plan. For this reason, coordination and cooperation with relevant offices in all tiers of government should be pursued as necessary.

The first stage of the overall planning of the low carbon town is to develop a low carbon town development plan. The plan is closely associated with the distribution of town functions, land utilization, and control of building density, etc., especially in the case of urban development. Therefore, a low carbon town development plan should be developed by taking advantage of the ordinary town development plan already in place.

The first step is to make the target area clear including a clear definition of the town area, highlighting the perimeter and boundary of the town, and whether it is a greater city area, a whole city, a district within a town, or a block within a district. The next step is to completely grasp the characteristics of the area for the development. These are important steps because ideal combinations of low carbon measures for creating a synergistic effect will vary depending on the size of the area and its characteristics.

Examples of effective measures for the low carbon development plan for a big city may include, strengthening of traffic axes via a public transportation system such as LRT (Light Rail Transit), BRT (Bus Rapid Transit), etc. and guiding land utilization to areas near such traffic axes, coordinated creation of a green network along the traffic axes, and provision of incentives to utilize lands near unused heat source. On the other hand, if it is a low-carbon development plan at the level of a district within a town or a block of a district, spatial utilization of energy tailored to its main activity centers, leveling of energy load through mixed use of various energy sources, side-by-side development of energy and transportation facilities with parks and other spatial development, and transport and energy management using AEMS (Area Energy Management System) might be effective.

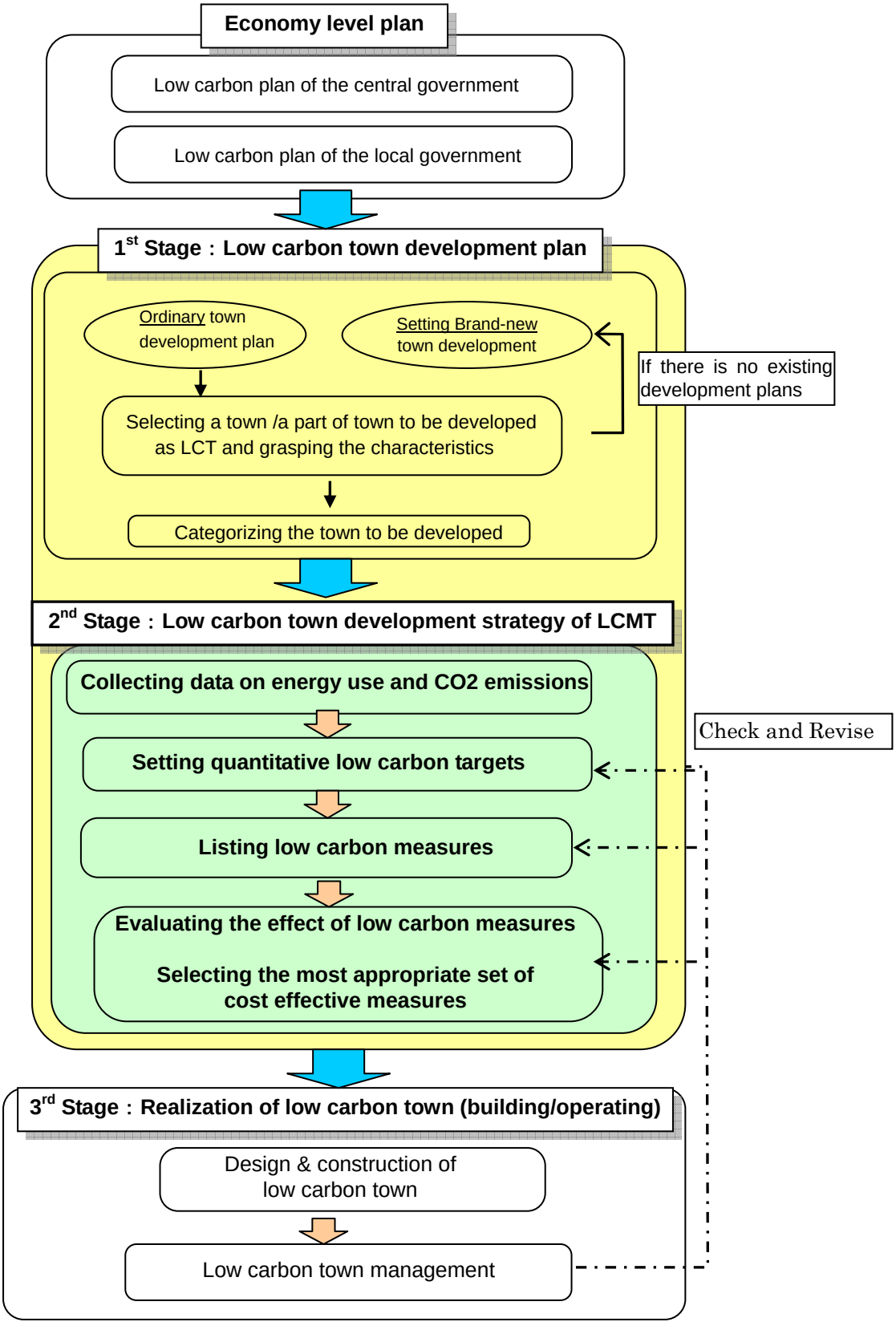
The last step of this planning stage is to develop a low carbon development basic plan. In that regard, it is essential to take a holistic approach, giving full consideration to other aspects of towns rather than just CO2 emissions reductions, such as economic dynamism, convenience and disaster prevention, etc. in order to develop an attractive as well as economically sustainable low carbon town. Developing a low carbon town relates closely the way the life will be in the future of the town. Therefore, it is also important to take a transparent decision making process including relevant stakeholders in order to develop a viable plan which gains full support from the people.

There are many stakeholders involved when planning a low carbon town. Therefore, it is not easy to get them properly involved in the transparent decision making process. At a later stage of the LCMT project, policy issues will be assessed, such as what kinds of regulatory schemes are appropriate for land use, energy use, water quality, air quality, etc. At that time, the issue of a transparent decision making process will be explored.

The second stage of planning the low carbon town is to develop its strategy. Key steps of developing a low carbon town development strategy are to collect necessary energy and CO_2 emissions related data, set quantitative low carbon targets, and select the most appropriate set of cost effective low carbon measures. This will be discussed in the following section in detail.

The last stage is to actually design, construct and operate a Low Carbon Town based on the Low Carbon Town development strategy. It is not covered in this “Concept of the Low Carbon Town”. However, it will be discussed when the “Concept of the Low Carbon Town“is to be further refined, and a practical guide may be prepared at a later stage of LCMT project depending on the results of the discussion..

Figure 8 Procedure of overall planning to develop the low carbon town



3.2 Strategy to Develop the Low Carbon Town

It is essential to set quantitative low carbon reduction targets with a time frame to achieve them, and select the most appropriate set of low carbon measures in a comprehensive manner. These make up the core of the strategy to develop a low carbon town. The process to follow under this strategy, which starts with collecting energy related data and ends with selecting measures, is shown in figure 9 in detail.

1) Collecting data on energy use and CO_2 emissions

Baseline energy balance and energy efficiency data for all sectors as well as predicted future energy consumption. It is important that these data be collected from reliable and consistent sources.

2) Setting quantitative low carbon targets

The quantitative low carbon targets are set for the town as a whole, considering the upper level low carbon target, i.e., economy level, provincial level, etc., and characteristics of the intended town. It is recommendable to set both an overall and setoral low carbon targets, for example, building sector, transportation sector, residential sector as a holistic approach is effective to reduce CO_2 emissions across a town.

The way which is explained here on how low carbon targets are set is a so called “Top-Down Approach”. The targets set this way are not backed up by the result of CO_2 reduction calculations which would come out through applying a certain set of low carbon measures. So, ideally, the target should be backed up by the ideas on how much CO_2 reduction could be possible through studying the actual examples where the same low carbon measures were applied to other towns with similar characteristics.

To evaluate the effect of low carbon measures, proper indicators should be selected. These indicators will also be used to measure the progress toward the targets in the implementation stage. There are several different indicators to measure CO_2 reduction. The following indicators could be used to assess low-carbon objectives directly.

- Reduction in CO_2 emissions: t-CO_2 / year, t-CO_2 / year- floor space
- Reduction in CO_2 emissions per GDP
- Reduction in CO_2 emissions per person
- CO_2 emissions reduction rate (%)
- Reduction in primary or secondary energy consumption: GJ / year

There are other indicators, which could be used complementarily so as to enable a multi-dimensional

assessment of low carbon targets.

- Reduction in the amount of traffic
- Public transportation conversion rate
- Reduction in wastes produced
- Water recycling rate

3) Listing low carbon measures

There are limits to the measures that can be selected to pursue a low-carbon town solely from the energy supply side. However, by combining low-carbon measures from the energy demand side along with the supply side, greater results can be achieved. A comprehensive low-carbon approach that aims to balance both the demand and supply side energy consumption is crucial.

For this purpose, the most possible low carbon measures that can be adopted for developing a low carbon town should be screened based on the town categorization, which will be mentioned in Chapter 4. Then, a listing of these measures will be carried out on the energy supply side and demand side, with more detailed classification on both sides, for example, building, transportation, etc. on the demand side. An example of the classification of low carbon measures is shown in the table of the appendix 2.

4) Evaluating the effects of low carbon measures screened through the previous step

Based on the energy and CO_2 related data, the effect of low carbon measures in terms of CO_2 emissions reduction is to be made for each measure using an appropriate method. A variety of simulation models and tools are developed for conducting comprehensive and detailed simulations of energy-saving measures. These include energy efficiency improvements for different building types (such as office, commercial and residential buildings), area energy systems such as DHC (District Heating and Cooling) Systems, and technologies for the utilization of untapped energy supplies.

The effect will be summed up to generate total CO_2 emissions reduction as well as sub-total of CO_2 emissions by the classification of low carbon measures. The costs of implementing these measures are also estimated. The method how the effect of low carbon measures should be evaluated will be explained in Part II of “The Concept of the Low Carbon Town in the APEC”.

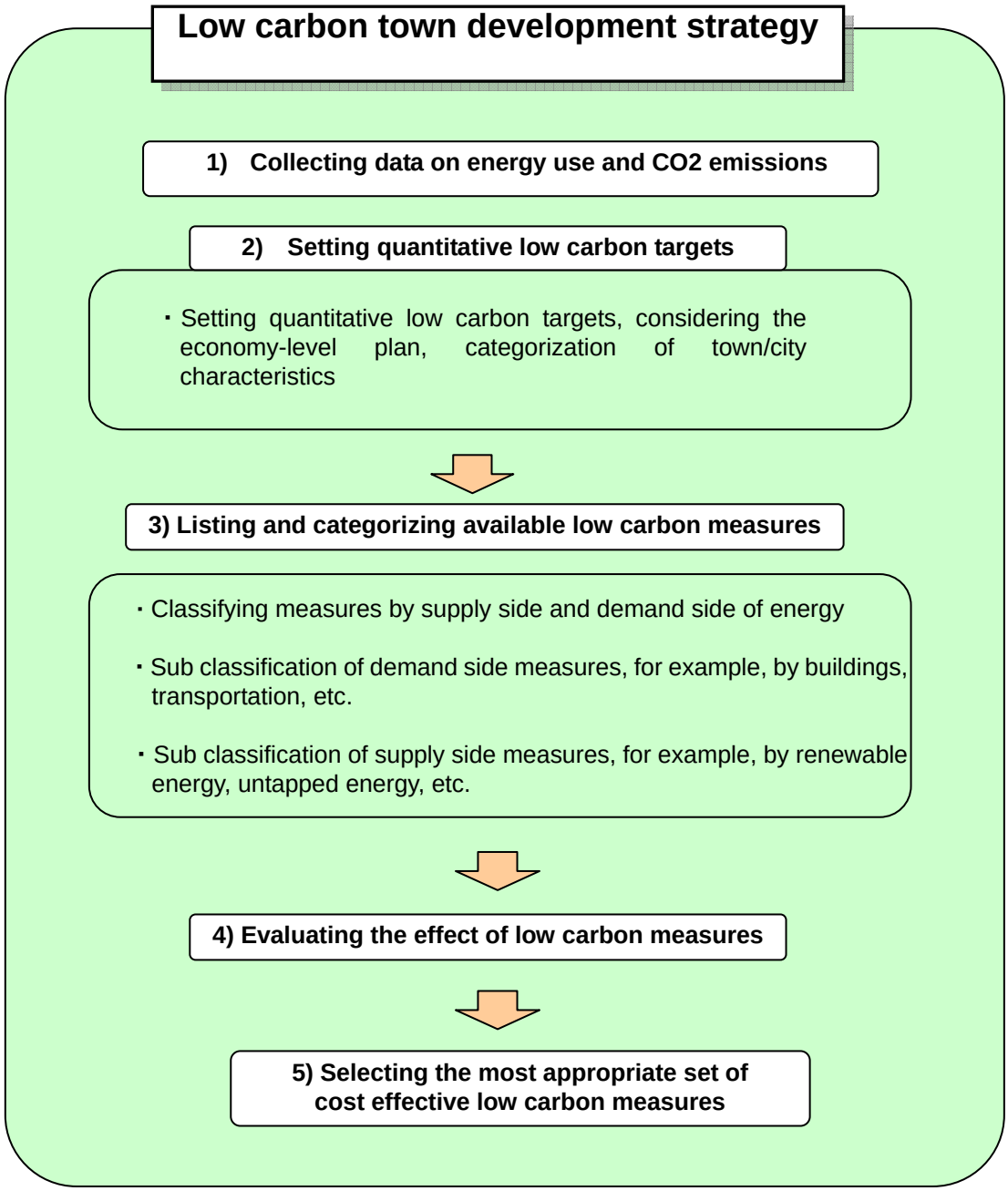
5) Selecting the most appropriate set of cost effective low carbon measures

The most appropriate set of cost effective low carbon measures to achieve the set targets is to be selected by considering the cost required for implementing these measures versus the benefits that will be acquired. In some cases, the selection will be made in reference to the basic low carbon development plan, which covers wide ranging features of the town at present as well as the future vision of the town. From this perspective, it may become necessary to prepare multiple options.

The step from 3) to 5) is the process to check the validity of the set targets. The work needs wide ranging professional expertise of urban design, and therefore, they will normally be commissioned to urban design consultants.

APEC LCMT Project is designed to provide responsible government officials with the opportunity to assess and refine the low carbon development plan through conducting F/S.

Figure 9 Low Carbon Town Development Strategy



Chapter 4 Characterization of Towns and Low Carbon Measures

Low carbon measures are classified according to whether they are on the supply side or demand side of energy. Cogeneration system, DHC (District Heating/Cooling) system, using untapped energy such as waste heat from waste incineration plants and use of renewable energy like biomass power generation, etc. are classified as supply side measures. Meanwhile, TOD (Transit Oriented Development), energy efficient buildings, public transportation system and energy management system, etc. are classified as demand side measures.

It is worthwhile to mention that depending on the characteristics of town, it makes a difference as to whether these measures can be easily adopted or not, and/or whether they exert far-reaching effects or not. So, it is a useful approach to characterize the type of towns when selecting the most appropriate set of low-carbon measures.

There are several different characteristics of towns; including 1) climate conditions like solar irradiation, temperature, wind conditions, 2) geography like flat landscape or hilly land, 3) industrial structure, for example, the way different kind of industries are located across the town, 4) town structure or intensity of land use, namely, whether town is developed intensively in 3D space or it is developed loosely in 2D space and 5) town infrastructure, whether it is sufficiently developed or not.

It is worthwhile to note that town structure as well as its industry structure will change along with its growth. Therefore, the government officials responsible for low carbon town development, especially in the developing economies where rapid growth of town is being observed, should look at the future picture of the town, or even think about guiding these changes from a view point of reducing CO2 emissions in the town.

There are several different types of categorization reflecting the different socio economic conditions of towns. Table 1 shows the categorization which is based on land related characteristics, such as size of the town, population density, and land utilization.

Table 1 Characterization of Town

Type of Town			Characteristics of Town			Infrastructure Development	Laws and Regulations
Symbol	Type		Size	Population Density	Land Usage		
I	Urban	CBD	100ha-	High	Mixed	Sufficient	Sufficient
II		Commercial Oriented Town	-100ha	Middle to High	Mixed		
III		Residential Oriented Town		Middle	Mainly Housing	Insufficient	Insufficient
IV	Village	Village Island		Low	Farming Fishing Resort		Limited

City infrastructure, which is categorized into water/environment infrastructure, energy infrastructure, communications infrastructure and mobility infrastructure, supports the wide variety of activities in the city. Therefore, the level of its provision makes a big difference in evaluating whether a particular low carbon measure is applicable or not, especially in the case of introducing an advanced low carbon technology like a smart grid. So, it is an important factor to be considered in selecting the appropriate measures.

Laws and regulations are also an important factor to develop a low carbon town. Take reuse of raw garbage in Japan. Japan has technologies to utilize raw garbage into energy. However, present national legislations regulate collecting raw garbage beyond the border of the local government, resulting in the delay of practical applications of these technologies.

The list of low carbon measures along with their applicability based on the town categorization is shown in the Appendix 2.

In the APEC region, there are several towns where a low carbon development project is ongoing or being planned. These projects vary in size and design approach according to their individual circumstances. The following table 2 shows some examples of low carbon town development projects based on the available information, and classified according to the type of town described as above. More examples will be added as there are more planned low-carbon towns in the APEC region.

Table 2　Low Carbon Town in the APEC

Type of Town	Low Carbon Town Project	Economy	Population
I　Urban Type1	Yujiapu CBD, Tianjin	China	500,000
	Sino-Singapore Tianjin Eco City	China	350,000
	Quezon City Green CBD	Philippine	
II　Urban Type2	Putrajaya　Green City	Malaysia	68、000 (300,000 planned)
	Chiang Mai	Thailand	160,000
	Da Nang (Pilot City of WB Eco2 Cities Project)	Viet Nam	1 million *
	Cebu City (Pilot City of WB Eco2 Cities Project)	Philippine	820,000*
	Surabaya (Pilot City of WB Eco2 Cities Project)	Indonesia	2.8 million*
	Yokahama Smart City Project	Japan	3.7 million*
III　Residence Type	Plunggol Eco Town	Singapore	
IV　Village Type	Muang Klang Low Carbon City	Thailand	17,000
	Jeju Island Smart Green City	Korea	6,000 households
	Low Carbon Island (Penghu Island and Others)	Chinese Taipei	88,000

* Total population

Chapter 5 Summary

The LCT Concept aims to promote the development of low-carbon towns in the APEC region by providing a basic principle that can assist the central and local government officials of the member economies in planning effective low-carbon policies and in formulating an appropriate combination of low-carbon measures while taking socio-economic conditions and city specific characteristics.

Setting quantitative low carbon targets is an essential element when planning a low carbon town development, as is the case with APEC PREE project. In the developed APEC economies, most of the local governments and municipalities have already started undertaking a task of developing low carbon towns. However, the level of their efforts in planning with targets is still at an early stage. Take Japan for example, more than half of municipalities are judged to be at 1^{st} or 2^{nd} level under the 4 levels classification of their efforts, namely, 1) making a start, 2) stepping forward, 3) moving for the top, and 4) taking a lead over others.

In the emerging economies in the APEC, there are a number of cities which have quickly developed in recent years. Therefore, it is no wonder that such cities do not always have the systematic methodology for planning and evaluating low-carbon town development. For example, in Japan, it is just 2010 when a report on “How to design low carbon cities” was published, which includes a concept for low-carbon town development and calculation methods of CO_2 mitigation. Given such circumstance, to develop the APEC “Concept of the Low Carbon Town” would be considered as a forehanded attempt.

Another important element described in “the Concept” is selecting a set of appropriate measures considering town characteristics. It is because that those town characteristics are critical for selecting appropriate measures. At the same time, it is to be noted that town characteristics such as city structure is variable so that it would be possible to guide transformation of town into economically as well environmentally sustainable one through carefully planning low carbon town on a long term perspective.

Appendix 1

Low Carbon Target for APEC economies

Appendix 1: Low Carbon Target for APEC economies

Economy	Emission reduction in 2010	Base year
Australia	-5% up to -15% or -25% Australia will reduce its greenhouse gas emissions by 25% on 2000 levels by 2020 if the world agrees to an ambitious global deal capable of stabilising levels of greenhouse gases in the atmosphere at 450 ppm CO_2-eq or lower. Australia will unconditionally reduce our emissions by 5% below 2000 levels by 2020, and by up to 15% by 2020 if there is a global agreement which falls short of securing atmospheric stabilisation at 450 ppm CO_2-eq and under which major developing economies commit to substantially restrain emissions and advanced economies take on commitments comparable to Australia's.	2000
Brunei Darussalam	Pledges to contribute to the 25% regional improvement in energy intensity by 2030 compared to 2005 levels, as agreed by APEC Leaders in the 2007 Sydney Declaration	2005
Canada	17%, to be aligned with the final economy-wide emissions target of the United States in enacted legislation	2005
Chile	Take nationally appropriate mitigation actions to achieve a 20% deviation below the “Business-as-Usual” (BAU) emissions growth trajectory by 2020, as projected from year 2007. To accomplish this objective Chile will need a relevant level of international support.	2007
China	Endeavor to lower its carbon dioxide emissions per unit of GDP by 40-45% by 2020 compared to the 2005 level, increase the share of non-fossil fuels in primary energy consumption to around 15% by 2020 and increase forest coverage by 40 million hectares and forest stock volume by 1.3 billion cubic meters by 2020 from the 2005 levels.	2005
Hong Kong, China	Pledges to reduce energy intensity of GDP by 25% by 2030 relative to 2005 levels, and to reduce electricity consumption in government buildings by 5% by 2013-14 relative to 2009-10 levels.	2005
Indonesia	-26% The reduction will be achieved, inter alia, through the following action: (1)Sustainable peat land management, (2)Reduction in rate of deforestation and land degradation, (3)Development of carbon sequestration projects in forestry and agriculture, (4)Promotion of energy efficiency, (5)Development of alternative and renewable energy sources, (6)Reduction in solid and liquid waste, (7)shifting to low-emission transportation mode	

Japan	25% reduction, which is premised on the establishment of a fair and effective international framework in which all major economies participate and on agreement by those economies on ambitious targets.	1990
Korea	To reduce national greenhouse gas emissions by 30% from the business-as-usual emissions by 2020.	
Malaysia	Pledges to reduce carbon dioxide emissions per unit of GDP in 2020 by up to 40% relative to 2005 levels contingent on the provision of international finance. Now in the process of instituting a renewable energy law and one of the mechanisms of the law are feed-in tariffs to promote the use of renewable energy. Malaysia also plans to include nuclear energy in the electricity generation fuel mix after 2020.	2005
Mexico	Reduce its GHG emissions up to 30% with respect to the business as usual scenario by 2020, provided the provision of adequate financial and technological support from developed countries as part of a global agreement	
New Zealand	New Zealand is prepared to take on a responsibility target for greenhouse gas emissions reductions of between 10 per cent and 20 per cent below 1990 levels by 2020, if there is a comprehensive global agreement. This means: • the global agreement sets the world on a pathway to limit temperature rise to not more than 2° C; • developed countries make comparable efforts to those of New Zealand; • advanced and major emitting developing countries take action fully commensurate with their respective capabilities; • there is an effective set of rules for land use, land-use change and forestry (LULUCF); and • there is full recourse to a broad and efficient international carbon market.	1990
Papua New Guinea	Pledges to reduce greenhouse gas emissions by at least 50% by 2030 (75% is technically possible subject to enabling finance) while becoming carbon neutral before 2050, contingent on international support.	
Peru	-By 2021, net deforestation of primary or natural forest to be reduced at 0% -At the end of 2020, total energy demand will represent, at least, 33% of share from renewable energies(non-conventional energies, hydro and biofuels -Design and implementation of measures to reduce emissions by inappropriate management of solid wastes	
The Philippines	Sets the goal of improving energy utilisation through the National Energy Efficiency and Conservation Program (NEECP) launched in August 2004. This program will save a cumulative 9.08 million barrels of fuel oil equivalent during the period 2007-2014 compared with business-as-usual. Sector energy efficiency goals are to reduce final energy demand by 10% (under the 2009-2030 Philippine	

	Energy Plan) in each sector: industry, residential, commercial, transport, and agriculture.	
The Russian Federation	15-25 % the range of the GHG emission reductions will depend on the following conditions: - Appropriate accounting of the potential of Russia's forestry in frame of contribution in meeting the obligations of the anthropogenic emissions reduction; - Undertaking by all major emitters the legally binding obligations to reduce anthropogenic GHG emissions.	1990
Singapore	Mitigation measures leading to a reduction of greenhouse gas emissions by 16%(footnote 1) below Business-as-Usual (BAU) levels in 2020, contingent on a legally binding global agreement in which all countries implement their commitments in good faith(footnote 2). (Footnote 1) Although a legally binding agreement has yet to be achieved, Singapore will nonetheless begin to implement the mitigation and energy efficiency measures announced under the Sustainable Singapore Blue print in April 2009. These measures are an integral part of the measures to achieve a 16% reduction below BAU referred to in (1). When a legally binding global agreement on climate change is reached, Singapore will implement additional measures to achieve the full 16% reduction below BAU in 2020. (Footnote 2) The clarifications set out in Singapore's Letter dated 28 January 2010 apply to paragraph (1).	
Chinese Taipei	Pledges to reduce economy-wide CO_2 emissions to the 2008 level during the period 2016-2020, and then further reduce emissions to the 2000 level by 2025 (uncontingent). The main measures to achieve this goal are to develop carbon-free renewable energy, to increase the utilisation of low carbon natural gas, and to promote energy conservation schemes in various sectors. Chinese Taipei has overall energy efficiency goals to reduce energy intensity by 20% by 2015 and by 50% by 2025 compared with 2005. All sectors have specific energy efficiency goals, such as: reducing the CO_2 intensity of industry by 30% by 2025, raising new car energy efficiency standards 25% by 2015, improving the energy efficiency of appliances and devices by 10% to 70% by 2011, and a 7% reduction of government energy use by 2015. All of the sectoral energy efficiency improvement goals are compared to 2008 levels.	
Thailand	Pledges to reduce energy intensity by 8% by 2015 and 25% by 2030 compared with 2005. To reduce greenhouse gas emissions, Thailand will also increase the use of renewable energy and nuclear power.	2005
United	In the range of 17%, in conformity with anticipated U.S. energy and climate	2005

States	legislation, recognizing that the final target will be reported to the Secretariat in light of enacted legislation. [1]The pathway set forth in pending legislation would entail a 30% reduction in 2025 and a 42% reduction in 2030, in line with the goal to reduce emissions 83% by 2050.	
Viet Nam	Pledges to reduce total energy consumption by 3% to 5% by 2010 and by 5% to 8% by 2015 compared with 2006. The government has also approved the following targets for renewable energy and the development of nuclear power plants: a) achieve a 3% share of renewable energy in total commercial primary energy by 2010, 5% by 2025 and 11% by 2050 b) introduce the first nuclear power plant in 2020 and then quickly increase the contribution of nuclear energy to the energy structure.	2006

（Source）UN FCCC (http://unfccc.int/meeting/cop/_15/copenhagen_accord/items/5264.php) and (http://unfccc.int/meeting/cop/_15/copenhagen_accord/items/5265.php),

”Pathways to Energy Sustainability: Measuring APEC Progress in Promoting Economic Growth, Energy Security, and Environmental Protection”, pp.86-91, APERC, 2010(Brunei Darussalam, Hong Kong, China, Malaysia, the Philippines, Chinese Taipei, Thailand and Viet Nam).

Appendix 2

Low Carbon Measures Along With Their Applicability

Appendix 2: Low Carbon Measures Along With Their Applicability

Classification of Measures			Low Carbon Measure	Applicability as per Type of Town Note 1)			
Supply / demand	Major Classification	Minor Classification		I	II	III	IV
Supply side	Generating / distributing power	Infrastructures for generating/ storing power					
			Distributed power facility	M	M	L	L
			Cogeneration system	H	H	L	L
			Large-scale power storage, etc.	M	M	L	L
	District energy (heat supply)	District heating /cooling			H	M	L
	Untapped energy	Using sea/river/sewage water			H	M	L
		Using waste heat from as waste incineration plants			H	M	M
		Using waste heat from sewage treatment plants			H	M	L
		Using waste heat from factories		M	M	M	X
	Renewable energy	Solar power generation (mega solar power generation)		M	M	M	M
		Using solar heat (large-scale solar heat)		M	M	M	M
		Biomass power generation (bio gas power generation, etc.)			L	L	M
		Wind power generation			L	L	H
		Geo-thermal power generation			L	L	M
		Hydroelectric power generation (small- and middle-scale)			L	L	M
Demand side	Composition of urban space	TOD development					
		Environment space development	Green way NW	H	H	H	M
			Underground space NW	M	L	X	X
	Buildings	Reducing loads		H	H	H	H
		Highly efficient facility systems		H	H	H	H
		Equipment installed at facilities	Fuel cells, etc.	H	H	M	M

	Management	Energy management systems	BEMS (HEMS, FEMS)	H	H	H	H
			ZEB	M	M	H	H
			AEMS	H	H	H	H
	Environment-related infrastructures	Urban climate	Micro climate, heat island	H	M	M	X
		Wastes	Collecting wastes, recycling resources	H	H	H	H
			Using energy (bio gas), using sewage sludge	M	M	L	H
		Water supply / sewage	Re-using treated waste water Using rainwater	H	H	M	L
		Reducing pollutions	Treating exhausts, contaminated soils (Treating waste water is included in the sewage.)	H	H	H	H
	Transportation system	Public transportation systems	Public transportation NW	M	M	M	X
			Intra-district transportation system (busses, LRT, etc.)	H	H	H	L
		Short-distance transportation systems	Intra-city community bicycle	H	H	H	L
			Short-distance transportation system	H	H	H	L
		Vehicles	EV	M	M	M	M
			EV bus	M	M	M	M
		EV-related hardware	Fast charger, small battery	M	M	M	M
		Natural gas-driven vehicles, etc.		M	M	M	M
Both supply and demand sides	Smart grid system (mainly for electric power system)	Power control systems	Power monitoring control system	H	H	M	L
			Power stabilization system	H	H	M	L
			Other systems				
		Network	Network infrastructures	H	H	M	L
			Network-related technology, communication modules, measuring systems, etc.	H	H	M	L
	Smart energy		Smart energy system	H	H	M	L

	system (energy integration)						

Note 1:

H: Potentially highly effective

M: Potentially effective

L: Potentially less effective or difficult to apply

X: Not effective at all or unlikely to apply

BEMS: Building Energy Management System

HEMS: Home Energy Management System

FEMS: Factory Energy Management System

ZEB: Zero Energy Building

AEMS: Area Energy Management System

TOD: Transit Oriented Development