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

Fifth Edition

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The APEC Low-Carbon Model Town Task Force

APEC Energy Working Group

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Executive Summary

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. In the first phase of the LCMT Project, an initial version of the "Concept of the Low-Carbon Town" was developed and F/S and policy review for the Yujiapu CBD (Central Business District) Development Project in Tianjin, China was provided. In the second phase of the LCMT Project, the "Concept of the Low-Carbon Town" was refined as a Second Edition, which mainly focused on "resort area", and F/S and policy review for the Samui Island in Thailand was provided as same procedure as previous phase. In the third phase of the LCMT Project, the "Concept of the Low-Carbon Town" was refined as a Third Edition, which mainly focused on "redevelopment of the existing area", and F/S and policy review for Da Nang in Viet Nam was provided as same procedure as previous phases. In the fourth phase of the LCMT Project, the "Concept of the Low-Carbon Town" was refined as a Fourth Edition, which mainly focused on "residential area", and F/S and policy review for San Borja in Peru was provided as same procedure as previous phases.

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 town design, building on the case studies of other Low-Carbon Towns in the APEC as well as incorporating the practical methodologies for town 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).

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 into consideration.

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 (greenfield 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 i) set quantitative low-carbon reduction targets with a time frame to achieve them, and ii) 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 a town in both physical terms and its governance arrangements make a difference in selecting the most appropriate set of low-carbon measures.

There are several different characteristics of towns including climate conditions, geography, industrial structures, town structures or intensity of land uses and town infrastructures. Unlike the first two characteristics, industrial structures, town structures and town infrastructures are variable. Therefore, the government officials responsible for low-carbon town development, especially in the developing economies where rapid growth of towns are 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 central as well as local government officials in APEC economies to refine and enhance their current low-carbon town development plans based on the "Concept of the APEC Low-Carbon Town".

The first part of "The Concept of the Low-Carbon Town (LCT) in the APEC Region" set out the basics of what low-carbon towns are, as well as an effective way they can be developed, taking into account the characteristics of individual towns. This second part of the document outlines the overall planning process for low-carbon towns, including how to set quantitative low-carbon targets. It details a range of measures and /or technologies that can be employed to reduce carbon emissions on both the energy demand and supply side, effective selection processes optimised for individual situations, and methodologies to evaluate their actual effect.

"The Concept of the Low-Carbon Town (LCT) in the APEC Region - Part II" is intended to be a guidebook for central and local government officials responsible for low-carbon town policies, as well as municipality officials and city planners who are directly responsible for low-carbon town development.

The planning of a low-carbon town requires considerable public input and it is essential to gain buy-in from champions among all groups of people involved and affected (the stakeholders). Though the initial issues of "Concept" mainly focused on the practical methodologies for low-carbon town development planning and design, the phase 5 highlighted the significance of consideration of relationships and roles of city, state/province and national governments, as well as the importance of participation by business and communities. These issues will be explored at the later stage, - this initial “Concept”, focuses on the practical methodologies for low-carbon town development planning and design.

The “Concept of the Low-Carbon Town (LCT) in the APEC Region” stresses the importance of setting quantitative low-carbon reduction targets with a time frame for achievement. Most of the towns in the developing economies in the APEC region, however, do not have such targets at present. In the meantime, they have been actively dealing with air and water pollution, waste management, and recycling of used water with numerical targets. It may not be an easy task for cities and towns to set quantitative low-carbon reduction targets.

However, the efforts in this direction would help resolve many of the urban problems they already face. The low-carbon targets can complement and strengthen action aimed at other targets. For example, low-carbon solutions generally improve air quality, support effective waste management strategies and are closely linked to water management. Moreover, working on and achieving low-carbon development will make a town and city more attractive and livable. Note that the targets are designed to be town specific and are not broad- based ones that would apply across all APEC economies.

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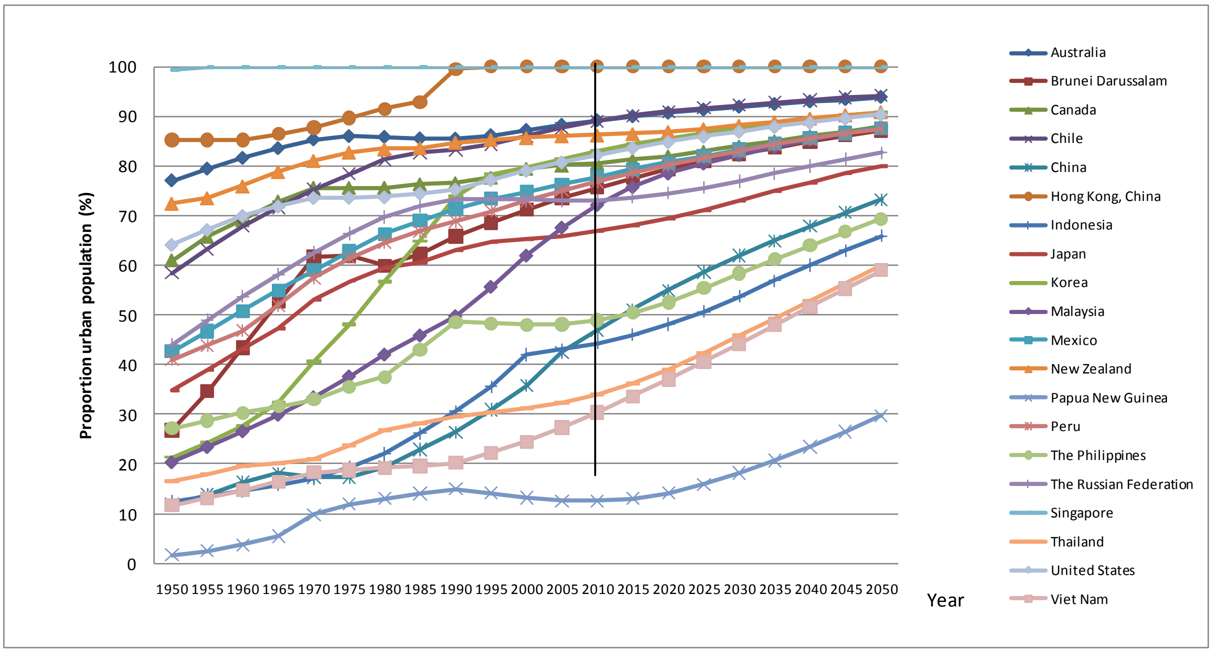
Chapter 1 Background

1.1 Urbanisation and the Impact in the APEC Region

The APEC region has increasingly been urbanised in recent years. In 2010, the average urbanisation rate in all APEC economies was 68.5%. Urbanisation is likely to increase in the future. In 2050, the average urbanisation rate is predicted to be around at 80.9%. Especially in Asia, the increase in urbanisation 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 Urbanisation

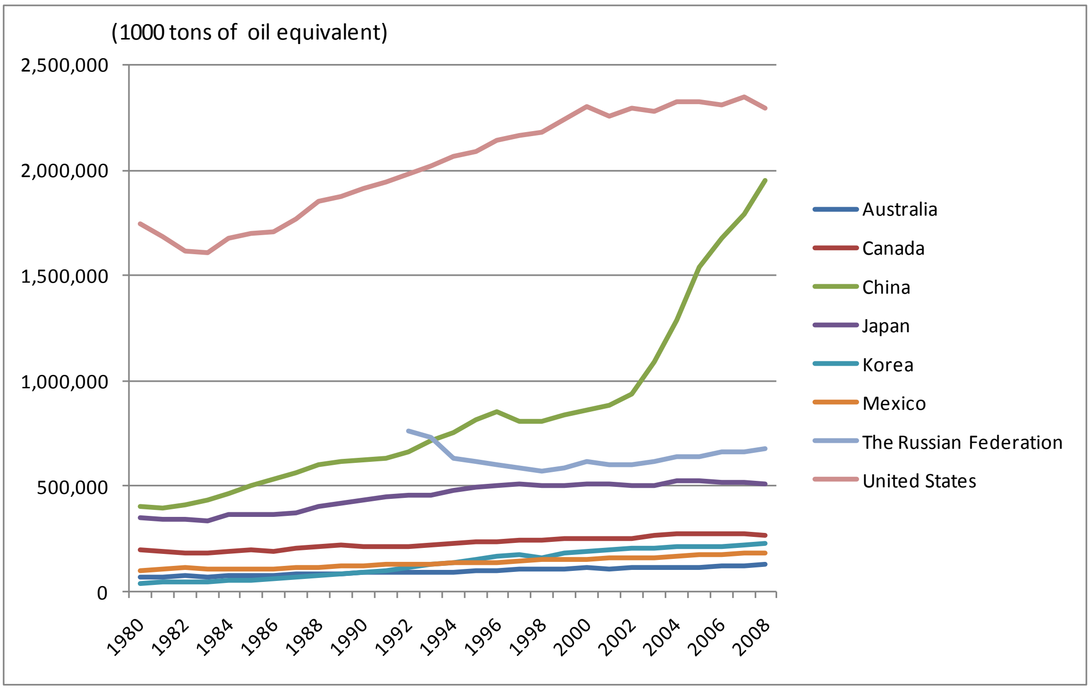


Source: World Urbanization Prospects 2009 (United Nations Development Program)

Energy consumption has also increased in responses to urbanisation 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 (tonne of oil equivalent), an 84.2% increase compared to year 1990 and a 26.2% increase compared to year 2000.

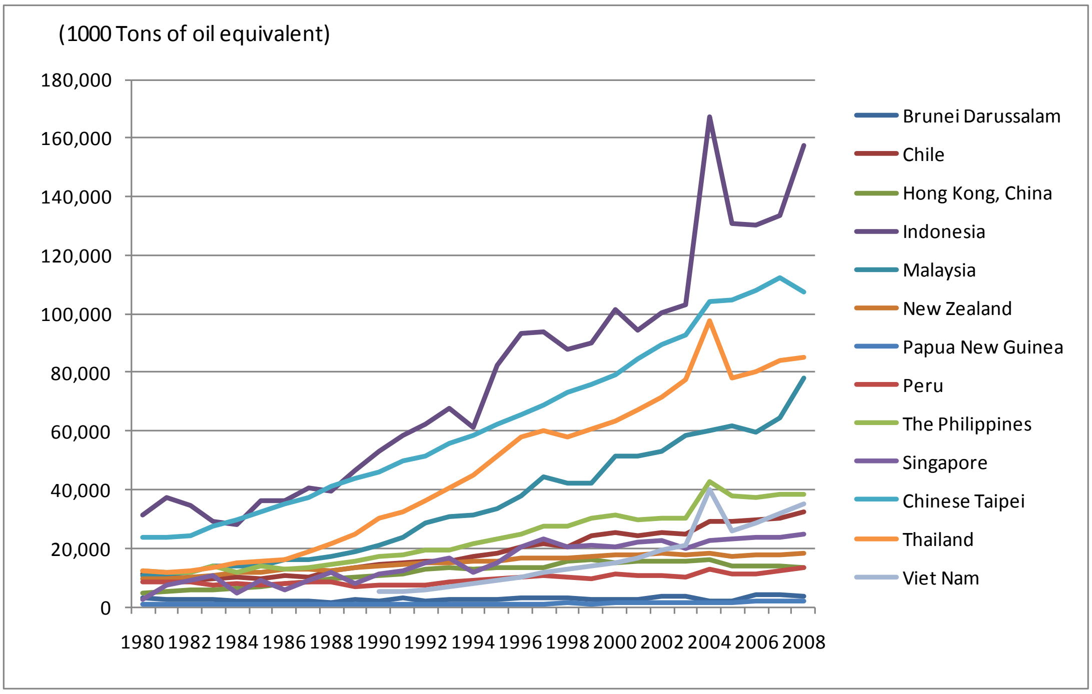
The increase in the energy consumption is remarkable especially in China where the consumption has more than doubled during the period from 2000 to 2008. China accounted for 76.9% of the total increase in energy consumption in the APEC region during the period (Figure 2). Energy consumption has also 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– unless very effective decarbonisation, energy efficiency and innovation measures are introduced.

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 urbanisation has been a major factor driving the increase in energy consumption in the APEC region. Naturally, much of the energy is consumed in the urban areas. Reducing greenhouse 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.

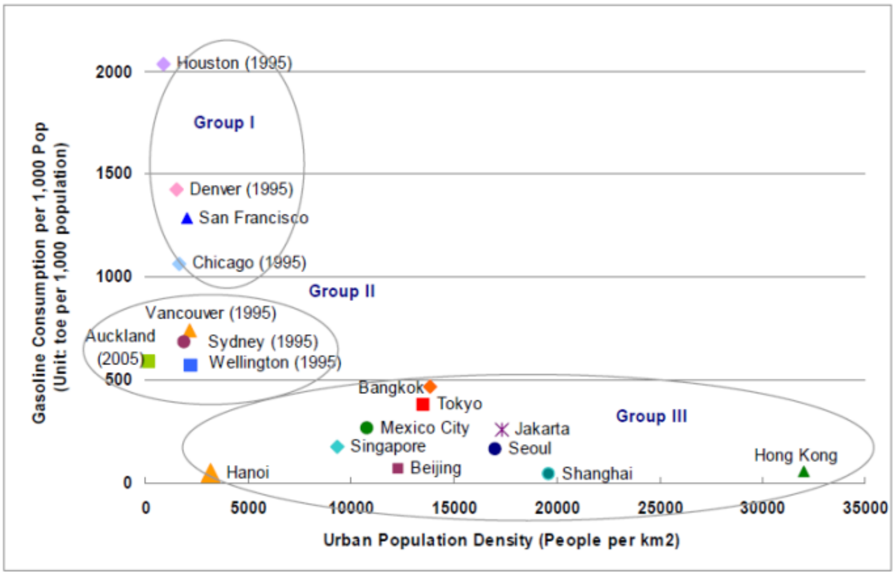
1.2 Low-carbon Target for Each APEC Member Economy

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 urbanisation 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 unless alternatives are pursued.

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

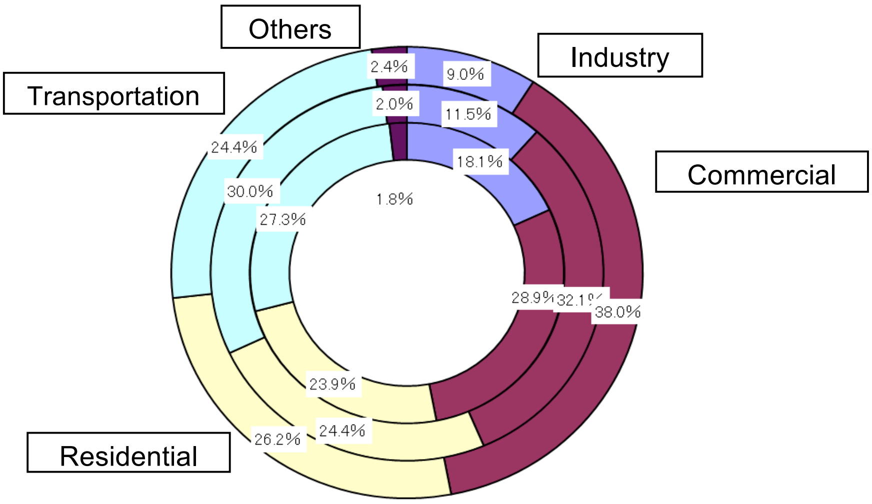


Source: Urban Transport Energy Use in The APEC Region

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 urbanisation process changes the living habits, CO_2 emissions in residential, commercial and transportation sectors have, in the past, increased. For example in Tokyo, the percentage of CO_2 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 CO_2 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 CO_2 Emissions in Tokyo



Inner circle：FY 1990（Total 54.4 million ton-CO2）
Middle circle：FY2000（Total 58.8million ton-CO2）
Outer circle：FY2008（Total 54.9million ton -CO2）

Source: Tokyo Metropolitan Government

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.

Urbanisation could also lead to overpopulation, deteriorated sanitary conditions, traffic congestion, air and water pollution which adversely affect economic productivity and decrease 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 are expected to create new values to them such as reducing the adverse impacts of the above problems to enjoy cleaner and safer living environment.

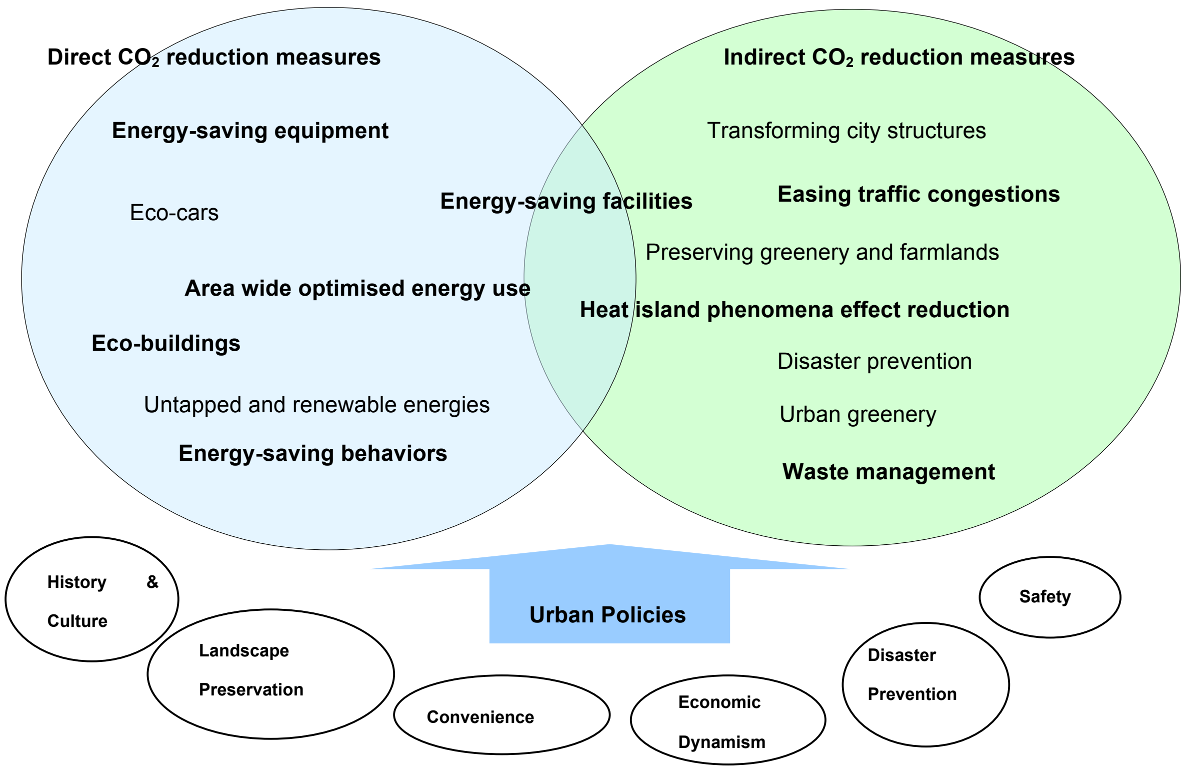
Chapter 2 APEC Low-Carbon Town (LCT) and Its Concept

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 CO_2 emissions. They are divided into different types of measures, namely, 1) energy related measures which directly result in CO_2 emissions reductions, such as introduction of energy efficient equipment/facilities, use of renewable energy, transportation, etc. (shown in the left-hand circle of the figure) and 2) other environment related measures which indirectly facilitate CO_2 emissions reductions such as recycling, forestation, 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 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, recycling 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 and a mechanism to monitor the progress toward the target of CO2 emissions reduction.
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 redevelopment of an existing city. 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 redevelopment, 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 or by focusing on some activities and infrastructure first.

To summarize, the APEC LCT means villages, towns, cities and regions and 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.

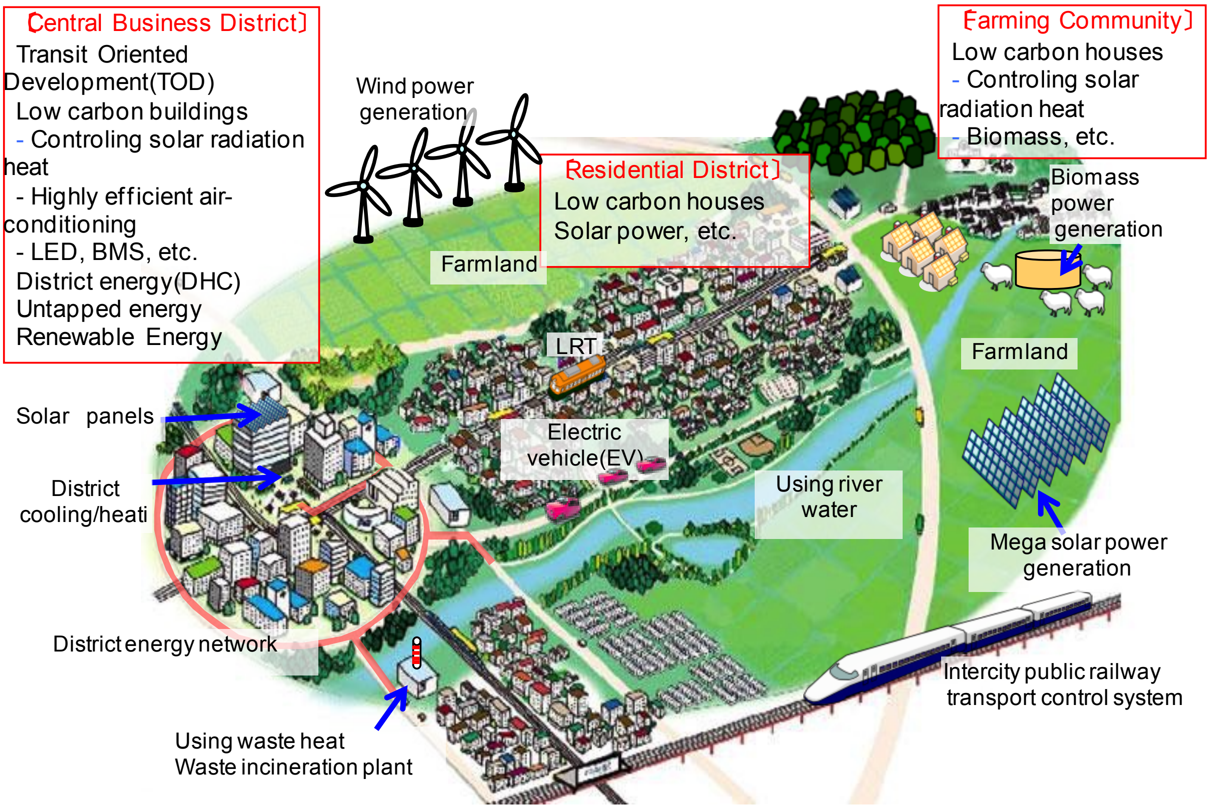
Figure 7 shows an example of the image of one approach the APEC LCT where the most suitable low-carbon measures are applied to different districts of the “Town” in a comprehensive manner considering cost effectiveness, availability of resources and characteristics of each district.

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 other towns may be comprised of a primarily industrial manufacturing district, residential districts, or an agricultural town, etc.

Government structures, and the powers and resources of local, regional and national governments also vary. This affects the range of actions a local government can take without engaging with higher levels of government.

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 Low-Carbon Town



Source: based on Special Report SR-79, 2008, National Institute for Environmental Studies

2.3 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 LCMT. 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 actively in cooperation with other member economies or cities or regions within them.
- 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.

- Organisation 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, opportunities and potential priority areas/actions 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 case of the F/S, 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 planned low-carbon development projects 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 and other policy mechanisms are appropriate for land use, energy use, water quality, air quality, etc.?
- How should government be best organised 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?
- How the community and business best be engaged?

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 utilisation, 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 utilisation to areas near such traffic axes, coordinated creation of a green network along the traffic axes, and provision of incentives to utilise lands near unused heat (or cooling) sources. 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 utilisation of energy tailored to its main activity centers, leveling of energy load through mixed use of various energy sources, demand management and storage, 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 CO_2 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 and shapes 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.

Are there some key principles that can be applied at this stage, e.g.:

- Locate facilities and housing to minimise the need to travel, and provide good access to public transport, for example higher density around public transport nodes
- Make each trip to a destination a step towards being able to reach other likely destinations, so trips for different purposes can be easily combined
- Ensure adequate amenity is provided for people using or living in areas
- Provide high standard telecommunications infrastructure so that ‘virtual’ service delivery can be used to minimise need for travel and physical goods and infrastructure requirements can be reduced.
- Ensure that energy infrastructure encourages efficient, smart energy use and utilises low and zero emission energy sources

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, simulate and optimise design for low carbon operation, 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.

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. In a greenfield development, strong measures can be applied across the development while in case of existing development, a transition strategy will be needed, as much ‘high carbon’ infrastructure and behavior is in place. In both cases, the underlying aim should be to ensure that long-lasting decisions that “lock-in” future behavior.

3.2.1 Collecting Data on Energy Use and CO_2 Emissions

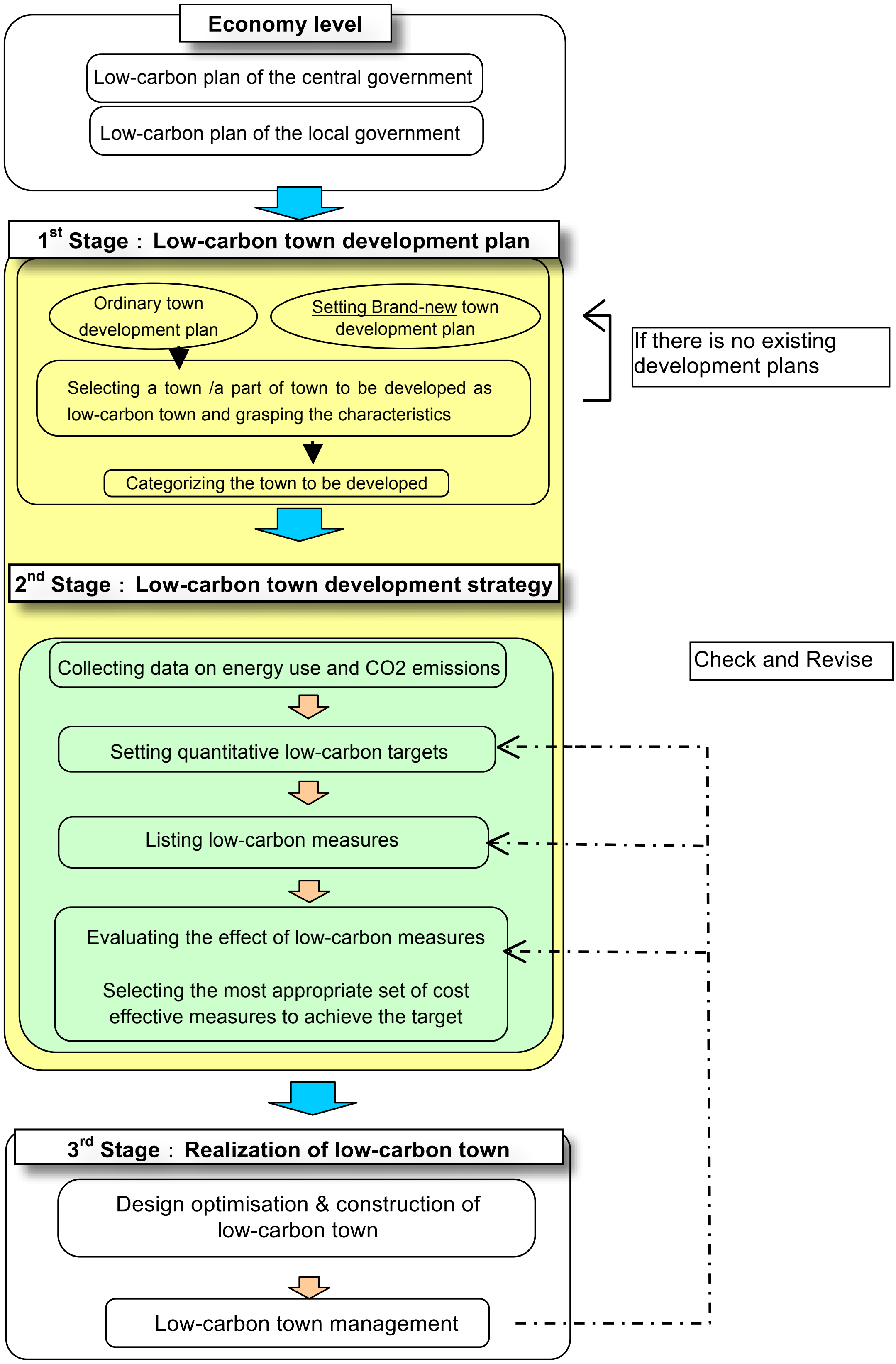
Baseline energy balance and energy efficiency data for all sectors as well as predicted future energy consumption. It is important that these data be collected from reliable and consistent sources.

3.2.2 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 sector specific low-carbon targets, for example, building sector, transportation sector, and residential sector as a holistic approach is effective to reduce CO_2 emissions across a town. It is also important to recognise that most human energy-related activity will need to be close to zero net carbon emission performance by around 2050, and this has implications for the targets set for long-lived infrastructure, buildings, etc. that will shape energy demand for many decades.

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.

Figure 8 Procedure of Overall Planning to Develop the Low-Carbon Town



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 and time taken to access specified services
- Public transportation conversion rate (and low emission transport such as bicycles, electric bicycles etc.?)
- Reduction in wastes produced and air pollution levels
- Water recycling rate

3.2.3 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. Smart energy management and storage are also emerging as key elements of a resilient energy system.

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.

It should be noted that, in districts where essential infrastructure—including roads, waterworks and sewerage facilities (and water supply and distribution networks and sewer main networks), and waste treatment centers—are being constructed, it will be important to achieve CO_2 reductions targeted within actual infrastructure development for both operation and energy used for materials and construction.

3.2.4 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 estimated 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 utilisation of untapped energy supplies, storage and smart management.

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”.

3.2.5 Selecting the Most Appropriate Set of Cost Effective Low-Carbon Measures

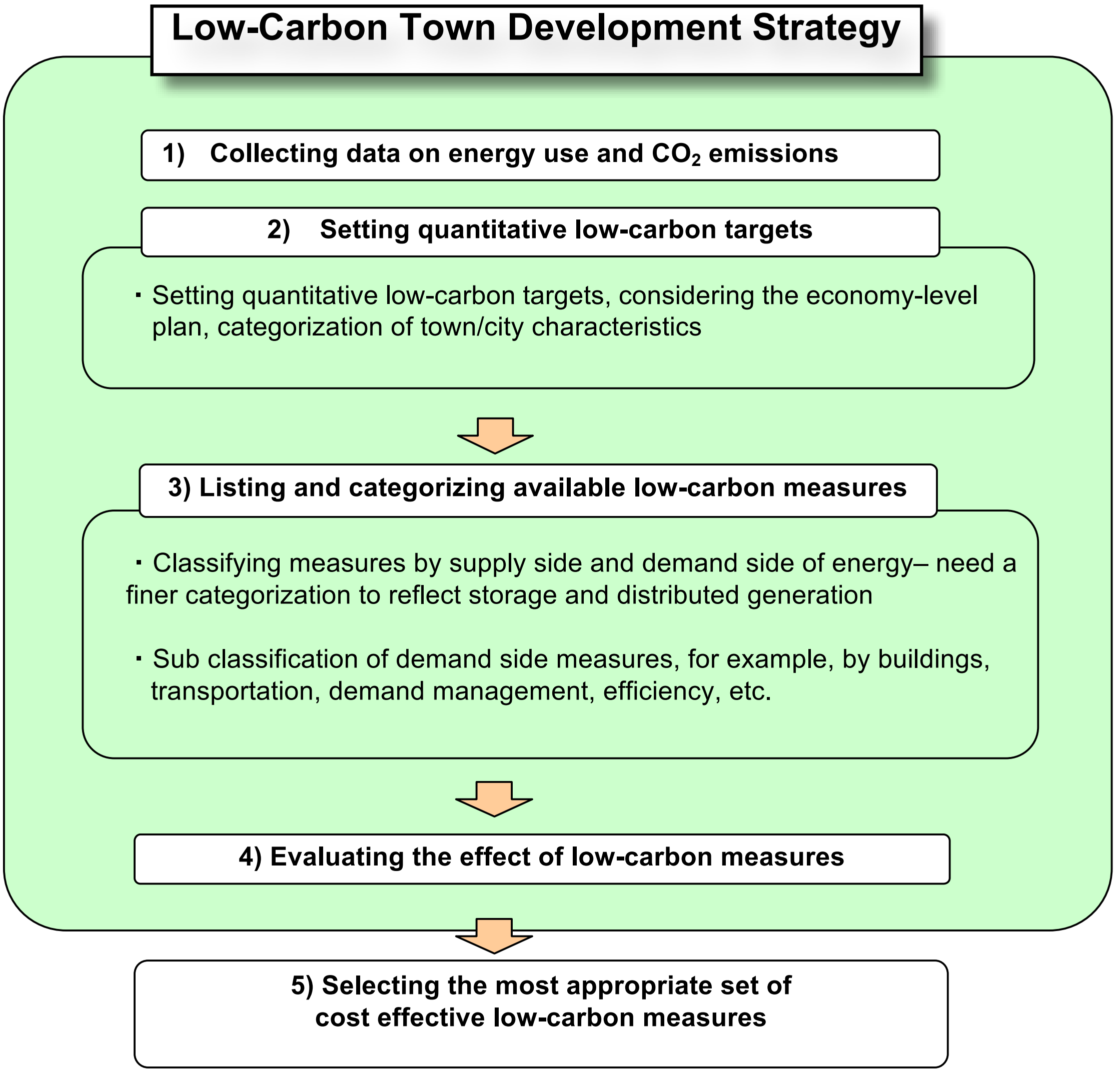
The most appropriate set of cost effective low-carbon measures to achieve the set targets is to be selected by considering the cost required for implementing these measures versus the benefits that will be acquired. In some cases, the selection will be made in reference to the basic low-carbon development 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.

Rural areas have lower land use density compared to central business districts (CBDs) and can more easily access renewable energy and untapped energy sources from forests, rivers, and other natural features. Thus, introducing mega solar power generation, large-scale wind power generation, hydropower generation, and other systems that take full advantage of such regional characteristics as well as on-site or precinct scale solutions must be proactively considered in these areas. Here, medium- to long-term construction plans that take into account not only current energy efficiency but also efficiency improvements to be gained from future technical innovation should play an important role. The time period and discount rate used for the evaluation must be carefully considered, as a high discount rate or assumed short life can understate the lifetime economic benefit from a long-lived asset.

In the transport sector, under low-density land-use conditions, building railroads and other public transport infrastructure that entails high construction costs will be difficult. Given this, methods that lower the carbon emissions of automobiles, buses, motorcycles, and other vehicles (e.g., by using biofuels, using electric vehicles, expanding road-based public transport, etc.) may be practical options.

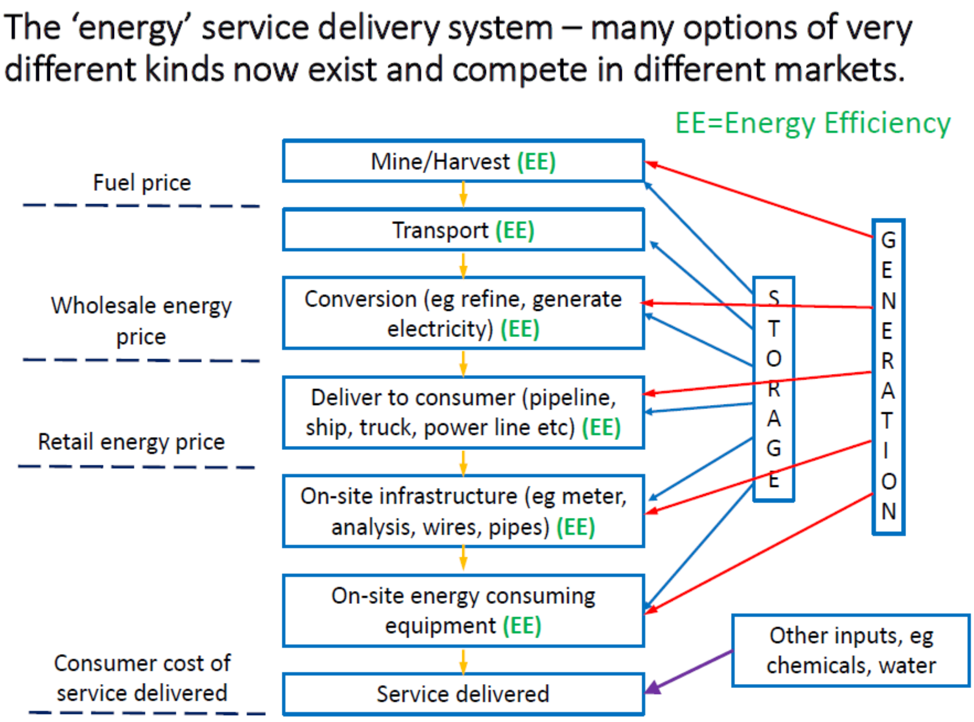
Figure 9　Low-Carbon Town Development Strategy



Chapter 4 Characterization of Towns and Low-carbon Measures

Low-carbon measures are mainly 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 (rooftop solar and storage, etc.), public transportation system and energy management system, etc. are classified as demand side measures.

Figure 10 Diversity of Energy Options



Source: Mr. Alan Pears, Presentation Material at the 2015 APEC Energy Ministerial Meeting

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 and the timeframes over which they may be applied.

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. Access to low-carbon energy sourced from its hinterland or from further afield can also be important, especially if major industry is to be located there, local renewable sources are limited, or there is potential for trading of energy at a regional level.

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 CO_2 emissions in the town.

There are several different types of categorization reflecting the different socio economic conditions of towns. Table 1 show the categorization which is based on land related characteristics, such as size of the town, population density, and land utilisation for the purpose of Low-Carbon Town project.

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	Rural	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 utilise 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 (Central Business District :CBD)	Yujiapu CBD, Tianjin[*1]	China	500,000
	Sino-Singapore Tianjin Eco City	China	350,000
	Quezon City Green CBD	Philippine	
II Urban(Commercial Oriented Town)	Putrajaya　Green City	Malaysia	68,000 (300,000 planned)
	Chiang Mai	Thailand	160,000
	Da Nang (Pilot City of WB Eco2 Cities Project)[*3]	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**
	Yokohama Smart City Project	Japan	3.7 million**
III Urban(Residential Oriented Town)	Plunggol Eco Town San Borja, Lima[*4]	Singapore Peru	
IV　Rural	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
	Samui Island[*2]	Thailand	53,990

*1 LCMT Phase I feasibility study
*2 LCMT Phase II feasibility study
*3 LCMT Phase III feasibility study
*4 LCMT Phase IV feasibility study
**Total population

Chapter 5 Summary of Part I

The LCT Concept aims to promote the development of low-carbon towns in the APEC region by providing a basic framework and principles 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 was 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 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 over time 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.

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

Part II

Fifth Edition

December 2015

Chapter 1 Basic Approach to Developing Low-Carbon Town

1.1 Overall Planning for Development of Low-Carbon Town

The overall planning process for the development of a low-carbon town is shown in Figure 1.

The essential preparatory step is to gain a full and complete understanding of the goals and background of your economy's central and local government low-carbon plans, to ensure the low-carbon town development plan is consistent with economy level planning.

The first stage of the actual planning process is to develop a low-carbon town development plan. This needs to build on the existing urban development planning if available, especially in regard to integration of town functions, land utilisation, and control of building density.

A low-carbon town development plan will focus on setting targets for reducing CO_2 emissions. It should also emphasize that land utilisation, urban transport, energy, green space, etc. should be considered in a comprehensive manner. When addressing the integration of town functions, it may be useful to outline the basic principles of area energy network (including District Heating and Cooling) and energy management, while the discussion of the control of building density may need to define appropriate town scale and population density in line with an ideal compact town.

Town development planning traditionally centers on the transportation and energy departments of local governments and municipality offices, with supporting roles played by other departments such as science, technology and telecommunications. A difference in the low-carbon development process is that environmental departments also need to be central to the planning process.

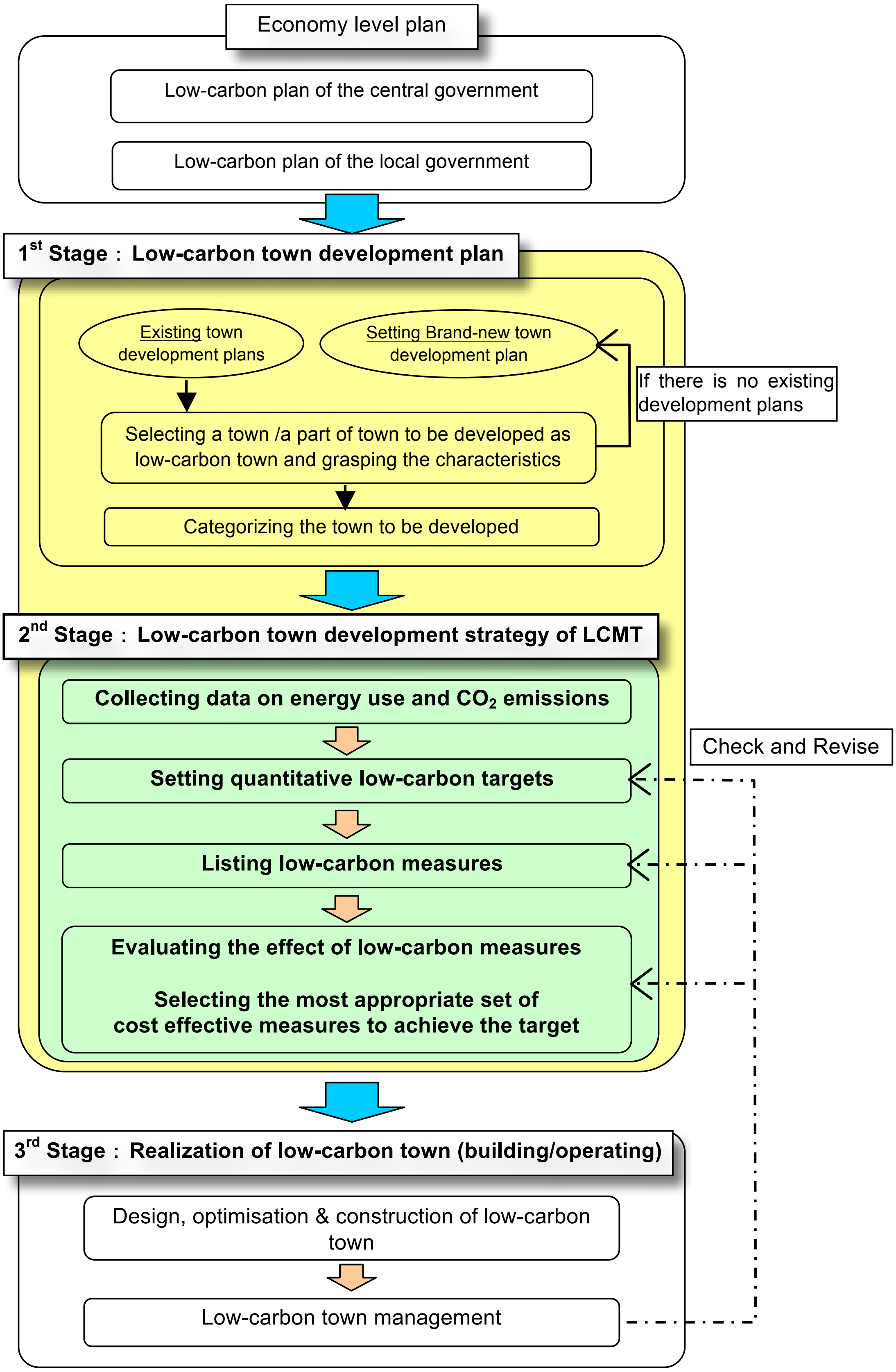
The scope of the plan needs to be set, including a clear definition of the town area, highlighting its perimeter, and whether it is a greater city area, a whole city, a district within a town, or a block within a district. The next step is to identify the characteristics of the designated area. This is essential, as ideal combinations of low-carbon measures for creating a synergistic effect will vary depending on the size of the area and its characteristics.

The last step of this initial stage is to prepare a low-carbon development plan. This requires a comprehensive planning approach, giving full consideration to other aspects of towns besides CO_2 emissions reduction, such as economic dynamism, convenience, and disaster prevention, to develop an attractive as well as economically sustainable low-carbon town. Low-carbon town development relates closely to the way the life will be in the town's future. 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.

The second stage of planning the low-carbon town is to develop the development strategy. Key steps include collecting the necessary data about energy and CO_2 emissions, setting quantitative low-carbon targets, and selecting the most appropriate set of cost effective low-carbon measures.
The last stage is to actually design, construct and operate a low-carbon town based on the low-carbon town development strategy. In this stage, it is essential to monitor and report CO_2 emissions to ensure that the city remains on a low-carbon path. It is not covered in this "Concept"

document.

Figure 1 Procedure of Overall Planning to Develop the Low-Carbon Town



1.2 Setting Quantitative Low-Carbon Targets

The recommended course is to set low-carbon targets for the town as a whole, taking account possible carbon reductions in each sector such as building, transportation, etc. Since the outcomes of measures interact, it can be useful to develop a model to reflect this: for example, changes in land-use affect transport demand, changes in end use efficiency of buildings changes energy demand (and hence energy infrastructure requirements), etc.

The validity of these targets can be checked using the "Plan Do Check Action" (PDCA) process:

> Set the targets for the town as a whole → select the set of low-carbon measures to apply to the individual sectors → conduct trial calculations of the effects on CO_2 reduction → determine whether the target can be achieved based on the trial calculations →examine an alternative set of measures if the reduction target is not met.

There are various indicators that can be used to measure CO_2 reduction. Indicator selection is the key to accurate evaluation of the effect of low-carbon measures. These indicators will also be used to measure progress toward the targets in the implementation stage.

The following indicators could be used to assess low-carbon objectives directly.

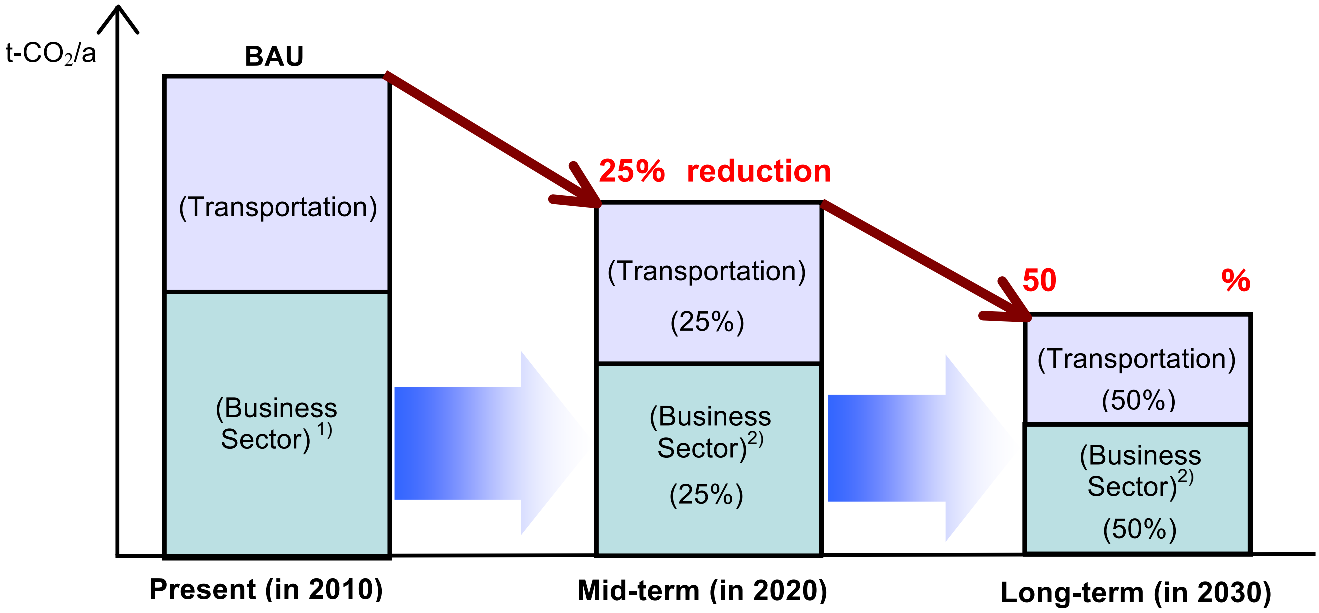
- Reduction in CO_2 emissions: t-CO_2 / year, t-CO_2 / year- floor space
- Reduction in CO_2 emissions per GDP
- Reduction in CO_2 emissions per person
- CO_2 emissions reduction rate (%)
- Reduction in primary or secondary energy consumption: GJ / year

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 congestion and/or decline in road vehicle kms per person
- Public transportation conversion rate
- Reduction in wastes produced
- Water recycling rate

The baseline for calculating the reduction amount is based on the CO_2 emission amount in the target region in the base year. The base year itself is selected in reference to the policies of the economy and town concerned. In the case of unused land where no development is being pursued at present or where a large-scale development is planned, it is desirable to set the CO_2 reduction amount of BAU (Business as Usual) under the assumption that the development will be carried out without employing any low-carbon measures beyond business as usual.

Figure 2 Example of CO_2 Reduction Target



1) Standard type buildings without low carbonized
2) Business sector includes the reduction effects in terms of buildings, district energy, unused /renewable energy, etc.

<INDICATOR OF SUSTAINABLE TRANSPORTATION PLANNING>

Developing and implementing efficient transportation policies and programs will require more rigorous collection, analysis, and dissemination of both quantitative and qualitative transport data. The following resources deal with the selection of indicators of sustainable transportation planning.

Resources for Developing a Data Collection Methodology

"Developing Indicators for Comprehensive and Sustainable Transport Planning" outlines how to identify, organize and collect indicators. (http://www.vtpi.org/sus_tran_ind.pdf)

"New Zealand Transport Monitoring Indicator Framework" is a tool for monitoring and evaluating transport policies and programs. It contains a large set of transport indicators that the Ministry of Transport updates on an on-going basis. (http://www.transport.govt.nz/ourwork/TMIF/Documents/TMIFV2%20FINAL.pdf)

Chapter 2 Measures to Use in the Development of Low-Carbon Town

As in the Figure 3, low-carbon measures can be categorized under these headings:

1. Town Structure
2. Buildings
3. Transportation
4. Area Energy System
5. Untapped Energy
6. Renewable Energy
7. Multi Energy System
8. Energy Management System
9. Greenery
10. Water Management
11. Waste Management
12. Pollution
13. Policy Framework
14. Education & Management

As the measures addressed in this Concept were originally designed from the energy perspective, we first categorized into two main categories based on if it is "Directly Related" or "Indirectly Related" to the energy usage. In "Directly Related", measures on "Demand Side", "Supply Side" and "Demand and Supply Side" are included. Measure type 1-3 are on the energy demand side, and measure type 4-7 are on the energy supply side, while measure types 8 straddles both energy demand and supply. From the Fifth edition, the elements of Environment & Resource as well as Governance were added. Those two aspects are not directly linked with measures concerning energy, so they were put in the "Indirectly Related" measures. Though the contributions of measure type 9-14 are indirectly related to energy, they are very important to take into account in order to effectively approach the development of low-carbon towns. An overview of these measures and basic ideas on how to introduce them are provided in the following sections.

Figure 3 Categories of Assessment

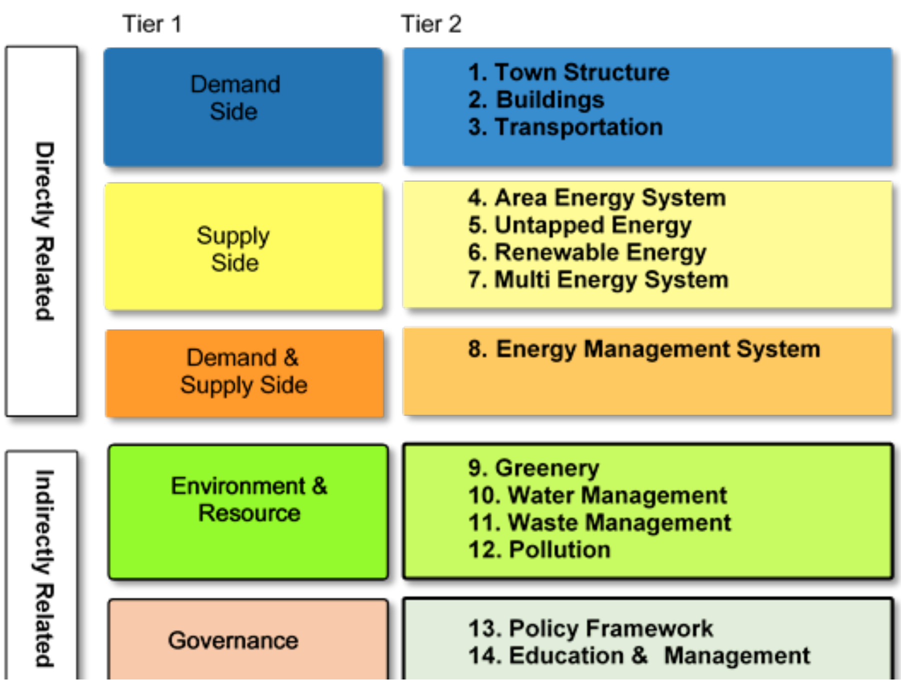


Figure 4 Overview of Low-Carbon Indicators

Tier 1	Tier 2	Tier 3
Demand Side	*1. Town Structure*	1. Adjacent Workplace and Residence 2. Land use 3. TOD
	2. Buildings	1. Energy Saving Construction 2. Green Construction
	3. Transportation	1. Promotion of public transportation 2. Improvement in traffic flow 3. Introduction of low carbon vehicles 4. Promotion of effective use
Supply Side	*4. Area Energy System*	1. Area energy
	5. Untapped Energy	1. Untapped energy
	6. Renewable Energy	1. Renewable Energy
	7. Multi Energy System	1. Multi Energy
Demand & Supply Side	*8. Energy Management System*	1. Energy management of building and area
Environment & Resource	*9. Greenery*	1. Securing Green Space
	10. Water Management	1. Water resources
	11. Waste Management	1. Waste products
	12. Pollution	1. Air 2. Water Quality 3. Soil
Governance	*13. Policy Frame Work*	1. Efforts toward a low carbon town 2. Efforts toward sustainability
	14. Education & Management	1. Life cycle management

2.1 Measures on Energy Demand Side

2.1.1 Low-Carbon Urban Structure and Land Use

i) Low-Carbon Urban Structure (TOD Type Land Use)

Transit Oriented Development (TOD) is to create a town concentrated around walking, low speed vehicles (e.g. bicycles and mobility scooters) and public transportation systems, which do not depend on automobiles, with their many impacts, and occupy much less urban space per unit of mobility. TOD has the following specific development means.

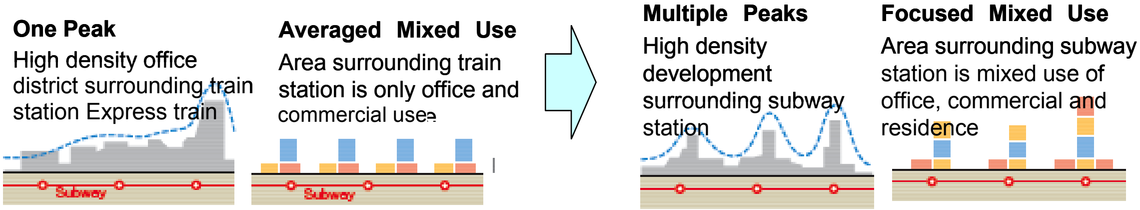
- Build a less CO_2 emitting town area by improving the land use (i.e. Concentrating a broad range of urban functions around the main transportation nodal points) as well as through systematic development of commercial, public, and residential areas.
- Build a town area whose transit is based on walking, bicycle, bus, etc. without depending on private vehicles. The aim is to provide convenient, quick, safe and low environmental impact access to the services individuals and businesses need to function.

< TRANSIT MALL >

Many towns in APEC developed economies have established a commercial space called a Transit Mall. It limits the car ride, and allows pedestrians and mass transit systems including buses and tramcars. Transit Mall is expected to vitalize the central built-up areas, improve road transportation environment and public transportation services.

When residential and office buildings are planned in the same area, energy demand equalization and/or energy sharing systems offer potential to absorb the different peak energy demands.

Figure 5 Image of High Density Development Surrounding Train Stations



<TOD Examples>

Creating a plan—New Zealand Transport Strategy
http://www.transport.govt.nz/ourwork/Documents/NZTS2008.pdf
Transport oriented development in Subiaco Australia:
http://www.mra.wa.gov.au/Projects/Subi-Centro/About-the-Project/
Bicycle Network in Chinese Taipei: http://biking.cpami.gov.tw/Page (in Chinese Only)

ii) Low-Carbon Land Use

Given predictions that population and economic growth will continue in the APEC region, it is anticipated that urbanisation of suburban, rural, and island areas will expand, leading to greater numbers of cars and buildings, unless alternative solutions are applied. This makes it necessary to formulate and execute plans that are founded on future population growth and composition and economic growth (and its composition) in such areas. Such plans should include encouraging use of appropriate development sites, use of low-carbon buildings, and systematic development of public transportation.

The urban planning in developed economies that are grappling with aging societies and falling birthrates, is required to change land-use planning for decreasing populations such as suburban "smart shrinkage", or land-use planning well-coordinated with public transportation plan. Given declining population and societal aging, challenges are likely to emerge in the future in regions that are currently enjoying continued economic growth, therefore land-use plans that take into account similar changes in socioeconomic conditions should be prepared at the present time.

2.1.2 Low-Carbon Building

In office and commercial buildings, a lot of electricity and heat energy are used for air conditioning, lighting, office automation (OA) equipment, and for hot water supply. At the same time, inefficient equipment releases large amounts of heat into buildings, increasing cooling requirements while (inefficiently) reducing heating requirements. The same applies to residential buildings, although on a different scale. When evaluating the low-carbon building measures, it is advisable to follow the following three steps as it will lead to more efficient and cost effective CO_2 reduction.

1st Step: Deploy passive energy design strategies such as reducing heat load into the building through improvement of the heat insulation of the building fabric and windows, with shading and rooftop greenery, etc. as well as minimising internally generated heat through utilising natural lighting and natural ventilation, etc. in appropriate climates.

2nd Step: Improve energy efficiency in air conditioning, lighting equipment, etc. This includes monitoring ongoing performance and enforcing building energy standards.

There are plenty of reduction measures within each step. It is necessary to examine the most appropriate combination of measures considering the use, targeted CO_2 reduction amount, construction cost etc. of the intended buildings.

i) Reduction of Heat Load in the Building

Evidence shows that heat energy demand for cooling/heating and electricity use for lighting and equipment depends greatly on the structure of the building, its outer environment and the use of the building.

In order to reduce CO_2 emissions associated with the building, the first step is to consider measures that will create a comfortable work and living environment in the building using less energy, in other words, the measures which will reduce the building load. In many retail buildings such as supermarkets and restaurants, energy use and heat generated by equipment can dominate building envelope driven energy demand.

Compared to large-scale businesses and commercial buildings, large hotels, or high-rise residential complexes, it will be difficult for small- and medium-sized resort hotels (comprised of cottage-type buildings) and low- and medium-rise housing to introduce centralized energy supply systems (e.g., DHC (District Heating/Cooling) system, central heat sources, central hot-water systems, etc.) Here, the further introduction of highly efficient equipment and facilities—such as high-efficiency air conditioners, heat-pump water heaters, and latent heat recovery-type water heaters—plays a very important role in reducing a building's CO_2 emissions.

Where central systems are used, attention must be paid to minimising distribution and standby losses associated with pipes, ducts, fans and pumps, and maximizing flexibility of operation, as these factors can seriously undermine overall energy efficiency, especially under low load conditions.

In addition, for small buildings, reinforcing insulation by using rooftop greenery, solar reflectance paint on roofs, etc., as well as use of natural energies (such as natural ventilation and natural lighting) will amplify the effectiveness of CO_2 reduction methods and should be actively introduced.

In many climates, and when building fabrics are efficient, energy use for appliances and equipment can exceed that used for heating and cooling, as well as injecting unwanted additional heat into buildings.

Especially where buildings are very efficient or climates are very mild, the amount of energy used to produce the materials used for construction can be significant on a life cycle basis. So use of materials with low embodied energy and carbon emissions, and efficient utilisation of materials are issues of increasing importance.

ii) Adoption of Passive Energy Design

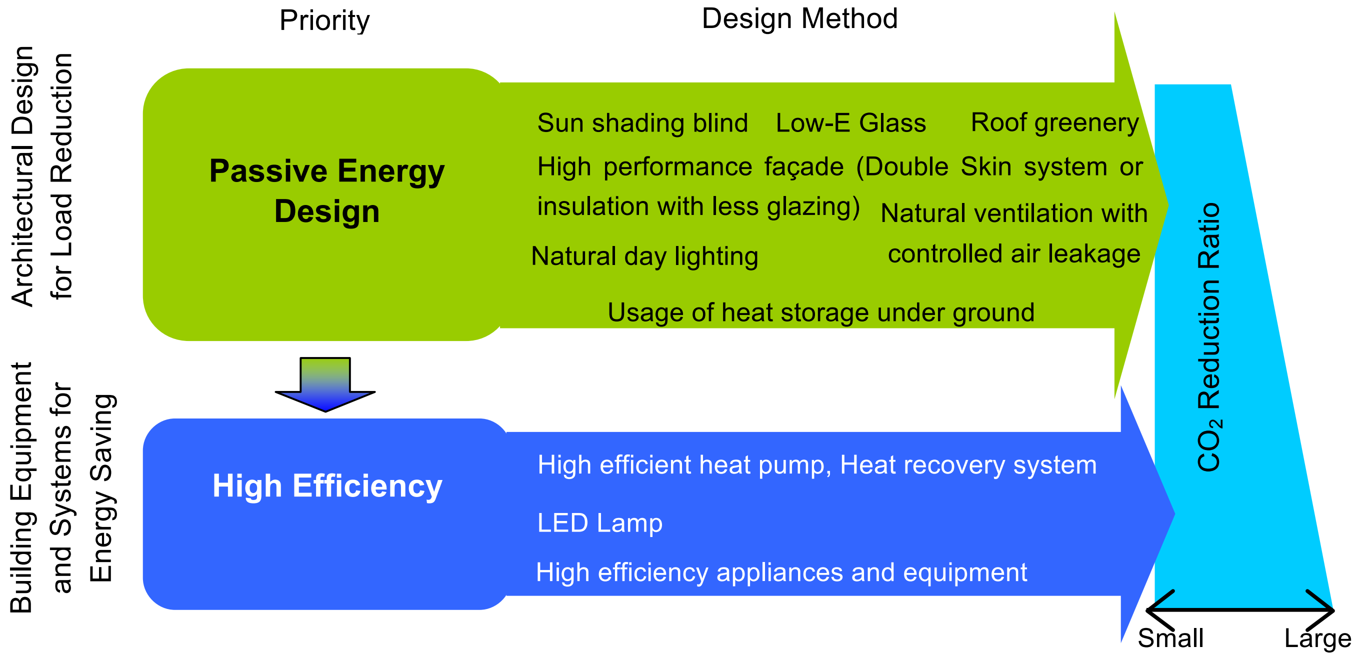
It can be effective to adopt passive forms of environment-friendly technology, which makes use of sunlight, solar heat, wind and geological conditions to adjust the indoor environment. For example, it may include building layout, envelop, geometry and infiltration & air-tightness design that can assist in utilising natural lighting or ventilation to obtain the desirable indoor environment quality. However, these approaches may be less appropriate under some conditions, such as in highly polluted cities, or where climate is extreme.

In the central built-up areas of large cities, the "heat island" phenomenon is of serious concern, because of the volume of heat released into the atmosphere from rooftop cooling towers, traffic road and pedestrian pavements. In this case, solar radiation reaching a building's rooftop is converted into heat, which causes higher room temperatures and rising air-conditioning costs. Thus, applying high solar reflectance paint for roof surfaces prior to the conversion of solar radiation into heat is effective in controlling rising room temperatures and lowering air-conditioning energy requirements.

iii) Improvement of Equipment Efficiency

Energy use in the building can be reduced by adopting high efficiency equipment for functions such as air conditioning, lighting, office automation, hot water supply. Schematic design flow of low-carbon building is shown in Figure 6.

Figure 6 Schematic Design Flow of Low-carbon Building



2.1.3 Low-Carbon Transport

i) Low-Carbon Measures in the Transportation Sector

Most of the CO_2 emissions from the transportation sector come from motor vehicles. CO_2 emissions from vehicles are represented as the product of traffic volume, distance traveled (trip distance) and emission intensity of automobiles. It follows that the low-carbon measures for the transportation sector will be based on measures to reduce values of these three factors by:

- a Reducing the distance that needs to be traveled, for example, through promoting a compact well-organised city which shortens the commuting distance and makes walking or bike riding more attractive.
- b Reducing traffic volume through promoting the shift to walking or bicycling and using mass transit systems such as carpools and buses, which have less per capita CO_2 emissions than automobiles and, where electric mass transit is used, it is more easily shifted to renewable energy and creates less local air pollution than liquid fueled transport.
- c Reducing intensity of CO_2 emissions per unit distance traveled through improving the road conditions to reduce time spent in traffic, introducing more fuel efficient vehicles, using alternative fuel vehicles, and eco-driving.

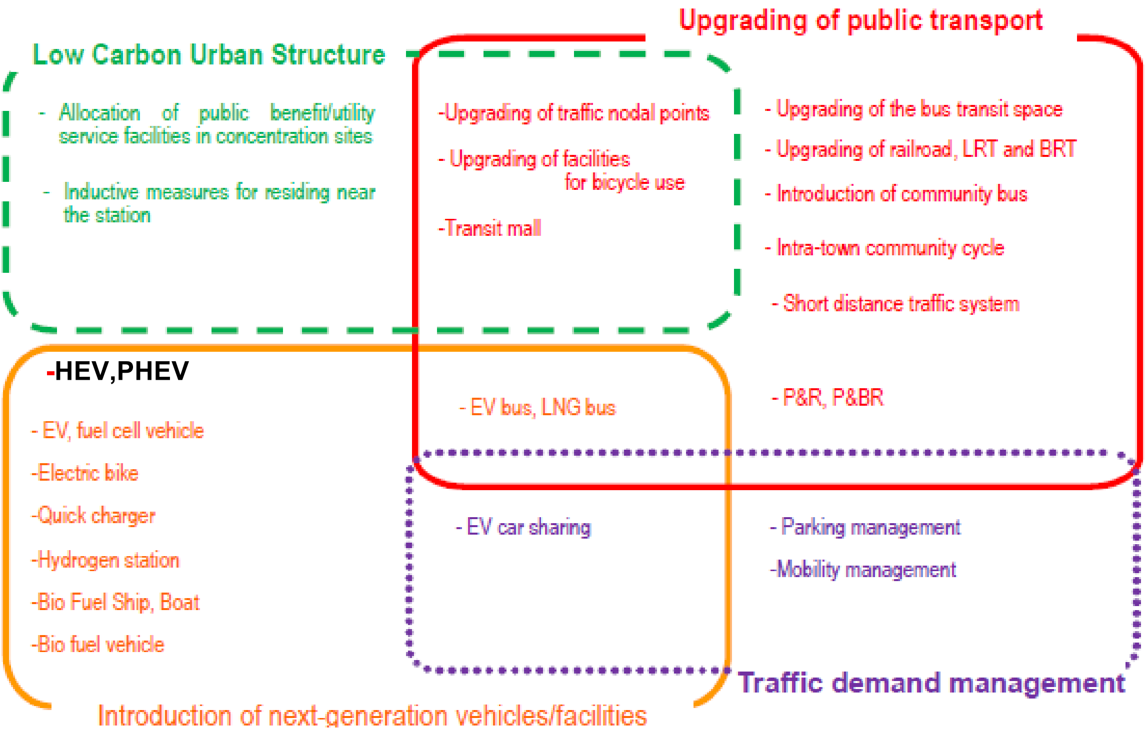
Figure 7 shows how these low-carbon transport measures can be integrated in low-carbon town structures.

The effects of measures to reduce CO_2 emission may not be obtained as anticipated if the measures are implemented individually. It is recommended that measures are implemented in ways where the greatest synergetic benefits can occur. The most important approach is to combine promotion of public transit systems with traffic demand management for motor vehicles. In addition, it is recommended practice to review how well the existing public transit facilities fit the requirements of the particular town.

Urban road freight, particularly light commercial vehicles, can be a major contributor to traffic congestion, fuel use and urban pollution. Many light commercial vehicles carry small amounts of freight. Improved coordination of freight activity can offer significant benefits.

It should be noted that applying fuel efficiency regulations on vehicles introduced in an economy together with measures in the targeted town will make it possible to promote lower CO_2 emission in both the targeted town and the economy as a whole. Stronger enforcement of pollution standards must be implemented to ensure regulations achieve intended outcomes.

Figure 7 Combination of low-carbon traffic measures



Changes in CO_2 emissions in Japan's transport sector

In Japan's transport sector, CO_2 emissions have been steadily declining since peaking in the early 21st century. This decline is the result of successful implementation of the following integrated measures.

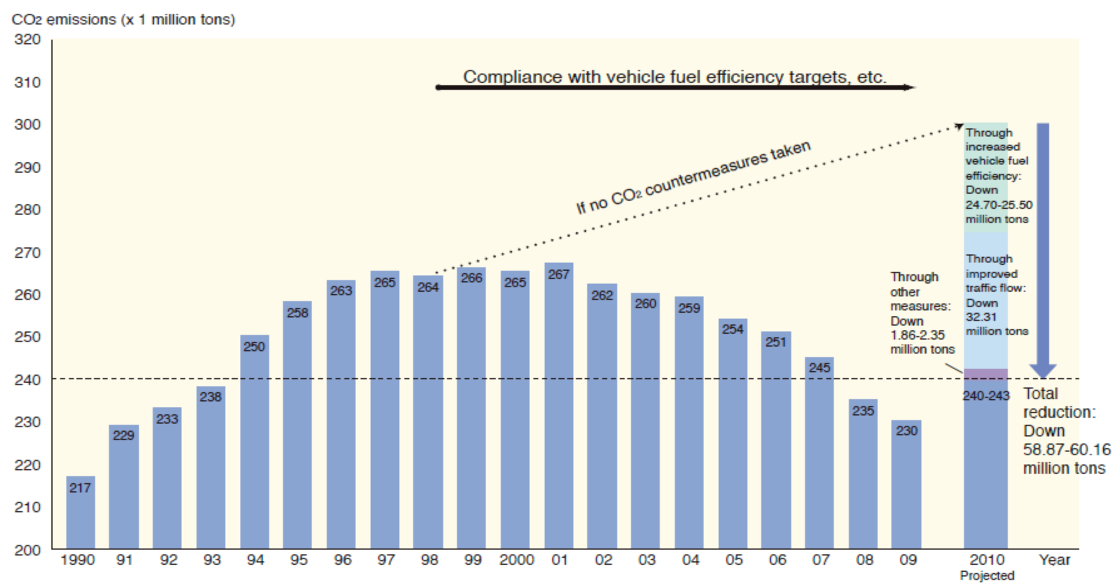
Road transport accounts for approximately 90% of CO_2 emissions in the transport sector. The volume of CO_2 emissions in the transport sector is obtained by multiplying together actual driving fuel efficiency, the CO_2 emission coefficient, and total distance traveled. Effective means of improving actual driving fuel efficiency include not only improving the fuel efficiency of individual vehicles but also alleviating traffic congestion through traffic flow measures and efficiently employing "eco-friendly driving." Improving the CO_2 emission coefficient requires the introduction of next-generation vehicles using alternative fuels that emit little CO_2 (electricity, hydrogen, natural gas, biofuels, etc.). And effective ways of reducing total travel distance include improving the transportation efficiency of freight vehicles and appropriately combining public transportation systems and personal mobility (i.e., introducing a modal shift, improving quality of experience of public transport).

The comprehensive implementation of the above-mentioned measures successfully reduced CO_2 emissions in the transport sector from 267 million tons at their peak in 2001 to 240 million tons in 2010.

The most rational way forward in reducing CO_2 emissions in the transport sector is to take integrated approaches—raising fuel efficiency, improving traffic flow, supplying appropriate fuels, using efficient vehicles, encouraging a modal shift, etc.—that involve all stakeholders, including automobile manufacturers, government, fuel businesses, and automobile users. The introduction of policies and measures to realize these approaches in ways that take regional characteristics into account is thus desired.

The potential of telecommunications to reduce and optimize transport energy use is significant. Growing popularity of personal media devices is also influencing desirability of travel modes that allow continued use of smart phones and personal media devices. In some countries this seems to be a factor in reduced car usage and ownership, especially among younger people.

Actual & Targeted CO_2 Emission Volumes in Japan's Transport Sector, 1990-2010



Source: Japan Automobile Manufacturers Association, Inc.

ii) Upgrading of Public Transit Systems

Public transit systems can reduce CO_2 emissions by reducing the volume of traffic of private vehicles, such as automobiles and motorbikes. They can also reduce traffic jams and travel time.

There are many types of public transportation system including standard bus, bus rapid transit (BRT), light rail transit (LRT), and subway or metro systems. It is crucial to select the most appropriate system to match the town size and traffic demand. As shown in Figure 8 , the capacity of a bus system is about 6,000 passengers per hour per direction, while that of an LRT system is 6,000-12,000 passengers, and a metro system is efficient for loads of above 25,000 passengers per hour per direction. Figure 9 illustrates the variation in capital cost between the different forms of public transportation.

Increased use of public transit systems can be promoted by improving the convenience of connections between different modes of transit, such as at train stations. Features to consider include barrier- free design, comfortable and safe spaces for pedestrians and people waiting for services and bicycle parking areas.

Figure 8 Transportation Capacity by Traffic Mode

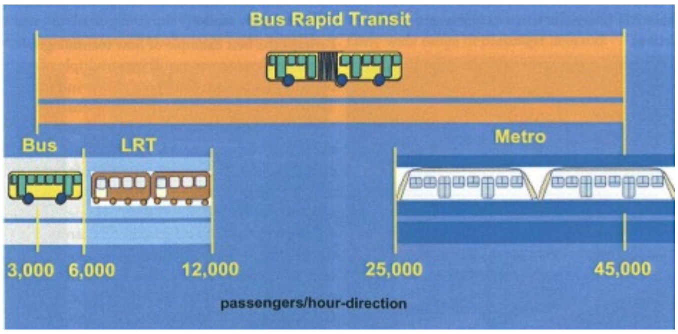
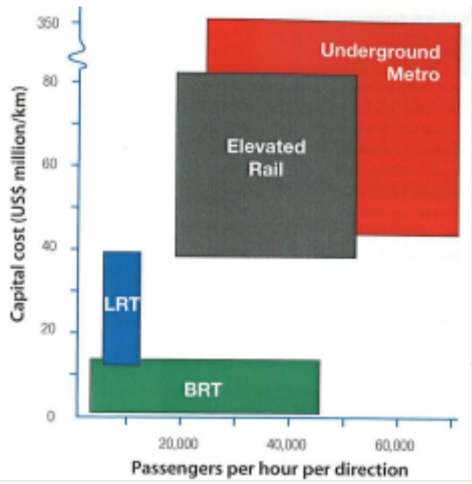


Figure 9 Transportation Capacity and Capital Cost



<Spotlight: Bus Rapid Transit Systems>

Many BRT systems use specially designed buses—called "trunk" or "bi-articulated" buses—that are long and divided into two or three compartments. Such buses can carry up to 140 passengers and travel in exclusive bus lanes, often with signal priorities at traffic lights. Since BRT uses or builds on existing road infrastructure, it is less expensive than light rail. In some cases where demand for mass transit is expected to grow but is not yet sufficient to justify the cost of light rail, BRT is an effective way to build ridership and shift driving commuters to the use mass transit, potentially paving the way for future light rail projects.

Successfully changing commuter behavior to maximize ridership on new BRT systems depends to a large extent on system planning. Criteria for successful BRT systems include:

- *Orientation (route alignment) to population centres and business/office centres*
- *Accessibility to housing and offices along the route*
- *Speed and efficiency of service (how fast to board, how fast to ride)*
- *Frequency of service at different times of day*
- *Comfort and safety for users (on vehicles and in associated facilities)*

iii) Introduction of Next-Generation Vehicles and Facilities

One option for reducing CO_2 emissions in the transport sector is to shift the current gasoline –driven cars and motorbikes to low-carbon emitting vehicles - such as the hybrid cars, electric cars, electric motorbikes and the fuel cell cars that are currently being developed and promoted.

CO_2 emissions from an electric car can vary from almost zero to nearly as high as that from a gasoline car, depending on the greenhouse intensity of the electricity. Fuel cell cars emit extremely small amount of CO_2. Figure 10 shows comparative levels of emissions from different vehicle types.

Given power supply conditions in low-carbon transport, the possibility that electric vehicles will be effective in reducing CO_2 emissions is quite high. However, electric vehicles face a number of challenges, among them restricted cruising range compared to gasoline vehicles with current storage battery technology and the need to establish new charging stations over a broad area.

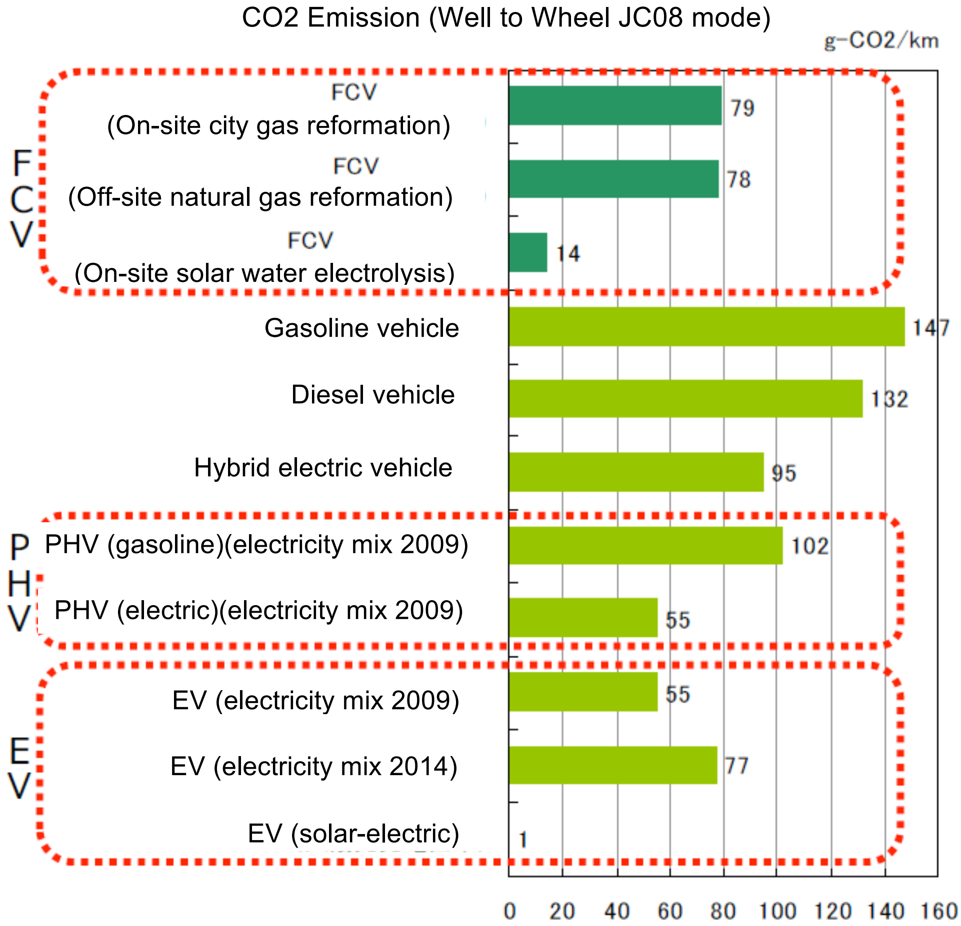
However, this point makes the introduction of electric vehicles suitable in remote islands and remote areas. This is because the travel range of residents and number of charging stations needed in such areas are naturally limited, thereby eliminating the above-mentioned disadvantages of electric vehicles, and because the price of gasoline generally tends to be higher there than on the mainland.

An effective option is the use of electric vehicles as rental cars in resort areas, where rental cars are a primary means of transport for tourists in resort area.

It is thought that the high cost of introducing low-carbon vehicles could inhibit the use of such vehicles. Measures to deal with this problem could include modifying existing vehicles (for example by converting them into electric vehicles or modifying them to run on biofuels) and applying high solar reflectance paint to the roofs of buses.

Motorbikes are now widely used in Southeast Asian economies - the motorbike share of total road traffic in Viet Nam is almost 90%. While it is expected the number of automobiles will increase significantly along with economic growth in APEC economies, it is also anticipated that motorbikes will make up a high proportion of future vehicle use, and the development of electric motorbikes is considered imminent. Electric bicycles also offer a useful option in many urban areas.

Figure 10 Comparison of CO_2 Emissions by Type of Vehicle, Japan



Comparison of CO_2 emission between gasoline cars and EVs electrically driven vehicle (Comparison of 1500cc-class vehicles)

Source: "Hydrogen/Fuel-cell strategy roadmap"

In the case of resort islands, routine travel between the mainland and the island often involves ferries or other such vessels. Converting these vessels to run on biofuels will be effective in reducing carbon emissions. Other measures could include converting island fishing boats to run on biofuels and utilising natural sunlight on pleasure boats. Electric boats and small ferries (often with solar charging) are also emerging as practical options.

iv) Traffic Demand Management

Traffic demand management is a valuable element of low-carbon transport measures. This management includes parking management, mobility management, "park & ride (P&R) systems. "Park & ride" systems provide facilities for people to drive in a private car from home to the nearest train station or bus stop, park there and transfer to the public transit systems to get to the center of the town. The systems which allow people to make connections from private cars to buses are especially called "park and bus ride (P&BR)".

Improved management of road freight, including consolidating loads, controlling delivery times and scheduling, shifting to rail, possibly carrying some freight on public transport, etc. can reduce congestion, air pollution and carbon emissions. Modern telecommunications can increase the potential for smarter urban freight management.

The greatest benefit in reducing CO_2 emission comes from supporting permanent change in commuter habits with other tangible measures.

<APEC Workshop on Policies that Promote Energy Efficiency in Transport (WPPEET)>
The workshop, which was held in Singapore on 24-25 March, 2009 provided a lively forum on a range of topics that covered fuel economy standards, operational efficiency programs, freight efficiency, mass transit, reducing road congestion, land use and urban planning, and the integration of transportation and energy policy.
http://www.apec-esis.org/www/egeec/webnews.php?DomainID=17&NewsID=178

2.2 Measures on Energy Supply Side

This section provides an overview of measures to reduce CO_2 emission on the energy supply side of low-carbon town development.

2.2.1 Area Energy System

Area energy networks for low-carbon towns are classified into two patterns—"linked" type and "independent" type—depending on the relevant network's relationship with the energy networks of neighboring areas.
In the case of a "linked" type area energy network, it is important to build the network after taking into account the regional characteristics of not only the low-carbon town but also neighboring areas, the status of existing infrastructure, forecasts for energy and power demand, and other considerations. Particularly in the case of remote islands, means for transporting equipment infrastructure needed by the network, means for connecting the network (e.g., laying of undersea cables, etc.), and other matters must be fully considered.
In the case of an "independent" type area energy network, it is assumed that the area will satisfy its own energy and power needs. Thus, the network must pay even greater attention to securing balance between energy/power supply and demand and providing backup power during times of disaster than is required for a "linked" network.

The costs of existing energy supply should also be evaluated when considering introduction of area systems. For example, transporting diesel fuel to islands can be expensive, unreliable and polluting, while also adding to balance of payments economic impacts.

A typical area energy network is a system that efficiently supplies cold/hot water to consumers from a central plant at the district or regional levels. The heat energy demand may be for cooling, heating or hot water supply, and is supplied via heat energy supply conduits, on a large scale.
These networks are possible in built-up urban areas around central transport nodes such as train stations where there is dense, mixed use of land, combining business, commercial, hotels, residential and cultural functions. These areas would usually contain a number of high-rise buildings, and variety of energy load patterns there would include some buildings with high energy loads.

It is possible to reduce CO_2 emission in a town through this kind of area-wide energy utilisation by purposefully constructing an "energy center" that integrates heat demands of different buildings based on a network that allows for the cross supply of energy.
Area energy network can be divided into three categories, depending on their scale.

- a District heating and cooling systems (DHC), covering a wide area (Figure 10)
- b Point heating and cooling systems, targeting multiple buildings in a single site (Figure 11)
- c Cross-supply of heat among multiple buildings

Figure 11: District Heating/Cooling Systems (DHC)

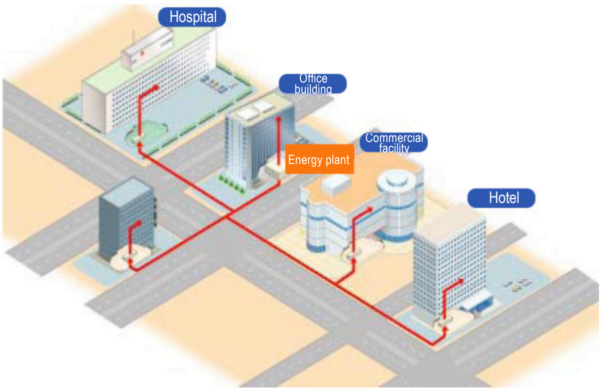
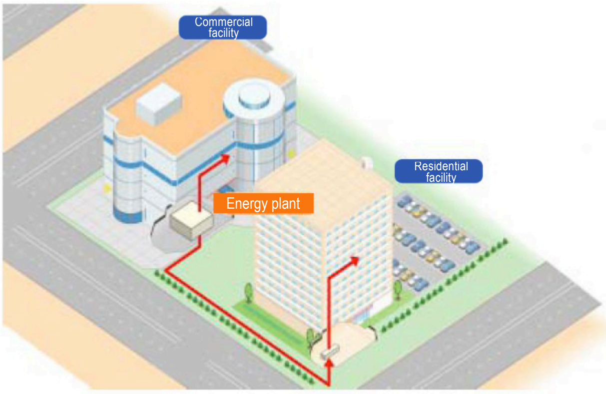


Figure 12: Point Heating/Cooling Systems



In recent years, co-generation (or CHP-combined heat and power) area energy networks that supply not only heat but also electricity have also been appearing, suburban residential and resort districts located in rural areas have relatively low energy consumption density per unit area compared to CBD. Thus, small- and medium-scale distributed power generation systems (co-generation), as well as small- and medium-scale power and heat networks that link the various forms of untapped energy and renewable energy to be mentioned below, are effective in such areas.

The emergence of energy storage systems (battery, thermal, etc.), improving energy efficiency of buildings and equipment, declining costs of on-site energy generation and increasing potential for more sophisticated monitoring and management of energy use are increasing the potential for area energy systems, including electricity micro-grids, to transform energy use. At the same time, they increase the importance of minimising distribution and standby losses and pumping energy use to achieve net benefits relative to individual systems.

2.2.2 Use of Untapped Energy

i) Untapped Energy Sources

In many towns and cities, waste heat is constantly produced in plants that incinerate garbage and/or sewage sludge, and by industrial facilities and power generation. However, these high volumes of waste heat are generally discarded, as there is little coordination with nearby energy demand. There are also other potential energy sources, such as river water, seawater, sewage water and sewage treated water. These can be used as a heat source or a heat sink using a heat pump technology, with the advantage that they vary less in temperature through the year than the ambient temperature.

These untapped energy sources could be developed at a regional level as part of low-carbon town development.

Heat pump technology efficiently transfers the heat energy contained in air or water in a source outside a building into cooling or heating required to keep interior thermal comfort; the energy demand for electricity or gas to run the heat pump is comparatively very low owing to the recent development of heat pump technology. Indeed, heat pumps capable of supplying steam efficiently have now been developed in Japan.

As was mentioned above, rural areas have relatively low energy consumption density. Thus, when using heat in such areas, it is important to fully study the use of waste heat from incineration plants while taking into consideration the heat demand volume (demand density) or wastewater treatment plants, which require connection with DHC or other heat-supply facilities. This can make such systems more difficult to gain net benefits from than in the CBD.

ii) Utilising Untapped Energy in Towns

In large cities and towns, garbage/sewage sludge incineration plants are often located near residential area, as are sewage pumping stations. These energy sources could be converted to energy supply for nearby buildings and houses, which would facilitate the cyclic use of energy at a regional level.

iii) Managing Urban Development to Promote Untapped Energy Use

An essential element of the effective use of untapped energy is to take all opportunities to link potential consumers with the energy source. Greenfield developments could intentionally site these waste treatment plants near urban areas with high energy load. In existing urban areas, road maintenance and other infrastructure improvements provide opportunity to establish the heat energy supply conduits.

Linking untapped energy to existing power networks is not easy due to limitations arising from power supply conditions in each economy. Promoting the effective use of untapped energy requires the ability to formulate introduction plans that are tied to commercial power network studies at a higher planning stage, such as in the formulation of master plans.

iv) Linking with Improvements to Urban Thermal Environment

In the central built-up areas of large cities, the “heat island” phenomenon is of serious concern, because of the volume of heat released into the atmosphere from rooftop cooling towers, traffic road and pedestrian pavements, surfaces of buildings and vehicle engines and air conditioning in congested traffic. In order to minimise the effect from solar radiation reaching surfaces, especially dark coloured ones and roads is converted into heat, which causes higher temperatures, urban planning taking into account the air ventilation of a town, greenery environment and the measures to apply high solar reflectance paint for roads, sidewalks and the roofs of public transport vehicles (e.g., buses, trains, and trams).

Water bodies such as rivers and underground aquifers can be effective absorbers of waste heat. This requires consultation with the administrators of the water body to make sure that it has sufficient flow to avoid the localized accumulation of heat in the waterway.

2.2.3 Use of Renewable Energy

i) Renewable Energy Sources

The energy that exists in nature and that can be used repeatedly is called renewable energy. It includes solar energy (photovoltaic (PV), and solar heat usage), wind energy, biomass energy, and geothermal energy. Renewable energy is widely available but is also unstable and dispersed. To make such low-density energy effective for power and/or heat generation may require concentration, storage and distribution through energy conversion facilities, such as, solar power plants. The declining cost of many renewable energy options, combined with improving energy efficiency (so less energy is needed), storage and improved energy management means that simple solutions such as PV are increasingly viable. However, in high density areas, adequate space and access to renewable energy are fundamental constraints.

Rural areas have lower land use density compared to CBD's (making it easier for them to utilise large blocks of land) and can more easily access natural renewable sources. Thus, introducing mega solar power generation, large-scale wind power generation, hydropower generation (small-scale hydropower), and other systems that take full advantages of such regional characteristics must be proactively considered in these areas. Here, medium- to long-term construction plans that take into account not only current energy efficiency but also efficiency improvements to be gained from future technical innovation should play an important role.

For cities, importing renewable energy from sources beyond the city can be a practical solution.

The introduction of heat pumps that utilise temperature differences in river water, oceans, lakes, marshes (example: as the condensing water to release heat) and soils—which have the potential as rich sources of natural energy that are closely tied to local communities—should be studied. Heat pump performance and efficiency is continuing to improve, so that heat pumps can save more energy and operate under more extreme conditions than in the past.
Moreover, possibilities for power generation by geothermal energy, ocean thermal energy, snow-ice heat, and ocean wave should be studied.

The output of renewable energy (with the exceptions of geothermal and biomass sources) is influenced by time-variant weather conditions. Because of this, renewable energy presents the following problems: 1) inability to serve as a stable supply; 2) negative impacts on the transmission system arising from fluctuating output; and 3) difficulty in adjusting the overall supply-demand balance.
Accordingly, additional measures will become necessary particularly when the share of renewable energy within the overall power source structure reaches a considerable level, for instance, making up for power generation instability by varying output of distributed power generation systems (co-generation), introducing DR (Demand Response) program, or building batteries (or other storage such as pumped hydro or thermal storage) with power plants and transmission systems. Such measures will include controlling output fluctuations caused by varying sunlight or wind conditions and shifting surplus power generated during the nighttime to peak daytime hours.

ii) Using Renewable Energy in Towns

While solar energy and geothermal energy can be utilised regardless of the regional characteristics, there will be a higher potential for utilisation in suburban areas or middle/small-sized local towns rather than in the central areas of large towns. While renewable energy that is used for electricity generation will be developed widely, the deployment of renewable energy as heat sources depends on the regional heat requirement. In this sense, it is essential to foresee the future status of heat use and formulate a strategy for the use of heat in the future.

Improvement in heat pumps, including their use to produce steam for industry, potentially provides a very efficient way of providing heat from electricity instead of gas, liquid or solid fuels.

< Renewable Energy for Urban Application in the APEC Region>

The above report, which was commissioned by APEC EWG/EGNRET and published in January 2010, assessed best practices in renewable energy technologies, systems and resources in urban areas of APEC member economies. It includes examples in the residential, commercial, industrial and utility sectors. It is worthwhile to read as it will provide insights about the approach to utilise renewable energy in the urban area, although it should be noted that recent cost reductions and innovations have increased the range of cost-effective opportunities available.

http://www.egnret.ewg.apec.org/reports/210_ewg_urban_application.pdf

iii) Managing Town Development to Promote Renewable Energy Use

The benefits of renewable energy such as solar and biomass are considered to be relatively high in the local towns where the building density in the built-up areas is relatively low. However, in these towns, there tend to be less opportunities such as district redevelopment and replacement of buildings, which could introduce renewable energy. Therefore, it will be necessary to capture the opportunities of refurbishment of government office buildings and hospitals etc. It will be also important to cooperate closely with town developers who have plans for large scale development.

iv) Linking Biomass Sources to Town Development

Low-carbon town development near the agricultural, forestry, or livestock farming area has the advantage of biomass energy. Effective use of biomass energy will require consolidation of the widely dispersed waste materials, and establishment of a framework for the production of energy locally and use of energy locally.

Rural areas should be able to make effective use of such biomass as agricultural waste, fisheries waste, and forestry waste (e.g., timber from forest thinning, etc.) in the same way that food waste and urban waste resources generated in CBD are used.

2.2.4 Multi Energy System

There has been an increase in urban management risk due to widespread natural disasters in response to the progression of urbanisation around the world, and the constraints of energy supply and the vulnerability of centralized energy systems have become apparent. At the same time, with the expanded introduction of renewable energy, ensuring the quality of electricity, for example voltage and frequency, is becoming a major issue. In response to such conditions, it has become more necessary to combine and optimally utilise a variety of energy sources in consideration of regional characteristics (renewable energy, distributed energy (relatively small-scale generation such as CHP (combined heating and power) and cogeneration)) in order to disperse the risk of energy supply and reduce CO_2 emissions.

Distributed energy is a relative concept formulated in contrast to conventional large-scale, centralized energy, and refers to energy that is distributed to many different regions on a relatively small scale such as CHP and cogeneration. The benefits of distributed energy include ensuring energy supply in emergency situations while reducing costs and environmental impact through efficient use of energy. In addition, activation of the regional economies, promotion of demand-side participation as well as reduction of load to the grid can also be expected as side effects of distributed energy.

CHP and cogeneration are power generation systems using fuels such as natural gas, oil, and LP gas via methods including engines, turbines, and fuel cells while recovering the waste heat generated during this process. The recovered waste heat can be used as steam or hot water for air conditioning and hot water supply, allowing for a more efficient use of heat and electricity. These methods are expected to achieve a high overall energy efficiency of up to 75% to 80% of the fuel's original energy.

The introduction of CHP and cogeneration can lessen the overall consumption of primary energy by reducing the amount of electricity supplied from the grid system while also utilising waste heat for heating and hot water supply.

2.3 Measures that Straddle Energy Demand and Supply

2.3.1 Energy Management System

i) Building-Level and Regional or District-Level Energy Management System

a)Building-Level Energy Management Systems

Building-level energy management systems prevent unnecessary energy use by automatically adjusting the operation of equipment in a building. For example, this kind of system turns off lights in unused rooms and controls the air-conditioners and lighting in response to variations in room temperature and light intensity. These systems can also improve monitoring of equipment performance and usage, so that faulty equipment and inefficient practices can be identified and addressed. Depending on the type of the targeted buildings, there are different forms of building-level energy management systems; building energy management systems (BEMS), home energy management systems (HEMS) and factory energy management systems (FEMS). Their introduction can result in significant reduction of energy use.

b) Regional or District-Level Energy Management System

Energy management systems at regional or district level will prevent unnecessary energy use in the central heat supply plants. These systems use surveillance and control systems and high-speed communication networks to monitor and control the plant operation. This energy management system is called AEMS (Area Energy Management System). AEMS may be regarded as an area-wide energy use based on IT technology, and this system has already been put to practical use.

ii) Smart Grid Systems

The smart grid system is a new concept of electricity transmission/distribution network that controls and optimises the flow of electricity from both the demand and supply sides. These systems require the installation of a “smart meter” on the demand side.

Conventional electricity transmission is designed for peak demand, which results in electricity wastage. In addition, outdated and aging transmission/distribution lines are vulnerable to overload and natural disasters, and can be difficult to restore service on after an outage. Smart grid systems have been proposed as the next-generation transmission/distribution system that can maximize efficiency, while also facilitating the introduction of electricity from distributed renewable sources, use of storage and smart energy management systems.

As well as offering these low-carbon benefits, it is noted that smart grid rely on advanced communication systems, which could be vulnerable to tampering or computer virus infection , and so need to be carefully safeguarded.

Smart grid systems are different from one economy to another, due to factors such as electricity market structure, or stability of power transmission/distribution network. Smart grid systems have following potential benefits:

1. Reduction of electricity consumption can be expected at demand side through measuring and visualising the electricity consumption with the smart meter and improved management using manual or automated control. It is also possible to shift peak demand by restraining the consumption at the time of peak electricity generation or utilising local energy storage.
2. Stability of electricity supply and prevention of blackouts will be improved by the safety-control equipment installed on the electricity transmission/distribution network. This reduces the social disturbances caused by blackouts, providing economic benefits for the whole society.
3. Electricity generated from solar and wind energy can be highly variable in volume, depending on the season or time of the day. If renewable power is connected to the power transmission/distribution network, it may turn out to be a voltage variation for the network. The smart grid systems avoid such a problem by matching the supply from the utilities with the demand of the consumers and, increasingly, by utilising storage.
4. Under the smart grid systems, it is expected that surplus electricity generated by renewable energy can be controlled by temporarily storing and discharging the electricity using batteries or other storage technologies (e.g. thermal storage, pumped hydro) connected to the grid. In future, it may be possible to adjust the demand-supply balance in the whole electricity network, making efficient use of the batteries mounted on “plug-in” type electric cars and hybrid vehicles stationed at households.

Overall, smart grid systems seek to reduce the wasteful electricity consumption on the consumer side and to promote the introduction of renewable energy on the supply side. In many towns and cities in the APEC member economies, smart grid system demonstration projects are under way, supporting innovation not only in the energy area but also in the wider town infrastructure, including buildings, traffic system design and management. The goals of these projects address the different socio-economic conditions of their respective economies and regions.

<APEC Smart Grid Initiative>

The APEC Smart Grid Initiative (ASGI), established in 2010 by APEC's Energy Working Group (EWG), evaluates the potential use of smart grids and grid management technologies, energy efficiency, renewable energy technologies, and intelligent controls to link customers to the grid and enhance the use of renewable energy and energy efficient buildings, appliances and equipment. The goal of the Initiative is to create best practices in operation (through workshops and actual testing) as well as interoperability standards to create highly efficient systems that are easily replicable.

http://www.egnret.ewg.apec.org/meetings/egnret36/E3-APEC%20Smart%20Grid%20Initiativ

Future energy systems will be "smart" at all levels. On the supply side, it is expected that town energy systems will combine large-scale integrated power generation from sources such as thermal, hydroelectric and nuclear, and a large number of CHP and small-scale renewable-energy power generation in individual households. On the demand side, there will be energy management systems in place at all levels: in homes, commercial and civic buildings and at area level. Energy storage could appear at many points in the smart grid.

Smart Energy System seeks to optimise the total energy use by coordinating all the energy management systems for a single district. It is also possible to optimise the total energy supply and consumption by combining not only electrical systems but also heat supply systems which use cogeneration and thermal storage equipment.

Another type of smart energy system in development aims to connect energy systems with water circulation systems by using water as a heat storage media and adjusting the operation of water treatment facilities to absorb variation in energy load.

Smart energy systems are likely to be a main approach to future low-carbon town development, even if not immediately applicable to all current projects.

Smart energy systems are optimised networks that integrate heat, power, and other energy with ICT, They are expected to see more effective utilisation through their application in CBD and other areas that have relatively high energy consumption density. When planning their use in rural areas, it is important to design smart energy systems, taking into consideration demand volume (demand density) for each energy type (power or heat).

2.4 Measures for Environment and Resource

2.4.1 Greenery

i) Effect of Greenery

a) The heat island phenomenon

Greenery is an effective way to create eco-friendly urban environments, absorb CO_2 and mitigate the heat island phenomenon (see chapter [x] for a description of CO_2 absorption).

The heat island effect is found mainly in urban areas where urban surfaces such as concrete and asphalt pavements, and building surfaces replace permeable moist open land and vegetation. The urban surfaces store heat from the sun or heat exhaust from buildings and vehicles, causing a 1-3 degree difference for urban heat islands compared with surrounding areas.
Urban air temperature has dramatically increased over the past 100 years compared with non-urban global levels. In Japan, the mean air temperature in Tokyo has increased by over 2.0 degrees, comparatively the average temperature increase for the whole of Japan is around 0.7 degrees.

Urban air temperature has increased continuously alongside global warming. This has especially been the case for Asian urban cities, which have rapidly urbanised in recent years. The heat island phenomenon also creates micro-climates. This has the potential to create secondary problems such as increased energy use from use of air conditioning in buildings, ecosystems degradation and new pathogens from increased temperatures.

Figure 13: Increase of Annual Mean Temperature

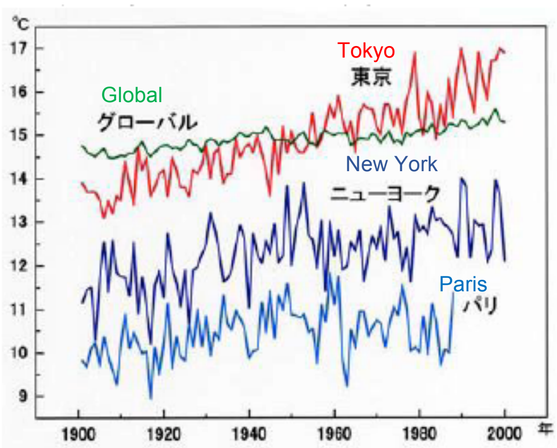


Figure 14: Spread of Heat Island Area in Tokyo Metropolitan (from 1891 to 1999)

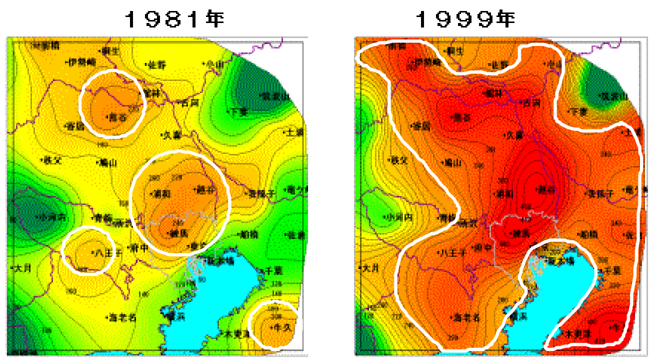


Figure 15 Distribution of Surface Temperature around Greenery Planning Area (12:00, August, Tokyo)

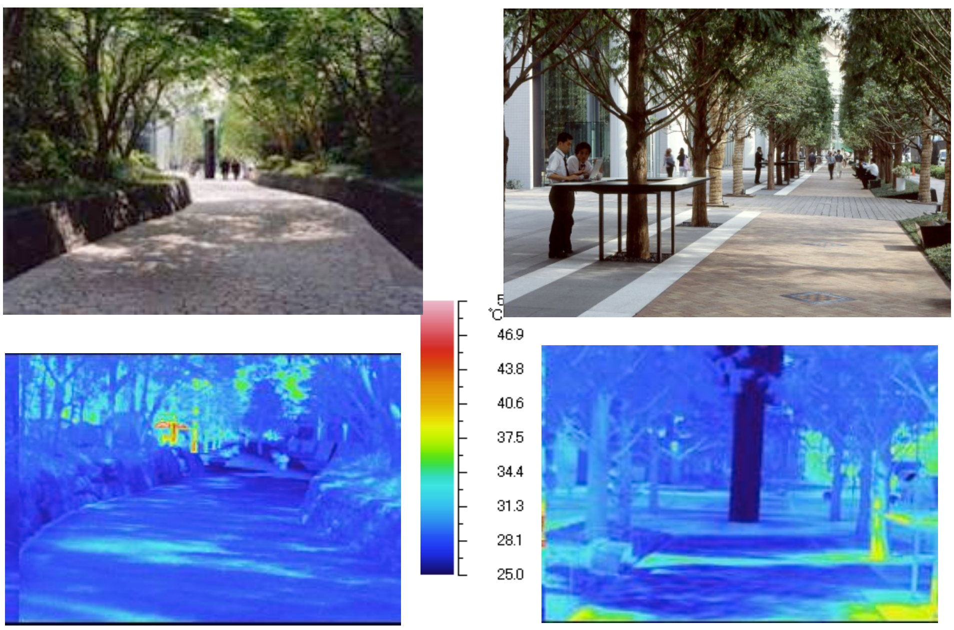
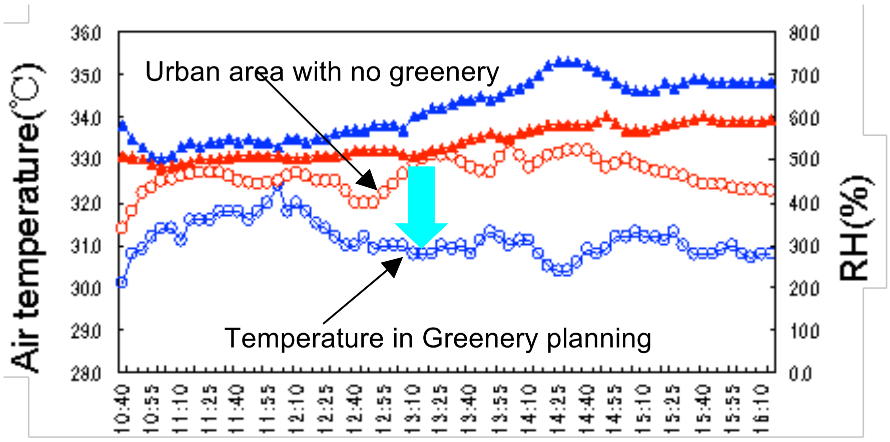


Figure 16 Mitigation Effect of Air Temperature by Greenery Area
(12:00, September, Tokyo, 2005)



b) How to mitigate the heat island phenomenon with greenery (Improving urban surfaces)
Greenery is an excellent way to control thermal environments. Tree leaves can help to decrease air temperature by around 1.0 degree due to evaporation occurring on the surface of leaves. It is important to enhance greenery in developed areas by promoting green building practices such as adopting green roofs and walls.

The type of greenery used is also important as tall trees with big crowns are not only more effective at mitigating air temperatures around the crown, but also work to decrease the surface temperature of the ground surface under and around the trees.

It is important to select appropriate plants and install effective irrigation and management systems so that they remain healthy.

ii) Greenery as Carbon Absorption Measure

Additionally, greenery works as a useful carbon absorption mechanism, which can contribute to establishing a LCMT by counteracting, in part, the impact of deforestation on CO2 absorption rates by forests. Forests are carbon absorption sites in suburban and rural areas. Hence, increasing tall tree planting in urban areas is a comprehensive low-carbon measure for a LCMT.
The strength of carbon absorption would be comparatively ranked as follows;
Tall tree (Ex: zelkova, around 10 – 20 years) ＞ Mid and low tree ＞ turf (ground surface green)

2.4.2 Water Management

i) What is Water Management?

Water management in urban areas roughly plays two roles: water management for supplying water used in human activities and water management for collecting and treating waste water and rainwater to return them to the natural world or reuse for irrigation or cleaning purposes.

a) Water Supply

A water supply is a system for supplying the required amounts of safe water according to the demand for it in an urban area. While water is used for daily life and in municipal, industrial, agricultural applications, water supply systems mainly supply daily life and municipal water.

The essential requirements for water supply to play this role are the quantity, quality, and pressure of water, which are called the three requirements of a water supply.

b) Sewerage

Sewerage is a facility for collecting and treating wastewater to return it to the natural world. The water taken in as clean water is used in human activities. Then, it is collected as sewage, treated at sewage treatment plants, and returned to the hydrological cycles system through waterways or re-used for various purposes, depending on the quality and volume of water and local community attitudes.

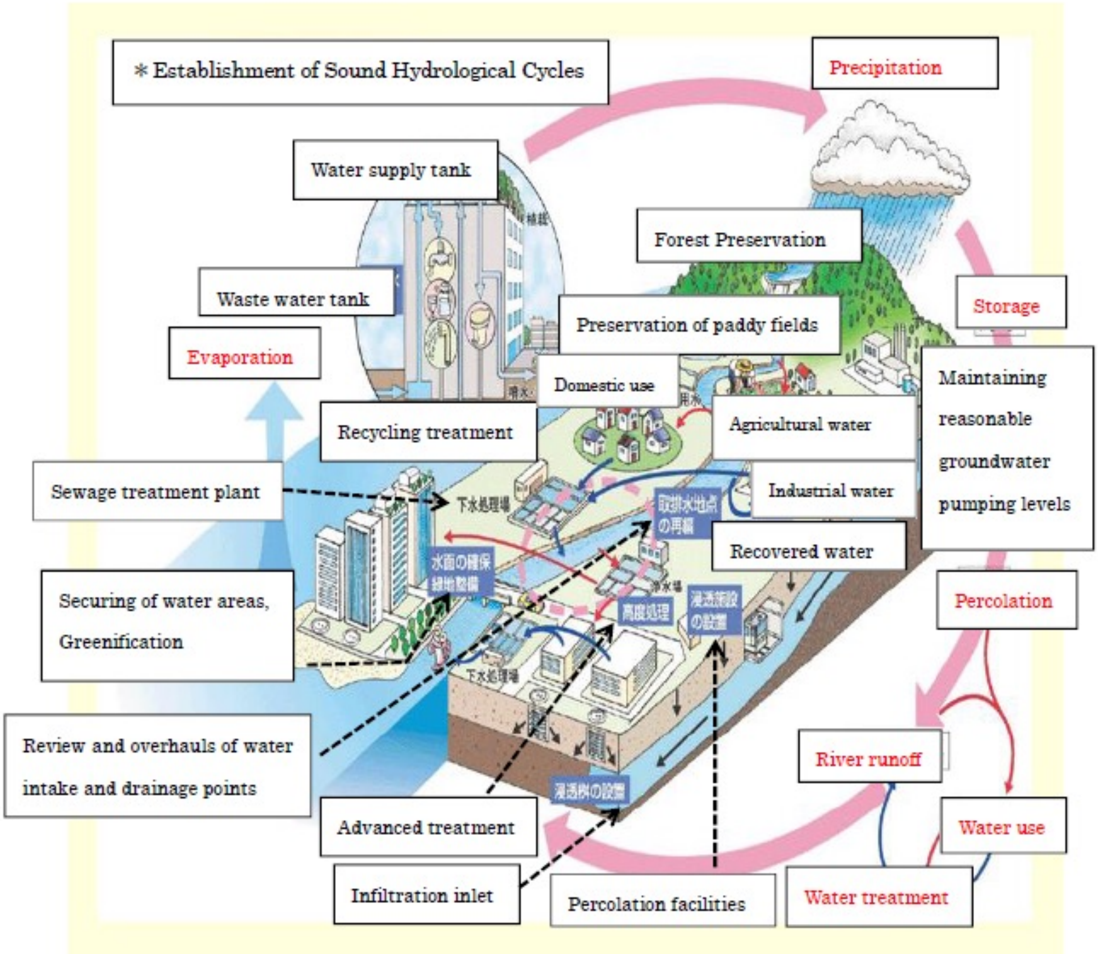
ii) Contribution of the Water Management to Low-Carbon Town Plans

To ensure sustainable water usage, it is important to preserve reservoir areas as well as reproduce a sound hydrological cycles through low-carbon and cyclic use of water resources by, for example, reducing emissions of greenhouse effect gases and making effective use of the natural energy obtained from water resources.

a) Contribution of Hydrological Cycles (Water Management) toward a Low-carbon Town

Basically, to contribute to low-carbon towns, measures will be taken, such as the use of potential and natural energy, development and incorporation of energy saving technologies, and efficient operation of facilities and systems. In addition, measures for avoiding waste, including measures against leakage and water saving, are effective.

Figure 17 Conceptual Rendering of the Construction of an Establishment of sound Hydrological Cycles



(Source) Drawn by Water and Disaster Management Bureau, Ministry of Land, Infrastructure, Transport and Tourism

(1) Water Supply Infrastructure Based on Gravity

When a new facility is set up or an existing facility is upgraded, upstream intake will be introduced (or a shift to it will be made) to construct a gravity-flow water distribution system using gravity based on potential energy. (The ultimate low-carbon implementation is to obtain potable raw water to supply water based on gravity flows.)

Considerations:

- ✓ In arranging water intake in the most appropriate upstream area, the current regionalization may have a limit to the effective use of water resources. It is important to select intake points across a broader range.
- ✓ Not only water quantity and quality but also various potential uses of water and location must be taken into account in selecting intake areas.

- ✓ Because upsized and integrated facilities due to wider areas present safety problems under emergency conditions, it is essential to ensure sufficient safety in considering the scales and locations of these systems (balance between the centralization and decentralization)

(2) Use of small-scale hydroelectric power generation based on a low flow rate and/or small drops at rivers and water supply and sewerage

Considerations

- ✓ Small scale hydro may not be cost-effective, but economies of scale in modular production and installation can cut costs. Also, if equipment feeds electricity to the grid at times of peak prices, or feeds power to end users instead of competing with much lower wholesale electricity prices, the economics may vary. This should be framed in a more neutral way – small scale hydro may not be cost-effective. But economies of scale in modular production and installation can cut costs. Also if equipment feeds electricity to the grid at times of peak prices, or feeds power to end users instead of competing with much lower wholesale electricity prices, the economics may vary.

Considerations associated with sewerage capabilities and waste water treatment systems

(3) Biogasification and conversion of sludge to fuel based on sewage sludge
Considerations

- ✓ Depending on the life-cycle environment and sewage piping, sewage sludge includes only a small amount of organic substances (energy). In this case, gasification or conversion fuel may not generate sufficient energy.
- ✓ In some areas where agriculture is dominant, composting may be the most effective means rather than gasification and conversion to fuel.
- ✓ It is necessary to consider to treat sludge from household and industry together to reduce greenhouse gases in treating sewage sludge and reuse of energy.
- ✓ Combining sewage sludge with other organic wastes sourced locally can improve the economics of biogas production or pyrolysis.

(4) Use of treated sewage effluent
Treated sewage effluent can be used as agricultural, industrial, and environmental water, for example.

Considerations:

- ✓ The use of treated sewage effluent has problems in terms of water quality/safety and energy saving.

(5) Use of space of water supply and sewerage facilities
Space of facilities is used to make use of renewable energy including photovoltaic power generation.

(6) Use of gray water in commercial buildings and other facilities
Relatively clean water used in buildings is treated so that it can be reused as gray water for rest rooms and irrigation of vegetation (the use of rainwater and reuse of miscellaneous drainage are

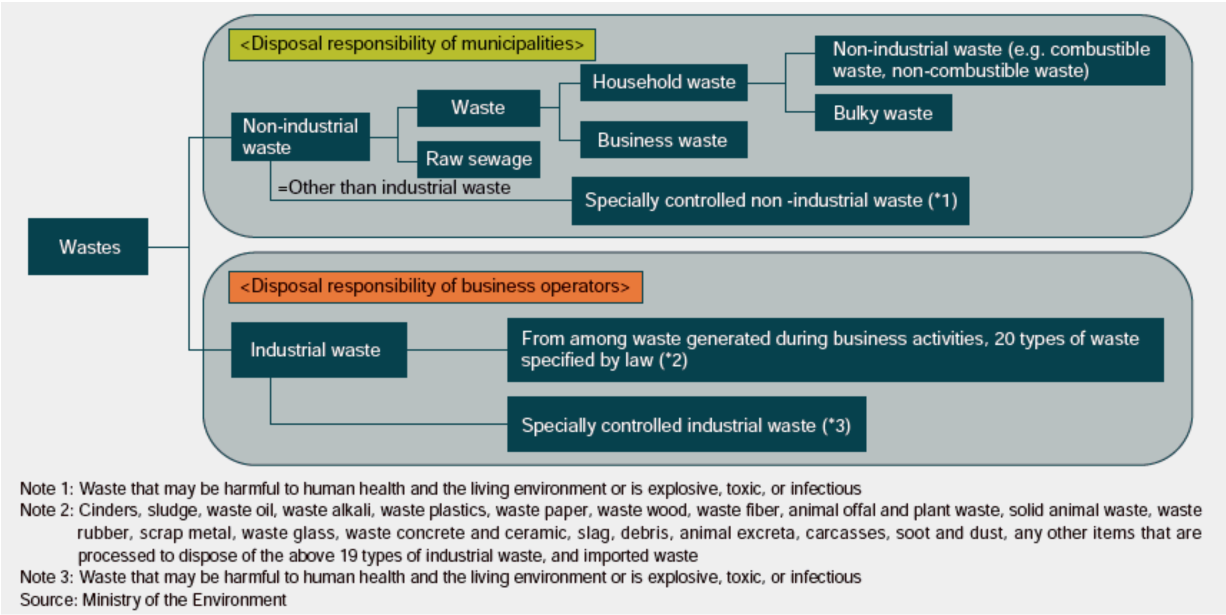
evaluation targets of CASBEE).

2.4.3 Waste Management

i) What is Waste?

Waste is defined as unwanted materials or items which are no longer used personally or which are not delivered for value, and such materials or items can be described as, for example, garbage, bulky waste, burnt residue, polluted mud, feculence such as night soil and waste, either in solid or liquid form. In Japan, it is classified as shown in Figure 13 in accordance with the Waste Disposal and Public Cleansing Act.

Figure 18 Segregation of Wastes in Japan[1]



Source: Ministry of Environment, Japan

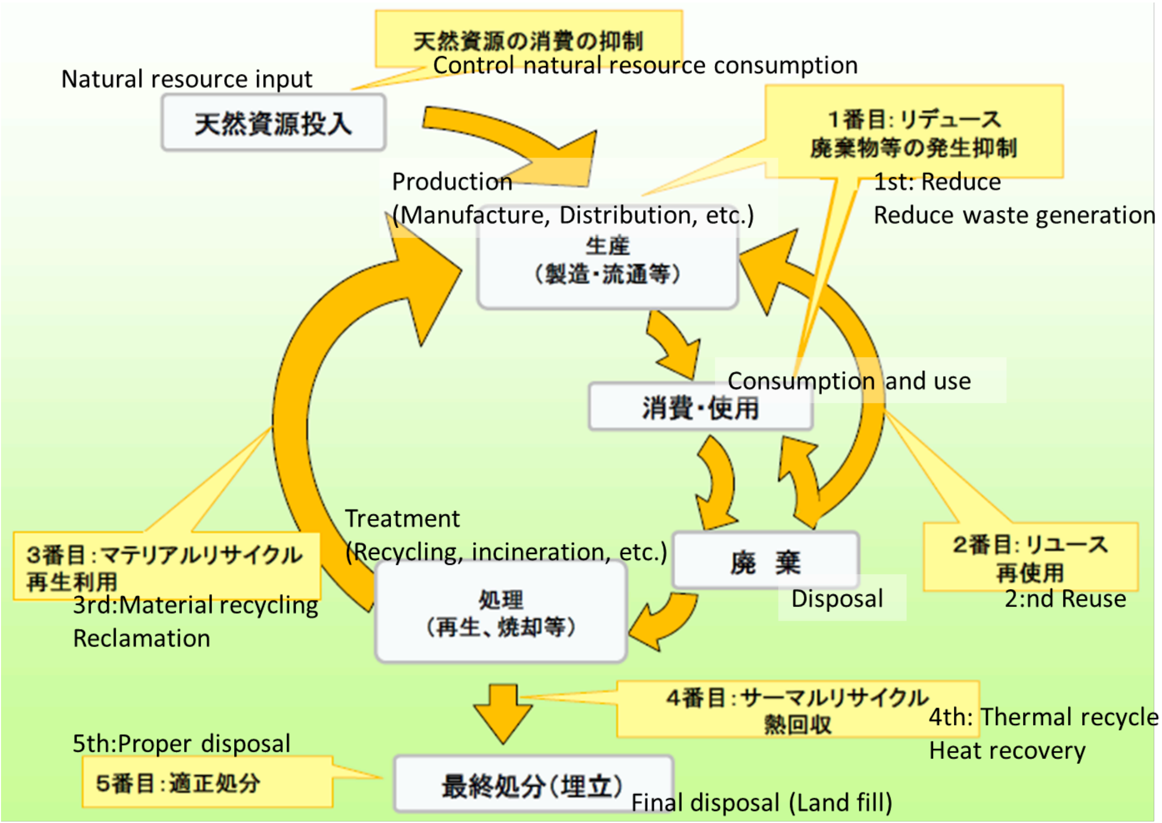
When developing a town, it is important to map out a town plan considering what measures should be taken to treat waste (non-industrial waste classified as waste generated in business operations or household waste), which will increase in pace with the expansion of the population.

[1]Each economy uses different terms or definitions for waste classification (e.g. categorize industrial waste into “Hazardous industrial waste” and “Non-hazardous industrial waste”).

ii) Realization of Low-Carbon Town by 3R Activities

We need to reduce the environmental load from waste treatment as a whole. Reducing the volume of discharged waste by means of the 3R activities (Reduce, Reuse, and Recycling) and choosing appropriate methods of waste treatment are two important elements of the reduction of greenhouse gas emissions from waste treatment. Some waste management strategies now include ‘recover energy’ as a 4^{th} ‘R’.

Figure 19: 3Rs and Recycling-Oriented Society



Source: Ministry of Environment, Japan

A conceptual diagram of 3Rs and recycling-oriented society is shown in Figure 14. A recycling-oriented society is a society where the consumption of natural resources is controlled and the environmental load is reduced to the maximum extent possible. It can be realized by ensuring the reduction of a chance where products become waste in the first place, the proper use of generated waste as resources in the second place, and the appropriate disposal of what cannot be reused in the last place. To realize a recycling-oriented society, the 3Rs need to be promoted

To establish a recycling-oriented society through the promotion of the 3Rs in Asian nations, the Regional 3R Forum in Asia was established in November 2009 based on a proposal by Japan. The aims of the activities are to promote high-level political dialog regarding the 3Rs and the implementation of 3R-related projects in each nation, share institutional and technological information that may be helpful for 3R promotion, and establish a network of parties concerned.

While organic wastes can be used to produce useful energy, metals, plastics and other non-organic wastes contain valuable resources. Recovery of them can avoid production of virgin materials, in many cases saving a large proportion of the energy that would have been used. For example, recycling aluminium can avoid around 90% of the energy used to produce virgin aluminium. The 'ores' available from wastes and landfills are rich in valuable materials. Research is progressing to develop methods to recover all these resources.

iii) Concrete Efforts to Realize Recycling-Oriented Society and Low-Carbon Town

By promoting the 3Rs of waste, the volume of waste incineration[2] and direct landfilling is reduced. At the same time, power generation and utilisation of the heat exhausted from the incineration of waste and the use of biomass energy is promoted in Japan to reduce the consumption of fossil resources. It is executed by means of subsidies from the government for the facilities of waste to energy and the ones where methane is collected from organic waste at high efficiency.[3]

a) Example: Waste to energy

Waste to energy is a generic name for the electricity generation using energy from waste, although useful heat can also be produced. In many cases, it is specifically used for the system where steam is produced in a boiler using high-temperature combustion gas generated from the incineration of waste, and the turbine of a power generator is rotated by the steam to generate electricity[4]. In a broad sense, waste to energy concept also includes landfill gas utilisation, which is commercially used in the U.S. and other economies. For example, methane gas retrieved from organic wastes in landfill can be utilised in the power generating process.

Strengths of waste to energy[4]

i. Fossil fuel consumption and CO_2 generation are reduced, as it uses the energy generated by waste incineration.
ii. Electricity supply is more stable than other new energies.
iii. The facility is located in or near a city and therefore it is a distributed power supply directly connected to the area of demand, though the scale is small.

Weaknesses of waste to energy[4]

i. The temperature of the steam in a boiler must be kept lower than an ordinary thermal power plant. Therefore, the power generation efficiency is low.
ii. The power generation efficiency of small-scale facilities (under 100 ton/d) is even lower. The effect of the introduction of waste to energy is undermined unless the waste heat can also be utilised.
iii. Long-term storage and stable combustion are more difficult than such fuels as natural gas and coal.

[2] It is important to control dioxin in incineration process both in exhaust gas and ash residual

b) Example: Utilisation of Waste Biomass[5]

Direct landfill of waste biomass including woodchips on a final disposal site must be stopped at the earliest opportunity because it produces methane gas that has a high global warming effect. It is necessary to recycle such resources in a way suitable for the characteristics of the region. Food waste composting is one of the more mature and practical recycle ways to turn waste into fertilizer. Waste biomass is an organic resource derived from an animal or plant, from which fossil resources are excluded. There are a variety of types; waste such as livestock excrement, sewage sludge, and kitchen waste; non-edible parts of farm products such as rice straw; unused resources such as timber from forest thinning; resource crops such as sorghum; and algae. To make the waste biomass useful in our daily lives, technologies to convert it into heat, gas, fuel or chemical substances are necessary. The types of the technologies vary from such simple ones as direct combustion to sophisticated ones such as saccharification, fermentation, gasification, and re-synthesis. Their attained levels are also varied from a basic research phase to the subsequent validation phase and practical application phase.

[5]MAFF: “Biomass Commercialization Strategy”, 2012, (in Japanese)

2.4.4 Pollution

Urbanisation, a population concentration in urban areas as a result of developments in industry, began in the 19th century, and in recent years rapid urbanisation has been taking place in APEC economies as well. Energy consumption has increased as a result of mass consumption by residents in urban areas, as well as high-density social and economic activities, resulting in increasing CO2 emissions. At the same time, typical environmental pollution resulting from urban lifestyle (urban-type environmental pollution), such as air pollution caused by automobile exhaust and inefficient cooking, water pollution caused by domestic wastewater, and soil contamination caused by improper processing of household and business waste, are becoming big problems.

Environmental pollution can also be caused by exhaust gas, wastewater, and other waste discharged from factories in urban areas, and this environmental pollution is called industrial-type environment pollution. Depending on the socioeconomic development level of an economy, the extent to which the urban-type and industrial-type environmental pollution causes environmental pollution in the cities varies. In developed economies, the relocation of factories out of urban areas has greatly reduced the proportion of industrial-type urban environment pollution. However, soil contamination in factory sites has become apparent as a result of the relocation, and there have been cases where the soil contamination became impediments for the re-development of the sites.

In developing economies there are many factories in urban areas, and there is a combination of urban-type and industry-type environmental pollution. The industry-type environmental pollution has been decreased by strong initiatives taken by the government and local authorities, but policies to address urban-type environmental pollution have been lagging, causing an increase in the proportion of urban-type environmental pollution in certain cities. It is partially due to the fact that sources of industrial type environment pollution are stationary sources such as factories and power plants, whereas sources of urban-type environmental pollution are individually small, but widely dispersed, and sometimes it is not enough to regulate the sources of pollution.

Global population growth and economic development will create excessive loads on the global environment, causing global warming. Urbanisation will create excessive loads on urban environment, causing urban environmental pollution. Although both are threatening the sustainable development of society, urban environmental pollution can directly damage human health and can therefore be considered as a more serious issue in the short term. In addition, urban-type air pollution is different from industrial type environmental pollution as individuals can be both the party at fault and sufferers. It is necessary to reform the patterns of consumption, technologies used and lifestyle of individuals in order to overcome the issue.

Increased urbanisation resulting from economic development is a phenomenon seen in every economy. Cities have strong social, economic and cultural activities that maximize the benefits of the integration of various urban functions. In recent years, there have been examples of economies positioning “urbanisation” itself as a powerful driving force behind the economy's growth. Only when cities have overcome the negative aspects of urban environmental pollution, and have ensured safety and security, ease of living, and comfort can we say that they have truly been developed. To this end, efforts to address urban environmental pollution are becoming increasingly important.

i) Air Pollution

The major air pollutants are nitrogen oxides (NOX), sulphur oxides (SOX), suspended particulate materials (SPMs), and photochemical oxidants (OX). All NOX, SOX, and SPMs may damage the respiratory tract. While SPMs refer to particles of diameter 10um or less, those particles with an even smaller diameter or 2.5um or less often cause asthma and bronchitis by entering deep into the lungs. It is said SPMs can also cause lung cancer. OX causes sore eyes and nausea, etc.

The sources of NOX include thermal power plants, factories, offices, inefficient cooking, open fires and motor vehicles. Sometimes NOX is formed when fuels, such as oil, are burned, and the nitrogen contained in these fuels reacts with oxygen in the air. While a large percentage of NOX emissions are from stationary industrial sources, in urban areas where there is a concentration of service functions, the proportion of these emissions from automobile traffic is higher. SOX is formed when the sulphur contained in fuels reacts with oxygen in the air, and their source is the same as NOX. However, due to decreases in the sulphur content of automobile fuel, the majority of SOX now come from thermal power plants, factories, etc.

SPMs are generated by soot and dust emitted from factories, as well as black smoke, etc. in the exhaust gas from diesel vehicles and from open fires. SPMs cause smog, which is currently a big problem in China. SPMs are classified into primary particles, which are discharged as particles directly into the atmosphere from the source, and secondary particles, which are discharged as gaseous substances (SOX, NOX, volatile organic compounds (VOC), etc.) and transformed into particles in the air through photochemical reactions. SPMs are made through a photochemical reaction that happens when NOX and VOC, etc. released in the atmosphere are exposed to the ultraviolet rays of the sun.

The efforts to prevent air pollution in cities begin with setting emission reduction targets for air pollutants and determining emission standards for each type of pollutant. As described above, since air pollutants are also discharged from factories in urban areas, emissions reduction targets must be set by region. In addition, in order to reduce the emission of industrial-type pollutants, the efforts must be taken by individual pollution sources. Therefore, factories and power plants, etc., should be required to make air pollution prevention plans. When doing so, they should also be requested to set emission reduction targets for each type and scale of their facilities.

The monitoring of air pollution is a particularly important role of the municipal government. This is because through monitoring, it becomes possible to analyse the condition of discharged air pollutants and the causes of air pollution in detail. The monitoring location, frequency and related limits for each type of pollutants should be specified in official environmental monitoring and audit manuals. Based on the monitoring, some specific regulations may be tightened if needed. Furthermore, management procedures that can reduce identified pollutants to levels below the stipulated limits should be specified. However, except for the largest cities (e.g. in Hong Kong), such monitoring has not yet been implemented in most cities. It is additionally important to publish monitoring results and create programs to protect the health of citizens, such as issuing a pollution alert. There can be a wide range of measures for air pollution prevention. It is also important to ensure human resources such as government officials and specialists, and train them for the long-term measures.

ii) Water Pollution

The major water pollutants are heavy metals such as cadmium and lead, organic mercury, and volatile organic compounds. The sources of these pollutants are mainly drainage water and industrial waste from factories in the chemical and metal industries. Heavy metals from ground water used for drinking can also be a significant source of human consumption. These contaminants cannot be degraded naturally, and can cause serious health problems if they accumulate in the human body.

In addition, organic substances contained in the wastewater from households, food industry, pulp and paper industry are also be regarded as water pollutants. When these organic substances are discharged into rivers in quantities above their natural purification capability, a large amount of dissolved oxygen is consumed in order to degrade them. The depletion of oxygen in the water causes environmental pollution such as the bad odour of ammonia or hydrogen sulphide. The degree of organic pollution is represented by indicators such as the amount of oxygen dissolved in the water (DO), and the oxygen consumed when organic substances are oxidized and decomposed by aerobic microorganisms (BOD).

In many cities organic pollution is becoming urban–type environmental pollution rather than industry-type environmental pollution due to the fact that sewage treatment infrastructure cannot keep up with the urban development. If large volumes of untreated sewage continue to be discharged into rivers, it can threaten the safety of citizens and the water shortage may negatively impact the economic growth.

As in the case of air pollution prevention, it is important to establish emission reduction targets and emission standards, and to regularly monitor discharge conditions as part of efforts to prevent water pollution in cities. Also, the retention and training of staff is similarly important.

iii) Soil Pollution

Urban soil contaminants include radon, benzene, cyanide, lead, arsenic, chromium, and mercury, etc. that penetrated into the underground of factory sites, etc. While normally these contaminants are undetectable since they penetrated deeper into the ground, their damage becomes apparent after the relocation of the factory or the source of pollution. These soil pollutants tend to stay regionally without diffusion due to the adsorption. The health of local residents may be at risk due to the diffusion of dust from contaminated soil and penetration into the groundwater. Soil pollution may also be caused by improper handling of waste.

When making policies to address soil pollution, it is important to take preventative measures to make sure new soil pollution does not occur in the future, and to establish appropriate framework to supervise and process the treatment of contaminated soil by industry professionals.

2.5 Governance

2.5.1 Policy Framework

Policy implementations such as low-carbon transport and low-carbon construction, will promote the efficient use of energy, and eventually build a low-carbon society. Since it is difficult for private sectors to keep these efforts solely, proactive efforts and leadership of the government are also necessary. For cities, it is often necessary to work cooperatively with governments at other levels, such as regional and national governments. This may be necessary because those levels of government have the necessary regulatory powers and policy roles, as well as finance.

i) Low-Carbon Policy / Planning Budget

In order to promote a variety of low-carbon town initiatives at each regional, national and local level, it is important to develop and promote the "software" such as laws, regulations, policies, systems, and public-private partnerships in addition to the technological "hardware", therefore, the establishment of administrative structure for implementing the initiatives is also necessary.

To be precise, the government efforts should include planning low-carbon urban development measures, developing a project implementation plan, and ensuring the budget and resources. For example, the government can create their own low-carbon guidebooks and climate change policies, or supervise developers to create them.

ii) Sustainability Efforts

In order to make low-carbon towns sustainable while ensuring citizens' safety and considering the environment, the government should only allow development that has low impact on the environment and does not cause blackouts or other failures resulting from natural disasters, etc.

For example, the measures include making plans in order to continue daily life and business activities even in the event of a disaster. These are known as Life Continuity Plans (LCP) and Business Continuity Plans (BCP).

iii) Low Impact Development

The government should create regulations taking into account the terrain characteristics and alterations for the sustainability of low-carbon towns.

In the development activities, conservation of natural terrain and restriction on artificial modifications (e.g. development activities such as installation of the retaining walls, etc., that interrupt continuous landscape) to a certain level should be regulated by the government.

2.5.2 Education & Management

i) Education

When developing low-carbon towns, education and awareness campaigns are important so that citizens can recognize the importance of low-carbon activities and deepen their understanding. In advanced low-carbon towns, various local stakeholders work individually/together to promote the low-carbon activities without too much dependence on the government's leadership. We can start low-carbon activities from small changes in daily actions, such as turning off unnecessary lights, setting the air-conditioning at a proper temperature, and stop littering. Additionally, if employers of business vehicle drivers require them to drive in an environmentally friendly manner, prevention of air pollution and reduction in accidents as well as fuel consumption can be achieved while saving the corporate costs. It is effective for the government and developers in the private sector to approach and work together with various stakeholders including local residents, companies, and educational institutions.

Training tradespeople, professionals, sales people etc. to understand low carbon actions and encourage them in their work is important. At the same time, if individuals do not call for products and services with low carbon outcomes, businesses will be less likely to provide appropriate offerings. Children must also be educated to prefer a low carbon future and understand what is involved.

ii) Management

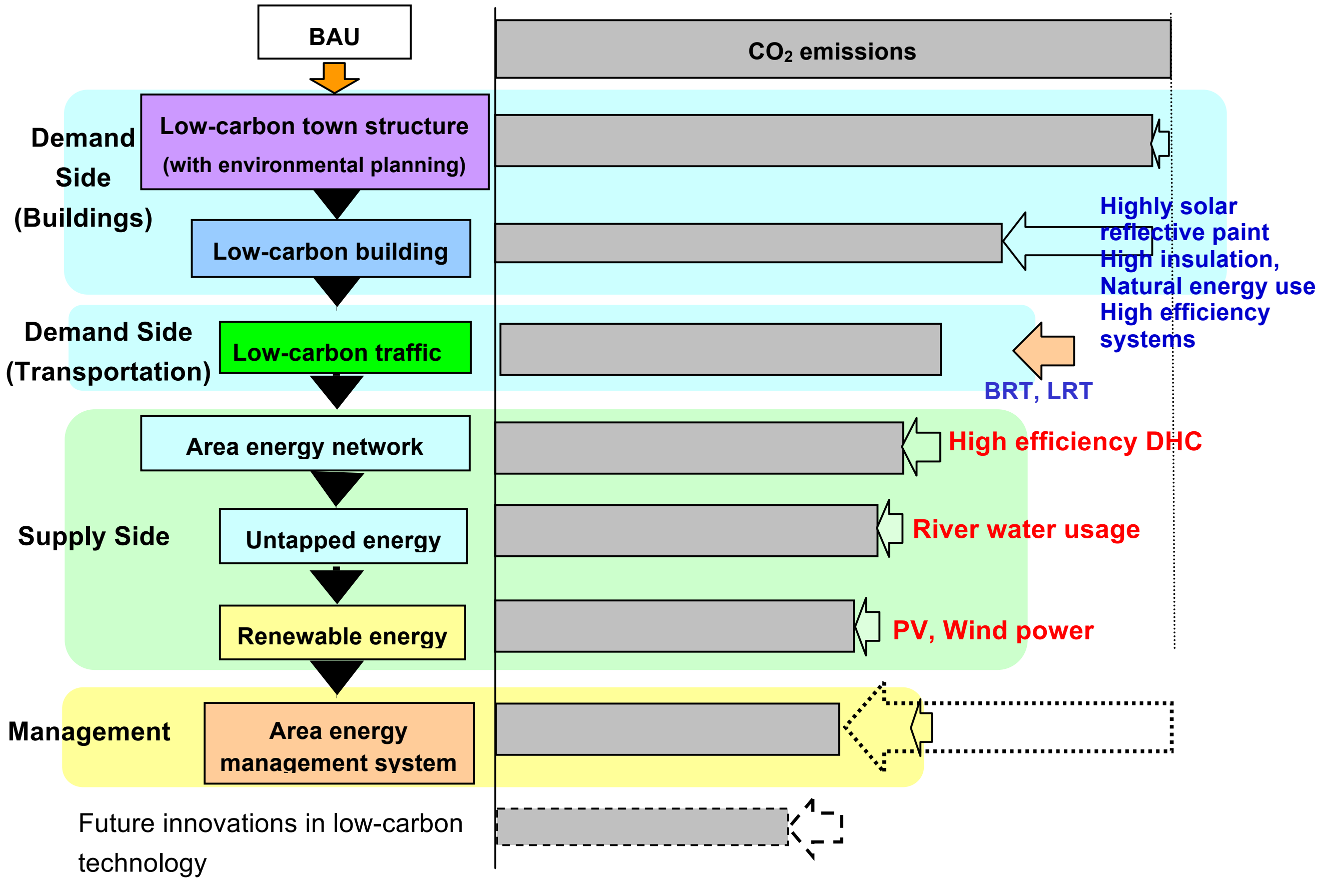
Low-carbon activities can also be developed by area management organisations such as community councils and neighbourhood associations in addition to the government and private developers. There are many examples where involving local residents from the early planning stage and the stakeholder involvement brought a success in spreading the low-carbon activities throughout a town. Additionally, it is desirable for organisations rooted in the region to share information using their community networks, and to continue the low-carbon activities. If the regions can improve their problem-solving abilities and attractiveness through such low-carbon activities, low-carbon towns are sure to spread both domestically and abroad.

Chapter 3 Evaluating the Effect of Low Carbon Measures

3.1 Purpose of Evaluating the CO_2 Reducing Effects

Estimates of the reduction in CO_2 emissions from various measures, and combinations of measures will make it possible to quantify the effectiveness of a planned approach to low-carbon town development. This also makes it possible to compare the predicted reductions with the designated CO_2 reduction target for the town, which provides a check on the practicality of the target itself, and ongoing outcomes, which underpins updating of the strategy based on actual performance.
A hierarchy approach is recommended for the review purpose. This uses the emissions level in a business-as-usual (BAU) scenario as the basis, and assesses the increase in emission reduction in a hierarchical fashion as shown in Figure 19.

Figure 20 Hierarchy approach for assessing effectiveness of low-carbon measures



3.2 Basic Methodology to Evaluate CO_2 Reducing Effects

Basic methodologies for evaluating the CO_2 reducing effects of the different measures are shown below.

3.2.1 Demand Side

i) Low-Carbon Town Structures (Transit Oriented Development (TOD) Type Land Use)

Low-carbon town structures are being discussed in terms of intensive town development and TOD-type development in CBDs, etc., and thus it is difficult to envision application of intensive town structures for rural and resort areas. Consequently, the need to study such structures should be determined based on the existence of intensive development or TOD-type development.

TOD has two key CO_2 reducing effects:

- Reduced energy use in buildings through their concentration in high density zones
- Reduced motor traffic

The two methods used to evaluate the effects of TOD type land use are set out separately below.

ii) Low-Carbon Buildings

General procedure for evaluation

CO_2 emission from the building sector can be calculated by multiplying “total floor area of buildings by use”, “CO_2 emission intensity of buildings by use “ and “(1- Overall CO_2 reduction rate)”, as shown in the formula below.

CO_2 Emission= **(**Total floor area of buildings by use) **×** **(**CO_2 emission intensity of buildings by use) **×** (1- Overall CO_2 reduction rate)

Data

a) Total floor area of buildings

The “floor area of buildings by use” figure is estimated based on the development plan of the area in question.

b) CO_2 emission intensity of buildings by use

Method 1: If statistical data on the energy consumption of the buildings by use is available for the area in the development plan, a figure for CO_2 emission intensity data can be obtained by conversion of such data.

Method 2: If that data is not available, but data for other cities of a similar nature is accessible, this can be used to estimate a figure for the CO_2 emission intensity.

Method 3: If that data is not available from the development zone or similar cities, an alternative can be to gather data via a survey of energy consumption of buildings in the town in question. The survey will have the greatest value if it documents seasonal differences in energy consumption and type of fuel use.

Estimation of the CO_2 emission reduction effect of each measure

The overall CO_2 emission reduction rate can be calculated by following these steps:

1. Evaluate separately the CO_2 emission reduction effect at energy consumption points in the building, such as heat source equipment, heat transfer, lighting, electric apparatus, hot water supply system.

2. Estimate the aggregated value by prorating these figures.

Detailed data like this may not be available. However energy utilities and oil companies should be able to provide overall usage data for their energy sources in the region. This provides a reality check on bottom up estimation.

Heat source equipment are those that generate cooling or heating energy, such as turbo or absorption/adsorption type refrigerators and heat pump chillers, as shown in the schematic diagram of the district cooling/heating system in Appendix 3. The efficiency of this technology, especially of heat pumps, has been improved year after year. Replacing outmoded equipment with high efficiency models is an effective way of reducing CO_2 emissions. However, where end use efficiency measures are introduced, the capacity of plant may be reduced relative to BAU, reducing capital costs.

Heat distribution equipment includes cold/hot water pumps and air conditioning fans. Effective energy savings can be achieved through adjusting the number of these equipment in operation, and by using an inverter system to control their use according to actual demand. There have also been significant improvements in efficiency in this area in recent years, so replacement of the pumps and fans themselves may also be justified.

In terms of lighting, energy savings can be achieved by adopting high-efficiency fluorescent lamps (Hf-type lamps), LED, organic EL lighting, illumination control using light sensors and motion sensors.

Reducing of the amount of electricity used for lighting and office appliances will result in the reduced internal heat, which also contribute to a reduction in electricity consumption for cooling purposes.

The reduction in CO_2 emission from the adoption of area energy network, such as district cooling/heating (DHC) can be estimated in a similar way.

iii) Low-Carbon Transportation

General procedure for evaluation

CO_2 emissions in the transportation sector can be calculated by the multiplication of “traffic volume”, “distance traveled”, and “emission intensity” (equation shown as below). These figures need to be obtained in order to calculate the reduction effect of low-carbon transportation measures. As an example, a procedure for automobile traffic is set out below. For the other transportation modes (ships, boats, aircrafts etc.), the basic concept and the procedure of evaluation is the same, but more detailed data specified for the transportation mode is required. Again, top down data on transport fuel use should be used as a reality check.

CO_2 emission = Traffic volume × Distance traveled × Emission intensity

a) Traffic volume

If an automobile traffic census has been conducted in the targeted district, this should be used to determine traffic volume. An automobile traffic census counts the number of vehicles passing a particular point of each district, by the type of vehicles, the time of the day and the direction. This is then used to calculate the traffic volume of each target district covered by the census, per day and per year as well as providing insights into the kinds of vehicles and activities that are significant contributors to demand.

Person-trip surveys can also be used to calculate traffic volume. A person-trip survey investigates “when”, “what type of people” moved, “from where”, “to where”, “by what means of transportation”, and “for what purpose” in a given district in one day. The survey, which studies the actual travel behavior of the people living in the cities, is a valuable source of information for traffic planning.

A “trip” is a unit for the movement of a person from one point to another for some purpose; the total of the number of trips that started from a certain district (traffic generation) and the number of trips that ended in the district (traffic concentration) is called the “generation concentration volume” of the district.

While the modes of transportation covered by these surveys include railroads, buses, automobiles, two-wheeled vehicles (bicycles, motorized bicycles), walking, it is possible to estimate the automobile traffic volume in a given district by calculating the generation concentration volume by the percentage use of automobiles. Person-trip survey data will provide automobile traffic volumes by types of vehicles and by routes.

b) Distance traveled

If an origin/destination survey (OD survey) has already been conducted in the targeted district, this should be used to determine the travel distance of automobiles. An OD survey investigates the movement of the cars in one day, regarding information such as the point of departure and destination, purpose of the trip and time of travel. This is carried out by selecting a certain number of car owners from a car registry, who are then surveyed by questionnaires. The OD survey data will provide figures for distance traveled by the type of vehicle.

If a person-trip survey was used to calculate traffic volume, the distance traveled should be calculated as the distance of each route.

c) Emission intensity

If statistical data on the fuel consumption and distance traveled by type of vehicle is available for the relevant driving conditions, the CO_2 emission intensity should be determined from these data. The CO_2 emission intensity should be settled separately by the type of vehicle, and the type of fuel used by the vehicle. The contribution of air conditioners to vehicle fuel use should be estimated based on average travel times and climatic conditions.

Calculation of the CO_2 emission reduction effect of each measure

a) Effects attributable to the upgrading of the public transit network

In principle, the effects can be estimated by assuming the reduction of traffic volume and distance traveled, that will be achieved through upgrading of the public transit network, offset by the additional energy use of the PT network.

b) Effects attributable to the introduction of low-carbon vehicles

In principle, the effects can be estimated by assuming the number of low-carbon vehicles that will replace conventional vehicles and their emission intensity relative to business as usual.

c) Effects attributable to the introduction of other measures (such as traffic demand management)

In principle, the effects can be estimated by assuming the change in traffic volume, distance traveled and emission intensity accordingly.

3.2.2 Supply Side

i) Effects attributable to the introduction of area energy system

The effects can be estimated by assuming the increase in efficiency at the central plants used for cooling, heating, hot-water supply and other purposes in the district.

ii) Effects attributable to the introduction of untapped energy/renewable energy

Heat: The CO_2 emission reduction effect can be calculated by assuming the amount of fuel necessary to generate the same amount of heat produced by untapped energy/renewable energy

Electricity:

The CO_2 emission reduction effect can be calculated by reducing the electricity supply from the commercial grid, which is equivalent to the electricity generated by solar photovoltaic etc.

3.2.3 Demand and Supply Side

The CO_2 reduction effects can be estimated separately for different types of benefits, such as energy efficiency increase in building sectors, or increase of renewable energy power generation.

Chapter 4 Summary of Part II

Low-carbon town development requires clearly specified carbon reduction targets, and the careful selection of measures to achieve those targets, chosen as the best match to the town's individual situation.

"The Concept of the Low-Carbon Town in the APEC Region – Part II" sets out the range of available measures. These are organised by categories, and overall by whether they affect energy demand or supply. The Concept also sets out key points for effective implementation of these measures, and methods of quantifying their effects on carbon reduction.

Transit oriented development (TOD) is one of the key elements of low-carbon town design. TOD land use planning combines intensive land use and public transit systems with other non-car transport forms, to reduce energy use and traffic volumes. Control of land use and enforcement of relevant policies are the crucial factors in successful implementation of TOD.

On the individual building level, there are opportunities in design and construction, and in retrofitting, to improve energy efficiency to reduce CO_2 emission. The potential measures include shading passive energy design, and high efficiency technology for air-conditioning and lighting, appliances and equipment. The integration of those technology with consolidated energy management systems is essential for effective carbon reduction. Models of innovative low-carbon buildings are available in many APEC member economies.

Some of the most pressing issues faced by large cities in the APEC region are air pollution and traffic congestion. Measures to reduce traffic volumes and emission levels offer significant benefits in energy use and also in traffic management. In addition to TOD land use plan, other key options in this area are upgrading public transportation, traffic demand management and introduction of next generation low emission vehicles. Use of telecommunications and intelligent technologies can also reduce demand for travel and shift its timing, modes and impacts. The most effective set of measures for any given low-carbon town development is the combination that has the greatest overall synergic effect.

As well as improving overall management of energy use and supply to increase efficiency, new low-carbon town developments can also incorporate untapped energy sources, such as heat from garbage incineration plants. When such heat energy is supplied to large-scale co-generation plants, significant improvements in energy efficiency are possible at regional level. River water, sea water and sewage treatment water can also improve energy efficiency if used as a heat source or heat sink via high efficiency heat pump technology.

Data is the key to effective choices, implementation and monitoring of low-carbon measures. However, good quality transport data is in short supply in most Asian developing economies. Statistics that would be of real assistance include figures for traffic volume, the distance vehicles are driven in a year, and fuel consumption by vehicle types. At the state or metropolitan level, occasional travel surveys and traffic counts are made, but there is little reliable data on fuel consumption and almost no data on vehicle use.

For the development of low-carbon towns in APEC economies, transport data collection will need to be improved markedly.

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

Appendices and Index

Fifth Edition

December 2015

Appendix 1 Low-Carbon Target for APEC Economies

Economy	Emission Reduction Target in 2015	Base year
Australia	Implement an economy-wide target to reduce greenhouse gas emissions by 26 to 28% below 2005 levels by 2030.	2005
Brunei Darussalam	Set an ambitious regional goal of a 45 percent energy intensity reduction by 2035 versus a 2005 baseline. This would heighten the importance of natural gas, given it is ‘cleaner’ than alternatives such as crude oil and coal, which could generate up to 50 percent higher carbon dioxide emissions.	2005
Canada	Intends to achieve an economy-wide target to reduce greenhouse gas emissions by 30% below 2005 levels by 2030.	2005
Chile	Chile has decided to present its contribution under the intensity of emissions framework (CO2 tons equivalent per unit of GDP in million CL$ 2011). In that sense Chile has defined two commitments: 1. Carbon intensity goal, expressed in GHG per unit of GDP, without considering Land Use, Land-Use Change and Forestry Sector Emissions: a. Chile has the commitment to reduce its CO2 emissions per unit of GDP in 30% by the end of 2030 compared to 2007 emissions. b. Additionally, and conditioned to the obtaining of international financial support, Chile could commit to reduce its CO2 emissions between 35% and 45% compared to 2007 levels. 2. Specific contribution considering Land Use, Land-Use Change and Forestry Sector Emissions: a. Chile commits to recover 100,000 hectares of native forests, representing and expected capture and reduction in GHG in around 600,000 tons of CO2 equivalent from 2030. b. Chile commits to forest 100,000 hectares mainly with native species, representing captures between 900,000 and 1,200,000 tons CO2 equivalent per year from 2030.	2007
China	China has nationally determined its actions by 2030 as follows: -To achieve the peaking of carbon dioxide emissions around 2030 and making best efforts to peak early; -To lower carbon dioxide emissions per unit of GDP by 60% to 65% from the 2005 level; and -To increase the forest stock volume by around 4.5 billion cubic meters on the 2005 level.	2005
Hong Kong, China	Proposed to set a carbon intensity reduction target of 50% - 60% by 2020 as compared with 2005 level. Set a target to achieve a reduction in energy intensity of at least 25% by 2030 (with 2005 as the base year)	2005
Indonesia	a) Unconditional Reduction	2010

	Indonesia has committed to reduce unconditionally 26% of its greenhouse gases against the business as usual scenario by the year 2020. The above commitment is a necessary prerequisite for embarking on a bolder commitment to further reductions by 2020 and beyond by outlining an emissions reduction plan using an evidence-based and inclusive approach. The commitment will be implemented through effective land use and spatial planning, sustainable forest management which include social forestry program, restoring functions of degraded ecosystems, improved agriculture and fisheries productivity, energy conservation and the promotion of clean and renewable energy sources, and improved waste management. As stated earlier, Indonesia is committed to reducing emissions by 29% compared to the business as usual (BAU) scenario by 2030, as a fair reduction target scenario based on the country's most recent assessment of the 2010's National Action Plan on GHG Reduction. The BAU scenario is projected approximately 2,881 GtCO_2e in 2030. b) Conditional Reduction Indonesia's target should encourage support from international cooperation, which is expected to help Indonesia to increase its contribution up to 41% reduction in emissions relative to BAU by 2030. Indonesia's additional 12% of intended contribution by 2030 is subject to provision in the global agreement including through bilateral cooperation, covering technology development and transfer, capacity building, payment for performance mechanisms, technical cooperation, and access to financial resources.	
Japan	A reduction of 26.0% by fiscal year (FY) 2030 compared to FY 2013 (25.4% reduction compared to FY 2005) (Approximately 1.042 billion t-Co2 eq. as 2030 emissions)	2013
Korea	Plans to reduce its greenhouse gas emissions by 37% from the business-as-usual (BAU, 850.6 MtCO_2eq) level by 2030 across all economic sectors.	
Malaysia	Malaysia announced country voluntary initiative to achieve up to 40 % reduction in emissions intensity of GDP by 2020 based on 2005 level with conditions that technology transfer and financial support provided from developed countries.	2005
Mexico	Mexico is committed to reduce unconditionally 25% of its Greenhouse Gases and Short Lived Climate Pollutants emissions (below BAU) for the year 2030. The 25% reduction commitment expressed above could increase up to a 40% in a conditional manner, subject to a global agreement addressing important topics including international carbon price, carbon border adjustments, technical cooperation, access to low-cost financial resources and technology transfer, all at a scale commensurate to the challenge of global climate change.	
New Zealand	Commits to reduce GHG emissions to 30% below 2005 levels by 2030	2005

Papua New Guinea	PNG's current economic development is seeing a growth in fuel use therefore a big effort will be to reduce fossil fuel emissions in the electricity generation sector by transitioning as far as possible to using renewable energy. The target in this respect will be 100% renewable energy by 2030, contingent on funding being made available. In addition PNG will improve energy efficiency sector wide and reduce emissions where possible in the transport and forestry sectors. The main forestry effort will be coordinated through the existing REDD+ initiative.	
Peru	The Peruvian Intended Nationally Determined Contribution (INDC) envisages a reduction of emissions equivalent to 30% in relation to the Greenhouse Gas (GHG) emissions of the projected Business as Usual scenario (BaU) in 2030. The Peruvian State considers that a 20% reduction will be implemented through domestic investment and expenses, from public and private resources (non-conditional proposal), and the remaining 10% is subject to the availability of international financing and the existence of favorable conditions (conditional proposal).	
The Philippines	The Philippines intends to undertake GHG (CO2e) emissions reduction of about 70% by 2030 relative to its BAU scenario of 2000-2030. Reduction of CO2e emissions will come from energy, transport, waste, forestry and industry sectors. The mitigation contribution is conditioned on the extent of financial resources, including technology development & transfer, and capacity building, that will be made available to the Philippines.	
The Russian Federation	Limiting anthropogenic greenhouse gases in Russia to 70-75% of 1990 levels by the year 2030 might be a long-term indicator, subject to the maximum possible account of absorbing capacity of forests.	1990
Singapore	In accordance with Decision 1/CP.19 and 1/CP.20, Singapore communicates that it intends to reduce its Emissions Intensity by 36% from 2005 levels by 2030, and stabilise its emissions with the aim of peaking around 2030.	2005
Chinese Taipei	(1) The Aim of Energy Conservation To annually increase more than 2% of energy efficiency next eight years, and make energy intensity decrease by 20% or above in 2015 comparing with 2005; moreover, to make energy intensity decrease by 50% or above in 2025 by means of technological breakthroughs and supporting measures. (2) The Aim of Carbon Reduction Reduce national carbon dioxide emissions, that is, the amount of emissions in 2020 decrease to the amount in 2005, and decrease the amount of carbon dioxide emissions in 2025 to the amount in 2000.	2005
Thailand	Thailand intends to reduce its greenhouse gas emissions by 20% from the projected business-as-usual (BAU) level by 2030. The level of contribution could increase up to 25%, subject to adequate and enhanced access to technology development and transfer, financial resources and capacity building support through a balanced and ambitious global agreement under the United Nations Framework Convention on Climate Change (UNFCCC).	2005
United States	The United States intends to achieve an economy-wide target of reducing its greenhouse gas emissions by 26-28% below its 2005 level in 2025 and to make best	2005

	efforts to reduce its emissions by 28%.	
Viet Nam	Viet-Nam's INDC identifies the GHG reduction pathway in the 2021-2030 period. With domestic resources GHG emissions will be reduced by 8% by 2030 compared to the Business as Usual scenario BAU. The above-mentioned contribution could be increased up to 25% with international support.	2006

Source:

- Bureau of Energy, Ministry of Economic Affairs Chinese Taipei (2012). Taiwan's Master Plan on Energy Conservation and GHGs Emission Reduction. https://web3.moeaboe.gov.tw/ECW/english/content/Content.aspx?menu_id=1527.
- Energy Department, Prime Minister's Office Brunei Darussalam (2014). Brunei Darussalam Energy White Paper. https://www.usasean.org/sites/default/files/uploads/Energy%20White%20Paper%202014.pdf.
- Environmental Protection Department, the Government of Hong Kong Special Administrative Region (2015). http://www.epd.gov.hk/epd/english/climate_change/hkactions.html.
- GovHK (Hong Kong Special Administrative Region Government) (2015). http://www.gov.hk/en/residents/environment/global/climate.htm.
- Ministry of Natural Resources and Environment Malaysia, National Corporate GHG Reporting Programme for Malaysia (2015). http://www.mycarbon.gov.my/web/index.php.
- UN FCCC (United Nations Framework Convention on Climate Change) (2015). Submitted Intended Nationally Determined Contributions (INDCs). http://www4.unfccc.int/submissions/indc/Submission%20Pages/submissions.aspx.

Appendix 2　Low-Carbon Measures and Their Applicability

Classification of Measures			Low-carbon Measure	Applicability as per Type of Town Note 1)				Case
Supply / demand	Major Classification	Minor Classification		I	II	III	IV	No.
Demand side	Composition of urban space	Transit Oriented Development (TOD) and improved organisation of location of services relative to sources of demand. "Virtual" service delivery also offers enormous potential to reduce travel and associated costs and impacts while improving service quality.						
		Environment space development	Green way Net Work	H	H	H	M	
			Underground space NW	M	L	X	X	
	Buildings	Reducing heat loads	Reflection of solar energy and heat insulation, high solar reflectance paint for roof, shading, advanced glazing, management of air leakage when heating or cooling; installation of very efficient appliances and equipment to cut internal heat generation	H	H	H	H	(4) (5)(31)
		Highly efficient facility systems	??	H	H	H	H	(9)
		Equipment installed at facilities	Fuel cells, energy storage, etc.	H	H	M	M	
		Passive energy design & equipment	day light use, natural ventilation,					(6) (7) (8)
	Environment-related infrastructures	Urban climate	Micro climate, heat island management	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, storage? Pump efficiency	H	H	M	L	
		Reducing pollutions	Treating exhausts, contaminated soils (Treating waste water is included in the sewage.)	H	H	H	H	

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

*EMS=Energy Management System
BEMS=Building Energy Management System
HEMS=Home Energy Management System
FEMS=Factory Energy Management System

Classification of Measures			Low-carbon Measure	Applicability as per Type of Town Note 1)				Case No.
Supply / demand	Major Classification	Minor Classification		I	II	III	IV	
Demand Side	Transportation system	Public transportation systems	Public transportation NW	M	M	M	X	(19)
			Intra-district transportation system (busses, LRT, etc.)	H	H	H	L	(20)
		Short-distance transportation systems	Intra-city community bicycle (and electric bike)	H	H	H	L	(23)
			Short-distance transportation system	H	H	H	L	
		Vehicles	Electrically driven vehicle	M	M	M	M	(21) (29)
			EV bus	M	M	M	M	(22)
			Natural gas-driven vehicles, etc.	M	M	M	M	
		EV-related hardware	Fast charger, small battery	M	M	M	M	
Both supply and demand sides	Management	Energy management systems(EMS)*	Energy monitoring, diagnostic and management systems, BEMS *(HEMS, FEMS)	H	H	H	H	
			Zero Energy Building(ZEB)	M	M	H	H	
			Area EMS	H	H	H	H	(26)
	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	(28)
			Network-related technology, communication modules, measuring systems, etc.	H	H	M	L	
	Smart energy system (energy integration)		Smart energy system	H	H	M	L	(24)

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

*EMS=Energy Management System

BEMS=Building Energy Management System

HEMS=Home Energy Management System

FEMS=Factory Energy Management System

Classification of Measures			Low-carbon Measure	Applicability as per Type of Town Note 1)				Case
Supply / demand	Major Classification	Minor Classification		I	II	III	IV	No.
Supply side	Generating / distributing power	Infrastructures for generating/ storing power	Distributed power facility–rooftop PV, storage suits III and IV too	M	M	L ?	L ?	
			Cogeneration system	H	H	L	L	(1)
			Large-scale power storage, etc. may be located in III or IV for exports	M	M	L	L	
	District energy (heat supply)	District heating / cooling			H	M	L	(3)
	Untapped energy	Using sea/river/sewage water			H	M	L	(2)
		Using waste heat from waste incineration plants			H	M	M	(12)
		Using waste heat from sewage treatment plants			H	M	L	(10)
		Using waste heat from factories		M	M	M	X	
	Renewable energy	Solar power generation (mega solar power generation)		M	M	M	M	(13)
		Using solar heat (large-scale solar heat)		M	M	M	M	(14)
		Biomass power generation (biogas power generation, etc.)			L	L	M	(15) (25)
		Wind power generation			L	L	H	(17)
		Geo-thermal power generation			L	L	M	(16)
		Hydroelectric power generation (small- and middle-scale)			L	L	M	(11)

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

Appendix 3 Low-Carbon Measures with Case Examples

(1) Cogeneration System/Combined Heat and Power/Trigeneration

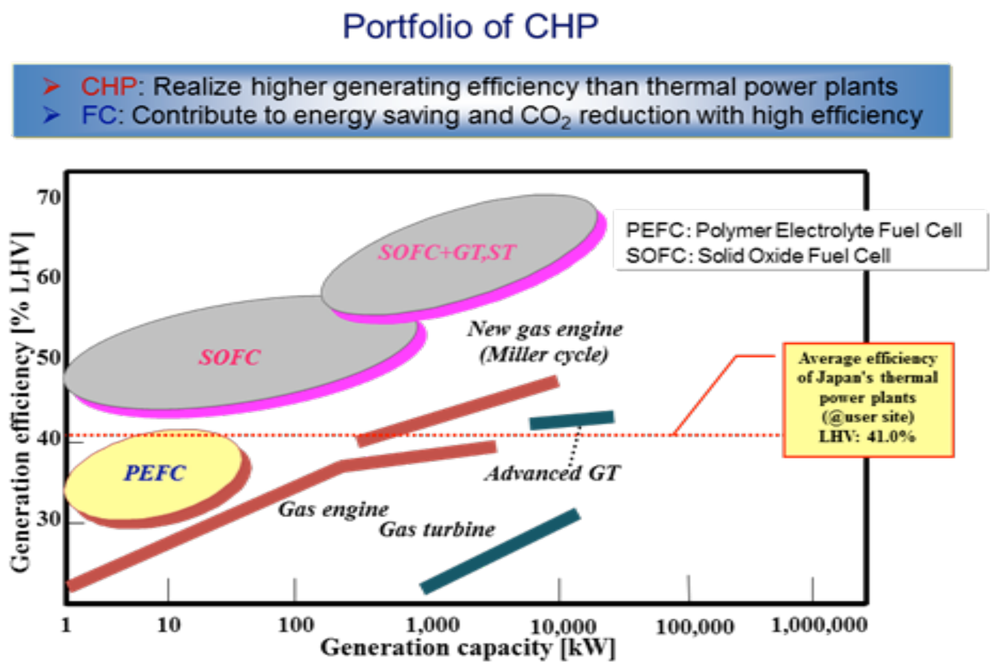
Classification of Measures			Low-carbon Measure	Applicability as per Type of Town			
Demand/ Supply	Major Classification	Minor Classification		I	II	III	IV
Supply	Generating/ distributing power	Infrastructures for generating/ storing power	Cogeneration System(CHP)	H	H	L	L

Overview of Measures and Applicability

- Cogeneration is a system that generates electricity on site where needed, and at the same time makes efficient use of generated heat for space heating, cooling, hot-water supply, steam, etc. Sometimes cogeneration is called combined heat and power or, when cooling is provided as well as heat and power, “trigeneration”.
- Cogeneration has a wide range of application for a variety of areas and systems that use heat, including those for households/businesses, industries, large cities, middle cities and farming villages etc., as well as district cooling/heating (district-scale use) and smart energy systems, etc. As for its application in farming villages, there are cases where this system is used as a tri-generation using electricity, heat and CO_2 for greenhouse cultivation. Cogeneration can work in tandem with renewable energy to provide back-up for power. Operated with reliable fuel supply such as middle-pressure city gas pipelines, cogeneration can contribute to the users’ “Business and Living Continuity Plan”* as emergency power and heat supply systems.

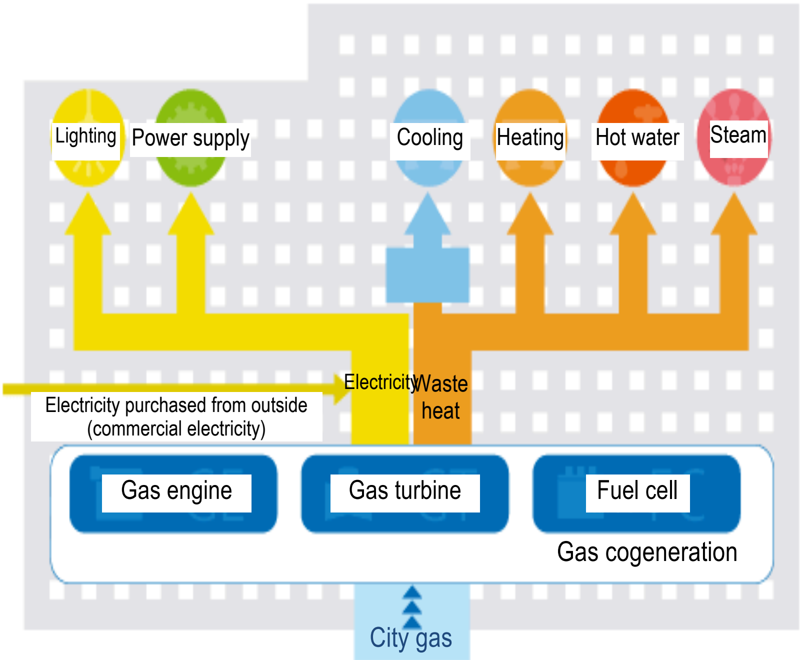
* See more at the website of the Centre for the Protection of National Infrastructure
http://www.cpni.gov.uk/Security-Planning/Business-continuity-plan/

Expected CO_2 Reducing Effect
Compared with conventional systems (thermal power + boilers), it can reduce CO_2 emissions by about 30-40% or more.

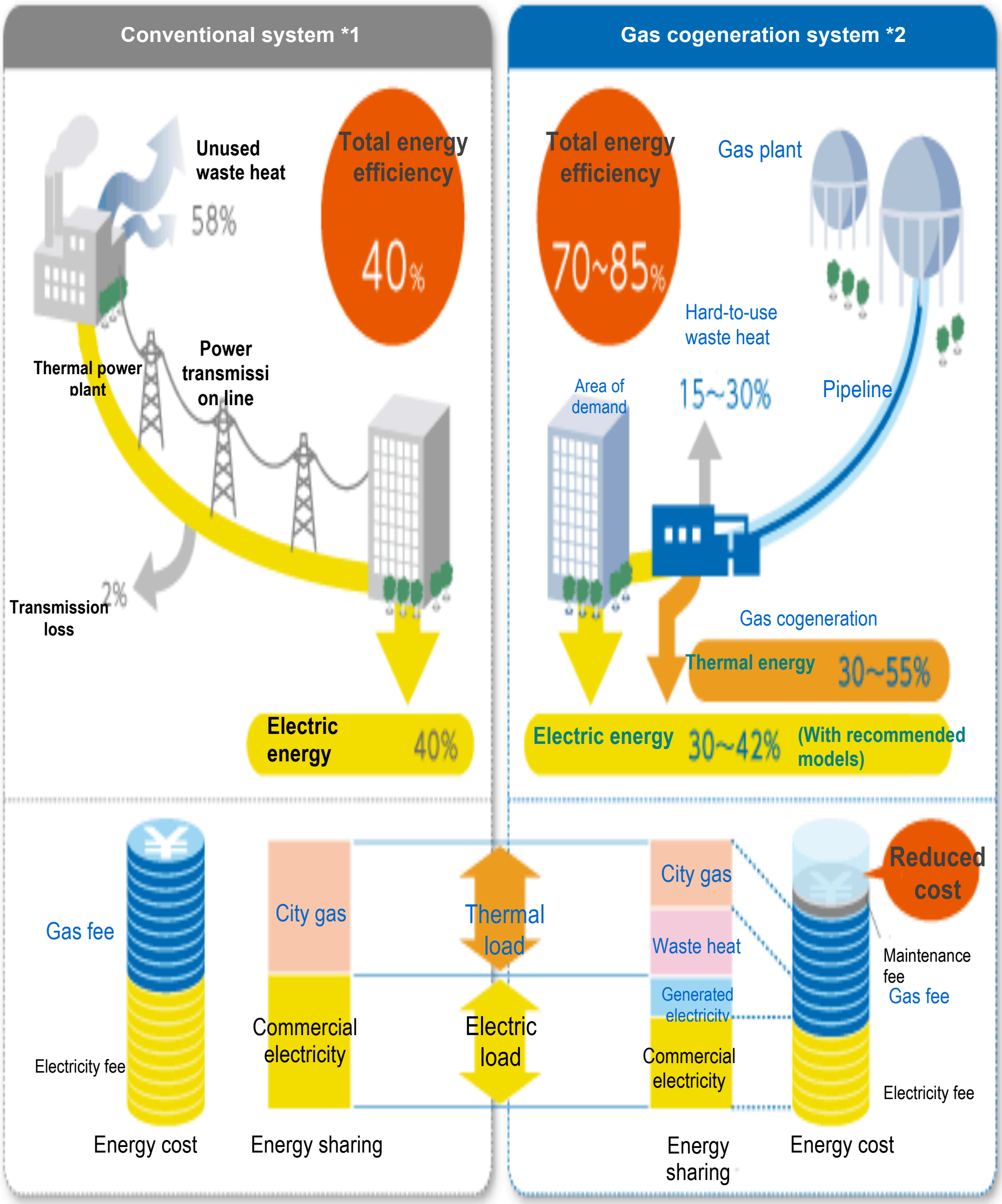


Examples of Application

- Around 10.0 million kW of electricity generation capacity using cogeneration in total has been introduced in Japan (in stock). March 2014 (http://ace.or.jp/web/works/works_0050.html)

Schematic Diagram of the System, etc.
● Schematic diagram of the system  The generated electricity is combined with that purchased from outside and is supplied into the building.

- The energy/cost-saving performance of gas cogeneration



*1 Lower Heating Value (LHV) standard. The thermal efficiency and total loss of thermal power plants were calculated on the basis of the operation performance of nine (9) power utilities and wholesale power utilities in 2003FY (The Working Group on Energy-Saving Standards, September 2005).

*2 The efficiency of gas cogeneration system is an example based on LHV standard.

(2) Using sea/river water

Classification of Measures			Low-carbon Measure	Applicability as per Type of Town			
Demand/ Supply	Major Classification	Minor Classification		I	II	III	IV
Supply	Untapped energy		Using sea/ River water		H	M	L

Overview of Measures and Applicability

- As sea/river water temperature is stable and is lower in summer and higher in winter than the atmospheric temperature, it will contribute to improving energy efficiency both as a coolant of heat pumps used in heat source equipment for cooling and as a heat source water of heat pumps for heating/hot-water supply. Because heat pump efficiency is improved as the temperature difference between condenser and evaporator is reduced.
- As the use of seawater requires countermeasures for salt damage to equipment and for marine organisms, and the use of river water requires drought management measures etc., it is a common practice to combine the use of sea/river water with large-scale facilities such as district heat supply systems.

Expected CO_2 Reducing Effect

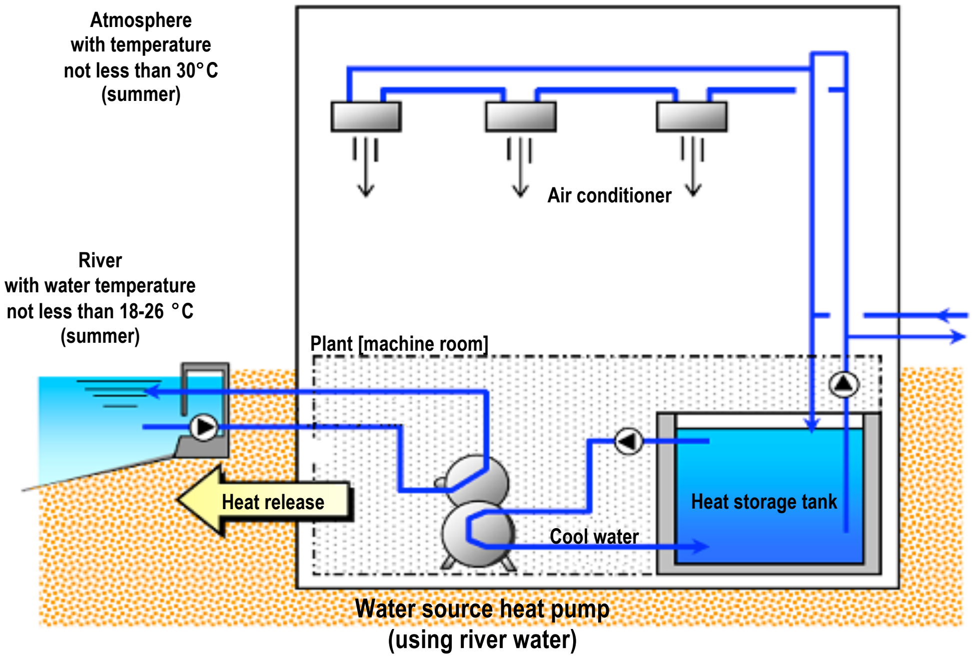
- It is expected that CO_2 will be reduced through improving energy efficiency in cooling/heating and hot-water supply in the relevant communities.

Examples of Application

- Examples of applications for river water temperature: Hakozaki (Tokyo), North area of Toyama station (Toyama), Nakanoshima (Osaka), Temmabashi (Osaka), Ohkawabata river city (Tokyo) in Japan and ANZ Bank HQ (Melbourne) in Australia
- Examples of applications for sea water temperature: Chubu centrair international airport (Aichi), Osaka cosmosquare (Osaka), Sunport Takamatsu (Kagawa), Seaside Momochi beach park (Fukuoka)
- There is less of a record of new operation result recently.
- The construction cost tends to be high because of large-scale construction work.

Schematic Diagram of the System, etc.

- System making use of the temperature difference from river water



Source："An Investigative Report on District-Scale Energy Use", March 2005

(3) District heating and cooling (DHC)

Classification of Measures			Low-carbon Measure	Applicability as per Type of Town			
Demand/ Supply	Major Classification	Minor Classification		I	II	III	IV
Supply side	District energy (heat supply)		District heating and cooling (DHC)		H	M	L

Overview of Measures and Applicability

- It connects multi-purpose buildings in certain urban districts via thermal pipeline network, and supplies cooling/heating media from district energy supply plants in an efficient manner.
- By means of this system, the area receives not only energy-saving but also a variety of co-benefits such as energy security, labor-saving, efficient use of building spaces, pollution-abatement, reduction of urban heat-island effect, prevention of urban disasters, etc.
- It also contributes to effective use of unused thermal energy in urban area such as waste heat from incineration plant.
- Care must be taken to minimise pipe losses and pumping energy.
- Requires strong district policy

Expected CO_2 Reducing Effect

- Compared with individual (heat source) systems, primary energy consumption can be reduced by 10%-14%＊subject to climate. Further reduction of energy consumption (by not less than 20%）can be realized by utilising unused energy, contributing to a significant reduction of CO_2.

  * "District-Scale Utilisation of Unused Energy - the Current Status of Heat Supply and the Direction towards the Next Generation", Ministry of Economy, Trade and Industry (March 2008）

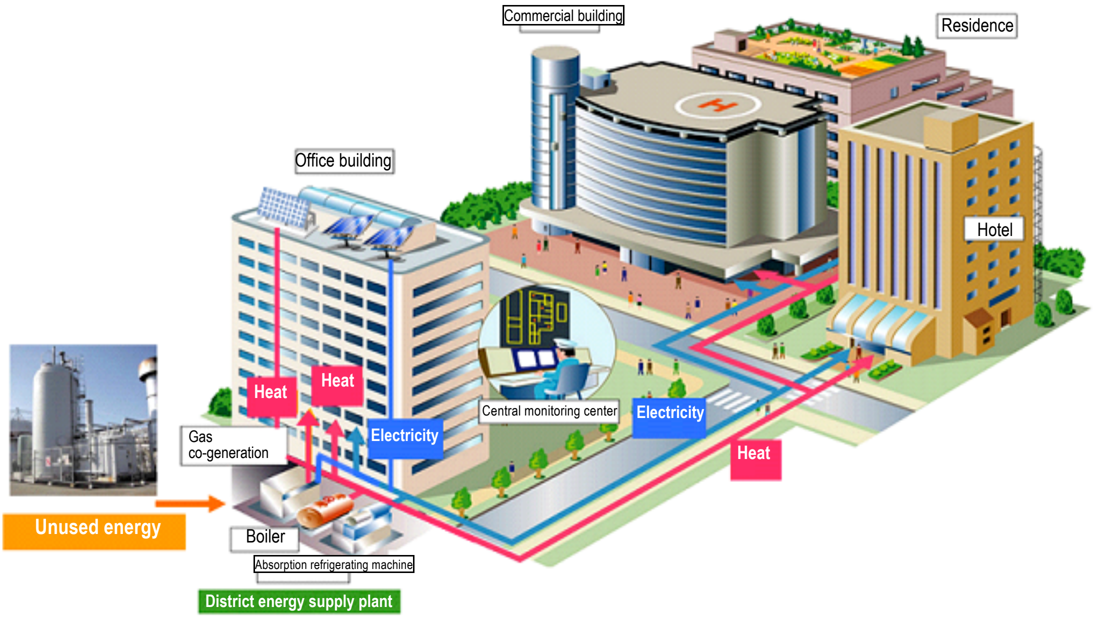
Examples of Application

- Shinjuku Sub-center, Marunouchi District, Roppongi Hills, Tokyo,
  Osaka Senri New Town Chuo District etc.

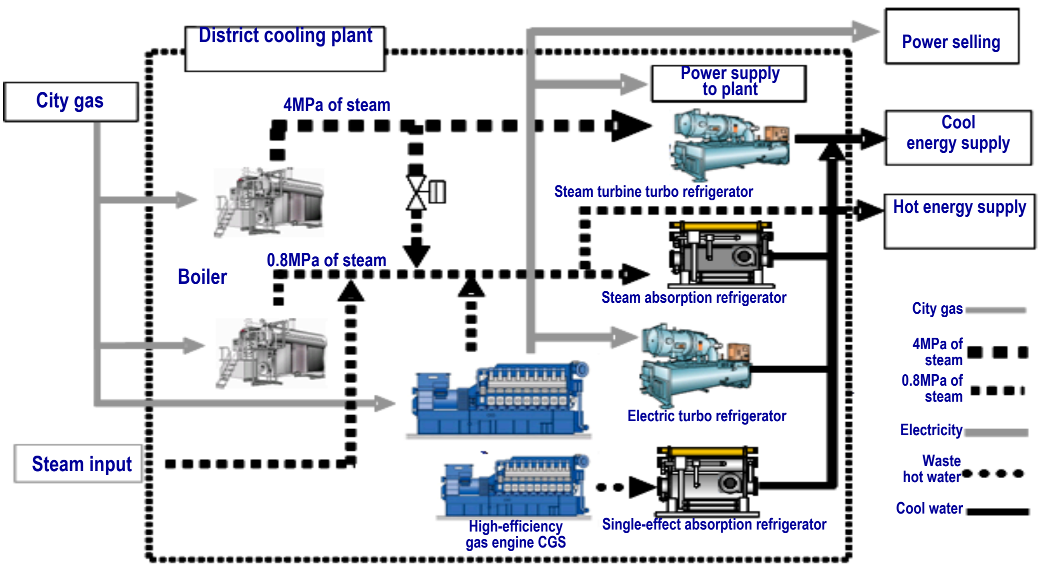
- Vancouver's Neighbourhood Energy Utility
  http://vancouver.ca/docs/planning/renewable-energy-neighbourhood-utility-factsheet.pd

- James James Cook University, Queensland, Australia – district cooling on campus

Schematic Diagram of the System, etc.



- Example of a Regional Cooling/Heating Plant



(4) Sunlight reflection, shading and thermal insulation

Classification of Measures			Low-carbon Measure	Applicability as per Type of Town			
Demand/ Supply	**Major Classification**	**Minor Classification**		**I**	**II**	**III**	**IV**
Demand	**Building**	**Reducing load**	**Sunlight reflection, shading and thermal insulation**				

Overview of Measures and Applicability

- Insulation reduces heat flow through building envelope.
- Solar radiation reaching a building's rooftop is converted into heat, which causes higher room temperatures and rising air-conditioning costs. Thus, applying high solar reflectance paint for roof surfaces prior to the conversion of solar radiation into heat is effective in controlling rising room temperatures and lowering air-conditioning energy requirements. The same measure is similarly effective for roads and sidewalks and the roofs of public transport vehicles (e.g., buses, trains, and trams).
- Sunlight shading is very effective in reducing thermal load put into a building from outside. As the solar elevation changes according to its bearing, the type of suitable eaves or blinds also varies. In planning sunlight shading, it is necessary to take the building exterior into account so that the sunlight would be effectively shaded.
- Shutting off sunlight on the outer side of a building is more effective. External blinds installed on the outer side of a building would help reduce the thermal load in the rooms. They also play the role of adjusting natural lighting when the blinds are designed to change their angles automatically according to the solar elevation.
- Planting vegetation around a building cuts direct sunlight off the concrete surface and takes effect on controlling the rise in the air temperature around the building because of evapo-transpiration effect.
- Air leakage can be a major contributor to energy waste, especially in strong winds.

Expected CO_2 Reducing Effect

- Power consumption cut is expected due to the reduction of air conditioning load thanks to the lowered temperature inside the building and natural lighting. As a result, it takes effect on the reduction of CO_2 emission and peak energy demand.

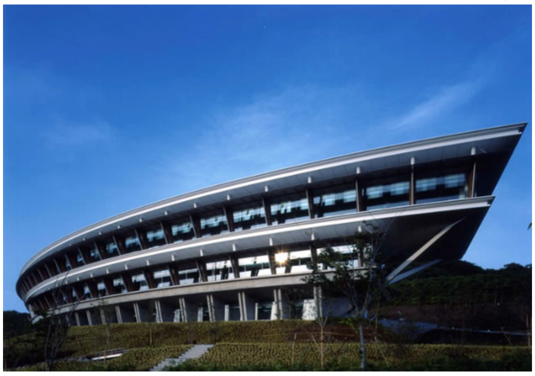
Examples of Application

- Itoman city Municipal Office, Institute for Global Environmental Strategies (IGES) Main office Building, Across Fukuoka (Commercial-Office-Cultural Complex)
- Public Works Dept HQ, Jakarta (around 90 kWh/square metre/year in hot humid climate)

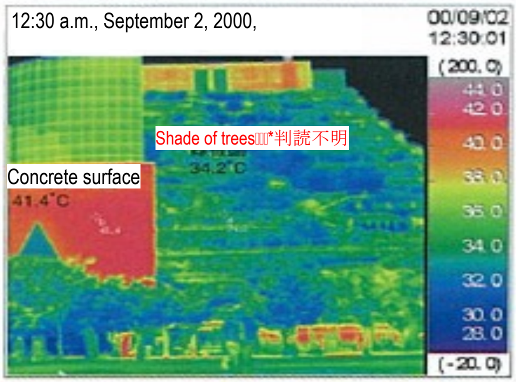
Schematic Diagram of the System, etc.

- Itoman city Municipal Office


- Institute for Global Environmental Strategies (IGES)




- Across Fukuoka

(5) Façade engineering

Classification of Measures			Low-carbon Measure	Applicability as per Type of Town			
Demand/ Supply	Major Classification	Minor Classification		I	II	III	IV
Demand	Buildings	Reducing heat load	Façade engineering				

Overview of Measures and Applicability

- The façade engineering refers to the technology of reducing thermal load from outside by applying high heat characteristics to the window and outer wall which constitute a façade.
- The important component is high performance glass, such as the duplex glass (double glazing) containing air space between two pieces of glass and low-e glass with specific coating for blocking the radiation heat from traveling through. These types of glass also enhance indoor environmental performance around the windows.
- One possible approach is the “Air flow windows”. They improve the thermal insulation properties and sunlight shading around a bow window by creating a kind of air curtain by ventilating inside the double-layered glass equipped with a built-in blind. Ordinarily, room air is sucked from beneath the glass window and the air inside the double-layered glass is led to under the ceiling with a ventilation fan mounted under the ceiling.

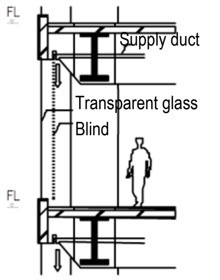
Expected CO_2 Reducing Effect

- Diagrams below show the simulation examples of Predicted Mean Vote (PMV) when using ordinary glass only and using low-e glass plus eaves, the peak load of the perimeter, and annual thermal load. The result shows that the employment of eaves plus low-e glass cuts the peak load by 43%, indicating that approximately 16% of thermal load will be slashed annually. The potential of load reduction varies with climate and exposure to sun.

Examples of Application

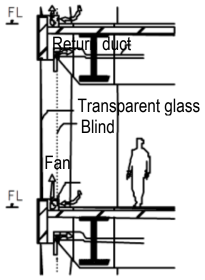
- Iidabashi First Building in Tokyo, Japan, etc.

Schematic Diagram of the System, etc.



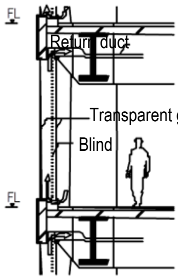
The load around the window is handled by the air conditioner. In winter, some devices such as a panel heater is required because cold draft is generated.

Iidabashi First Bldg.



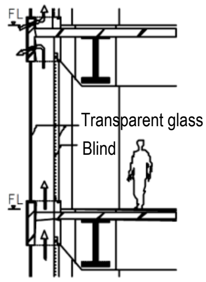
By creating an air curtain barrier between the glass and the blind by a fan, the thermal load generated around the window is collected in order to cut in-room load.

PCP Marunouchi



The thermal load around the window is contained inside the Air Flow, and then collected by the air taken from the slits of sashes in the room in order to cut in-room load.

JR East Japan Head Office



In summer, open air is taken in from the slits on the outer wall to naturally ventilate thermal load accumulated inside the double skin. In winter, open air is shielded off to collect heat.

Chiba Prefecture Autonomous Hall

(6) Natural ventilation

Classification of Measures			Low-carbon Measure	Applicability as per Type of Town			
Demand/ Supply	Major Classification	Minor Classification		I	II	III	IV
Demand	Buildings	Passive energy design & equipment	Natural ventilation				

Overview of Measures and Applicability

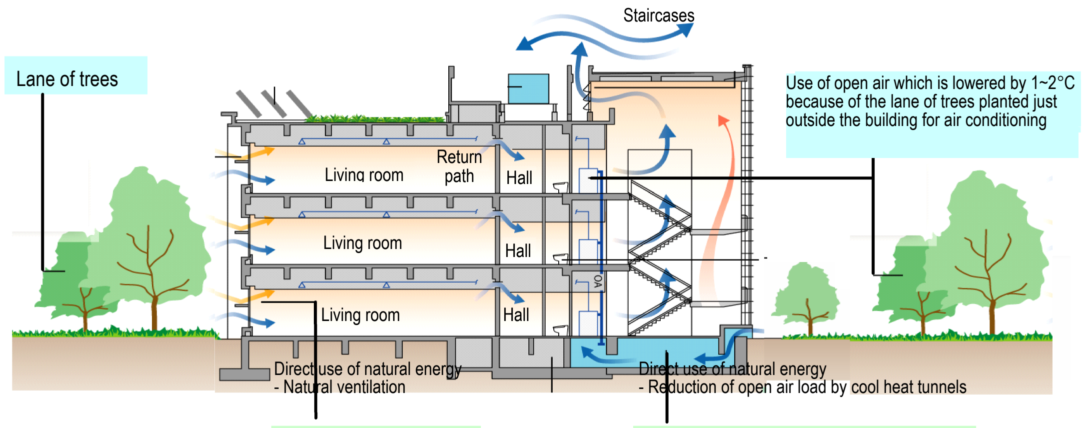
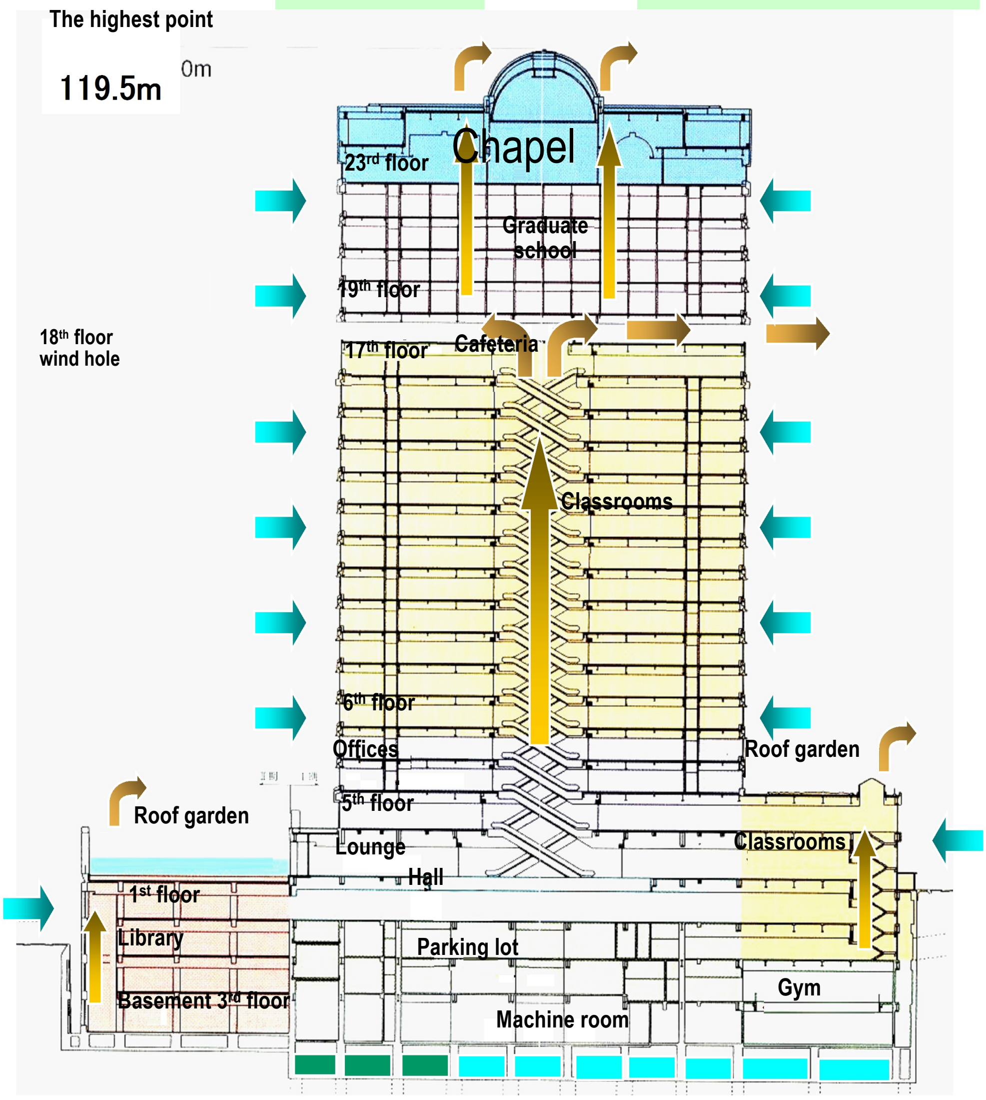
- The mid-term air-conditioning energy can be reduced by planning to take natural wind into rooms, for instance by installing apertures or opening-closing windows effectively or natural ventilation voids inside the building.
- The void enables natural air flow even when it is calm. (The natural ventilation by the difference in temperatures between tops and bottoms.) Moreover, natural ventilation can be effectively obtained no matter which direction the wind blows. (The wind shielding board prompts natural ventilation as negative pressure zone is created when the wind flows through the upper part). Example: Meiji University Liberty Tower (Top figure)
- Natural ventilation using the staircases can also produce the same effect as installing natural ventilation voids and wind shielding boards. (When air is calm, ventilation is enabled naturally by the difference in temperatures between upper and lower part of the staircases. When a wind shielding board is mounted on the top, a negative pressure zone is created as the wind passes through the upper part, thereby allowing natural ventilation free of the wind direction. (Bottom figure)
- Care needed if outdoor air is polluted or noise level high. Fire risk must be managed. Also if ventilation system leads to increased uncontrolled leakage of air when building is being heated or cooled, savings can be offset by waste. As fan efficiencies improve and cost of on-site renewable energy generation reduces, use of powered ventilation can be easier and cheaper overall as complexity of building envelope can be reduced.

Expected CO_2 Reducing Effect

Air conditioning load can be reduced.

Examples of Application

- Meiji University Liberty Tower, Tokyo, Japan

Schematic Diagram of the System, etc.
● Natural ventilation using the staircases, Sagamihara Campus, Aoyama Gakuin University  ● 

(7) Daylight use plus lighting system

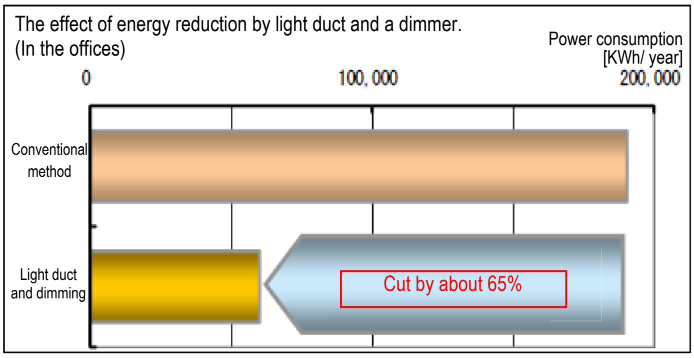
Classification of Measures			Low-carbon Measure	Applicability as per Type of Town			
Demand/ Supply	Major Classification	Minor Classification		I	II	III	IV
Demand	Building	Passive energy design & equipment	Daylight use, lighting system				

Overview of Measures and Applicability

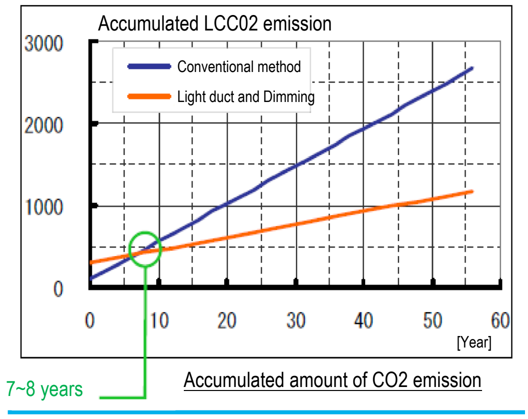
- The light from the window is limited in its reach, or no lighting is available if there is no window in the room. However, natural light can be reached to the darker areas in the building by using a light duct or light shelf. The illustrations given below show the system of a light duct using aluminum mirror with 95% reflectivity of visible light for its inside in order to get the light transported from the light collection part to the light-releasing part.

Expected CO_2 Reducing Effect

- The system of using light ducts shown below is effective in cutting the annual lighting electricity consumption by approximately 65% over the conventional systems. It is noted that the Life Cycle (LC) CO_2 can be recovered in 7 to 8 years.



Amount of annual electricity consumption for illumination



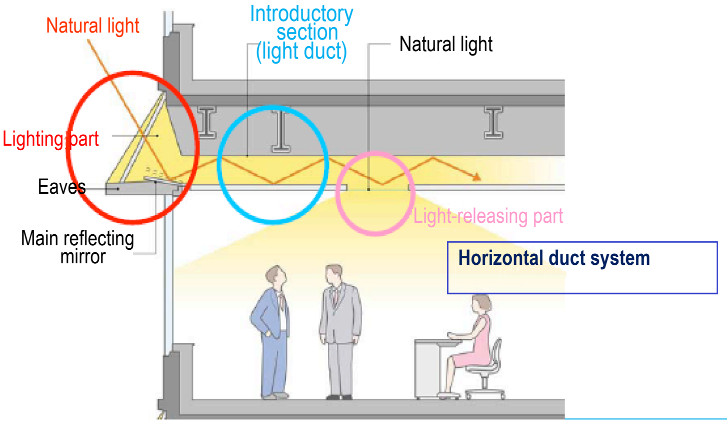
Accumulated amount of CO2 emission

Examples of Application

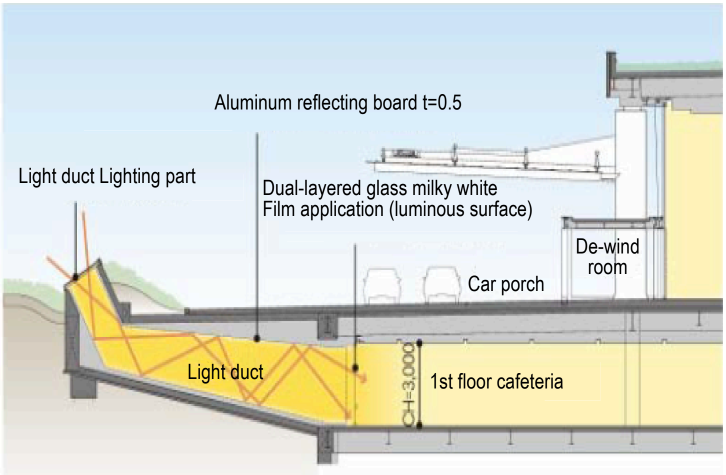
- Japan Aerospace Exploration Agency (JAXA), Tsukuba Space Center (TSC), Toyota Motor Corporation Office Main Building

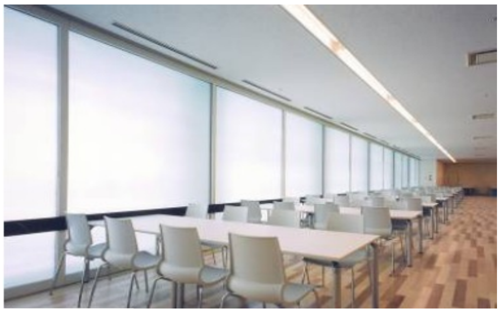
Schematic Diagram of the System, etc.

- Example of using light duct in offices (JAXA, TSC)



- Using example in the basement cafeteria (Main Building of a Car Company)





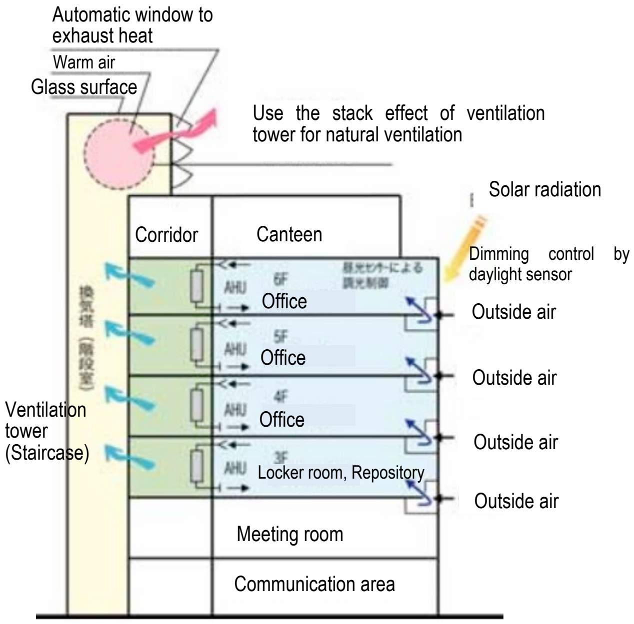
(8) Hybrid of natural ventilation plus air conditioning

Classification of Measures			Low-carbon Measure	Applicability as per Type of Town			
Demand/ Supply	Major Classification	Minor Classification		I	II	III	IV
Demand	Building	Passive energy design & equipment	Hybrid of natural ventilation plus air conditioning				

Overview of Measures and Applicability

- As an air conditioning facility system incorporated into a building, it is a hybrid air conditioning system which combines three types of air conditioning systems, air current feeding by the ceiling fan, floor blow-out air conditioning as well as the natural ventilation.
- A ceiling fan generates gentle air current by stirring a large amount of wind with less electricity. It can realize a comfortable space at 28°C even in summer.
- Very high efficiency ceiling fans are now becoming available: otherwise large numbers of fans can consume a surprisingly large amount of energy.

Cross-sectional view of building



建物断面構成図

Expected CO_2 Reducing Effect

- Air conditioning load can be reduced by making natural ventilation as the principal approach. Further CO_2 reduction can be expected by employing a human sensor or an automatic light dimmer for making the best of daytime light along with natural ventilation.

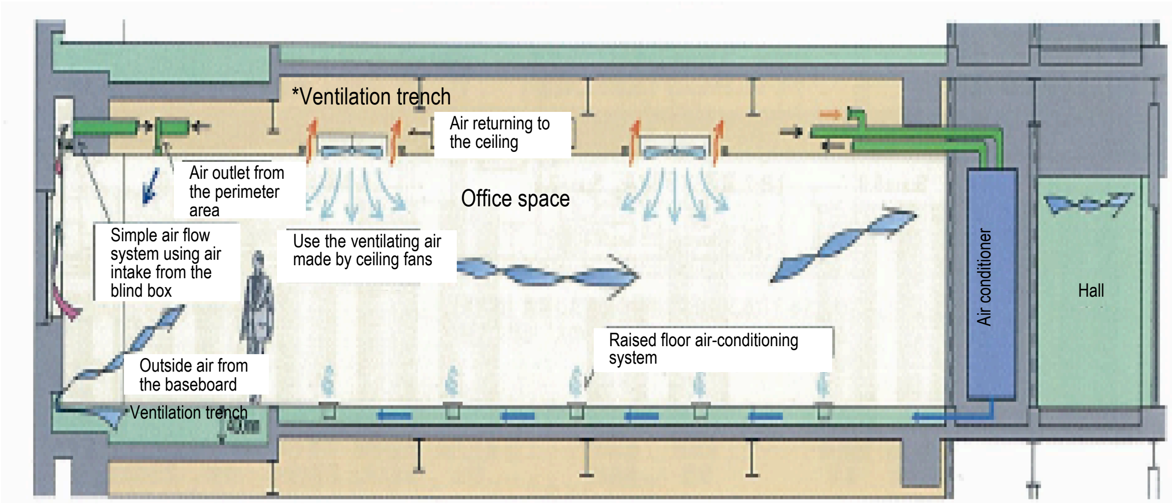
Examples of Application

- "Sakai Gas" Building, Osaka, Japan

Schematic Diagram of the System, etc.

- Sakai Gas Building

- Hybrid AC ventilation system using natural ventilation and ceiling fans



Source: CASBEE Studies on Actual Examples, JSBC, 2005

(9) High-efficient heat or cooling source plus thermal storage

Classification of Measures			Low-carbon Measure	Applicability as per Type of Town			
Demand/ Supply	Major Classification	Minor Classification		I	II	III	IV
Demand	**Building**	**High-efficient Facility systems**	**High-efficient heat source plus heat storage**				

Overview of Measures and Applicability

- In an intensive and high density district development on a large scale, a system of generating cold/hot water and steam at the central plant in the district and supplying them to individual buildings can better contribute to the realization of a low-carbon society by making the best of scale merit. However, it is important to minimise pumping energy and heat transfer to and from pipes to avoid undermining overall efficiency, especially in milder climates and where buildings are very energy efficient.
- The central plant in the district is divided into three categories.

1) Electricity system: a system of generating cold and hot water by using turbo chillers, heat pump chiller, etc.
2) Gas system: a system of generating cold water and steam by gas-absorption chillers or steam absorption chillers using the co-generated (CHP) steam exhaust heat.
3) Electricity/gas combination system: a system of generating cold water, steam (hot water) by combining 1) electric heat source and 2) gas heat source.

- There are systems which combine one of the above-mentioned systems with untapped energies such as river water, sewage heat, exhaust heat from waste incineration plants, and so on.

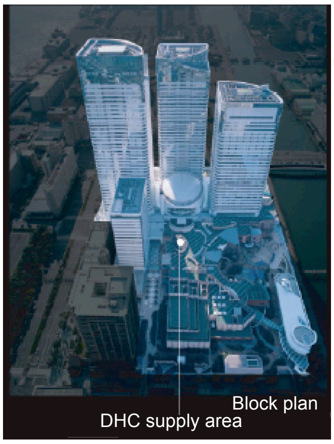
Expected CO_2 Reducing Effect

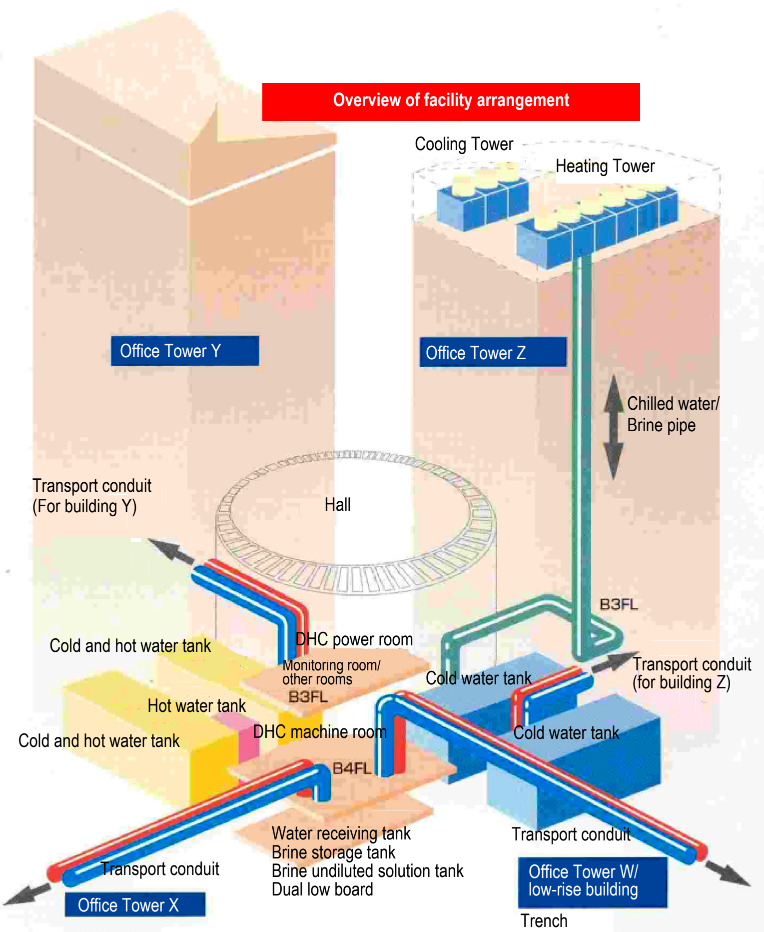
- The use of highly efficient district air conditioning and heating allows the reduction of air conditioning load, which is expected to reduce CO_2 emission significantly.
- Furthermore, the reduction of CO_2 emission in per unit can be expected by storing heat energy in thermal storage tanks with the use of night time electricity.

Examples of Application
● Harumi Island, Triton Square, Tokyo Japan, Nakanoshima Festival Tower, Osaka, Japan 

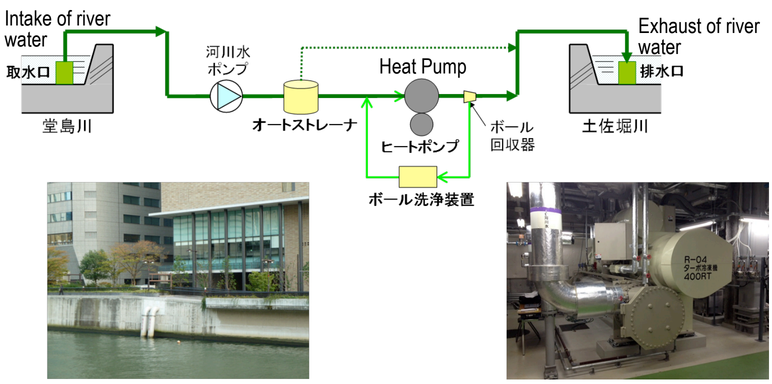
Schematic Diagram of the System, etc.

- Harumi Island area, Tokyo





- Nakanoshima Festival Tower, Osaka



(10) Waste heat from sewage treatment plant

Classification of Measures			Low-carbon Measure	Applicability as per Type of Town			
Demand/ Supply	Major Classification	Minor Classification		I	II	III	IV
Supply	Untapped energy	Using Waste heat	Using Waste heat from sewage treatment plant		H	M	L

Overview of Measures and Applicability

- As sewage water temperature is lower in summer and higher in winter than the atmospheric temperature, it will contribute to improving energy efficiency both as a coolant of heat pumps used in heat source equipment for cooling and as a heat source water of heat pumps for heating/hot-water supply.
- Using sewage water heat means the reuse of city waste heat, and it may be regarded as a recycling-oriented city energy system.
- It is necessary to pay attention to the balance between the heat supply source and the heat load from cooling/heating as well as hot-water supply, considering such regional conditions as the amount of sewage water, daily/seasonal variations in temperature and interfusion of snow-melt water. In addition, as heat demand also varies in terms of time period and season, this variation should be reduced by installing heat storage tanks.
- Moreover, it requires corrosion-resistant treatment of the related equipment based on the water quality, as well as strainers for removing foreign matters contained in the sewage water.

Expected CO_2 Reducing Effect

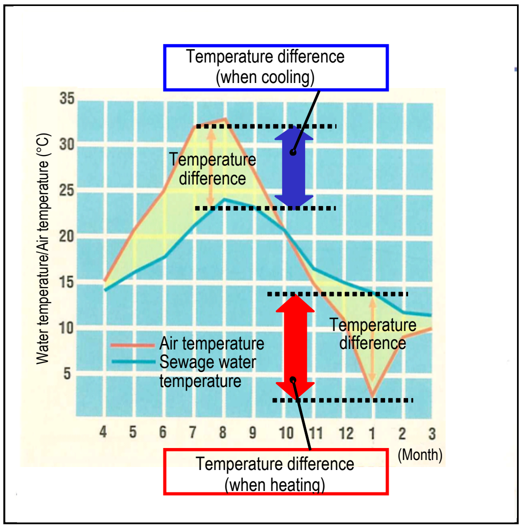
- It is expected that CO_2 will be reduced by means of improving energy efficiency in cooling/heating and hot-water supply in the relevant communities.

Examples of Application

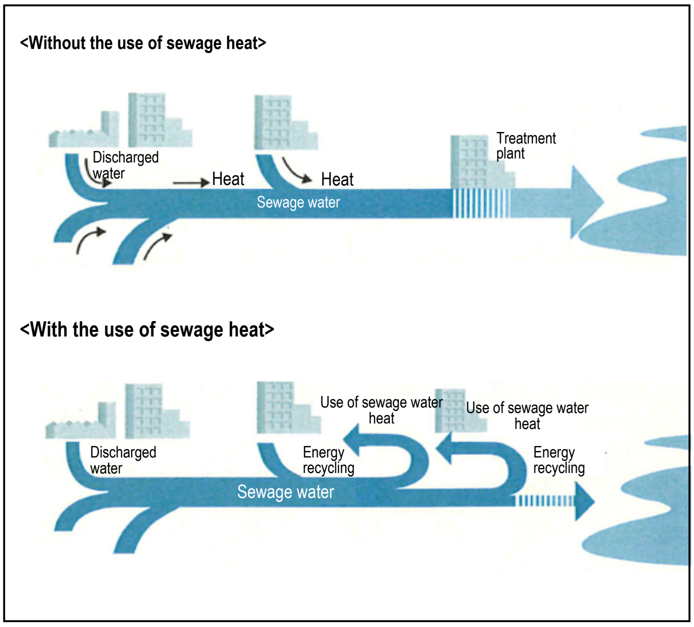
- There are 12 records of application for sewage water temperature, such as applications in wastewater treatment plant and outside of the plants in Japan (as of Feb 2014). These applications for sewage water temperature are desirable because it has high potential for energy.

Schematic Diagram of the System, etc.

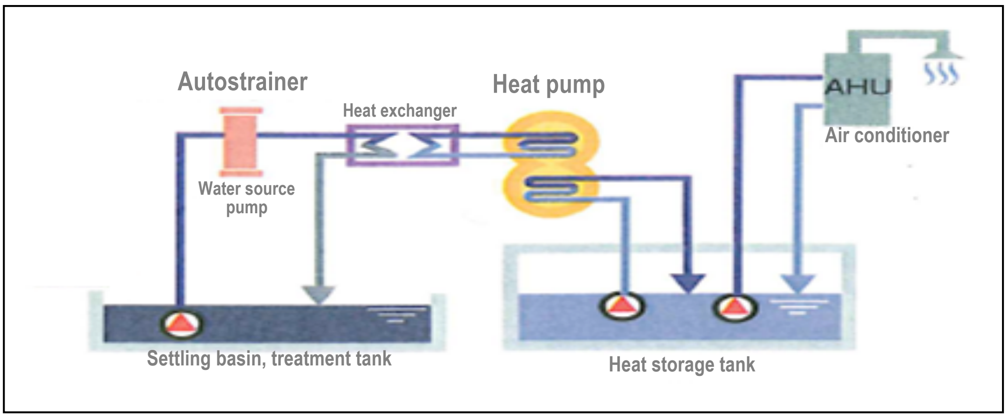
- Image of temperature variation in sewage water and atmosphere



- Heat cycle using sewage water heat



- Schematic diagram of a heat pump system using sewage water heat



(11) Hydroelectric power generation

Classification of Measures			Low-carbon Measure	Applicability as per Type of Town			
Demand/ Supply	Major Classification	Minor Classification		I	II	III	IV
Supply	**Renewable energy**		**Hydroelectric power generation (Small and middle scale)**		**L**	**L**	**M**

Overview of Measures and Applicability

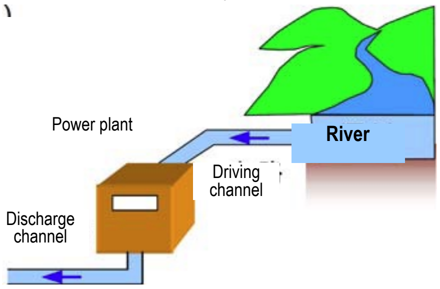
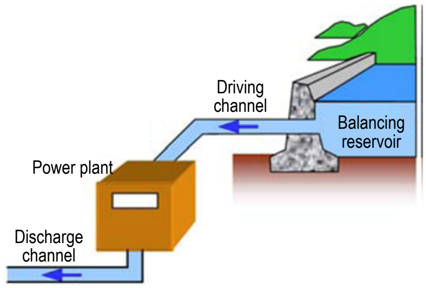
- Small and middle scale hydroelectric power generation generally makes use of water without storing it. Depending on the method of water use and the structure for gaining a head of water, several forms exist.
- Small and middle scale hydro power generation carries a heavy burden of electrical equipment costs. It takes a greater share of the total construction cost in comparison to large scale hydro power generation.
- In addition to the systems utilising the nearby rivers, the cases can be assumed where hydroelectric power generation systems are installed as a form of agricultural drainage facility in farming villages.
- Small hydro can also take advantage of existing infrastructure such as water supply dams or water supply pipes that are running downhill.
- “Pumped hydro” where water is pumped uphill to a storage dam when excess cheap energy is available, then generates electricity when it is needed can be a low cost storage option. Instead of a lower dam, the sea or a lake can be used to reduce costs
- Low cost technologies can reduce the capital costs of small hydro – for example, in Palmerston North, New Zealand, a pump that ‘runs backwards’ to generate electricity was installed on the local water supply dam. Although this is about 30% less efficient than a purpose-designed hydro unit, it was much cheaper to install.

Expected CO_2 Reducing Effect

- It is expected that CO_2 will be reduced by means of increasing electricity generation from renewable source. Pumped storage allows renewable energy to contribute a larger proportion of electricity demand by providing hydro generation at times when other renewable sources are not available, and storing excess renewable energy.

Examples of Application

- Palmerston North New Zealand (Ralph Sims) – low cost hydro installed on local water supply dam
- Melbourne Water (Australia) has installed mini-hydro units in water supply pipes between dams and consumers
- In some developing economies, farmers use very small ‘run of river’ hydro generators driven by water flow rather than vertical head that can be easily moved to avoid floods

Schematic Diagram of the System, etc.
● Run-of-river type power station  ● Reservoir type power station  Source: NEDO White Paper on Renewable Energy Technologies

(12) Waste heat from incineration plants

Classification of Measures			Low-carbon Measure	Applicability as per Type of Town			
Demand/ Supply	Major Classification	Minor Classification		I	II	III	IV
Supply	Untapped energy		Using Waste heat from incineration plants		H	M	M

Overview of Measures and Applicability

- The exhaust gas from refuse incineration at garbage disposal facilities has a high temperature and it can be utilised for power generation and as an infrastructure for heat supply.
- As garbage disposal facilities are often built away from residential areas, it is necessary to develop a siting plan which facilitates heat use, on the basis of garbage disposal facilities as an infrastructure for energy supply.
- Local community concerns about air pollution can undermine support for this technology unless implementation is carefully managed. In many developing economies, this can significantly improve local air quality, odours and health relative to existing waste management practices.

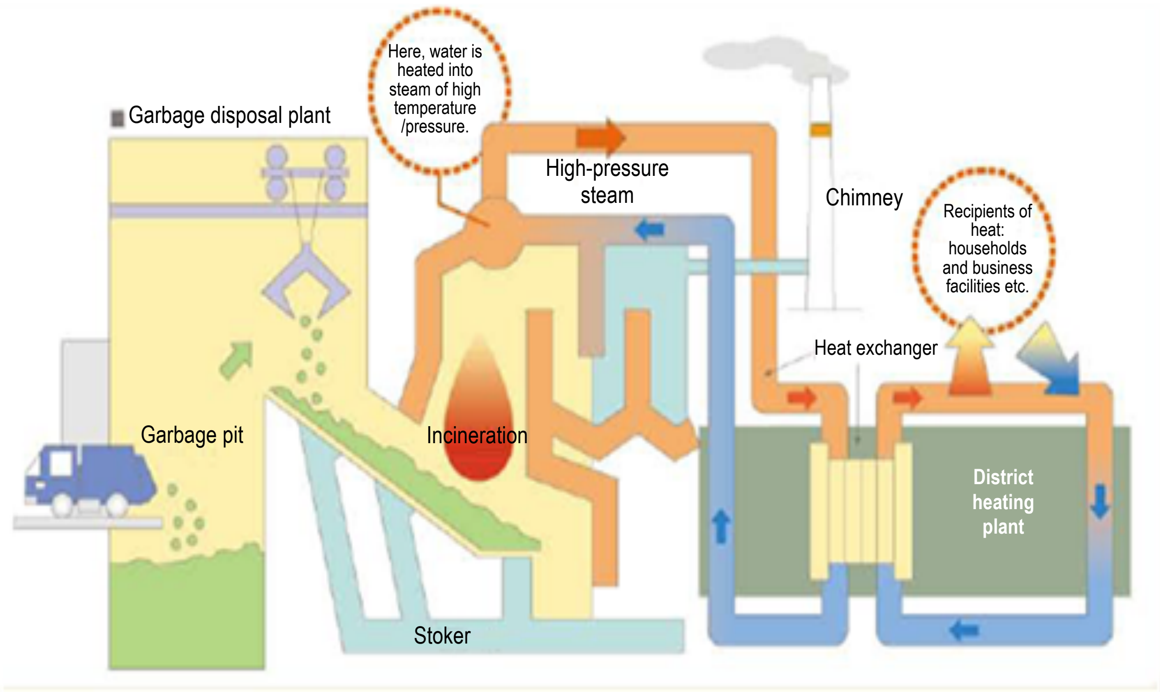
Expected CO_2 Reducing Effect

- It is expected that CO_2 will be reduced by means of improving energy efficiency in each region through power generation from unused energy and utilisation of surplus waste heat.
- Note that where plastic, tyres and other wastes that do not decay in landfills coming from materials produced from fossil fuels are burned, net greenhouse gas emissions relative to landfill may be small. But where it replaces open burning of wastes or simple incineration it provides zero emission energy and significant environmental and health benefits.

Examples of Application

- In case of Yokohama city
  The heat generated during the incineration process is converted to electric power by steam turbines; the power thus generated is used for operating various plant components such as appliances, air-conditioning, and heat-utilising facilities (heated swimming pools and welfare centers for the elderly).
  In addition to using the electricity generated within the plants, the city also supplies it to other heat-utilising facilities, as well as the Northern Area Water Recycling Center II and the Northern and Southern Area Sewerage Centers. The city also sells electricity to power companies, and the amount we sold in 2011 was equivalent to the amount approximately 71,000 households (equivalent to the whole of Isogo-ku) use over the course of one year.

Schematic Diagram of the System, etc.



(13) Solar power generation

Classification of Measures			Low-carbon Measure	Applicability as per Type of Town			
Demand/ Supply	**Major Classification**	**Minor Classification**		**I**	**II**	**III**	**IV**
Supply	**Renewable energy**		**Solar power generation**	**M**	**M**	**M**	**M**

Overview of Measures and Applicability

- In principle, the cost and efficiency of renewable energy power generation depend on such factors as the climate condition and administrative support measures in the relevant regions.
- Solar photovoltaic power generation is a collective term for technologies using semiconductors to convert light energy into electricity. Semiconductors (solar cells) can be classified into the types using multi-crystalline silicon, thin film silicon, chemical compound/organic etc. Solar power generation ranges from large-scale power generation systems to middle- and small-sized power generation systems for industry and household use.
- Compared with other renewable energy power generation systems, this system has an advantage in terms of the ease of installation and maintenance, and no conditions for installation. On the other hand, it has the highest introduction cost per unit of electricity generated. However, on-site PV competes with retail electricity prices, which are much higher than wholesale electricity prices, so it can often be cost-competitive where electricity grids exist. And costs are falling rapidly. In areas without access to a reliable electricity grid, it can be a low cost energy supply option. However, for reliable supply it may require energy storage and smart demand management as well. For many small applications where it avoids a need to install power cables, it can also be attractive, eg for lighting on bicycle tracks, traffic lights, signs, street lights, irrigation pumps etc.
- A certain amount of energy output can be expected where solar insulation is obtained, and this system has a wider applicability than solar heat power generation or wind power generation systems.

Expected CO_2 Reducing Effect

- It is expected that CO_2 will be reduced by replacing fossil fuel use with solar electricity.

Examples of Application

- Example of Solar Power Generation (Ground Mounted)

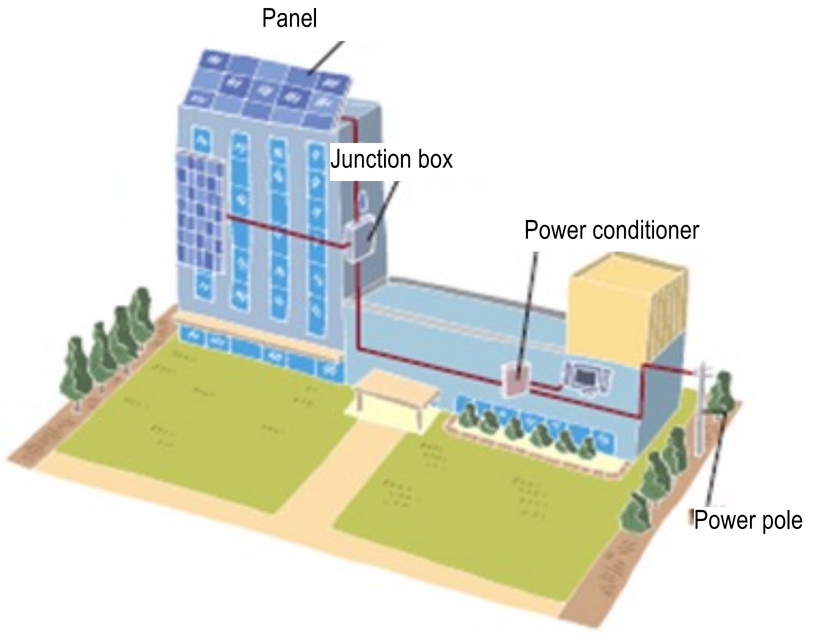
  Mito Newtown Mega Solar Park, Japan Renewable Energy Co., Ltd
  Location: Mito City, Ibaraki Prefecture, Japan
  Power Generation Output: 39,210kW

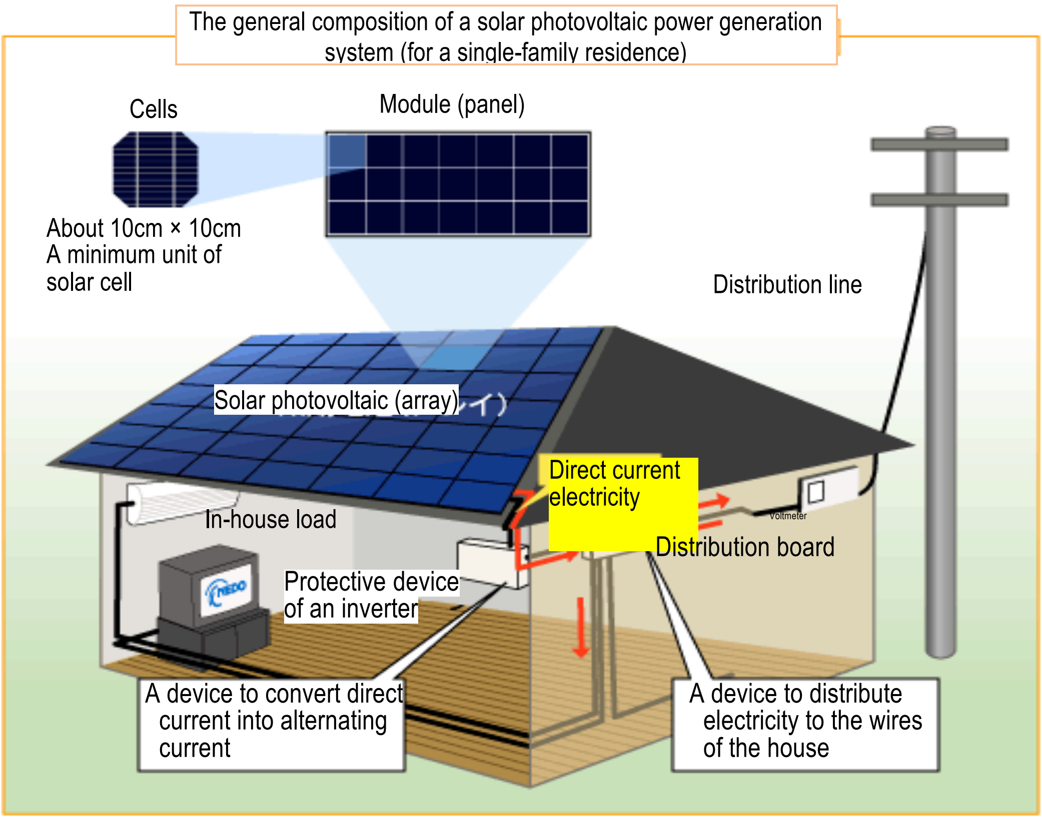
- City of San Diego, California, USA Solar Energy Implementation Plan
  http://www.sandiego.gov/environmental-services/pdf/sustainable/SolarImplementationPlan-May2010.pdf
- Santiago, Chile – the precinct the APEC study group visited had solar lighting for a bicycle track.

Schematic Diagram of the System etc.

- Middle-sized power generation system



- Small-sized power generation system



(14) Solar heating & cooling

Classification of Measures			Low-carbon Measure	Applicability as per Type of Town			
Demand/ Supply	Major Classification	Minor Classification		I	II	III	IV
Supply	Renewable energy		Using Solar heat	M	M	M	M

Overview of Measures and Applicability

- Utilising the natural energy of solar heat for hot-water supply and cooling/ heating makes it possible to promote energy saving and CO_2 reduction in buildings.
- Solar heat can be utilised for household and commercial use.
- The improving performance of heat pumps combined with declining cost of PV means that solar thermal system costs should be carefully compared with alternatives such as PV powered heat pumps.

Expected CO_2 Reducing Effect

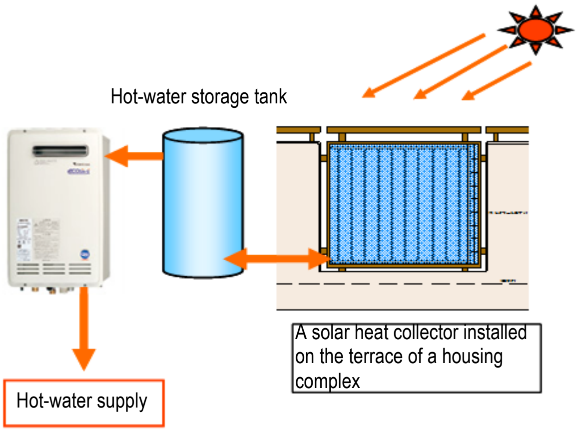
- Annual gas consumption and CO_2 emissions can be reduced by about 30% by using solar heat (Based on an average household of three family members in a housing complex; a trial calculation for a solar heat system with a heat collection area of 3m^2, installed facing south).

Examples of Application

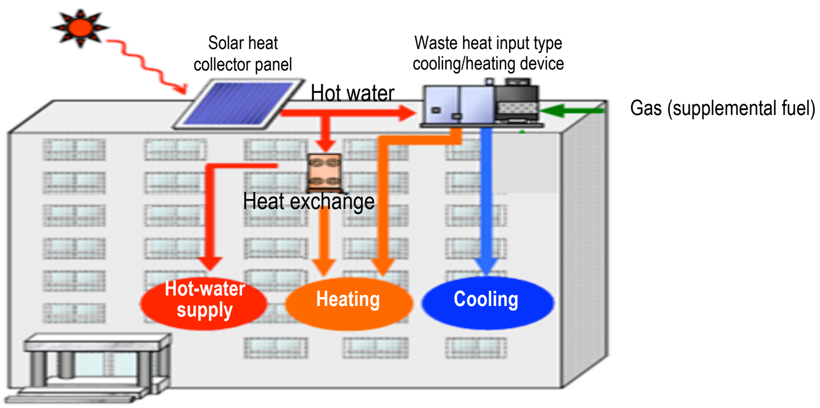
- A housing complex in Kawasaki, Japan
- An office building in Kumagaya, Japan
- Solar thermal cooling system at a hospital in Echuca, Victoria, Australia

Schematic Diagram of the System, etc.

- Combination of solar heat and gas hot-water heater systems (for household use)



- Use of solar heat for gas air-conditioning (for buildings)



(15) Biomass Power Generation

Classification of Measures			Low-carbon Measure	Applicability as per Type of Town			
Demand/ Supply	Major Classification	Minor Classification		I	II	III	IV
Supply	Renewable Energy		Biomass Power Generation		L	L	M

Overview of Measures and Applicability

- Biomass power generation is a collective term for power generation technologies using biomass (animal/plant resources and organic wastes from these resources) for direct incineration, heat decomposition, fermentation, etc. The form of biomass can be roughly classified into unused resources (forest resources, agricultural residues, etc.), waste resources (building materials, paper manufacturing materials, livestock manure, food residues, etc.) and production resources (pasture grass, water plant, vegetable oil, etc.).
- Suitable locations vary with the type of resources because biomass needs stable supply. Where seasonal sources exist, storage of fuel or alternative biomass sources may be needed to ensure reliable generation.

Expected CO_2 Reducing Effect

- CO_2 will be reduced through renewable power generation.
- Where biomass energy use avoids anaerobic decay and leakage of very greenhouse-active methane into the atmosphere, there are large additional emission benefits from avoiding the leakage of methane.

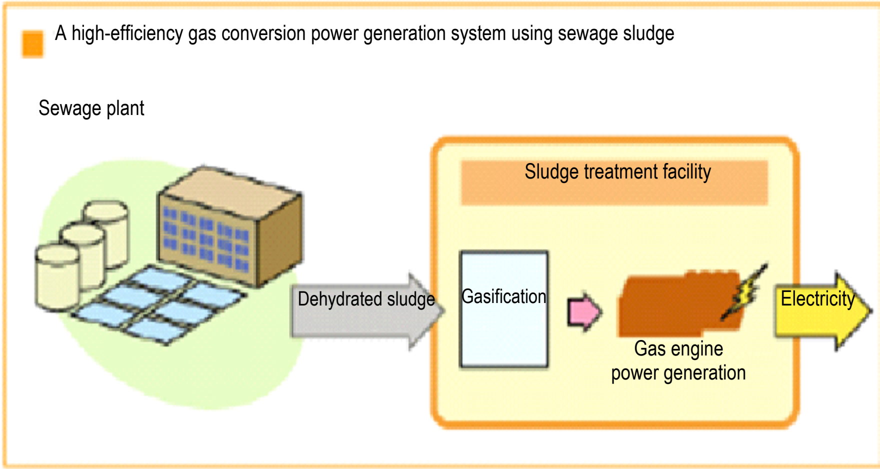
Examples of Application

- Example of Biomass Power Generation (recycling of food residue)

  Recycling plant of Shochu (Japanese spirit) lees, KIRISHIMA SHUZO CO., Ltd.
  Location: Miyakonojo City, Miyazaki Prefecture, Japan
  Processing Objects: Shochu lees 800t/day, Sweet potato pulp 10t/day, Factory waste water 10t/day, Dehydrated cake 60t/day
  Power Generation Output: 1,905kW
  Type of Power Generation: Gas engine

Schematic Diagram of the System etc.

- Biomass power generation system (NEDO)



- Melbourne Water (Australia) captures methane from sewage ponds at one site for electricity generation. At another site it uses sewage in a biodigester to provide heat energy for the sewage plant.

(16) Geo-thermal power generation

Classification of Measures			Low-carbon Measure	Applicability as per Type of Town			
Demand/ Supply	Major Classification	Minor Classification		I	II	III	IV
Supply	Renewable energy		Geo-thermal power generation		L	L	M

Overview of Measures and Applicability

- Geo-thermal power generation is a collective term for power generation using geo-thermal energy. There are two different systems to convert thermal energy into electrical energy via steam turbines; a flash and binary system.
- Compared with other renewable energy generation systems, this system has an advantage in terms of energy stability, but it is necessary to take account of environmental risks (air pollution caused by releases of hydrogen sulfide, etc.).
- The regions where this system can be applied are limited to those which can meet the criteria, namely, a specified amount of geo-thermal energy resource existing under the ground which can be developed at a reasonable cost.

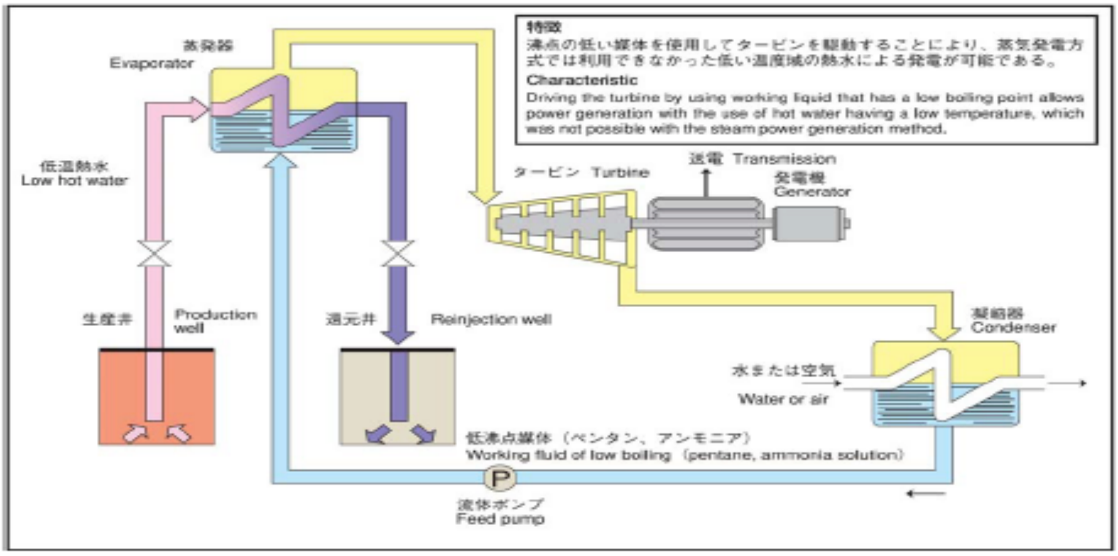
Expected CO_2 Reducing Effect

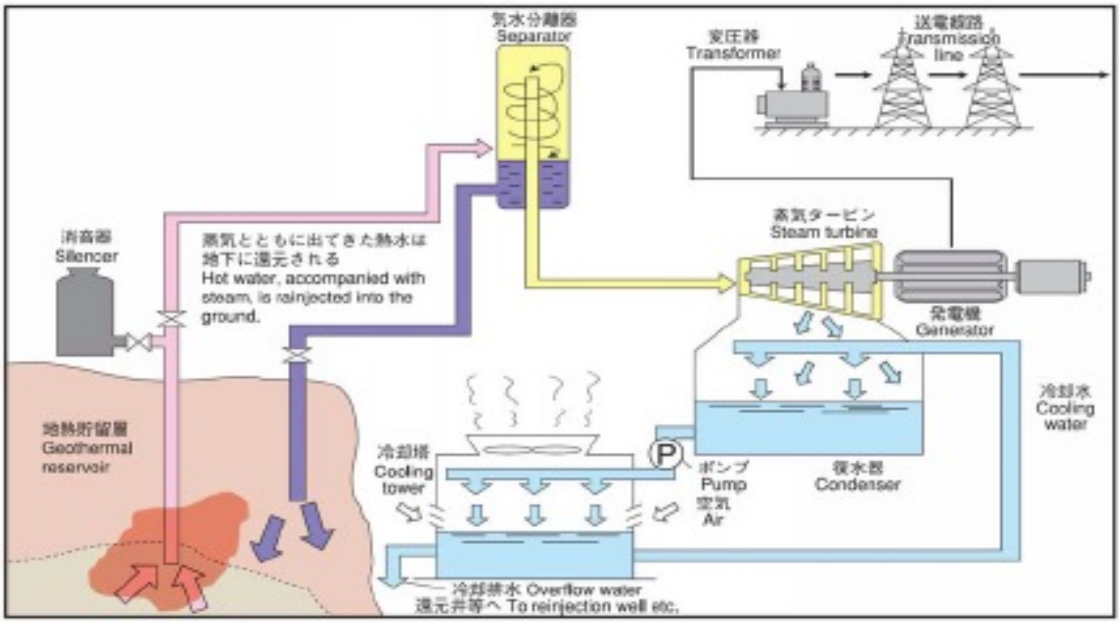
- It is expected that CO_2 will be reduced by means of using clean energy for electricity/heat generation in the relevant communities.

Examples of Application

- The Lahendong geothermal power plant, which is located at 30km south of Manado, in North Sulawesi, Indonesia, supplies almost 40% of electricity demand in Manado. It comprises four 20MW units utilising flush system. At present, the demonstration project (550kW) is now ongoing at Lahendong in order to show the viability of binary technology, which utilises lower temperature liquid phase from high temperature wet stream.
- Indonesia, Philippines, New Zealand and USA are the top 4 geothermal electricity producers
- In areas off grids where expensive diesel fuel is used for generation, lower temperature geothermal heat (e.g. from hot aquifers providing water supply) can be used to produce electricity using Organic Rankine Cycle and other emerging technologies. These units can also use waste heat from a diesel generator to produce electricity.

Schematic Diagram of the System etc.
● Geo-thermal power generation system (A binary system (upper) vs. a flush system (lower) – "White Paper on Renewable Energy", NEDO)





(17) Wind power generation

Classification of Measures			Low-carbon Measure	Applicability as per Type of Town			
Demand/ Supply	**Major Classification**	**Minor Classification**		**I**	**II**	**III**	**IV**
Supply	**Renewable energy**		**Wind power generation**		**L**	**L**	**M**

Overview of Measures and Applicability

- Wind power generation is a collective term for technologies used to generate electricity by means of capturing wind energy with rotor blades and transferring the rotational energy to generators. This power generating system has various types depending on the structure of blades and size, but it can be roughly classified into large-scale wind power generation linked to the grid and middle- or small-scale wind power generation intended to be used within each region.
- Compared with other renewable energy generation systems, this system has an advantage in terms of low introduction cost per unit of electricity generated. On the other hand, it has a disadvantage of low energy efficiency in case of limited geographical conditions (dependent on wind conditions) or small-scale power generation.
- As wind energy increases in proportion to the cube of wind velocity, it is highly probable that this system can be applied in regions with favorable wind conditions. Local terrain features can concentrate wind, while small wind turbines can be installed on tall existing structures (subject to turbulence issues)
- While offshore wind generation is still expensive, costs are declining and the wind resources are often better.

Expected CO_2 Reducing Effect

- It is expected that CO_2 will be reduced by means of using clean energy in electricity generation in the relevant communities.

Examples of Application

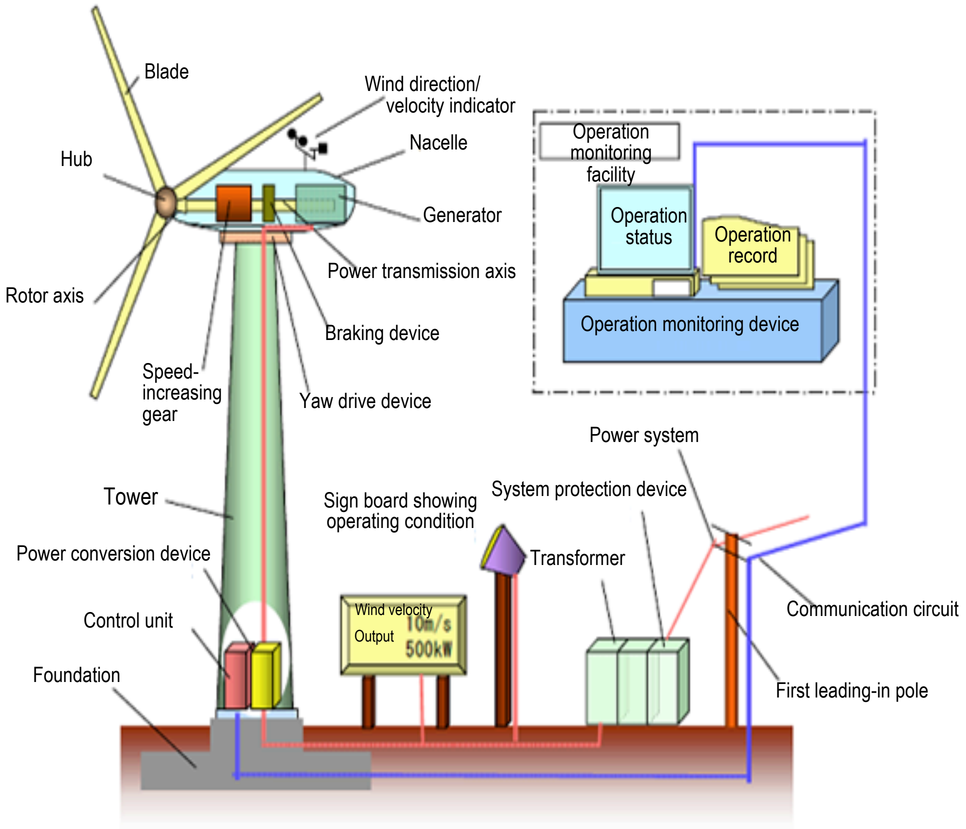
- Example of Onshore Wind Power Generation

Oga Wind Farm, SUMMIT ENERGY CORPORATION
Location: Oga city, Akita Prefecture, Japan
Power Generation Output: 28,800kW

- Example of Offshore Wind Power Generation

Joint demonstration study conducted by New Energy and Industrial Technology Development Organization (NEDO) and TOKYO ELECTRIC POWER COMPANY
Location: 3.1 km off the coast of Choshi, Chiba Prefecture, Japan
Power Generation Output: 2,400kW
Observation Tower: 100m above sea level

Schematic Diagram of the System, etc.
● Wind power generation system (NEDO - "White Paper on Renewable Energy")



(18) Fuel cell

Classification of Measures			Low-carbon Measure	Applicability as per Type of Town			
Demand/ Supply	Major Classification	Minor Classification		I	II	III	IV
Demand	Buildings	Equipment installed At facilities	Fuel cell	H	H	M	M

Overview of Measures and Applicability

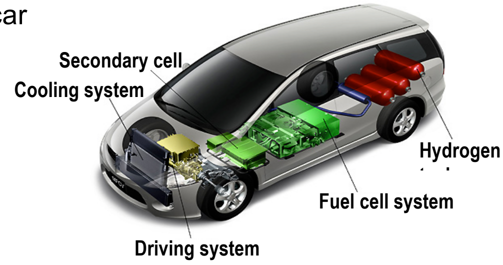
- Electricity is generated by hydrogen taken out of natural gas, methanol, etc. and oxygen from air, while the heat concurrently generated is collected as steam or hot water. This is a highly efficient power generation because electricity is generated directly from hydrogen using an electrochemical reaction.
- Fuel cell can be used for various uses and systems with different scales (0.75kW~200kW).
- It also contributes to the reduction of peak time power consumption and the improvement of energy security.

Expected CO_2 Reducing Effect

- Because power is generated as hydrogen and oxygen react to each other, water is the only substance that is formed. Although carbon dioxide (CO_2) is generated while hydrogen is being produced, its generated amount is less while using the identical volume of electricity and heat, thanks to the high overall efficiency.
- For an ordinary household of four people living in a house, CO_2 can be reduced by approximately 40% per year compared to the conventional system (thermal power generation +boiler).
- In the long term, fuel cells will be able to achieve zero emissions by using renewable energy generated hydrogen. Technology development in this area is occurring rapidly, as many see hydrogen as a key transportable form of renewable energy, while the efficiency of hydrogen production from renewable energy is also improving.

Examples of Application

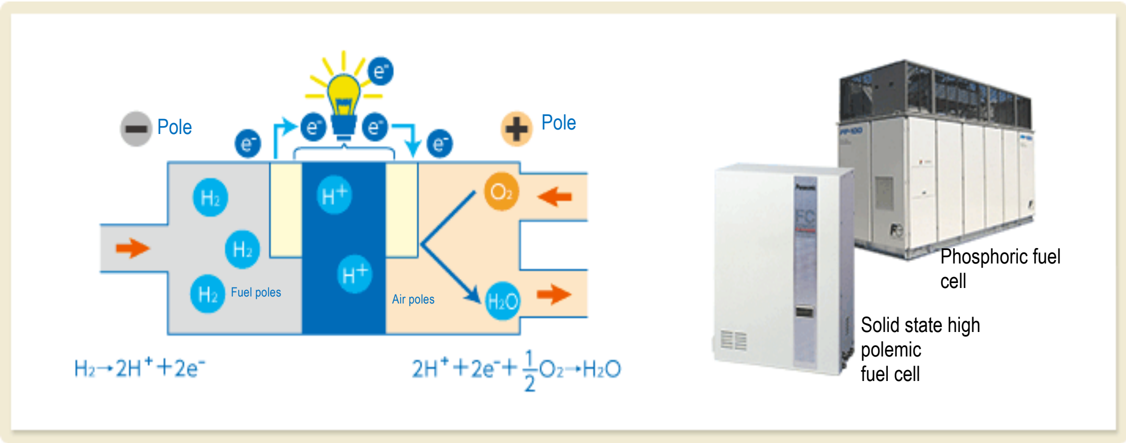
- For buildings, automobiles, personal computers, etc.
  Fuel cell car



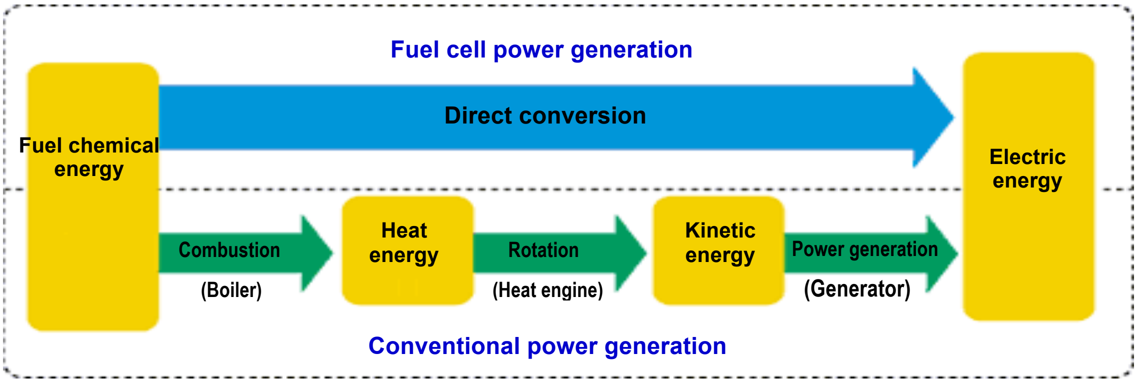
- Fuel cell for residences

Schematic Diagram of the System, etc.

- Fuel cell system



- Power generation with fuel cell



(19) Transportation (Establishment of public transportation network)

Classification of Measures			Low-carbon Measure	Applicability as per Type of Town			
Demand/ Supply	**Major Classification**	**Minor Classification**		**I**	**II**	**III**	**IV**
Demand	**Transportation system**	**Public transportation systems**	**Well developed Public Transportation Network**	**M**	**M**	**M**	**X**

Overview of Measures and Applicability

- There are a variety of public transportation systems in cities. Typical transportation systems are subways, LRT (Light Rail Transport), BRT (Bus Rapid Transport), route buses, etc.
- By establishing a public transportation network which combines optimal public transportation systems based on the city size and the demand for transportation, low-carbon urban life and sustainable cities must be realized through the use of public transportation with less CO_2 emission.
- There is evidence that early provision of light or heavy rail or metro services encourages urban development along the routes that supports lower dependence on cars. The perception of permanence of investment in PT infrastructure is important, as it reduces perceptions of investment risk for developers in comparison with provision of bus services, which can easily be removed or redirected by future policy decisions.
- Provision to securely store and carry bicycles, wheelchairs and mobility scooters can be important ways of increasing utilisation of PT systems. Emerging small personal electric scooters, skateboards and other easily carried local transport personal vehicles will also enhance the viability of PT systems for a wider catchment of users.

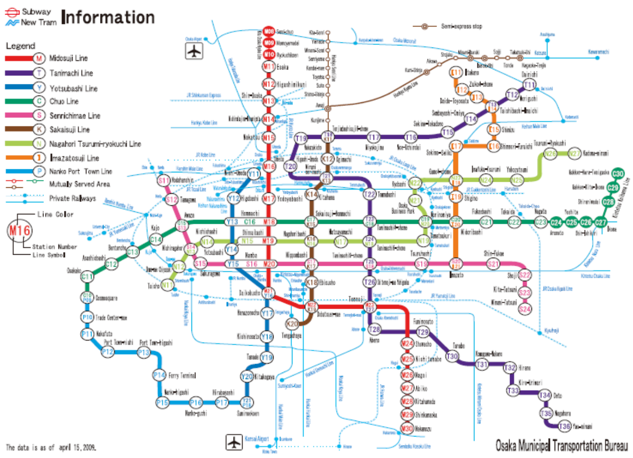
Expected CO_2 Reducing Effect

- As people use public transportation systems which emit less CO_2 than automobiles do, its development contributes to curbing the amount of CO_2 emission in cities.
- Electrified PT is easily shifted to renewable energy, simply by producing renewable electricity for the grid that serves it. Conversion of diesel or gas fueled PT is more difficult, although hybrid and electric buses are emerging.

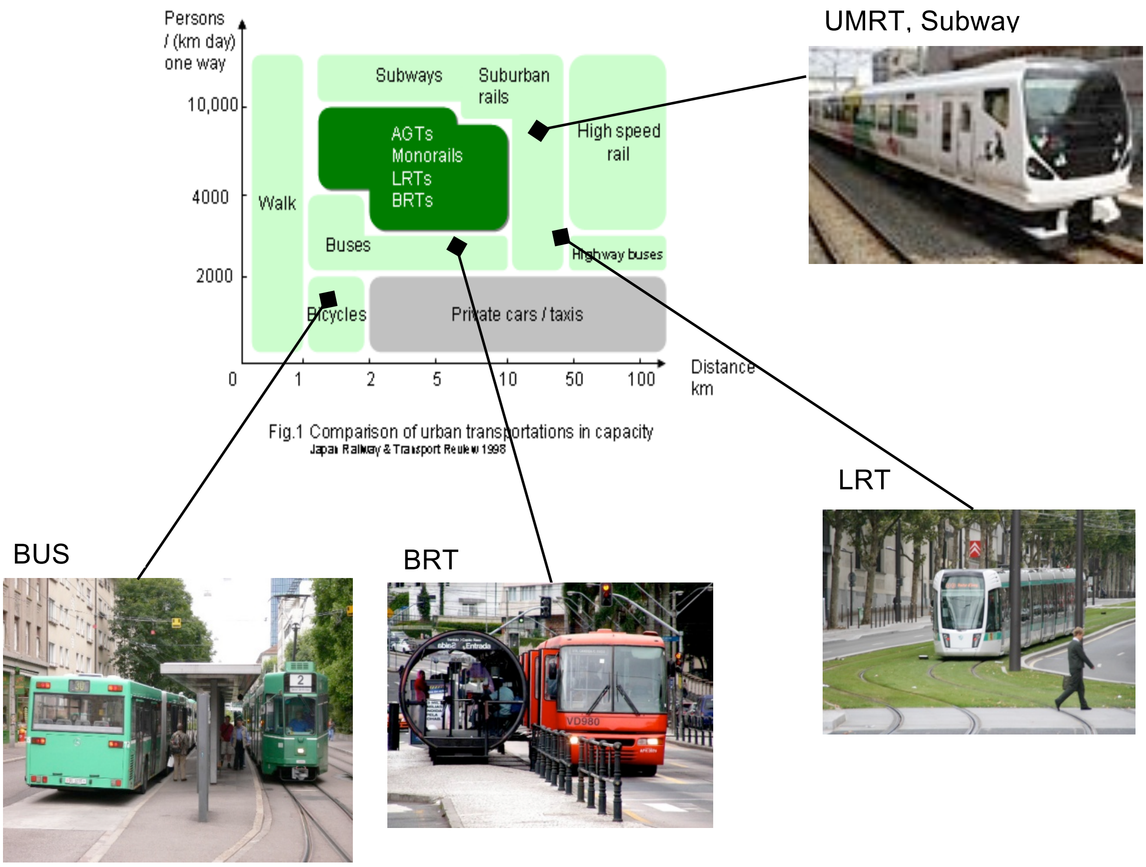
Examples of Application

- There are a number of examples of well-developed public transportation network in cities in the APEC region.

Schematic Diagram of the System, etc.



Subway network of Osaka City, Japan



(20) Local Transportation System (Bus, LRT, etc.)

Classification of Measures			Low-carbon Measure	Applicability as per Type of Town			
Demand/ Supply	Major Classification	Minor Classification		I	II	III	IV
Demand	Transportation system	Public Transportation System (Bus, LRT)	Intra-district Transportation system	H	H	H	L

Overview of Measures and Applicability

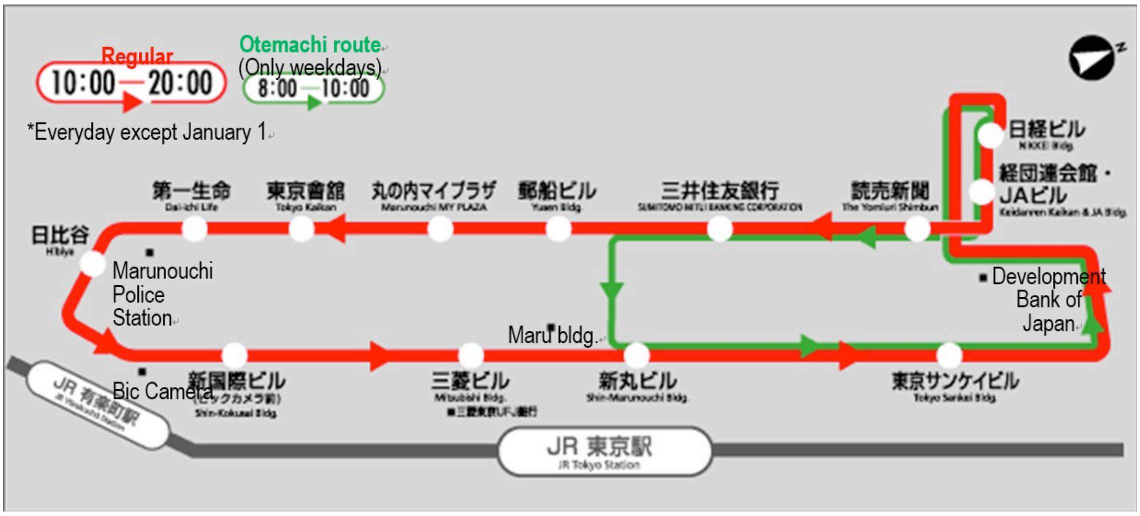
- The LRT, BRT, and buses are the public transportation systems that offer services in a part of city area such as CBD (Central Business District). The establishment of those systems would serve to improve convenience for the people who travel in the area.
- Although the carrying capacity is smaller than that of mass transportation systems such as subways, they can be established with less cost and the distance between stops can be set shorter as well, compared to subways.
- Note points I made previously about complementing these PT modes with supplementary personal transport to expand the catchment area of potential users.

Expected CO_2 Reducing Effect

- As traveling by local public transportation becomes more convenient, people begin to use public transportation systems which emit less CO_2 compared to cars. Therefore these measures are effective in curbing the amount of CO_2 emission from inside cities.

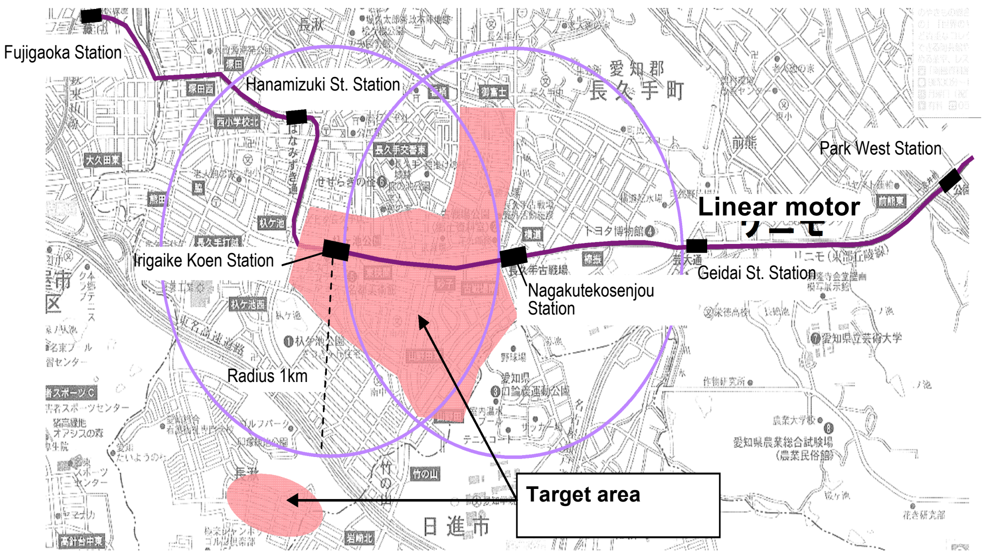
Examples of Application

- Bus Service Route & Vehicles in Tokyo CBD (Marunouchi)



(http://www.hinomaru.co.jp/metrolink/marunouchi/index.html)

- Light Rail System (Linimo) in Nagoya,Japan



http://www.linimo.jp/sonota/index.html#02

(21) Electrically Driven Vehicle

Classification of Measures			Low-carbon Measure	Applicability as per Type of Town			
Demand/ Supply	Major Classification	Minor Classification		I	II	III	IV
Demand	Transportation system	Vehicles	Electrically Driven Vehicle (EV, HEV, PHV, FCV)	M	M	M	M

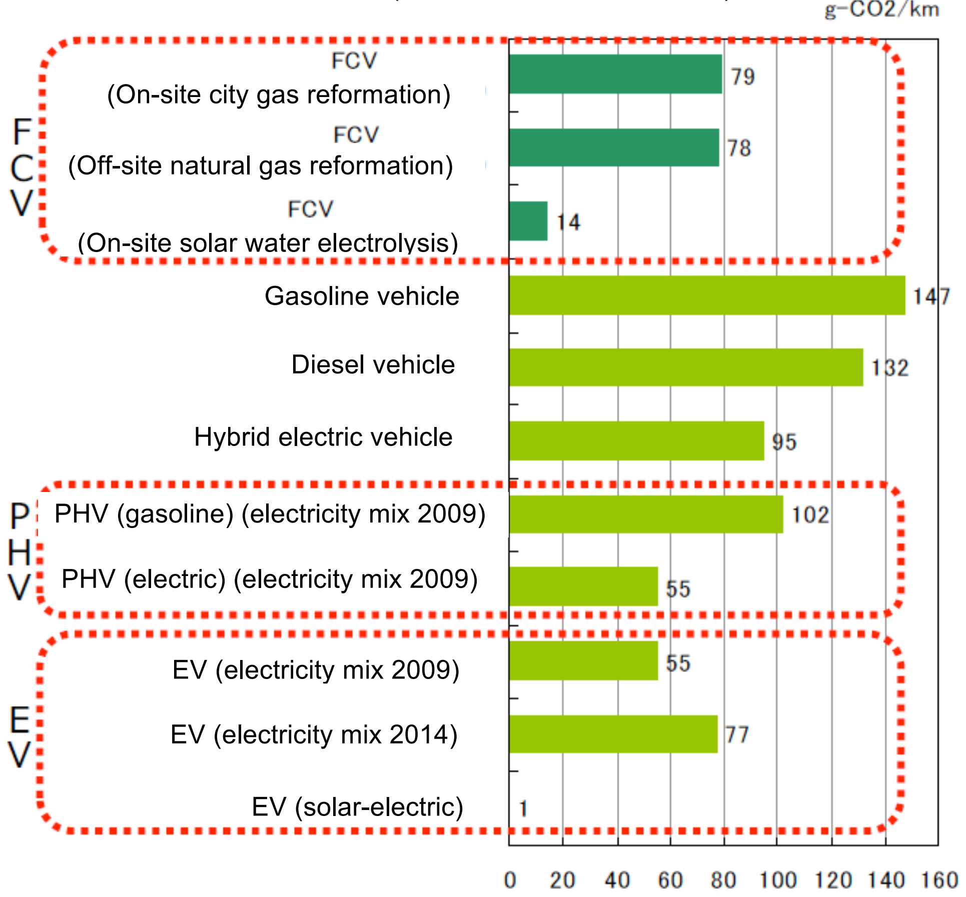
Overview of Measures and Applicability

- The wide use of electrically driven vehicles will be promoted through improving the environment for the usage such as installing chargers, and public relations activity for the electrically driven vehicle environmental performance over conventional cars, etc.

Expected CO_2 Reducing Effect

- Electrically driven vehicles don't run on fossil fuel such as gasoline unlike existing automobiles, and they are more efficient, therefore, they serve to reduce the amount of CO_2 emission from traffic, as well as local air pollution.
- A wide variety of electric vehicles including e-bikes, mobility scooters for the disabled and elderly, electric skateboards, Segways, etc. are emerging. These allow young, old and those without driving licenses to be independently mobile. This reduces the number of ‘chauffeuring’ trips in cars. For example, in Sydney Australia in 2011, 22% of weekday car trips were to take a passenger to a destination the driver did not want to go to.

CO2 Emission (Well to Wheel JC08 mode)



Source: Hydrogen/Fuel-cell strategy roadmap

Comparison of CO_2 emission between gasoline cars and electrically driven vehicle (Comparison of 1500cc-class vehicles)

Note that EVs using all coal generated electricity can produce emission levels close to that of petrol cars.

Examples of Application

- Introduction of electrically driven vehicle has already started in some economies in the APEC, even though it is in a small scale or for the experimental purposes. Recently, commercial production of EV has started for the use of general public.

HEV

PHV

EV

FCV

Schematic Diagram of the System, etc.

(22) Infrastructure for electrically driven vehicle

<table>
<tr><th colspan="3">Classification of Measures</th><th rowspan="2">Low-carbon Measure</th><th colspan="4">Applicability as per Type of Town</th></tr>
<tr><th>Demand/ Supply</th><th>Major Classification</th><th>Minor Classification</th><th>I</th><th>II</th><th>III</th><th>IV</th></tr>
<tr><td>**Demand**</td><td>**Transportation system**</td><td>**Infrastructure for electrically driven vehicle**</td><td>**Charger, Hydrogen filling station**</td><td>**M**</td><td>**M**</td><td>**M**</td><td>**M**</td></tr>
<tr><th colspan="8">Overview of Measures and Applicability</th></tr>
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- Chargers for electric vehicles will be installed taking their usage scenes and driving ranges into account.
- The introduction of chargers and hydrogen filling stations will be promoted by grasping business opportunities such as city redevelopment projects, etc.
- At the same time, battery technology is improving, so that EVs have longer range and are less dependent on charging stations. In the medium term, charging stations may also be used to send excess electricity generated at off-grid buildings into the grid via an EV.

</td></tr>
<tr><th colspan="8">Expected CO_2 Reducing Effect</th></tr>
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- Compared to gasoline cars, the driving range of EVs is limited (approximately 160km with one full-charge, but increasing, e.g. Tesla has up to 400 km range), which exerts a significant influence on the sales of EVs. As chargers spread, the diffusion of EV will be boosted, which will, in turn, contribute to the reduction of CO_2 emission from traffic.
- Also hydrogen filling station will boost the diffusion of FCV.

</td></tr>
<tr><th colspan="8">Examples of Application</th></tr>
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- Installation has already started at parking lots, gasoline stations, and shopping malls, etc.

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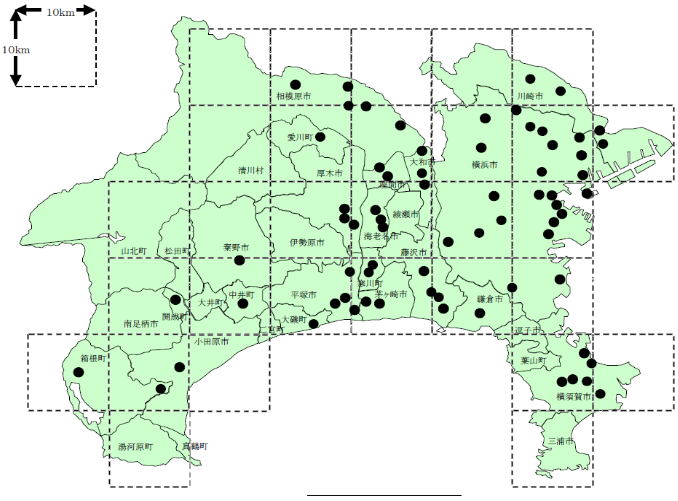
Schematic Diagram of the System, etc.

- Installation of charger



Installation points of fast chargers in Kanagawa Prefecture
Source: Kanagawa Prefectural Government

- Installation of hydrogen filling station

(23) Community Cycle Sharing

Classification of Measures			Low-carbon Measure	Applicability as per Type of Town			
Demand/ Supply	Major Classification	Minor Classification		I	II	III	IV
Demand	Transportation system	Public transportation systems	Community Cycle Sharing	H	H	H	L

Overview of Measures and Applicability

- The community cycle or bike-sharing (hereinafter, the CCS) refers to a system of sharing bicycles where users can pick-drop a bicycle at their convenience. This system aims at improving the use of bicycles as an alternative to cars, and addressing the problems of illegal parking or abandoned bicycles.
- By installing CCS ports mainly around railroad stations and public facilities, this system is expected to take effects in making up for the unavailability of public transportation infrastructure and improving accessibility.
- Where bicycle helmets are mandatory (e.g. Australia) operation of CCS can be difficult.

Expected CO_2 Reducing Effect

- With respect to the NUBIJA (the CCS of Changwon city, Korea), about 45% of users in their 30s and older have reportedly switched from cars to bicycles for commuting, after one year of the CCS introduction (source: NUBIJA HP). The appropriately introduced CCS will prompt people to switch from automobiles to bicycles, and it is expected to take effect in reducing CO_2 emission in the transportation sector.

Examples of Application

- There are a number of examples of CCS in cities in the APEC region.

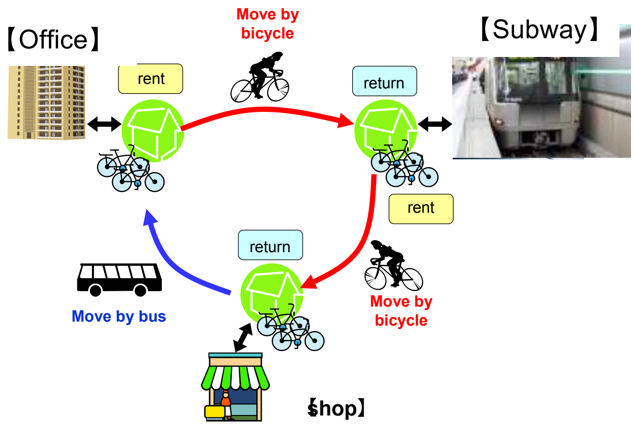
Yokohama City (Japan)

Toyama City (Japan)

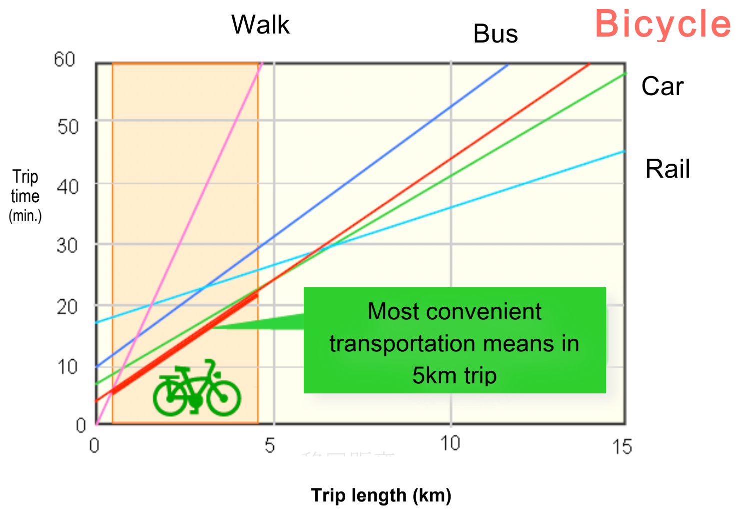
Taipei

Schematic Diagram of the System, etc.

- The CCS ports will be installed at railroad stations, public facilities, parks, commercial facilities, office buildings, apartment complexes, and so on. Users can pick-drop a bicycle freely. Registration required. IC cards will be introduced for payment.



- According the Japanese experiences, bicycles have been used conveniently in approximate 5km trip.



(24) Smart Grid

Classification of Measures			Low-carbon Measure	Applicability as per Type of Town			
Demand/ Supply	Major Classification	Minor Classification		I	II	III	IV
Demand and Supply	**Smart Grid System and others**	**Electric Power System**	**Smart Grid System**	**H**	**H**	**H**	**H**

Overview of Measures and Applicability

- The Smart Grid concept is a next-generation power grid in which the electric power flow is controlled flexibly by fully utilising the latest information technologies. It monitors the condition of electricity consumption and generation, balancing "demand" and "supply," at a time when demand and supply will further diversify due to the installation of EV/PHEV, wind power generation, etc. to power grid. A wide range of information/communications and control technologies are required for the development of Smart Grids. These include communication technology for advanced metering infrastructure and grid stabilizing technology to mitigate any negative impact on the grid such as unstable renewable energy.

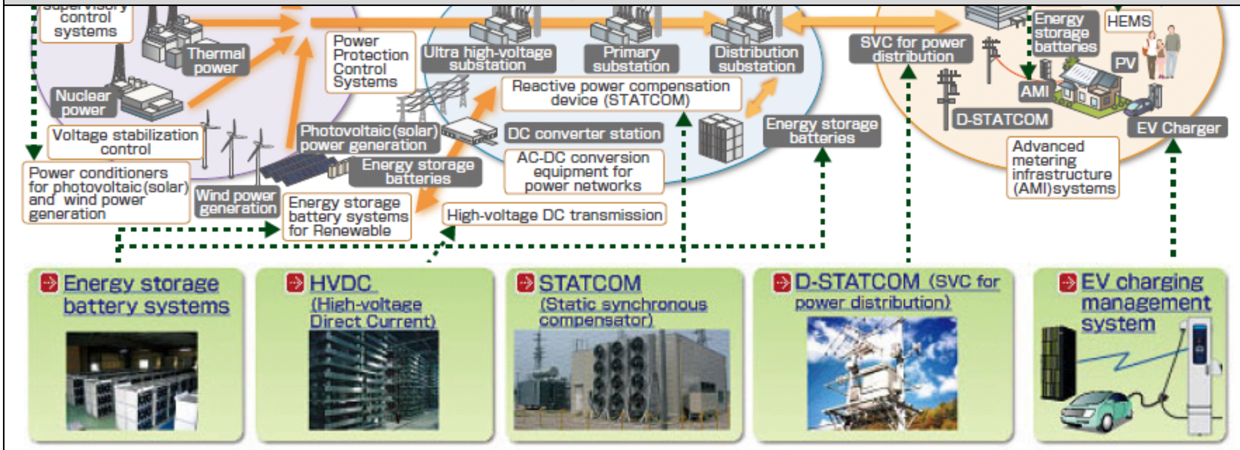
Expected CO_2 Reducing Effect

- Expansion of the use of the renewable energy sources and distributed power supply through the system stabilization control
- Reduction of the overall emission of CO_2 from electric power generation

Examples of Application

- Kashiwa-no-ha Smart City, Chiba, Japan
- Woking, UK

Schematic Diagram of the System, etc.



DMS:Distribution Management System
BEMS:Building and Energy Management System
CEMS:Community Energy Management System
FEMS:Factory Energy Management System
HEMS:Home Energy Management System
AMI:Advanced Metering Infrastructure
MDM:Meter Data Management
PCS:Power Conditioning System
SVC:Static Var Compensator
PV:Photovoltaic
EV:Electric Vehicle
PHEV:Plug-in Hybrid Electric Vehicle

Source:
http://www.hitachi.com/businesses/infrastructure/product_solution/energy/smartgrid/index.html

(25) Garbage

Classification of Measures			Low-carbon Measure	Applicability as per Type of Town			
Demand/ Supply	Major Classification	Minor Classification		I	II	III	IV
Supply	Renewable energy	Biomass power generation	Biogas injection into City gas combustion				

Overview of Measures and Applicability

- Excessive biogas generated from sewage sludge or food waste, etc. is put to an effective onsite use as the fuel for power generation or automobiles. If generated biogas or electricity still remains after onsite use, it would be possible to supply energy (biogas, co-generation power) to outside.
- Not only these measures contribute to energy conservation and CO_2 reduction, but also they help make the best use of and recycle the local biogas resources, such as sewage sludge or kitchen garbage, for a long-term in a stable manner.

Expected CO_2 Reducing Effect

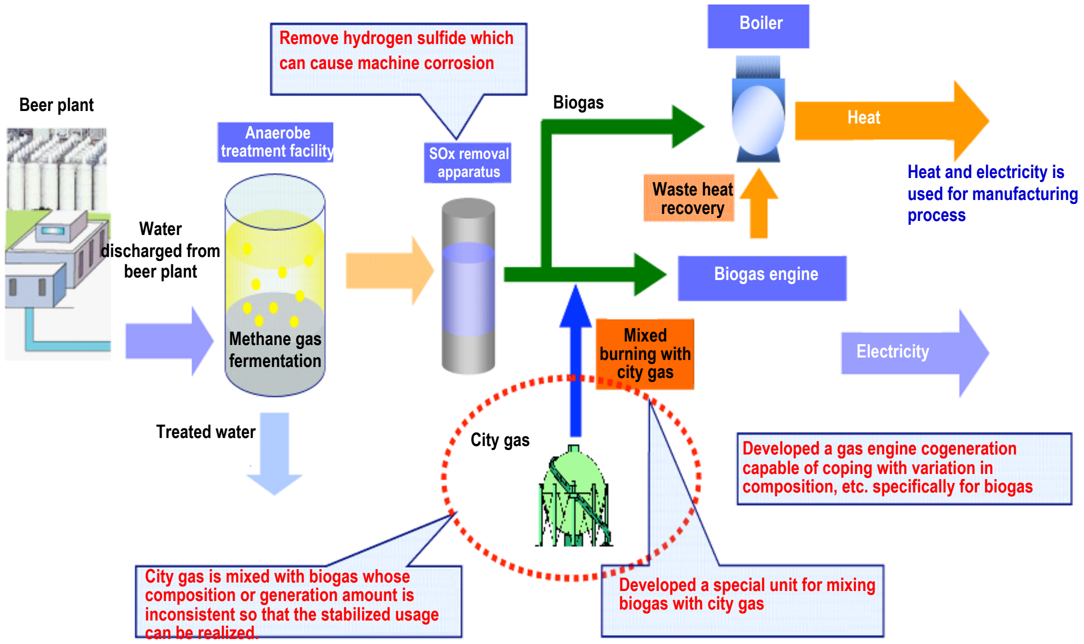
- CO_2 can be drastically reduced by using carbon-neutral biogas.
- Avoiding leakage of climate-active methane into the atmosphere offers large emission reduction benefits, as methane is around 25 times as climate-active as the same mass of CO2.
- (Example) Injection of biogas into city gas conduits: Approx. 1,830 tons/year
- (outlined in below: case example of Tokyo metropolitan)

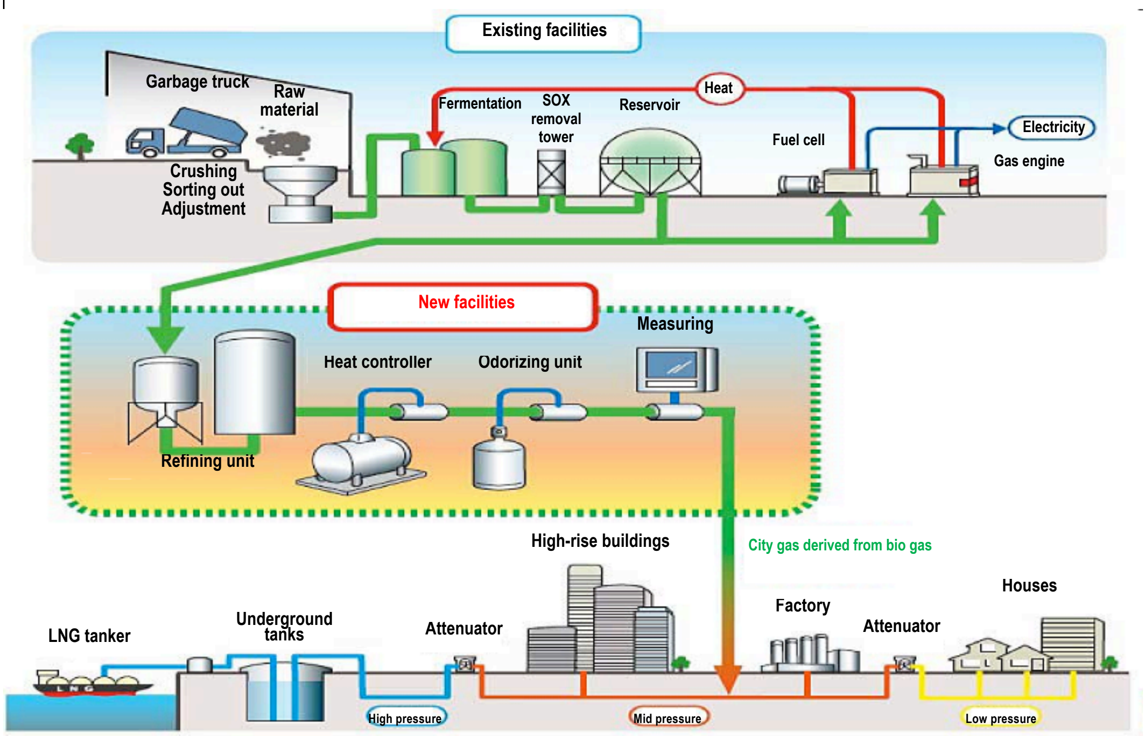
Examples of Application

- Biogas generation: Tokyo metropolitan, Yokohama city, etc. (About 30 sewage treatment facilities, etc.), Japan
- Biogas automobiles: Kobe city, Ueda city, Japan
- Injection of biogas into city gas conduits: Kobe city, Tokyo metropolitan, Japan

Schematic Diagram of the System, etc.

- Example of onsite biogas use (Beer plant)





(26) Community Energy Management System

Classification of Measures			Low-carbon Measure	Applicability as per Type of Town			
Demand/ Supply	Major Classification	Minor Classification		I	II	III	IV
Demand and Supply	Energy Management System	Area Energy Management System	Community Energy Management System (CEMS)	H	H	H	H

Overview of Measures and Applicability

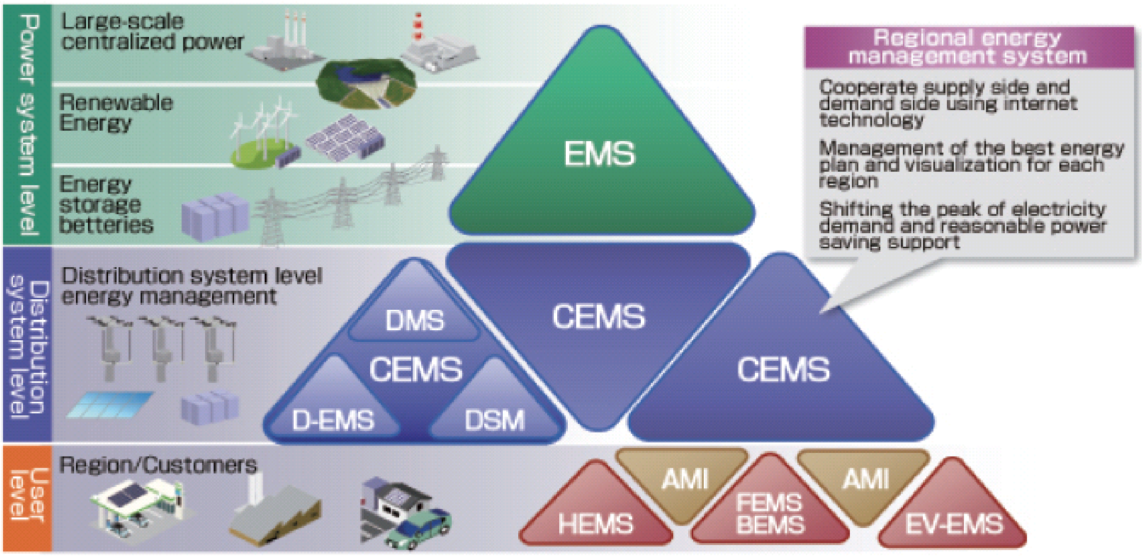
- Energy management system - autonomous decentralized architecture
- Realize regional energy management utilising IT
  - Control storage equipment efficiently by distribution level energy management system (D-EMS) in addition to distribution management system (DMS) to utilise renewable energy.
  - Realize DSM by providing various services according to the usage situation and contract terms such as data cooperation with demand side (such as "EV-EMS", "FEMS" and "HEMS") and provision of supply and demand forecast and power saving information.

Expected CO_2 Reducing Effect

- Reduction of CO_2 emission in a neighborhood through improved energy savings.
- Reduction of CO_2 emission from the concentrated power supply through the total optimisation of energy consumption and generation in a neighborhood

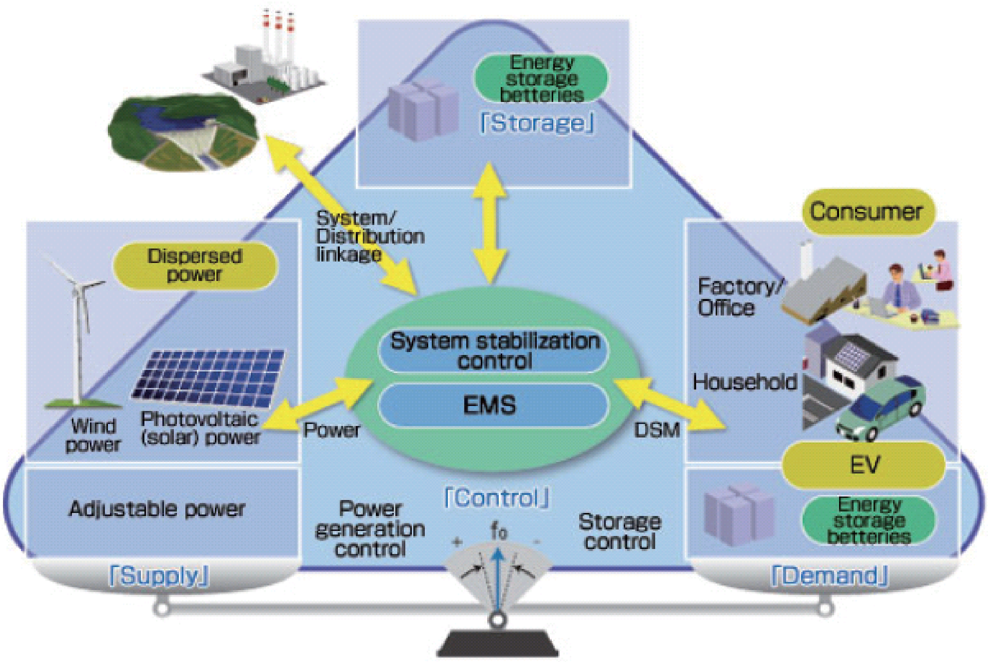
Examples of Application

Schematic Diagram of the System, etc.



AMI:Advanced Metering Infrastructure
BEMS:Building and Energy Management System
CEMS:Community Energy Management System
D-EMS:Distributed Energy Management System
DMS:Distribution Management System
DSM:Demand Side Management
EMS:Energy Management System
EV-EMS:Electric Vehicle Energy Management System
FEMS:Factory Energy Management System
HEMS:Home Energy Management System

Support minimum energy to keep up life even during an emergency. Introduce each function of CEMS and demand side according to the object function and scale step-by step and partially by autonomous decentralized system.



Supply	Traditional power generation such as thermal power and renewable energy (such as photovoltaic (solar) and wind power)
Demand	Home consumers, large scale consumers, such as factories and offices, and EV charging stations which are expected to increase in the future
Storage	The function to mitigate the fluctuation of electricity demand and power output by the energy storage equipments such as storage of electricity and thermal energy.
Control	The whole optimization function by coordinating above three factors with grid stabilizing control, generation control, DSM and power supply control.

Source:
http://www.hitachi.com/businesses/infrastructure/product_solution/energy/smartgrid/promote/management.html

(27) Home Energy Management System

Classification of Measures			Low-carbon Measure	Applicability as per Type of Town			
Demand/ Supply	Major Classification	Minor Classification		I	II	III	IV
Demand and Supply	Energy Management System	Area Energy Management System	Home Energy Management System (HEMS)	H	H	H	H

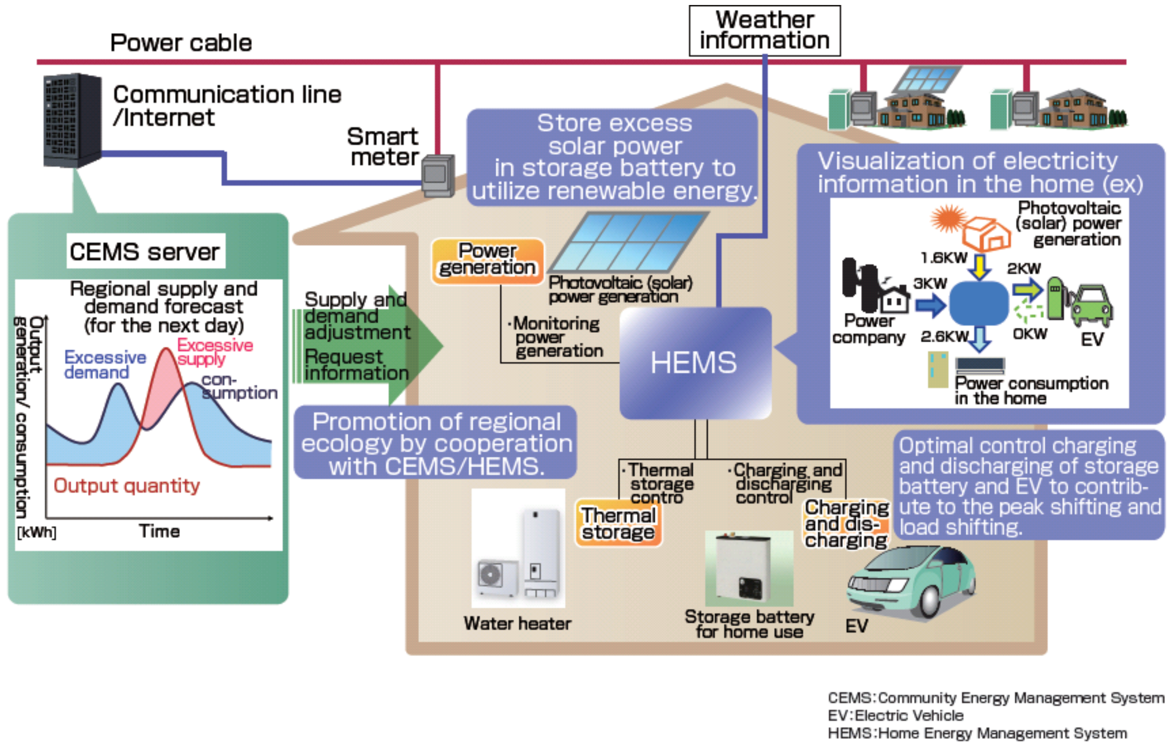
Overview of Measures and Applicability

- Utilise renewable energy such as photovoltaic (solar) power effectively by controlling load equipment in the home such as water heater, storage battery and EV.
- Contribute to reducing the regional environment impact by cooperating with community energy management system (CEMS).
- HEMS utilise renewable energy effectively by visualising load equipment information in the home (such as water heater, storage battery and EV) and controlling it properly.
- HEMS contribute to the reasonable peak shifting and load shifting according to the information of supply and demand arrangement request from community energy CEMS.
- Calculate necessary power quantity from demand forecast and output forecast of photovoltaic, and store in storage battery and EV in advance to contribute to maintain minimum energy life in an emergency.
- These systems should be combined with high efficiency appliance and equipment technologies such as LED lighting, heat pump hot water and space conditioning, high efficiency TVs, etc. to optimise costs and emission reduction.

Expected CO_2 Reducing Effect

- Optimise home energy use

Examples of Application

Schematic Diagram of the System, etc.
● Energy Management System http://www.hitachi.com/businesses/infrastructure/product_solution/energy/smartgrid/promote/management.html

Source: http://www.hitachi.com/businesses/infrastructure/product_solution/energy/smartgrid/consumer/hems.html

(28) Factory Energy Management System

Classification of Measures			Low-carbon Measure	Applicability as per Type of Town			
Demand/ Supply	Major Classification	Minor Classification		I	II	III	IV
Demand and Supply	Energy Management System	Area Energy Management System	Factory Energy Management System (FEMS)	H	H	H	H

Overview of Measures and Applicability

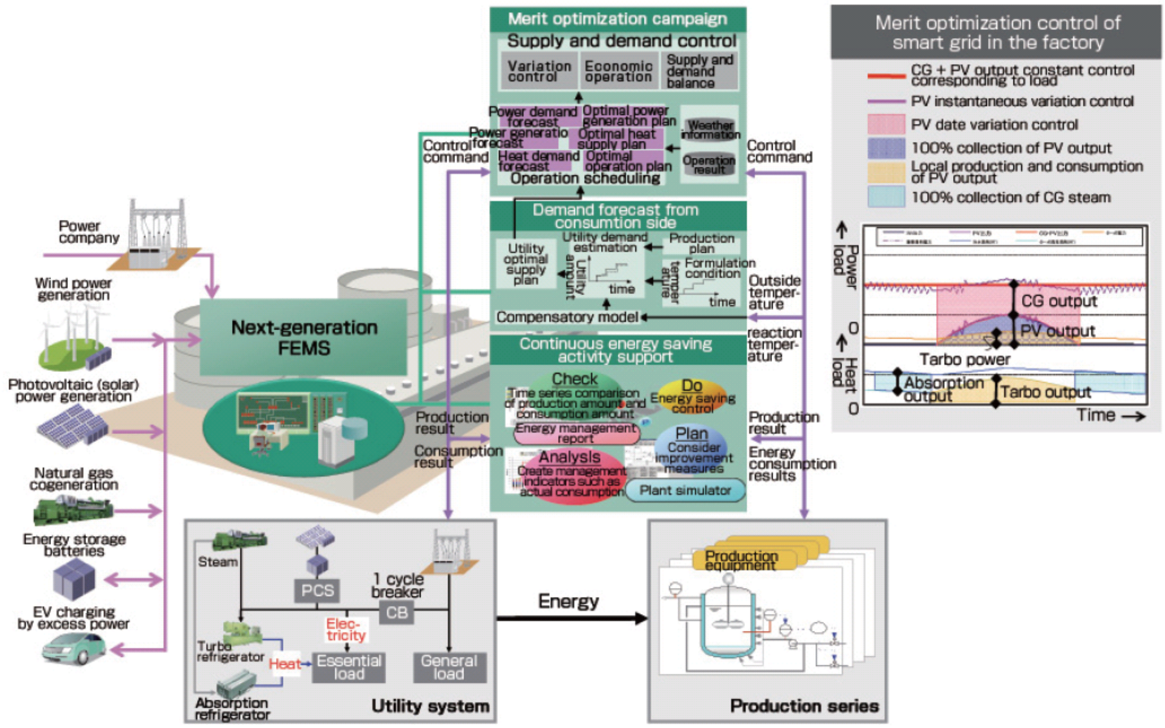
- Next-generation energy management system that maximizes the advantage of dispersion cogeneration system with renewable energy and natural gas energy by managing and controlling both energy supply and consumption in the factory.
- Forecast variable renewable energy output, power demand and heat demand to realize supply energy cost reduction and supply stabilization.
- Realize the accuracy improvement in energy demand forecast by adding production result, production plan and formulation conditions.
- Support continuous energy saving activity by PDCA cycle and visualising consumption.
- These systems can complement on-site energy recovery and energy efficiency measures and interaction with neighbouring businesses and the grid.

Expected CO_2 Reducing Effect

- Optimise Factory energy use

Examples of Application

Schematic Diagram of the System, etc.



CB : Circuit Breaker
CG : Co-Generation
EV : Electric Vehicle
FEMS : Factory Energy Management System
IGCS : Intelligent Grid Control System
PCS : Power Conditioning System
PV : Photovoltaics

Source:
http://www.hitachi.com/businesses/infrastructure/product_solution/energy/smartgrid/consumer/fems.html

(29) EV charging management solution

<table>
<tr><th colspan="3">Classification of Measures</th><th rowspan="2">Low-carbon Measure</th><th colspan="4">Applicability as per Type of Town</th></tr>
<tr><th>Demand/ Supply</th><th>Major Classification</th><th>Minor Classification</th><th>I</th><th>II</th><th>III</th><th>IV</th></tr>
<tr><td>Demand</td><td>Management</td><td>Energy Management System</td><td>EV charging management solution</td><td>H</td><td>H</td><td>H</td><td>H</td></tr>
</table>

Overview of Measures and Applicability

- Provide a set of foundation functions such as user authentication/billing/settlement/monitoring and log collection, which are necessary to operate EV charger as a necessary service of EV charging infrastructure business.
- Realize EV charging management with the consideration of regional charging station cooperating with energy management system.
- Charging management solution
  - Large screen touch panel type service controller performs batch processing of user operation.
  - Possible to respond to card settlement, car navigation, mobile phone, integration with charger of other maker and shop system cooperation by cooperating with operation/management server.
  - Adopt OSGi framework for the controller. Provide remote maintenance of the equipment and JAVA middleware environment of which functions can be expanded.
- Cooperation with “CEMS” and “EV-EMS”
  - Enable preferential guide to the available charging station and charging with less environment impact by prioritizing effective time zone for renewable energy.

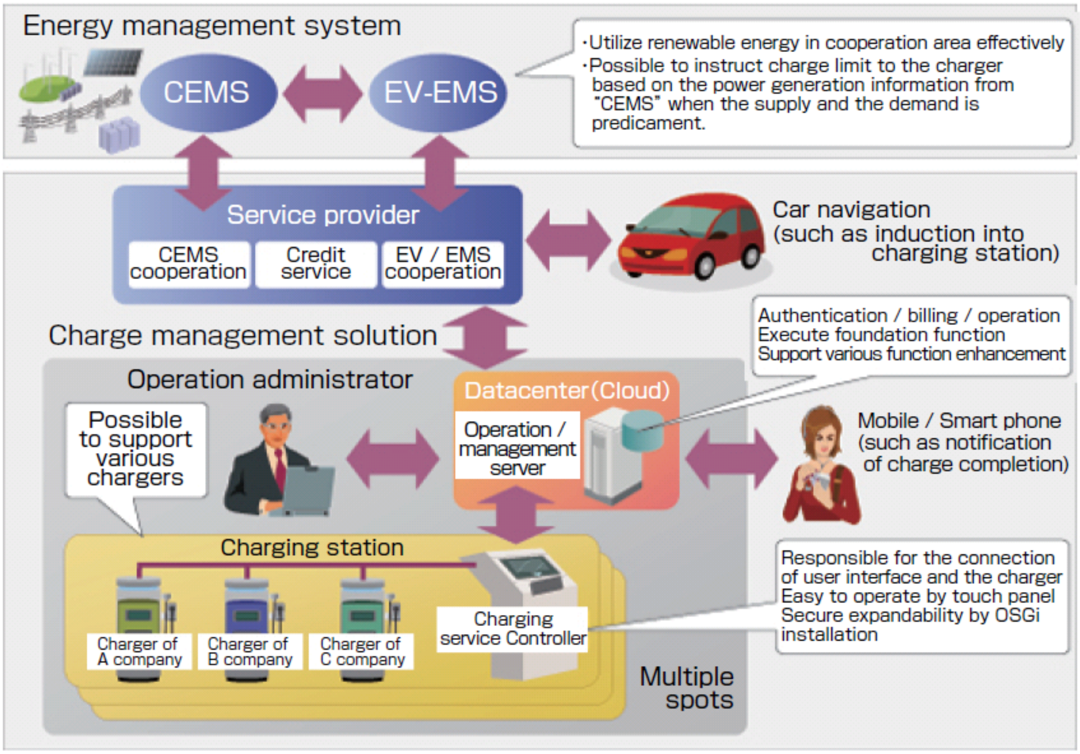
Expected CO_2 Reducing Effect

- Reduction of CO_2 by introducing EV – the volume of reduction depends on the number of EVs replacing conventional gasoline engine vehicles.
- Combination of EV management system and conventional CEMS further optimise the use of electricity, which, in turn, reduces the emission of CO_2.

Examples of Application

- Pilot system in Malaga, Spain
- Pilot system in Hawaii, United States
- Pilot system in Okinawa, Japan

Schematic Diagram of the System, etc.



CEMS:Community Energy Management System
EV:Electric Vehicle
EV-EMS:Electric Vehicle Energy Management System
OSGi(Old name:Open Services Gateway initiative):(Remote management foundation of Java application)

OSGi is omission of OSGi™ which is a trademark of US OSGi Alliance.
Java is a trademark or registered trademark of Oracle Corporation, its subsidiaries and affiliated companies in US and other countries.
Product specification is subject to change for the improvement.

Source:
http://www.hitachi.com/businesses/infrastructure/product_solution/energy/smartgrid/consumer/ev.html

(30) Demand side management

Classification of Measures			**Low-carbon Measure**	**Applicability as per Type of Town**			
Demand/ Supply	**Major Classification**	**Minor Classification**		**I**	**II**	**III**	**IV**
Demand	**Smart Grid System (mainly for electric power system)**	**Network**	**Demand side management**	**H**	**H**	**H**	**H**

Overview of Measures and Applicability

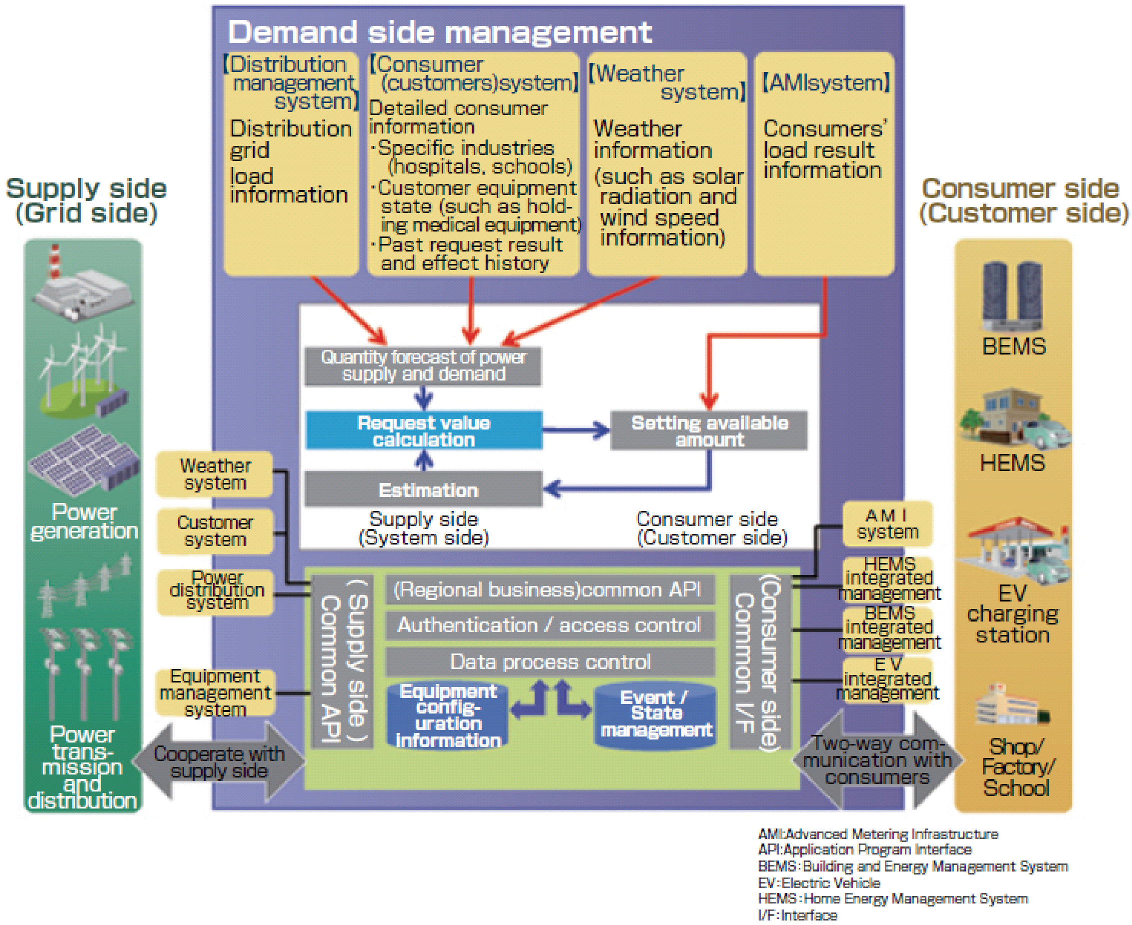
- Coordinate the data with demand side (such as HEMS) to provide supply and demand forecast and power saving information– diagnosis of issues, feedback to users, correction of problems, interaction with the grid for pricing, supply reliability, optimising energy exports, etc.
- Realize the reasonable peak decreasing and peak shifting by providing various services according to the usage situation and contract terms.
- Forecast precisely the power supply and demand plan and the power demand of the next day by utilising current supply capacity, past demand result and weather information.
- Request power saving and recommend shifting time of power using to out of peak time to consumers.
- Possible to provide various services such as offering incentive according to the precise load power using state.

Expected CO_2 Reducing Effect

- Contribute to the utilisation of renewable energy and reasonable power saving

Examples of Application

Schematic Diagram of the System, etc.



Source:
http://www.hitachi.com/businesses/infrastructure/product_solution/energy/smartgrid/cems/demand.html

(31) Simulation results for CO_2 emission reduction (Central TOKYO 7 wards area)

Classification of Measures			Low-carbon Measure	Applicability as per Type of Town			
Demand/ Supply	**Major Classification**	**Minor Classification**		**I**	**II**	**III**	**IV**
Demand	**Building**	**Low-carbon Building**	**Reducing Heat Loads**				

Overview of Measures and Applicability

- Tokyo prefecture Environmental Agency made a 2-years demonstration project from 2007 to 2008 estimating the CO_2 emission reduction when the building roof top was covered by green planting or Cool roof paint.
- CO_2 emission reduction weight (kg –CO_2/year・m^2) for green planting or Cool roof paint were investigated for specific buildings preceded by the demonstration project.
- CO_2 emission rate (kg –CO_2/year・m^2) were estimated as Table-1.

Expected CO_2 Reducing Effect

Table-1 CO_2 emission reduction (kg –CO_2/year・m^2)

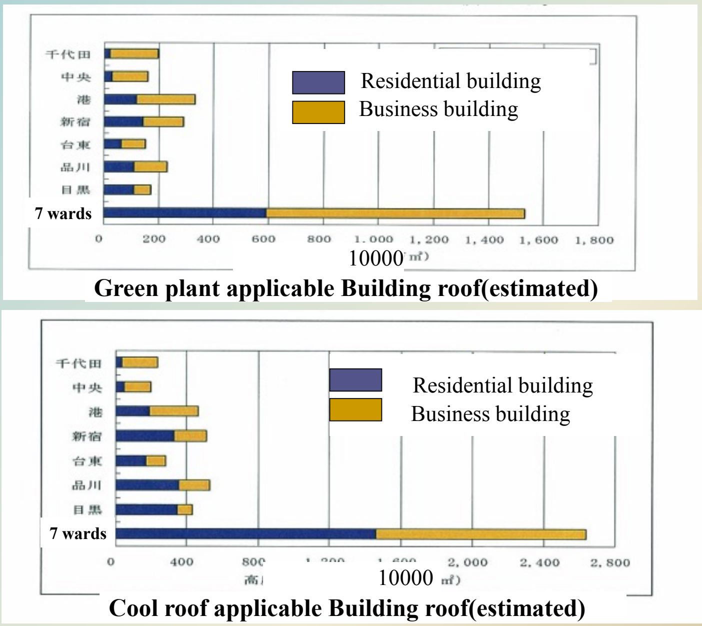
Type of roof top	CO_2 emission reduction	CO_2 emission reduction (Life cycle cost added)
Green planting	5.218	4.167
Cool roof paint	1.919	1.873

Insulation thickness 25mm

Table-2 CO_2 emission reduction in 2-years Demonstration project

Type of roof top	Constructed area m^2	CO_2 emission reduction Tone-CO_2/ year
Green planting	6,458.8	33.7
Cool roof paint	29,175.1	56.0

Table-3 Expected roof top area for CO_2 reduction (Central TOKYO 7 wards area)



Green plant applicable Building roof(estimated)

Cool roof applicable Building roof(estimated)

Data from 2008 Tokyo pref. Environmental agency report

- At the stage of 50% adoption, 25,307 tones of CO_2 emission reduction can be expected for Cool roof paint.

Table-4 CO_2 Gas reduction (T/year) VS Two measures adoption rate

• CO_2 Gas reduction (T/year) VS Two measures adoption rate

Adoption rate / Method	Trial period (%) 0.04 0.11	3%	10%	30%	50%
Green planting Roof	33.7	2,395	7,983	23,948	39,913
Coolroof paint	56.0	1,518	5,061	1,5184	25,307

t / year (-CO_2)

Data from 2008 Tokyo pref. Environmental agency report

Examples of Application

- Central TOKYO 7 wards area (Chiyoda-ku, Chuo-ku, Minato-ku, Shinjuku-ku, Taito-ku, Shinagawa-ku, and Meguro-ku), Japan

Schematic Diagram of the System, etc.

Appendix 4 APEC Low-Carbon Town Indicators (LCT-I) Guideline (Draft)

APEC
Low Carbon Town Indicators
(LCT-I)

Guideline

[Draft]

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

Table of Contents

1. Background and Objective

APEC initiated APEC Low Carbon Model Town (LCMT) project in 2011, and has carried out Feasibility Studies (hereafter "F/S") in multiple economies up to now. Moreover, the Concept of the APEC Low Carbon Town (hereafter "LCT Concept") has been established and revised according to the progress of the F/S. In 2011, the first phase of the LCMT Project was carried out in Yujiapu Central Business District (CBD) Development Project in Tianjin. Development is progressing based on the LCT Concept and the results of the F/S, and service is scheduled to begin in parts the financial district. Also, after the second phase of the LCMT project was carried out in Samui Island, Thailand, the government has taken the lead in efforts to realize the LCT.

On the other hand, in the consideration and methods to proceed to a Low Carbon Town, there is still a large disparity between individual economies, and progress by APEC as a whole is difficult. In order to proceed with efforts in each economy, evaluation of LCT projects and progress management is needed. In order to do so, it is important to establish indicators (criteria) to assess and manage various efforts to reduce CO_2 emissions and create a low carbon town at the town level.

Consequently, LCMT- Task Force (TF) carried out a basic survey towards the construction of APEC Low Carbon Town Indicators (APEC LCT-I) in 2013, in order to establish indicators for self-assessment and growth management for the creation of the LCT. The objective of LCT-I is for each economy the administration side to easily carry out an assessment from the stage of planning until the stage of maintenance management after construction of LCT projects of various scales and characteristics and at different stages of progress. In the viewpoint of the above, when existing assessment systems were considered for direct application, such an existing assessment system which could sufficiently match the purpose of LCT-I could be found. However, parts of existing assessment systems, such as CASBEE included many practical individual assessment key points which should be referred. The active introduction of these parts were considered.

The results of this consideration have been published in the APEC Energy Working Group (APEC EWG) in 2014, and approval has been obtained.

On the other hand, with the increase in the number of F/S town in the APEC LCMT project, much data could be accumulated. With these results also in mind, a review of the first draft of LCT-I formulated in the 2014 basic survey was determined at this time.

We expect utilisation of LCT-I to further promote efforts for low carbon towns at the town level and the management of CO_2 emissions, as well as increase the number of the LCT within APEC economies.

2. Outline of LCT-I

2-1. Overview of LCT-I

(1) Characteristics of LCT-I

The objective of LCT-I is to further promote efforts for a low carbon town at the town level, and to control CO_2 emissions. It is easy to use and understand by many economies. In addition, LCT-I is expected to be used as an indicator that reflects the circumstances of each economy and the characteristics of the project, and should not obstruct sustainable development. Furthermore, LCT-I cannot be replaced by an existing assessment system, but shall be used as an indicator which fully adopts elements of existing indicators such as CASBEE.

Table: Features of LCT-I

Simple and easy-to-understand. ・LCT-I is intuitive and easy-to-understand, utilising existing statistical data where possible. ・LCT-I seeks to assess each individual area and function as a comprehensive indicator for the whole project ② Reflects the circumstances of each economy and the characteristics of the project. ・LCT-I reflects the economic circumstances of each nation and the characteristics of the project and does not obstruct sustainable development. ・LCT-I can grasp the degree of achievement over time in each conceptualization, planning, implementation and maintenance phases. ③ Based on the achievements of the existing APEC LCMT TF, existing assessment indicators and global trends. ・LCT-I reflects global trends, such as smart community infrastructure assessment indicators (TC268) and OECD activities, while using the existing indicators including CASBEE as reference.

(2)Merits of Utilisation of LCT-I for each economy

The following points can be expected as merits of introducing LCT-I into each economy.

・Each economy can grasp the advantages and disadvantages of each area in its efforts to achieve the LCT, and the results the LCT-I assessment are easy to reflect in the implementation plans (road map, launch of a specialized department, prioritizing of measures, etc.) and in the budget. ・LCT-I is a simple assessment system, and self-diagnosis is possible. ・Progress can be understood by assessment at each phase, such as concept, planning, implementation, maintenance management, and feedback can be easily obtained to review measures, budget, etc. ・Conditions of efforts by each economy to achieve the LCT can be confirmed, and information sharing in between economies is easy. ・Efforts toward the LCT can be visualised and used as a PR tool to attract domestic and international developers, investors, and companies. ・Provision of low-interest financing by financial agencies for future development activities, due to the utilisation of the assessment results of LCT-I, might be possible.

(3)Targeted Space Scale and Assessment Range

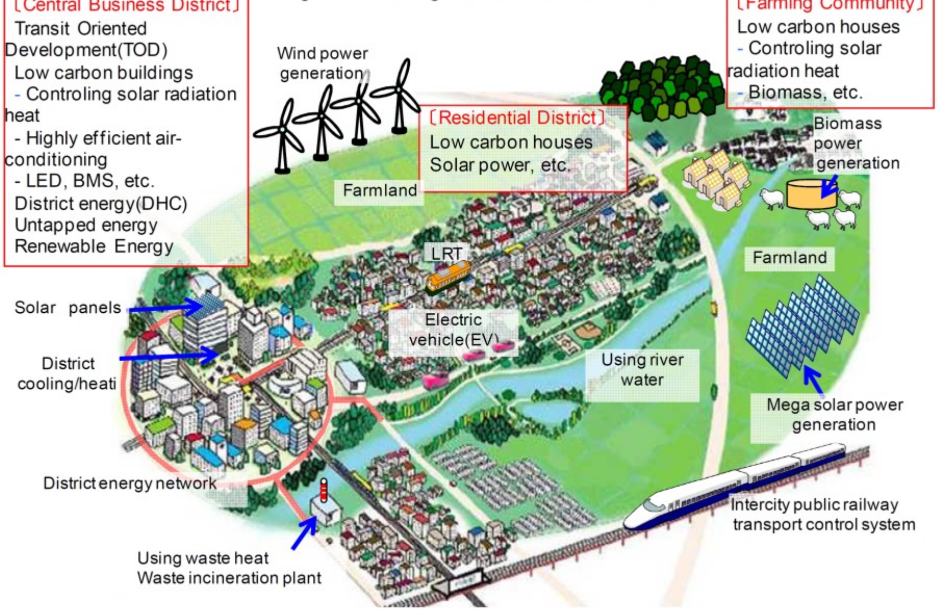
Town classification and assessment range targeted in LCT-I are described below.

- Designed to conform to LCT Concept.
- The targeted towns are classified into four types; 1.Urban (Central Business District: CBD), 2.

Commercial-oriented Town, 3. Residential-oriented Town, and 4. Rural (Village or Island).

- In most cases, the assessment area includes the buildings, transportation systems, and the district's infrastructure within the LCMT boundary (project boundary or administrative district)

Figure 7 Image of a Low Carbon Town



Source: based on Special Report SR-79,2008, National Institute for Environmental Studies

Fig. Image of LCT

Source: Concept of the Low-Carbon Town in the APEC Region, Fourth Edition

Table: Characteristics 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	Insufficient	Insufficient
III		Residential Oriented Town		Middle	Mainly Housing		
IV	Rural	Village Island		Low	Farming Fishing Resort		Limited

Source: Concept of the Low-Carbon Town in the APEC Region, Fourth Edition

(4)Composition of Assessment Areas

For the technology to achieve LCT, three major items were classified- demand side, supply side, demand & supply side, and 12 mid-items, in consideration of "The Concept of the Low-Carbon Town in the APEC Region, Fourth Edition." These can be handled as technical areas which directly influence the reduction in CO_2 emissions. In the 2014 F/S, these were considered in the preparation of assessment indicators.

On the other hand, it was discovered that while carrying out the APEC LCMT project, not only areas which directly influence CO_2 emissions reduction are important, but also those which indirectly influence CO_2 emissions reduction, in order to achieve LCT. Especially in areas such as greening, wastewater processing, political measures, and education, there were cases where these areas were already introduced as strategic policies of the economies, and cases within LCMT project where these areas were clearly set as conceptual and targeted values.

In consideration of the above, greening, wastewater processing, political measures, and education, were newly adopted as fields which indirectly influenced the 2015 F/S.

- "Environment & Resources": Greenery, wastewater Management, Waste Management, pollution conditions are assessed.
- "Governance": Policy Framework, Education & Management are assessed.
-

- Assessment targets are comprised of five major items (Tier 1) and 14 middle items (Tier 2).
- Tier 1 was divided to items which directly influence CO_2 emissions and items which indirectly influence CO_2 emissions.
- In Tier 2, assessment indicators and assessment criteria to create a multi-level Tier 3 are set.
- Items in existing assessment indicators (such as CASBEE) are actively adopted.

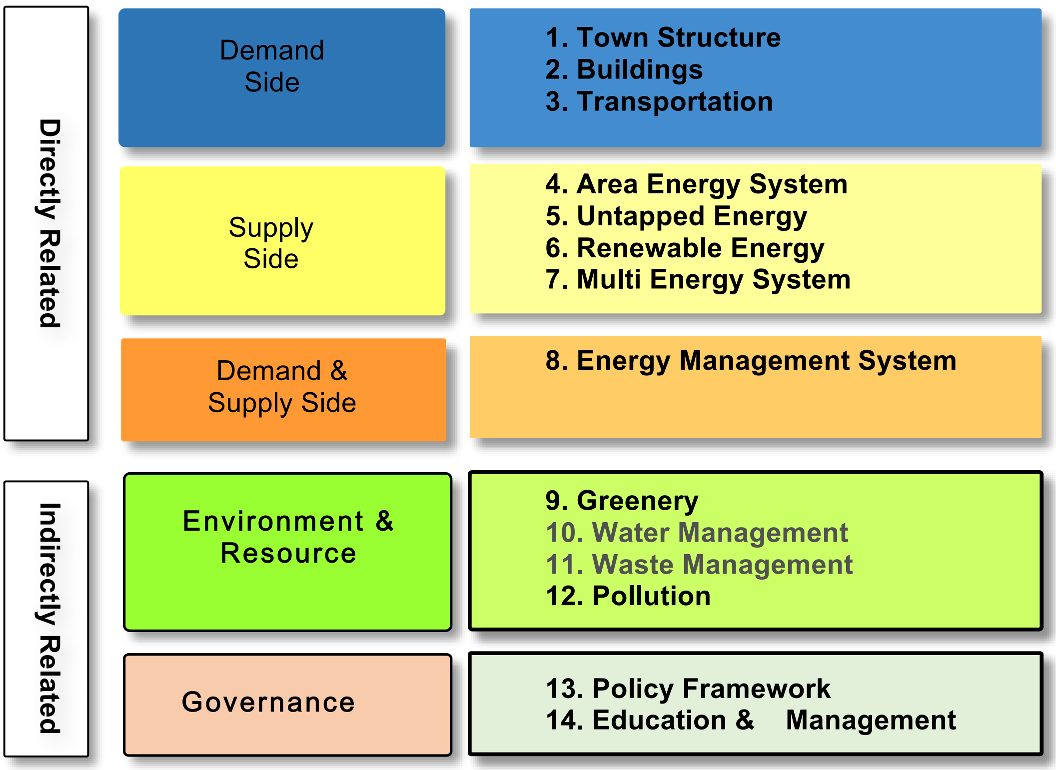


Fig. LCT-I Assessment Areas

(5)Scoring Criteria and Assessment Method

Scoring criteria is set according to the following concept.

- Achievement according to the assessment method is expressed as a five point scale- 、 、 、 、 for the assessment indicators. is the standard value.
- However, depending on the indicator, a three point scale (、 、) and a four point scale

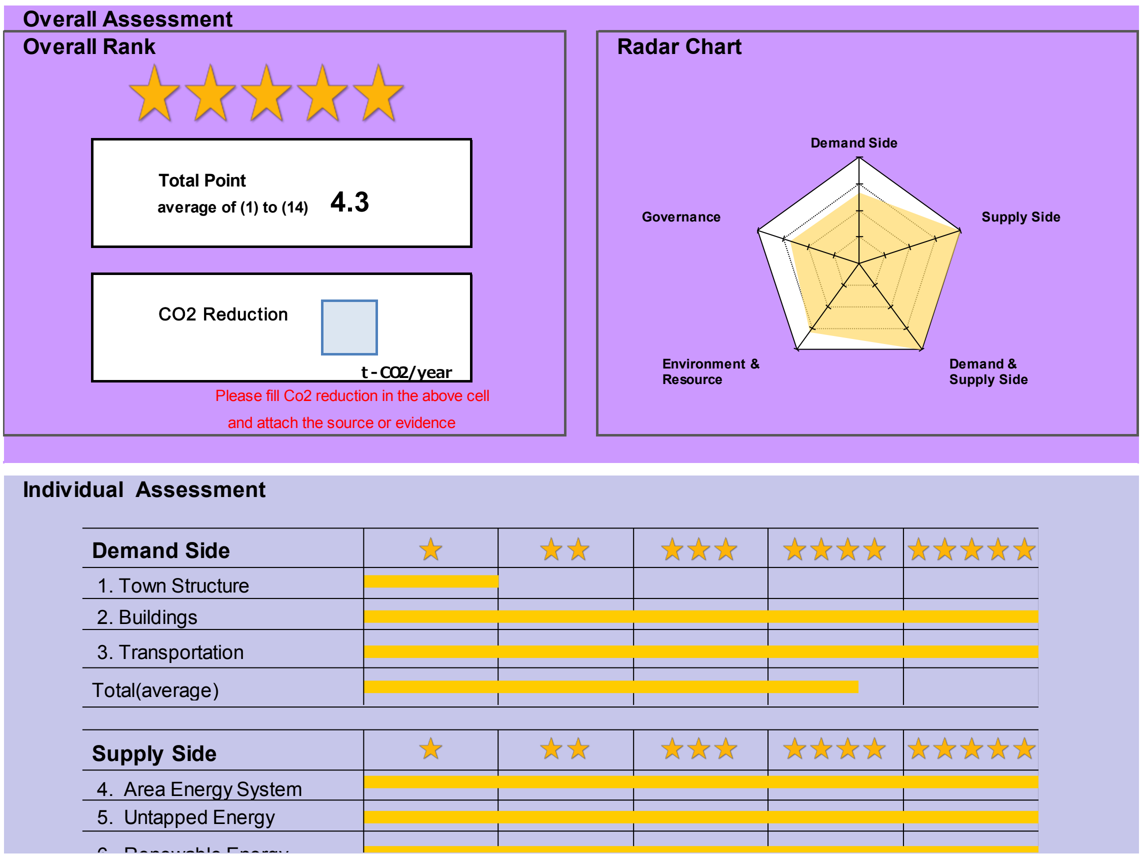
(, ,) may be applied at times.

- In cases without plans, efforts, systems or criteria, or in cases where the numerical value cannot be measured, an evaluation is not given (No are awarded).
- Regarding the quantitative assessment area, calculation is carried out in reference to the standards of each economy and international standards.

(6)Assessment Method

- Local and national governments are targeted for assessment.
- The assessment results are confirmed by individual evaluation of comprehensive assessment of overall rank, radar chart per area and individual assessment. By visualising these results, the degrees of achievement of the areas in the economy can be easily compared and issues that must be solved for the realization of a LCT can be identified.

Fig. Image of the Assessment Results Sheet



(7) How to Use the Assessment Results

After assessment by LCT-I, the following utilisation examples can be considered.

- For example, by publishing the results of LCT-I assessment on their websites, APEC and economies can share information on best practices in order to further facilitate the widespread dissemination of LCT.
- LCT-I assessment result of each district can be managed by each economy and APEC.
- Progress can be regularly reported at the LCMT Task Force of EWG meetings or other opportunities.
- It is desirable that a local or national government makes a request to each region for

correction/improvement based on the result of the LCT-I assessment.

- It might be desirable to have an incentive scheme, where priority (or preferential interest rate) is given to LCT projects which show excellent LCT-I results, with regards to financial support by international/regional organisations (World Bank, Asian Development Bank, etc.)
- A local or national government can outsource the assessment to a third party (e.g. consultant), if unable to perform the assessment by itself.

2-2. Concept of Individual Areas

LCT-I consisted of a total of 14 areas. These areas are organised according individual background and policy efforts for a low carbon town, as below.

Tier1	Demand side
Tier 2	1.Town Structure
Background	・ The amount of CO_2 emissions increased due to unplanned urban development and chronic traffic congestion. ・ The amount of CO_2 emissions increased due to disorganised development in the suburbs, and extended travel distance by automobile. Moreover, increase in maintenance cost of public infrastructure such as road/water supply and sewage due to urban sprawl is also an issue. ・ Therefore establishment of a town structure which minimises traffic itself, and guidance for town development that is transit oriented, are needed. ・ Concentration of urban functions and overcoming car-dependency will contribute to the improvement of town quality, including punctuality and comfort, as well as control of CO_2 emissions.
Policies to Create a Low Carbon Town	・ Establishment of a town structure which minimises traffic. ・ Control of town suburbanisation and sprawl. ・ Promotion of the use of public transportation in daily life, such as commuting and shopping ・ Shortening of transit distance and time by locating residential areas adjacent to work areas. ・ Promotion of effective land use (utilisation of maximum floor area ratio) ・ Multiple land use (concentration of functions of residence, business, commerce, medical care) ・ Development centered on traffic bases such as railroad stations, bus stations, and land use.

Tier1	Demand side
Tier 2	2. Buildings
Background	・ Regarding world energy demand, the ratio of the consumer sectors (house/business) exceeds 30%. Moreover, more than half of the energy consumption in household/business area is consumed by air conditioner/heater and hot water supply. Source of numerical values: The White Paper on Energy Usage, Ministry of Economy, Trade and Industry ・ Countermeasures for both the building itself and equipment are needed to reduce this energy consumption. Moreover, consideration not only of new buildings, but also of existing buildings (renovation, repair, etc.) is needed. ・ Some economies have prepared certification systems and guidelines for low carbon buildings, and encourage efforts such as energy savings, eco materials, and extended life.
Policies to Create a Low Carbon Town	・ (Hardware Countermeasures) Use heat insulation, energy-saving equipment, and natural energy to reduce energy consumption (heater and air conditioner) ・ (Software Countermeasures) Prepare a certification system and guidelines to promote criteria creation and energy saving buildings

Tier 1	Demand side
Tier 2	3. Transportation
Background	• Regarding overall world energy demand, the ratio of the transportation department is approx. 30%. • Regarding CO_2 emissions by each transportation method, emissions from private automobiles are higher than public transportation (bus, railroad). In recent years, the ratio of private vehicles ownership in developing economies has rapidly increased, and chronic traffic congestion has become an issue. • Traffic congestion is considered to lead to lower fuel consumption efficiency as well as economic loss, health damage, and social loss due to traffic accidents, etc. • Therefore, promoting public transportation by controlling the use of private vehicles and actively utilising low carbon transportation methods are needed. Source: White Paper on Energy Usage 2014, Ministry of Economy, Trade and Industry. CO_2 emission by each method were; walking 0, train 22, bus 56, private automobiles 147 (g-CO_2/ person/ km (2013), Ministry of Land, Infrastructure, Transport and Tourism)
Policies to Create a Low Carbon Town	• Develop traffic nodes to increase convenience for transfer to public transportation. • Introduce car sharing, park-and-ride, etc., as comprehensive transportation countermeasures centering on public transportation. • Introduce pioneering public transportation methods such as BRT and LRT as means of mass transportation • Introduce EV, PHV, HEV, FCV, natural gas vehicles, diesel vehicles, as low carbon vehicles. • Implement transportation demand management (TDM) by coordinating with ICT • Develop roads such as highways and interchanges to control traffic congestion and realize smooth traffic flow • Promote eco driving

Tier1	Supply Side
Tier 2	4.Area Energy System
Background	• As methods to supply cooling water, steam or hot water to facilities, there are cases where these are supplied to air conditioning/heater for each building, and the cases where cool/warm air is generated by district heating and cooling system supply equipment which is integrated in one location for multiple buildings, then supplied to the district equipment. • For the latter case, equipment is integrated in one location to utilise the area as one unit, energy is utilised effectively, and energy saving is enhanced. • Moreover, since space is not required to install a heat source in each building, effective use of spaces such as the basement and rooftop is possible. • Regarding energy sources, renewable and untapped energies such as river water heat, sewerage water heat, and biomass energy can be used. • In Europe, a network of hundreds km of pipeline is maintained by a district heating supply system using untapped energy, and most of the heat demand of cities is met.

	・ District energy systems such as DHC have been introduced.

Tier 1	Supply Side
Tier 2	5. Untapped Energy
Background	・ Untapped energy refers to sourced which have not been used previously, such as exhaust heat from river, sewage , and factories. By using these energy sources, energy savings can be expected. ・ Moreover, this will reduce the use of fossil fuels, contributing to a reduction in CO_2 emissions. ・ On the other hand, regarding characteristics of untapped energy, there are issues such as disparity in distribution, supply source located far away from the demand site, and high cost, so effective technologies such as heat pumps are needed.
Policies to Create a Low Carbon Town	・ Utilisation of exhaust heat from sea water, river water, sewage heat, heat from subway / underground shopping area

Tier 1	Supply Side
Tier 2	6. Renewable Energy
Background	・ Renewable energy largely contributes to a reduction in greenhouse gases as a substitute of fossil fuels, and can be repeatedly used with less resource depletion, unlike fossil fuels. According the above description, promoting the introduction of renewable energy is needed. ・ Power generation using renewable energy can greatly reduce CO_2 emissions over fossil fuels during the whole life cycle, including equipment building and waste, etc. ※ According to estimation by IEA, the contribution of renewable energy when the amount of world greenhouse gas emissions is reduced by half in 2050 compared to 2005 levels, is estimated to be 17%.
Policies to Create a Low Carbon Town	・ Introduction of renewable energies such as solar, wind, and small small-scale hydropower, and biomass

Tier 1	Supply Side
Tier 2	7. Multi Energy System
Background	・ It is important to take into energy consumption characteristics in a building is taken by air conditioning and hot water supply. Therefore, both electricity and heat must be used effectively. ・ An electric heat supply system (Cogeneration or Combined Heat & Power) is a system which carries out power generation and heat supply at the same time. Overall energy efficiency including power generation and heat supply exceeds 70%, and is higher than a

	conventional system (overall efficiency of a thermal power plant is approx. 40%). Source:Advance Cogeneration and Energy Utilisation Center Japan(A.C.E.J) ・ The amount of conventional energy can be reduced by a high overall energy efficiency, and total energy cost can also be reduced. Moreover, reduction of the amount of power purchased during peak of power demand is also an advantage.
Policies to Create a Low Carbon Town	・ Introduction of a high energy efficiency system. As possible effects- In addition to CO_2 emissions reduction effect, energy saving effect, cost reduction effect, can also be considered (During normal hours). Furthermore, electric heat energy supply in cases of emergency can be expected as a distributed power source system (at emergency time).

Tier 1	Demand & Supply System
Tier 2	8. Energy Management System
Background	・ For effective use of energy and the stable supply of renewable and untapped energy, a management system to control these is required. ・ By the introduction of an energy management system for individual buildings EMS (AEMS, HEMS, BEMS, FEMS), visualisation of electric power consumption, and effective use of electricity controlled by equipment, can be expected. ・ Furthermore, by the introduction of a Smart Grid System using information and communication technology (ICT), integration and utilisation of information of the distribution power source system and customers is possible. Moreover, high efficiency, high quality, and high reliability power supply are also possible. ・ The Smart Grid System can be introduced not only in areas where a power network has been developed, but also areas being developed from a zero base. ・ A Smart Grid System is cutting edge technology, but an essential element to achieve LCT. Positive planning and system introduction are expected.
Policies to Create a Low Carbon Town	・ System establishment to operate the management system ・ Introduction of management system in buildings, households, and factories ・ Introduction of a management system for each district. ・ Understanding and controlling demand-supply energy utilising ICT.

Tier 1	Environment & Resource
Tier 2	9. Greenery
Background	・ Factors which increase air temperature in urban areas include man-made heat due to various activities in town life, and heat release from the ground surfaces such as buildings and asphalt. Due to these factors, temperatures in urban areas relatively high (heat island phenomenon) compared to the surrounding suburbs. ・ Greenery works to control the surrounding temperature by evapotranspiration, and efforts in rooftop and wall surface greenery are also effective. ・ Moreover, providing continuous shade area contributes to wind paths and cool spot formation. ・ Greenery contributes as a CO_2 absorption.
Policies to	・ Increase greenery

Create a Low Carbon Town	• Create continuous shade area to introduce wind paths • Conserve existing green spaces and nature

Tier 1	Environment & Resource
Tier 2	10. Water Management
Background	• Due to population increase and economic activities, the amount of wastewater due to daily living and factory disposal has increased in many cities, but development of drainage treatment facilities have not kept up with demand. • Regarding actual conditions, obtaining land for treatment facilities in a town is difficult, a budget cannot be ensured, a large amount of energy is required for drainage treatment, and maintenance of drainage treatment facilities is not easy. • For the above described reasons, efforts to reduce water volume, regardless of whether a household or business, are needed at first. • Next, creation of a mechanism for rainwater use to promote water reuse is needed. In facilities within a certain range in the area, individual rainwater use facilities and joint intermediate water facilities will connect to water resource conservation and to energy reduction related to water re-treatment.
Policies to Create a Low Carbon Town	• Reduction of water use • Promotion of water recycling
Tier 1	Environment & Resource
Tier 2	11. Waste Management
Background	• There are still in many cities, a waste treatment system has not been established. • In these cities, controlling the amount of discharged waste, garbage separation, recycling, etc., are not thoroughly carried out in most cases, and is usually buried in suburban areas as is. As a result, a large burden is placed on the global environment, such as generation of methane gas (CH4) and bad smells. CH4 is approximately 25 times of CO_2 emission volume, in CO_2 conversion. • Positive efforts in the 3Rs (Reduce, Reuse, and Recycle) is important to create a society which effectively and repeatedly uses energy and limited resources of the earth. • Note) Since LCT-I positions areas related to energy as "directly related," 11. Waste Management is relatively determined as "indirectly related."
Policies to Create a Low Carbon Town	• Activities for 3R regarding waste treatment

Tier 1	Environment & Resource
Tier 2	12. Pollution
Background	• Air and water pollution are caused by town activities, but air and water pollution do not necessarily have the same pollution source and effect destination, and as a result

	pollution source may not be clearly specified at times. Regarding soil pollution, the source and degree of the pollution can be specified, but for sewage water, the effect destination may spread over a wide area. • Appropriate treatment of air and waterpollution before it becomes environment pollution is desirable, but if left as is without an appropriate response, even more time and energy will be needed to deal with it later. • Effort at the local and national government levels are needed, since there are regions which cannot be managed by town block and project unit. • Furthermore, with the pollution effect from neighboring economies becoming an issue in recent years, each economy must act with common awareness.
Policies to Create a Low Carbon Town	• Setting environmental criteria • Efforts to achieve the criteria • Reinforcement of regulations and penalties

Tier 1	**Governance**
Tier 2	13. Policy Framework
Background	• Establishing low carbon society and realizing a sustainable society by reduction of CO_2 emissions, effective use of energy, low carbon transportation and low carbon construction only through efforts by the private sector is difficult. Leadership and its positive effort by the administration are essential. • Introduction not only in the area of technology (hardware), but also in the area of software, etc., such as regulations, control, political measures, and partnerships, is needed to promote various efforts related to the creation of a low carbon town at each economy, region and province.
Policies to Create a Low Carbon Town	• (Software countermeasures) Measures for the creation of a low carbon town, project planning and ensuring a budget Ex: Preparation of a low carbon guidebook, global warming countermeasures, LCP, BCP, educational systems, campaigns, etc. • (Hardware countermeasures) Promotion of a disaster response and development which have a smaller effect on the environment as sustainable efforts. Ex: Blackout in the event of a nature disaster, and conservation of the natural terrain with minimal environmental effect.

Tier 1	**Governance**
Tier 2	14. Education & Management
Background	• Clarification and implementation of both public and private roles in order to create an effective and sustainable low carbon town is needed. In addition, residents must have a high awareness of a low carbon town and volunteer efforts based on such awareness are

	needed. • Consequently, schools, household, and companies should carry out enlightenment through education to connect daily life activities of each person to energy saving activities. • Moreover, information sharing and holding related events to energy saving are needed by local government and management organisations with the participation of residents and companies within the town blocks of a certain scale.
Policies to Create a Low Carbon Town	• Enlightenment and Education • Environment education (environment studies, eco driving, etc.) • Establishment and operation of area management organisation

List of Assessment Item

Tier 1	Tier 2	Tier 3
Demand Side	*1. Town Structure*	1. Adjacent Workplace and Residence 2.Land use 3.TOD
	2. Buildings	1. Energy Saving Construction 2. Green Construction
	3.	1. Promotion of public transportation 2.Improvement in traffic flow 3. Introduction of low carbon vehicles 4. Promotion of effective use
Supply Side	*4. Area Energy*	1. Area energy
	5. Untapped	1. Untapped energy
	6. Renewable	1. Renewable Energy
	7. Multi Energy	1. Multi Energy
Demand & Supply	*8. Energy Management System*	1. Energy management of building and area
Environment & Resource	*9. Greenery*	1. Securing Green Space
	10. Water Management	1. Water resources
	11. Waste Management	1. Waste products
	12. Pollution	1.Air 2.Water Quality 3.Soil
Governance	*13. Policy Frame*	1. Efforts toward a low carbon town 2. Efforts toward sustainability
	14. Education & Management	1. Life cycle management

3-1. Demand Side

1. Town Structure

1.1. Adjacent Workplace and Residence

Achieve concentration (compact-ization) of urban functions by locating workplaces and residences adjacent to each other.

1.1.1. Residential Use and Non-residential Use

Assess the ratio of residential use and non-residential use for the total floor area of the entire building.

★	15% or less
★★	—
★★★	15% to 30%
★★★★	—
★★★★★	30% or more

■ Remarks

- Locating workplaces and residences adjacent to each other enables people to commute to work or school, and carry out daily activities such as shopping by of short-distance transportation including walking, bicycle, as well as by bus, train, etc.
- All buildings in the target area, whether newly-constructed or existing, are assessed.
- Since the characteristics of urban (CBD), commercial-oriented (Commercial), residential-oriented (Residential), and rural (Rural) differ in land-use planning, they are divided into the following two groups and then assessed.
  1) Urban (CBD) and Commercial-oriented (Commercial)
     The ratio of residential use to the total floor area of all buildings is assessed.
  2) Residential-oriented (Residential) and Rural (Rural)
     The ratio of non-residential use to the total floor area of all buildings is assessed.
- Residential use includes residential buildings such as single-family houses, apartments, company housing, and dormitories.
- Non-residential use refers to any use other than the above-mentioned “residential use”.

* Refer to LEED-ND for assessment ratios. When implementing a trial, adjustments are made as needed. (LEED ND – SMART LOCATION AND LINKAGE – Housing and Jobs Proximity)

1.2. Land Use

Using land efficiently and in multiple ways (mixed use) will lead to a concentration of urban functions.

1.2.1. Efficient Land Use

Assess the degree of use of the standard floor area ratio specified by the land-use planning. Assessment shall be also carried out for multiple-use planning.

★	30% or less is used

★★	30% to 50% is used
★★★	50% to 90% is used
★★★★	90% or more is used
★★★★★	Floor area ratio exceeds the standard floor area ratio by applying a system/method. 90% or more of the standard floor area ratio is used, and a system/method for multiple-use planning in a specific area is prepared.

■ Remarks

- Using land efficiently and in multiple ways (mixed use) will contribute to a more level energy demand.
- All buildings in the target area, whether newly-constructed or existing, are assessed.
- Since achieving the standard floor area ratio and using land in multiple ways is difficult in rural areas (Rural), the following three-point assessment is set.
  - ★ : 30% or more is used
  - ★★★ : 50% or more is used
  - ★★★★★ : 90% or more is used

* A system/method refers to a comprehensive design system, district planning specifying special districts, high level use districts, districts promoted for redevelopment, and special urban renaissance districts.

* Specific areas refer to major public transportation bases (stations, terminals, etc.), central urban areas, etc.

* Multiple use planning refers to a building which is used not for a single purpose, but for multiple purposes.

* Refer to CASEBEE for ratios. When implementing a trial, adjustments are made as needed. (CASBEE for Urban Development – 3.1.2.2 Land Use)

1.3. TOD (Transit Oriented Development)

Transit oriented development promotes the shift to an urban structure that is not dependent on private cars.

1.3.1. City Development Centered on Public Transportation

Assess the presence or absence of upper-level plans which promote transit oriented city development.

★	There are no upper-level plans. However, a system for their formulation has been established
★★	There are no upper-level plans. However, a system for their formulation has been established, and prospects for their formulation are clear
★★★	There are upper-level plans.
★★★★	Projects are in place based on upper-level plans
★★★★★	Projects are in place based on upper-level plans, and a system/method to disseminate the plans has been established

■ Remarks

- Upper-level plans refer to basic concepts, basic plans, urban master plans, redevelopment policy, regional transportation plans, etc. by the low carbon town project planning of the local government
- Example of upper-level plans: Plans are formulated to concentrate residential and non-residential use areas within walking range (radius of between 750m and 1000m) centering on public transits such as train stations, bus terminals, etc.
- Example of upper-level plans: Plans are formulated for areas solely for residential and for rural areas (Rural), in order to concentrate residential use (partly include non-residential use) within walking range (radius of 750 to 1000m) centered on bus stops and LRT stations, etc.
- Regarding assessment rank 1(★), in cases where human resources, such as staff members in charge or specialists, are secured with the goal of establishing a system, an equivalent assessment can be obtained, even if a system is not actually established.

* Prospects indicate that formulation of plans will be completed within a certain period of time (approx. one to three years).

* A system/method refers to a comprehensive design system, district planning specifying special districts, high level use districts, districts promoted for redevelopment, and special urban renaissance districts.

2. Buildings

2.1. Energy Saving Construction

Energy saving construction contributes to the creation of a low carbon town by reducing the amount of energy consumed by a building.

2.1.1. Thermal Insulation Performance

Assess the presence or absence of systems or criteria to evaluate the thermal insulation performance of buildings

★	There are no systems or criteria in place. However, a system for their formulation has been established.
★★	There are no systems or criteria in place. However, a system for their formulation has been established, and prospects for their formulation are clear.
★★★	There are systems and criteria in place.
★★★★	There are systems and criteria in place, which have been implemented.
★★★★★	There are systems and criteria in place, which have been implemented. In addition, there are subsidy systems and incentive systems to accelerate implementation, or have legal binding force.

■ Remarks

- Energy used for heating and cooling can be conserved by reducing the amount of heat transfer through walls and windows to the inside of the building, or from inside the building to the outside.

- Therefore, controlling the thermal load through the building envelope is important at the design and construction stages.
- Regarding evaluation rank 1 (★), in cases where human resources such as staff members in charge or specialists are secured with the goal of establishing a system, an equivalent assessment can be obtained, even if a system is not actually established.

* Prospects indicate that formulation of plans is to be completed within a certain period of time (approximately one to three years).

2.1.2. Energy Saving Equipment Performance

Assess the presence or absence of systems or criteria to evaluate the energy-saving performance of building equipment.

★	There are no systems or criteria in place. However, a system for their formulation has been established.
★★	There are no systems or criteria in place. However, a system for their formulation has been established, and prospects for their formulation are clear.
★★★	There are systems and criteria in place.
★★★★	There are systems and criteria in place, which have been implemented.
★★★★★	There are systems and criteria in place, which have been implemented. In addition, there are subsidy systems and incentive systems to accelerate implementation, or have legal binding forces.

■ Remarks

- Building equipment refers to building service systems such as air conditioning, lighting, water supply and drainage. Building equipment could consist of machineries, piping and wiring, and other instruments.
- The overall energy consumption of a building can be reduced by the introduction of new equipment or by the replacement of existing equipment with those which use less energy (electricity and gas).
- Regarding evaluation rank 1 (★), in cases where human resources such as staff members in charge or specialists are secured with the goal of establishing a system, an equivalent assessment can be obtained, even if a system is not actually established.

* Prospects indicate that formulation of plans is to be completed within a certain period of time (approximately one to three years).

2.1.3. Natural Energy

Assess the presence or absence of systems or criteria to provide at least part of the energy required by a building by natural sources.

★	There are no systems or criteria in place. However, a system for their formulation has been established.
★★	There are no systems or criteria in place. However, a system for

	their formulation has been established, and prospects for their formulation are clear.
★★★	There are systems and criteria in place.
★★★★	There are systems and criteria in place, which have been implemented.
★★★★★	There are systems and criteria in place, which have been implemented. In addition, there are subsidy systems and incentive systems to accelerate implementation, or have legal binding force.

■ Remarks

- Use of natural energy refers to the direct use of daylight, natural ventilation, etc., to provide building services without using active equipment such as an air-conditioners and lighting devices.
- Passive design is one architectural design method. Light, heat, and air flow are controlled solely by natural energy using well devised structures and materials to create a comfortable indoor environment.
- Regarding evaluation rank 1 (★), in cases where human resources such as staff members in charge or specialists are secured with the goal of establishing a system, an equivalent assessment can be obtained, even if a system is not actually established.

* Prospects indicate that formulation of plans is to be completed within a certain period of time (approximately one to three years).

2.2. Green Construction

Expansion of buildings with high energy performance contributes to a low carbon town.

2.2.1. Green Construction Guidelines

Assess the presence or absence of the formulation of green construction guidelines

★	There are no guidelines in place. However, systems for their formulation have been established.
★★	There are no guidelines in place. However, systems for their formulation have been established, and prospects for their formulation are clear.
★★★	There are guidelines in place.
★★★★	There are guidelines which have been implemented.
★★★★★	There are guidelines which been implemented. In addition, subsidy and incentive systems to disseminate the guidelines have been established.

■ Remarks

- Green construction guidelines are used to assess a building by its environmental performance, using indicators to comprehensively evaluate the quality of the building with regards to the overall energy consumption, indoor comfort, reduction in environmental load caused by development, etc.
- Green construction guidelines refers to all assessment systems or guidelines formulated by

individual economy, such as CASBEE (Japan), LEED (US), BREEAM (UK), GBIS (China), GREENSTAR (Australia), and GREEN MARK (Singapore).

- In addition, the above guidelines also include other assessment systems or guidelines prepared by local governments or by public agencies for the development of specific areas.
- Regarding assessment rank 1 (★), in cases where human resources, such as staff members in charge of specialists, are secured with the goal of establishing a system, an equivalent assessment can be obtained, even if a system is not actually established.

* Prospects indicate that formulation of plans is to be completed within a certain period of time (approximately one to three years).

3. Transportation

3.1. Promotion of Public Transportation

The degree of dependence on private cars can be decreased by considering measures to promote the use of public transportation such as railways and buses, and by introducing means of transportation with high carrying capacities.

3.1.1. Easy-to-Use Public Transportation

Assess the ratio of the walking range centering around train stations and bus stops in the target area.

★	30% or less of the target area is covered
★★	30% to 50% of the target area is covered
★★★	50% to 70% of the target area is covered
★★★★	70% to 90% of the target area is covered
★★★★★	90% or more of the target area is covered

■ Remarks

- Public transportation, includes electric trains, buses, taxis, and ride-sharing.
  *Taxis include transport by motorcycle.
  *Ride-sharing includes use by an unspecified number.
- Public transportation includes train stations (includes light electric trains such as LRT, etc.) and bus stops.
- Coverage ratio refers to the proportion of range (area of a circle) with a radius of 500-1000m, centering on train stations and bus stops, to the entire range (assessment target area).
  Train station: radius of 1000m
  Bus stop: radius of 500m

* Regarding the range of walking distances (500m or1000m), refer to CASBEE.
(CASBEE for Urban Development – 3.1.1.1 Development of traffic facilities)
(LEED ND : 400 or 800m)

* Since there are no indicators for reference, the ratio may vary.
When implementing a trial, adjustments are made as needed.

3.1.2. Comprehensive Transportation Measures

Assess efforts in transportation measures which aim for a low carbon society

★	Efforts in measures for transportation are not made. However, a system for their formulation has been established.
★★	Efforts in measures for transportation are not made. However, a system for their formulation has been established, and prospects for their establishment are clear.
★★★	One or more measures for transportation are in place.
★★★★	Three or more measures for transportation are in place.
★★★★★	Five or more measures for transportation are in place.

■ Remarks

・ Comprehensive transportation measures refer to measures to formulate a traffic environment to achieve a sustainable traffic system where public transportation, which plays a central role, cars, bicycles, and walking are integrated in a balanced way. (excerpt from CASBEE)

・ The following are examples of efforts in measures for transportation.

1) Ride-sharing
2) Rental bicycle system
3) Provision of bicycle lanes
4) Provision of bicycle-parking areas around public transportation stations (electric train or bus)
5) Implementation of park and ride (P&R)
6) Introduction of transportation methods with high carrying capacities such as BRT and LRT
   ・Promotion of measures such as the introduction of subsidies to promote BRT or LRT.
   ・Formulation of a master plan for transportation measures, etc.

・ Transportation measures in addition to those mentioned above are also targeted for assessment.

・ Low carbon vehicles include EV buses, natural gas buses, fuel-cell buses, etc. Definitions of these vehicles are pursuant to those specified by each economy.

・ Regarding assessment rank 1 (★), in cases where human resources, such as staff members in charge of specialists, are secured with the goal of establishing a system, an equivalent assessment can be obtained, even if a system is not actually established.

* Prospects indicate that formulation of plans is to be completed within a certain period of time (approx. one to three years).

3.2. Improvement in Traffic Flow

Improve traffic flow by seeking solutions to traffic congestion and by traffic management

3.2.1. TDM（Transportation Demand Management）

Assess efforts to collectively control traffic signals in order to reduce traffic congestion

★	Efforts are not made. However, a system for their formulation has been established.
★★	Efforts are not made. However, a system for their formulation has

	been made, and prospects for their formulation are clear.
★★★	One or more efforts are in place.
★★★★	Three or more efforts are in place.
★★★★★	Five or more efforts are in place.

■ Remarks

・ TDM (Transportation Demand Management) refers to efforts to reduce traffic congestion by making "adjustments in traffic demand" such as control of traffic volume and alleviating concentrated traffic by promoting traffic behavior including the efficient use of cars and shifting use to public transportation. (excerpt from the Bureau of Environment, Tokyo Metropolitan Government)

・ Assess the presence or absence of efforts to collectively control traffic signals including road signals, signals for pedestrian crossing, systems for handling traffic accidents, etc.

・ Assess the presence or absence of efforts by the local governments in the target area

* Regarding local governments, priority is given to the smallest administrative district (ward or town). However, assessment targets include efforts at the prefecture level.

・ In addition to the above mentioned approaches, efforts to reduce traffic congestion taken by each economy are also targeted.

・ Regarding assessment rank 1 (★), in cases where human resources, such as staff members in charge of specialists, are secured with the goal of establishing a system, an equivalent assessment can be obtained, even if a system is not actually established.

* Prospects indicate that formulation of plans is to be completed within a certain period of time (approx. one to three years).

* Reference: References and excerpts regarding traffic demand management in climate change measures are taken from the Bureau of Environment, Tokyo Metropolitan Government.

3.2.2. Transportation Infrastructure Planning

Assess road development and improvement to control congestion and achieve smooth traffic flow.

★	There are no plans for development. However, a system for their formulation has been established.
★★	There are no plans for development. However, a system for their formulation has been established, and prospects for their establishment are clear
★★★	There are plans for development
★★★★	There are plans for development, and they have been partially achieved
★★★★★	There are plans for development, and they have been mostly achieved

■ Remarks

・ Assess plans for a transportation infrastructure including road development and improvement in order to achieve smooth traffic flow.

・ Plans for traffic infrastructure to be assessed refers to developments to improve congestion and promote smooth traffic flow, and also refers to plans such as multi-level crossings and roundabouts.

- Regarding assessment rank 1 (★), in cases where human resources, such as staff members in charge of specialists, are secured with the goal of establishing a system, an equivalent assessment can be obtained, even if a system is not actually established.

* Prospects indicate that formulation of plans is to be completed within a certain period of time (approx. one to three years).

3.3. Introduction of Low Carbon Vehicles

The dissemination of low carbon vehicles which hardly emit exhaust gases such as carbon dioxide and air polluting substances when operating contributes to a low carbon town.

3.3.1. Introduction of Low Carbon Vehicles

Assess subsidy systems etc. to introduce low carbon vehicles

★	There are no subsidy systems etc. However, a system for their formulation has been established.
★★	There are no subsidy systems etc. However, a system for their formulation has been established, and prospects for their formulation are clear.
★★★	There are subsidy systems etc.
★★★★	There are subsidy systems etc., and measures to make use of these systems including publicity are in place or are already operating.
★★★★★	There are subsidy systems etc., and activities to make use of these systems including PR activities are in place, or are already operating. In addition, there are subsidy systems to develop an infrastructure (EV charging facilities, hydrogen stations, etc.) for low carbon vehicles.

■ Remarks

- Targets for assessment include the presence or absence of subsidy systems formulated by local governments of assessment target areas.
  * Regarding local governments, priority is given to the smallest administrative district (ward or town). However, assessment targets include systems at the prefecture level.
- Low carbon vehicles refers to EV, HEV, PHV, FCV, and natural gas vehicles, etc. Targets for assessment include vehicles designated by each economy as low carbon vehicles such as diesel engine vehicles, etc.
- Targets for assessment also include subsidy systems for the development of related infrastructures such as EV charging facilities, hydrogen stations, etc.
  * Targets for assessment which include cases of the purchase of low carbon vehicles or the development of a related infrastructure are awarded ★★★★★.
- Regarding assessment rank 1 (★), in cases where human resources, such as staff members in charge of specialists, are secured with the goal of establishing a system, an equivalent assessment can be obtained, even if a system is not actually established.

* Prospects indicate that formulation of plans is to be completed within a certain period of time (approx. one to three years).

3.4. Promotion of Efficient Use

Reduction of fuel consumption by promoting eco-driving contributes to a low carbon town.

3.4.1. Support for eco-driving

Assess plans for the introduction of eco-driving support devices and their implementation status

★	There are no plans. However, a system for their formulation has been established.
★★	There are no plans. However, as system for their formulation has been established, and prospects for their formulation are clear.
★★★	There are plans.
★★★★	There are plans, which are actually in operation.
★★★★★	There are plans, which are actually in operation. In addition, subsidy and incentive systems to promote the introduction of eco-driving support devices have been prepared

■ Remarks

・ Regarding assessment rank 1 (★), in cases where human resources, such as staff members in charge of specialists, are secured with the goal of establishing a system, an equivalent assessment can be obtained, even if an operation system is not actually established.

* Prospects indicate that formulation of plans is to be completed within a certain period of time (approx. one to three years).

* Eco-driving support devices refers to devices such as eco-driving meters (on-board devices, fuel consumption meters, etc.), which are installed in vehicles to control CO^2 emissions by promoting eco-driving.

3-2. Supply Side

4. Area Energy System

4.1. Area Energy

Area energy utilises thermal energy (cold water, steam, hot water) among multiple facilities to contribute to a low carbon town.

4.1.1. Introduction of Area Energy

Assess the annual air-conditioning consumption in the target area covered by area energy and the presence or absence plans for introduction.

★	There are no plans for introduction in place. However a system for introduction has been established.
★★	There are no plans for introduction in place. However a system for introduction has been established and prospects for its introduction are clear.
★★★	There are plans for introduction in place.
★★★★	50% or more of the annual air-conditioning costs are covered by area energy.
★★★★★	70% or more of the annual air-conditioning costs are covered by area energy.

■ Remarks

- Area energy refers to DHC (District Heating and Cooling).
- Coverage ratio of area energy should be calculated adding hot-water supply to air-conditioning.
- The introduction plans should be evaluated by municipalities or development agencies.
  - ※ Regarding municipalities, the smallest administrative units (wards, cities) in the target area should be first priority, but units at the higher level (prefectures, districts) could also be considered.
  - ※ Development agencies refer to administrative entities or private developers planning to carry out development in a specific area.
- Regarding evaluation rank 1 (★), in cases where human resources such as staff members in charge or specialists are secured with the goal of establishing a system, an equivalent assessment can be obtained, even if a system is not actually established.

※ Prospects indicate that formulation of plans is to be completed within a certain period of time (approximately one to three years).

※ Refer to LEED for coverage ratios. When implementing a trial, adjustments should be made as needed. (LEED ND – GREEN INFRASTRUCTURE AND BUILDINGS – Districts Heating and Cooling)

5. Untapped Energy

5.1. Untapped Energy

Utilisation of untapped energy contributes to a low carbon town.

5.1.1. Introduction of Untapped Energy

Assess the annual consumption of electricity and thermal energy in the target area covered by untapped energy and the presence or absence of introduction plans.

★	There are no plans for introduction in place. However a system for introduction has been established.
★★	There are no plans for introduction in place. However a system for introduction has been established and prospects for its introduction are clear.
★★★	There are plans for introduction in place.
★★★★	2.5% of annual electricity/thermal energy costs are covered by untapped energy
★★★★★	5% of annual electricity/thermal energy costs are covered by untapped energy.

■ Remarks

・ Untapped energy refers to potential energy sources such as thermal energy from sea or river water and wastewater, and exhaust heat from underground facilities (subways, underground malls, etc.) .

・ The introduction plans should be evaluated by municipalities or development agencies.

※ Regarding municipalities, the smallest administrative units (wards, cities) in the target area should be first priority, but units at the higher level (prefectures, districts) could also be considered.

※ Development agencies refer to administrative entities or private developers planning to carry out development in a specific area.

・Regarding evaluation rank 1 (★), in cases where human resources such as staff members in charge or specialists are secured with the goal of establishing a system, an equivalent assessment can be obtained, even if a system is not actually established.

※ Prospects indicate that formulation of plans is to be completed within a certain period of time (approximately one to three years).

6. Renewable Energy

6.1. Renewable Energy

Utilisation of renewable energy contributes to lower carbon emissions.

6.1.1. Introduction of Renewable Energy

Assess the annual consumption of electricity and thermal energy in the target area covered by renewable energy and the presence or absence of introduction plans.

★	There are no plans for introduction in place. However a system for introduction has been established.
★★	There are no plans for introduction in place. However a system for introduction has been established and prospects for its introduction are clear.
★★★	There are plans for introduction in place.
★★★★	7.5% of annual electricity/thermal energy costs are covered by renewable energy.
★★★★★	15% of annual electricity/thermal energy costs are covered by renewable energy.

■ Remarks

・ Renewable energy refers to sunlight/solar heat, wind power, water power, geothermal power biomass, etc.

- The introduction plans should be evaluated by municipalities or development agencies.
  - ※ Regarding municipalities, the smallest administrative units (wards, cities) in the target area should be first priority, but units at the higher level (prefectures, districts) could also be considered.
  - ※ Development agencies refer to administrative entities or private developers planning to carry out development in a specific area.
- Regarding evaluation rank 1 (★), in cases where human resources such as staff members in charge or specialists are secured with the goal of establishing a system, an equivalent assessment can be obtained, even if a system is not actually established.

※ Prospects indicate that formulation of plans is to be completed within a certain period of time (approximately one to three years).

※ The above-mentioned coverage ratios were determined based on the introduction goals of renewable energy for the EU and Japan (EU: 20%, 2020; Japan: 20%, 2030). The coverage ratios were equally allocated for ‘untapped energy’ and ‘renewable energy’. When implementing a trial, adjustments should be made as needed.

7. Multi Energy System

7.1. Multi Energy

Efficient energy use can be achieved by collecting (making use of) electricity and thermal energy (exhaust heat) simultaneously.

7.1.1. Introduction of a Multi Energy system

Assess the presence or absence of introduction plans for CHP (or Cogeneration) in an electric power supply system.

★	There are no plans for introduction in place. However a system for introduction has been established.
★★	There are no plans for introduction in place. However a system for introduction has been established and prospects for its introduction are clear.
★★★	There are plans for introduction in place.
★★★★	There are introduction plans which have been implemented.
★★★★★	There are introduction plans which have been implemented. In addition, a subsidy system, etc. for expansion of implementation has been established.

■ Remarks

- Multi energy refers to CHP (Combined Heat and Power) and Cogeneration.
- CHP and Cogeneration are systems which use natural gas, petroleum, propane gas, etc., to simultaneously generate electricity and waste heat by means of an engine, turbine, fuel cell, etc. The recovered waste heat, converted into steam or hot water, can be used for air-conditioning or heating. By effectively using heat and electricity without waste, an overall system energy efficiency of 75-80% (based on the potential energy of the fuel source) can be achieved. (source: ANRE Japan homepage)
- By introducing CHP or Cogeneration, the amount of electricity from the power grid can be

reduced awhile the waste heat can be used for hot water supply and air-conditioning, reducing the overall consumption of primary energy.

- In rural areas, '4.1. Area Energy' should be used for assessment.
- The introduction plans should be evaluated by municipalities or development agencies.
  ※ Regarding municipalities, the smallest administrative units (wards, cities) in the target area should be first priority, but units at the higher level (prefectures, districts)could also be considered.
  ※ Development agencies refer to administrative entities or private developers planning to carry out development in a specific area.
- Regarding evaluation rank 1 (★), in cases where human resources such as staff members in charge or specialists are secured with the goal of establishing a system, an equivalent assessment can be obtained, even if a system is not actually established.

※ Prospects indicate that formulation of plans is to be completed within a certain period of time (approximately one to three years).

3-3. Demand & Supply Side

8. Energy Management

8.1. Energy Management of Buildings/Area

Effective management of energy use in the buildings in an area individually and collectively will lead to energy conservation in a sustainable manner while contributing to the creation of a low carbon town.

8.1.1. EMS (BEMS, HEMS, FEMS)

Asses the presence or absence of EMS introduction plans.

★	There are no plans for introduction in place. However a system for introduction has been established.
★★	There are no plans for introduction in place. However a system for introduction has been established and prospects for their introduction are clear.
★★★	There are plans for introduction in place.
★★★★	There are introduction plans which have been implemented.
★★★★★	There are introduction plans which have been implemented. In addition, a subsidy system, etc. for expansion of implementation has been established.

■ Remarks

- EMS (Energy Management System) refers to systems or technologies that enable energy conservation through such means as visualisation of energy consumption, control and monitoring of building and equipment operations and optimised control of renewable energy.
- EMS could be divided into EMS for homes (HEMS), businesses (BEMS) and factories (FEMS) depending on the building use.
- Any and only one of the introduction plans (HEMS, BEMS, FEMS) should be used

evaluation.

- Regarding evaluation rank 1 (★), in cases where human resources such as staff members in charge or specialists are secured with the goal of establishing a system, an equivalent assessment can be obtained, even if a system is not actually established.

※ Prospects indicate that formulation of plans is to be completed within a certain period of time (approximately one to three years).

8.1.2. AEMS (Area Energy Management System)

Asses the presence or absence of AEMS introduction plans.

★	There are no plans for introduction in place. However a system for introduction has been established.
★★	There are no plans for introduction in place. However a system for introduction has been established and prospects for their introduction are clear.
★★★	There are plans for introduction in place.
★★★★	There are introduction plans which have been implemented.
★★★★★	There are introduction plans which have been implemented. In addition, a subsidy system, etc. for expansion of implementation has been established.

■ Remarks

- AEMS (Area Energy Management System) refers to the control and management of area-wide energy supply/demand which takes into account energy conservation and CO_2 emissions of the target area. AEMS enables efficient operations of electricity generation and storage by monitoring and analyzing the energy use status in multiple buildings in the area, climate information, etc.
- The introduction plans should be evaluated by municipalities or development agencies.
  - ※ Regarding municipalities, the smallest administrative units (wards, cities) in the target area should be first priority, but units at the higher level (prefectures, districts) could also be considered.
  - ※ Development agencies include administrative entities and private developers.
- Regarding evaluation rank 1 (★), in cases where human resources such as staff members in charge or specialists are secured with the goal of establishing a system, an equivalent assessment can be obtained, even if a system is not actually established.

※ Prospects indicate that formulation of plans is to be completed within a certain period of time (approximately one to three years).

8.1.3. Smart Micro Grid

Assess the presence or absence of smart micro grid introductions plans in the target area.

★	There are no plans for introduction in place. However a system for introduction has been established.
★★	There are no plans for introduction in place. However a system for introduction has been established and prospects for their introduction are

	clear.
★★★	There are plans for introduction in place.
★★★ ★	There are introduction plans which have been implemented.
★★★ ★★	There are introduction plans which have been implemented. In addition, a subsidy system etc. for expansion of implementation has been established.

■ Remarks

- Smart grid is typically used to describe the desired features of an electric power supply system and its concept varies depending on the economy or area. Generally speaking, it 'seeks to achieve a highly efficient, high quality, highly trusted electricity supply system that integrates and applies the information from multiple distributed electricity sources and users by utilising information communication technology in addition to the conventional integrated operations of a centralized power supply and transmission system'. (source: NEDO Renewable Energy Technology White Paper)
- Micro grid refers to the integration of multiple small distributed electricity sources, electricity storage equipment and electricity users to form a network. Although this integrated network (migro grid) can be operated independently from the central grid, it could be operated in connection with the central grid or other 'micro grids,' A micro grid should be designed, established, and controlled based on the needs of the users. (source: Guidebook for Region-focused Introduction of New Energy, New Energy and Industrial Technology Development Organization)
- Plans by municipalities or development agencies should be assessed. Introduction plans of underlying technologies that may affect energy demand, price fluctuations, etc. within the targeted area should be included in the assessment.
  - ※ Regarding municipalities, the smallest administrative units (wards, cities) in the target area should be first priority, but units at the higher level (prefectures, districts) could also be considered.
  - ※ Development agencies include administrative entities and private developers.
  - ※ Underlying technologies include smart meters, power conditioners, transmission facilities and fuel cells. For untapped energy/renewable energy, refer to 5.1 and 6.1 for assessment, and for EMS, refer to 8.1.1 and 8.1.2. When assessing underlying technology, 'smart meters' and 'relevant control equipment' are targeted.
- Regarding evaluation rank 1 (★), in cases where human resources such as staff members in charge or specialists are secured with the goal of establishing a system, an equivalent assessment can be obtained, even if a system is not actually established.

※ Prospects indicate that formulation of plans is to be completed within a certain period of time (approximately one to three years).

3-4. Environment & Resources

9. Greenery

9.1. Securing Green Space

Although greenery does not contribute directly to lower carbon emissions like renewable energy/untapped energy, it does contribute indirectly by alleviating city climate, reducing air-conditioning energy and the amount of CO_2 emissions. The effect of lower carbon emissions by greenery is as follows.

- ・Creation of cool spots by green shade
- ・Reduced heat island phenomenon by improving ground cover
- ・Creation of wind paths, etc. by the appropriate placement green network, greenery and buildings, etc.

In addition, greenery serves as a CO_2 sink and is an important factor from the standpoint of biomass energy application.

9.1.1. Formation of Green Shade

Assess the ratio of green shade in the targeted area

★	10% or less
★★	10%～25%
★★★	25%～40%
★★★★	40%～60%
★★★★★	60% or more

■ Remarks

・ Green shade refers to shade (shadows) created by trees.

・ The ratio of green shade refers to the percentage of total green shade area out of the total targeted area.

※ In LEED-ND, tree spacing (within 12m) is used as the assessment criteria.
(LEED ND – NEIGHBORHOOD PATTERN AND DESIGN – Tree-Lined and Shaded Streets)

9.1.2. Formation of Greening

Assess efforts to implement greening and efforts in ecosystem conservation of the entire targeted area.

★	The rate of greenery is 20% or less.
★★	The rate of greenery is 20% or less. However, efforts in ecosystem conservation have been made.
★★★	The rate of greenery is 20%～40%
★★★★	The rate of greenery is 20%～40%. However, efforts in ecosystem conservation have been made.
★★★★★	The rate of greenery is 40% or above and efforts in ecosystem conservation have also been made.

■ Remarks

- The ratio of greenery refers to the percentage of area of greenery for the total targeted area.
- That is, (Area of greenery + Area of water surface)/Total Area. (Excerpt from CASBEE).
- Targeted greenery is as follows.
  - Lawn
  - Flowerbeds
  - Trees
  - Rooftop greening/Wall area greening
  - Water streams, ponds etc.
- Efforts toward ecosystem conservation refers to the maintenance of habitat for various creatures such as biotopes, sanctuaries, etc. And the identification and maintenance of important wild creatures and their habitat, such as swamps and water areas or plans to do so.

※ For ratios, refer to CASBEE. When implementing a trial, adjustments are made as needed. (CASBEE for Urban Development – 1.2.1 Greenery)

10. Water Management

10.1. Water Resources

Assess the reduction of energy etc. achieved by water resource circulation and reprocessing of drainage.

10.1.1. Water Usage

Assess the presence or absence of efforts to reduce water usage in buildings.

★	Efforts are not made. However, a system for their formulation has been established.
★★	Efforts are not made. However, a system for their formulation has been made, and prospects for their formulation are clear.
★★★	Efforts are being made.
★★★★	Efforts are being made and actual reduction goals and fiscal year accomplishments are shown.
★★★★★	Efforts are being made and actual reduction goals and fiscal year accomplishments are shown. In addition, a subsidy system etc. for introduction of equipment is in place.

■ Remarks

- Assess efforts to save or reduce water usage.
- Regarding efforts, plans by municipalities or development agencies are targeted.

※ Regarding local governments, priority is given to the smallest administrative district (ward or town). However, assessment targets include efforts at the prefecture level.

※ Development agencies include administrative and private developers.

※ Refer to CASBEE. (CASBEE for Urban Development – 1.1.1 Water Resource)

10.1.2. Water Reuse

For water reuse, assess both ‘rainwater use’ and ‘use of recycled waste water’.

1) Assess the presence or absence of rainwater use.

★	Rainwater is not used. However, a system has been formulated for rainwater use.
★★	Rainwater is not used. However, a system has been formulated for rainwater use and prospects for its use are clear.
★★★	Rainwater is used.
★★★★	—
★★★★★	Rainwater is used and goals for its actual use ratio, etc. have been established.

■ Remarks

・ Assess the presence or absence of rainwater use and goals in each building and developments to a certain degree.

・ Regarding goals, plans by municipalities or development agencies are targeted.

※ Regarding local governments, priority is given to the smallest administrative district (ward or town). However, assessment targets include efforts at the prefecture level.

※ Development agencies include administrative or private developers.

・ As for evaluation rank 1 (★), even if the system has not actually constructed yet, the same level evaluation can be obtained as long as they have secured personnel such as officials in charge and experts with constructing the system in view.

※ Prospects indicate that formulation of plans will be completed within a certain period of time (approx. one to three years).

※ Refer to CASBEE. (CASBEE also assesses the ratio of rainwater use.)
(CASBEE for Urban Development – 1.1.1 Water Resource)

2) Assess the presence or absence of recycled wastewater use.

★	Recycled wastewater is not used. However, a system has been formulated for the use of recycled waste water.
★★	Recycled waste water is not used. However, a system has been formulated for the use of recycled wastewater and prospects of its use are clear.
★★★	Recycled waste water is used in some facilities.
★★★★	Recycled waste water is used in over half of facilities.
★★★★★	Recycled waste water is used in over half of facilities and promotive measures such as subsidy system to expand its use are in place.

■ Remarks

・ Assess the presence or absence of the introduction and use of joint recycled wastewater facilities or the use of ‘reclaimed water’ or ‘recycled wastewater’ from a common infrastructure in the target area.

※ Regarding local governments, priority is given to the smallest administrative district (ward or town). However, assessment targets include efforts at the prefecture level.

※ Development agencies include administrative or private developers.

・ As for evaluation rank 1 (★), even if the system has not actually constructed yet, the same level evaluation can be obtained as long as they have secured personnel such as officials in charge and experts with constructing the system in view.

※ Prospects indicate that formulation of plans will be completed within a certain period of time (approx. one to three years).
※ Refer to CASBEE. (Three point scale in CASBEE). (CASBEE for Urban Development – 1.1.1 Water Resource)

11. Waste Management

11.1. Waste products

Assess the reduction of waste products and promotion of recycling.

11.1.1. Reduction of waste products

Assess the presence or absence of goals to reduce the production of waste.

★	There are no actual reduction amount/goals. However, a system for the reduction of waste products has been formulated and goals have been set.
★★	There are no actual reduction amount and goals. However, a system for the reduction of waste products has been formulated and goals have been set up, and prospects for their formulation are clear.
★★★	An actual reduction amount and goals have been established.
★★★★	—
★★★★★	An actual reduction amount and goals have been established and various efforts to achieve the goals have been made.

■ Remarks

・Regarding the total amount of waste products (home/business/commerce/industry) produced in the target area assess the actual amount of reduction and goals over the long term, including the current situation.

・ Regarding the amount of reduction and goals, evaluate the plans by municipalities or development agencies.

※ Regarding municipalities, the smallest administrative districts (wards, cities) in the target area are priority, but systems at the prefectural level are also targeted.

※ Development agencies refer to administrative or private developers planning to carry out development in a specific area.

・ Regarding evaluation rank 1 (★), in cases where human resources such as staff members in charge or specialists are secured with the goal of establishing a system, an equivalent assessment can be obtained, even if a system is not actually established.

※ Prospects indicate that formulation of plans is to be completed within a certain period of time (approx. one to three years).

11.1.2. Reuse of waste products

Assess the criteria for garbage separation.

★	Separation is not performed. However, a system has been established for the development of a separation plan.
★★	Separation is not performed. However, a system has been established for the development of a separation plan and the prospects for development are clear.

★★★	Separation is performed.
★★★★	—
★★★★★	Separation is performed and various efforts to promote and improve separation are being made.

■ Remarks

・Regarding garbage separation, the more detailed it is, the higher the recycling ratio of resources and less energy is necessary for garbage incineration.

・ Since the type of garbage separation varies by each economy, assess whether separation is carried out or not.

・ For garbage separation, evaluate plans by municipalities or development agencies.

※ Regarding municipalities, the smallest administrative districts (wards, cities) in the target area are priority, but systems at the prefectural level are also targeted.

※ Development agencies include administrative or private developers etc.

・ Regarding evaluation rank 1 (★), in cases where human resources such as staff members in charge or specialists are secured with the goal of establishing a system, an equivalent assessment can be obtained, even if a system is not actually established.

※ Prospects indicate that formulation of plans is to be completed within a certain period of time (approx. one to three years).

12. Pollution

12.1. Air

Assess efforts to control air pollution and to reduce energy consumption required for air pollution countermeasures.

12.1.1. Air Pollution

Assess the presence or absence of efforts to prevent air pollution.

★	Efforts are not been made. However, a system for their formulation has been established.
★★	Efforts are not been made. However, a system for their formulation has been established and prospects for their establishment are clear.
★★★	Efforts are being made.
★★★★	Efforts are being made and smoke facilities are regularly checked and guidance provided.
★★★★★	Efforts are being made and smoke facilities are regularly checked and directions have been provided. Furthermore, specific goals, such as the amount of reduction of smoke substances, have been established.

■ Remarks

・ Facilities that release or spread air pollutants (by smoke) in municipalities within the targeted area are targeted. Assess the types of air pollutants and whether an emissions standard has been set for each facility.

※ Regarding municipalities, the smallest administrative districts (wards, cities) in the target area are priority, but systems at the prefectural level are also targeted.

・ Regarding evaluation rank 1 (★), in cases where human resources such as staff members in charge or specialists are secured with the goal of establishing a system, an equivalent assessment can be obtained, even if a system is not actually established.

※ Prospects indicate that formulation of plans is to be completed within a certain period of time (approx. one to three years).

12.2. Water Quality

Assess efforts to control water pollution and to reduce energy consumption required for water pollution countermeasures

12.2.1. Water Pollution

Assess the presence or absence of efforts to prevent water pollution.

★	Efforts are not made. However, a system for their formulation has been established.
★★	Efforts are not made. However, a system for their formulation has been made, and prospects for their formulation are clear.
★★★	Efforts are being made.
★★★★	Efforts are being made and regular checks and direction are provided to areas and facilities where water pollution is expected.
★★★★★	Efforts are being made and regular checks and direction have been provided to the area and facilities where water pollution is expected. Furthermore, actual goals to prevent water pollution have been established.

■ Remarks

・ Assess the environmental criteria regarding water pollution for public water areas in the municipality of the targeted area.

※ Regarding municipalities, the smallest administrative districts (wards, cities) in the target area are priority, but systems at the prefectural level are also targeted.

・ Regarding evaluation rank 1 (★), in cases where human resources such as staff members in charge or specialists are secured with the goal of establishing a system, an equivalent assessment can be obtained, even if a system is not actually established.

※ Prospects indicate that formulation of plans is to be completed within a certain period of time (approx. one to three years).

※ Regarding standard values, use the standard value set by each economy for assessment.

12.3. Soil

Assess efforts to control soil contamination and to reduce energy consumption required for soil contamination countermeasures.

12.3.1. Soil contamination

Assess the presence or absence of efforts to prevent soil contamination.

★	Efforts are not been made. However, a system for their formulation has been established.
★★	Efforts are not been made. However, a system for their formulation

	has been established and prospects for their establishment are clear.
★★★	Efforts are being made.
★★★★	Efforts are being made and are regularly checked and directions have been provided to the area and facilities where soil contamination is expected.
★★★★★	Efforts are being made and are regularly checked and directions have been provided to the area and facilities where soil contamination is expected. Furthermore, actual goals to prevent soil contamination have been established.

■ Remarks

・ Assess the investigations to grasp the condition and standard for judgment of soil contamination in municipalities where evaluation targeted area is located. In addition, assess the information disclosure in the case of going beyond the criteria and efforts to treat soil contamination such as soil improvements.

※ Regarding municipalities, the smallest administrative districts (wards, cities) in the target area are priority, but systems at the prefectural level are also targeted.

・ Regarding evaluation rank 1 (★), in cases where human resources such as staff members in charge or specialists are secured with the goal of establishing a system, an equivalent assessment can be obtained, even if a system is not actually established.

※ Prospects indicate that formulation of plans is to be completed within a certain period of time (approx. one to three years).

3-5. Governance

13. Policy Framework

13.1. Efforts toward a Low carbon town

Assess the various efforts and systems to create a low carbon town.

13.1.1. Policies/Business Plans to create a Low carbon town

Assess policies, plans and goal related to the creation of a low carbon town.

★	There are no policies, plans or goals. However, a system for their formulation has been established.
★★	There are no policies, plans or goals. However, a system for their formulation has been established, and prospects of developing plans and goals are clear.
★★★	There are policies, plans and goals.
★★★★	There are policies, plans and goals. Furthermore, there are cooperation between national and sub-national governments.
★★★★★	There are policies, plans and goals and actual efforts to carry out the plans and achieve the goals have been made.

■ Remarks

・ Assess efforts that consider a low carbon town in municipalities or development agencies in the targeted area.

※ Regarding municipalities, the smallest administrative districts (wards, cities) in the target area are priority, but systems at the prefectural level are also targeted.

※ Development agencies include administrative or private developers, etc.

・ Regarding efforts, the following items should be considered.

- Assistance in creating a low carbon town guidebook
- Creation of an approximation method of CO_2 emissions
- Countermeasures against global warming
- Support for development of policies related to a low carbon town
    - Creation of educational programs and systems for practices and awareness that promote a low carbon town
    - Campaign to broaden efforts toward a low carbon town, etc.

※ Educational system refers to matters which contribute to a low carbon town through educational activities, such as contributing to the reduction of CO_2 by eco-driving.

・ Regarding evaluation rank 1 (★), in cases where human resources such as staff members in charge or specialists are secured with the goal of establishing a system, an equivalent assessment can be obtained, even if a system is not actually established.

※ Prospects indicate that formulation of plans is to be completed within a certain period of time (approx. one to three years).

13.1.2. Budget for Policies/Business Plans to create a Low Carbon Town

Assess various business budgets related to the creation of a low carbon town

★	Budgets have not been secured. However, a system has been established for the development of policies, plans and goals.
★★	—
★★★	Budgets have been secured.
★★★★	—
★★★★★	Budgets have been secured and efforts such as newsletters have been performed to promote wider use.

■ Remarks

・ Assess the securement of a budget developed and planned by municipalities or development agencies in the target area for various efforts to achieve related to a low carbon town.

※ Regarding municipalities, the smallest administrative districts (wards, cities) in the target area are priority, but systems at the prefectural level are also targeted.

※ Development agencies include administrative or private developers etc.

・ Regarding evaluation rank 1 (★), assess according to '13.1.1 Policy for Lower Carbon/Project Plan'.

※ Prospects indicate that formulation of plans is to be completed within a certain period of time (approx. one to three years).

13.2. Efforts toward sustainability

By implementing development which is less affected by natural disasters, blackouts, etc. safety is ensured and environment consideration achieved.

13.2.1. B/LCP Plan

Assess the daily life, business continuation plan and establishment situation in case of disaster etc.

★	There are no plans. However, a system for their formulation has been established.
★★	There are no plans. However, a system for their formulation has been established and prospects for their development are clear.
★★★	There are plans.
★★★★	There are plans which have been established in some parts of the area.
★★★★★	There are plans which have been established in more than half of the area.

■ Remarks

・ Assess the presence or absence of development of plans and the establishment situation regarding LCP ad BCP by municipalities or development agencies in the targeted area.

※ Regarding municipalities, the smallest administrative districts (wards, cities) in the target area are priority, but systems at the prefectural level are also targeted.

※ Development agencies include administrative or private developers etc.

・ The establishment situation of LCP・BCP shall follow the criteria set by each economy.

・ Regarding evaluation rank 1 (★), in cases where human resources such as staff members in charge or specialists are secured with the goal of establishing a system, an equivalent assessment can be obtained, even if a system is not actually established.

※ Prospects indicate that formulation of plans is to be completed within a certain period of time (approx. one to three years).

13.2.2. Developments with Less Influence

Assess regulations which consider geographical characteristics and changes, etc.

★	There are no regulations. However, a system for their formulation has been established.
★★	—
★★★	There are regulations.
★★★★	There are regulations, and development based on the regulations is underway.
★★★★★	There are regulations, and development based on the regulations has been completed.

■ Remarks

・ Artificial change of the natural geography refers to cases where continuous geography becomes discontinuous space due to development, such as placement of retaining walls.

・ Regulations are, for example, conservation of the natural geography etc. by development activities.

・ Regarding efforts such as regulations, plans by the municipalities or development agencies are assessed.

※ Regarding municipalities, the smallest administrative districts (wards, cities) in the target area are priority, but systems at the prefectural level are also targeted.

※ Development agencies refer to administrative or private developers etc.

・ Regarding evaluation rank 3 (★★★), in cases where human resources such as staff members in charge or specialists are secured with the goal of establishing a system, an equivalent assessment can be obtained, even if a system is not actually established.

※ Prospects indicate that formulation of plans is to be completed within a certain period of time (approx. one to three years).

14. Education & Management

14.1. Life cycle management

Assess efforts such as enlightenment and education for energy-savings and a low carbon town.

14.1.1. Enlightenment and education for energy-savings and a low carbon town

Assess efforts in educational activities, enlightenment and education targeting students and local residents.

★	No efforts are being made. However, a system for their formulation has been established.
★★	No efforts are being made. However, a system for their formulation has been established and prospects for their establishment are clear.
★★★	Efforts are being made.
★★★★	—
★★★★★	Efforts are being made and plans/pledges by implementation agencies, budgets etc. for continuous management have been established.

■ Remarks

・ Enlightenment and education, such as training etc. to assist each member of society to become aware of the importance of energy-savings, and carry out environmental conservation activities for energy-savings and lower carbon activities in daily life and business, are assessed.

・All activities which contribute to lower carbon use are targeted, such as turning off unnecessary lights, reduction of standby electricity consumption (unplug), education in eco-driving targeting drivers etc.

・ Formulation of efforts and budget securement by municipalities or development agencies are targeted.

※ Regarding municipalities, the smallest administrative districts (wards, cities) in the target area are priority, but systems at the prefectural level are also targeted.

※ Development agencies refer to administrative or private developers etc.

・ Agencies carrying out enlightenment and education shall target government, development agencies, community associations, area management organisations, private enterprises etc.

※ Area management organisations refer to town assemblies, merchants' associations and other community associations, etc.

・ Regarding evaluation rank 1 (★), in cases where human resources such as staff members in charge or specialists are secured with the goal of establishing a system, an equivalent assessment can be obtained, even if a system is not actually established.

※ Prospects indicate that formulation of plans is to be completed within a certain period of time (approx. one to three years).

14.1.2. Area Management toward an Energy-saving and Low Carbon Town

Assess community associations and area management organisations.

★	There are no community associations or area management

	organisations in the area. However a system has been established for the formulation of such organisations.
★★	There are no community associations or area management organisations in the area. However a system has been established for the formulation of such organisations and prospects for their establishment are clear.
★★★	There are some community associations or area management organisations in the area.
★★★★	There are some community associations or area management organisations in the area and plans/pledge such as promotion agencies for continuous administration and funds have been established.
★★★★★	There are some community associations or area management organisations in the area and cooperative systems such as regional community organisations around the area are established or planned.

■ Remarks

・ Community associations and area management organisations refer to town assemblies, coalition town meetings, merchant associations and other community associations etc., and the organiser can be residents, enterprises or governments.

・ As actual examples of 'plans/pledge for continuous administration and funds,' officials/expert members are selected and their terms of office have been set for continuous activities, conferences have been established and are regularly held, regulations have been set, appropriate account dealings have been made such as budget decision through voting by the entire committee, etc.

・ Furthermore, cooperative systems such as regional community organisations around the area shall include, for example, networks which have been made with other area management organisations outside the area including community associations, with awareness of the direction of the entire area, as an effort to a low carbon town, global environmental problems, BCP/ LDP.

・ Regarding evaluation rank 1 (★), in cases where human resources such as staff members in charge or specialists are secured with the goal of establishing a system, an equivalent assessment can be obtained, even if a system is not actually established.

※ Prospects indicate that formulation of plans is to be completed within a certain period of time (approx. one to three years).

※ Refer to CASBEE for the above description. (excerpt).
(CASBEE for Urban Development – 2.1.2 Area management)

4. Calculation Method of the Amount of CO2 Emissions

Regarding efforts to create a low carbon town, quantitatively assess CO_2 emissions.
The calculation method is according to the calculation criteria of each economy, but for economies which do not have a regulated calculation method, the following guideline can be used as an example.

・Using the guideline regulated by Intergovernmental Panel on Climate Change (IPCC)
http://www.ipcc-nggip.iges.or.jp/public/gl/invs1.html

Reference: Simplified Assessment Method for economies which do not have an assessment method
The following method is a simplified calculation method. Since this is an abbreviated calculation, it is only recommended for tentative use.

Chart: Calculation Example of CO_2 Assessment

CO_2 Assessment Calculation Example (based on the Low Carbon City Development Guidance, Ministry of Land, Infrastructure, Transport and Tourism)

Category	Assessment Target and Calculation Method
Industry Civil	CO_2 emissions from energy consumption associated with production activities in the manufacturing, agriculture/forestry/fisheries, mining, and construction industries.

CO_2 Emission= (Total floor area of buildings by use) × (CO_2 emission intensity of buildings by use)× (1- Overall CO_2 reduction rate)

Table: Setting of an annual CO_2 emission basic unit by building use

Building Use		Number of materials	Primary energy consumption	Primary energy component ratio (%) by energy type			CO_2 emission basic unit	Converted basic unit
		2003	MJ/m^2/year	Electricity	Gas	Other	kg-CO_2/m^2/year	kg-CO_2/MJ
Office	(Office)	558	1,936	87	11	1	108.98	0.0563
School		28	1,209	87	9	3	68.53	0.0567
Retail Store	(Department store, supermarket)	20	3,225	92	7	1	182.28	0.0565
Restaurant	(Department store)	28	2,923	89	10	1	164.57	0.0563
Meeting Place	(Office)	188	2,212	80	14	6	125.46	0.0567
Hospital	(Hospital)	45	2,399	67	15	18	139.15	0.0580
Hotel	(Hotel)	50	2,918	66	19	15	167.47	0.0574
Detached Housing	(Residence)						36.0	
Housing Complex	(Residence)						29.5	

Note: Terms in parentheses indicate building categories that were used in (3) (2): Ratio of energy consumer by use.
Source: CO_2 emission basic units related to the following are used: (other than housing) Comprehensive Assessment System for Built Environment Efficiency (CASBEE for New Construction, 2008 edition) (housing) CASBEE for Home (Detached House) and CASBEE for New Construction (Housing Complex)

Source: Low Carbon City Development Guidance (Materials)

Transport

■ Method to use Person Trip Survey data
<CO_2 emissions from automobiles and busses>

CO_2 emission = Traffic volume × Distance traveled × Emission intensity

Average traveling speed	CO_2 Emission Basic Unit (g-CO_2/km/car)

(km/h)	Small Vehicle (passenger car and small freight car)	Large Vehicle (regular freight car and bus)
5	547	2,110
10	342	1,515
15	269	1,277
20	229	1,133
25	204	1,042
30	186	963
35	172	894
40	161	836
45	152	788
50	146	750
55	141	723
60	138	706
65	137	700
70	137	705
75	139	719
80	142	744
85	146	780
90	152	826

Source: Low Carbon City Development Guidance (Materials), Administrative Circular on the "Method for calculating quantitative assessment indicators among objective assessment indicators" (November 25, 2003), Ministry of Land, Infrastructure, Transport and Tourism

< CO_2 Emissions from Railroad>

CO_2 Emissions (g) = Σ (Railroad OD traffic volume (person) x distance between OD (km) x CO_2 emission basic unit (g/person/km)

(Reference) Emission basic unit: 28 g-CO_2/person/km (A list of emission coefficients in the Directory of transportation-related energy and in the Order for Enforcement of the Act on Promotion of Global Warming Countermeasures, Article 3 (partially amended on March 24, 2006))

■ Method to use Road Traffic Census data

CO_2 Emissions (g) = Σ CO_2 emissions by OD (g) = Σ (Σ (OD traffic volume by vehicle type (vehicle) x distance been OD (km) x CO_2 emission basic unit by vehicle type (g/vehicle/km))

(Reference) CO_2 emissions are estimated from fuel consumption:

CO_2 Emissions (tCO_2) = Fuel consumption (kl) x 1,000 x calorific value (MJ/l) ÷ 1,000,000 x carbon emission coefficient (tC/TJ) x 44/12

(Reference) Carbon emission coefficient

Type	Calorific Value	Emission Coefficient	CO_2 Emission
Gasoline	34.6 (GJ/kl)	0.0183 (tC/GJ)	2.32 (tCO_2/kl)
Light Oil	37.7 (GJ/kl)	0.0187 (tC/GJ)	2.58 (tCO_2/kl)

Source: Calculation methods and a list of emission coefficients in calculation, reporting, and

	publication system (after amendment in March, 2010) (Ministry of the Environment)
Absorption	■ CO_2 absorption by forests CO_2 Absorption (tCO_2) = Forest area x basic absorption unit (Reference) Basic absorption unit: 2.92 (tCO_2/year/ha). Source: National Greenhouse Gas Inventory Report of Japan 2010, National Institute for Environmental Studies ■ Support for CO_2 emission control in other regions (emissions trading and others) Post the amount purchased.

Source: Quoted from CASBEE for Cities (2012), Low Carbon City Guidance: Materials, and the Concept of the Low-Carbon Town in the APEC Region Second Edition October, 2012

References

Examples of Trials

1. Evaluation Sheet

① How to use the sheet

How to use this file

★input1 sheet
・Input an abstract of your town in the "Abstract of your town" section
・Select the type that best fits your town in the Type of Town section
・Peste your town map or image (future) plan

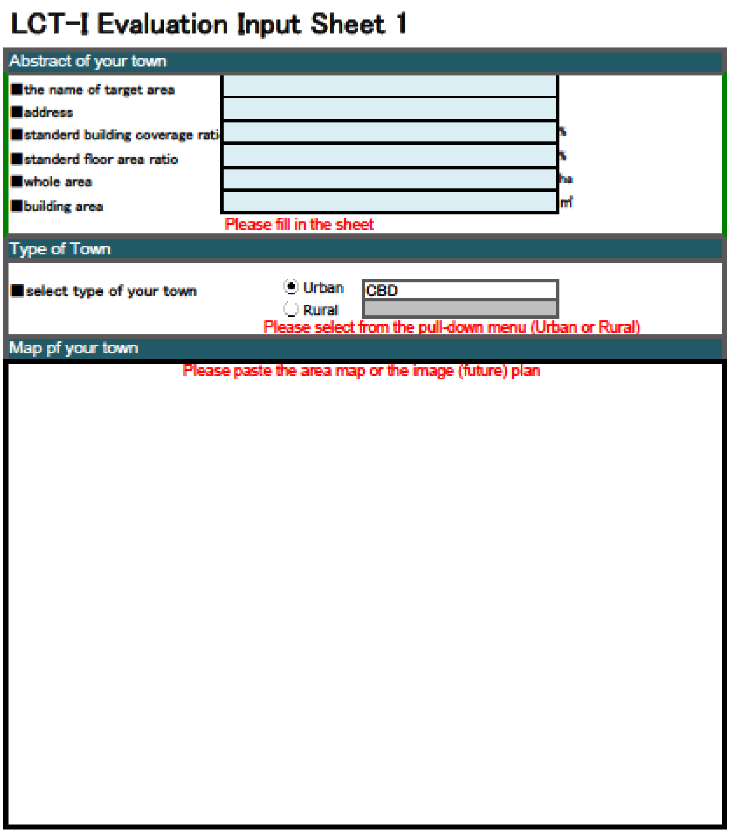
★input2 sheet
・In accordance with APEC Low Carbon Town Indicators (LCT-I) Guidelines, please select the applicable evaluation level for each item. Select the level using the pull-down list of each blue cell.
・Some items may not be applicable or no data may be available for an item. In such cases, select "-".
・There are comment boxes for each evaluation index. Please give us your unreserved comments for

☆output(abstract)
・The evaluation results are indicated using ★ marks, numbers, and radar charts.
・You can see the evaluation results for each TIER2.
・CO_2 should be input directly. If it has been calculated in the past, please use that figure.
・If calculation results are used, please include the calculation year and the basis for the calculation or the name of the organization who performed the calculation.

☆output(detail)
・The evaluation results for each TIER3 are shown in a list.
・You can see the details of the level of each evaluaiton item.

★questionnaire
・We prepared a questionnaire regarding LCT-I overall. In order to develop this LCT-I further so that it is utilized in APEC economies, we would like to hear your straightforward opinions. Please answer

② Input sheet


LCT-I Evaluation Input Sheet 1

Abstract of your town

■the name of target area
■address
■standerd building coverage rati %
■standerd floor area ratio %
■whole area ha
■building area ㎡

Please fill in the sheet

Type of Town

■select type of your town ◉ Urban ○ Rural CBD

Please select from the pull-down menu (Urban or Rural)

Map pf your town

Please paste the area map or the image (future) plan

LCT-I Evaluation Input Sheet 2

Please select from the pull-down menu (blue cell) and fill in your comments in the comments cell (green cell)

Demand Side

1. Town Structure
1.1. Adjacent Workplace and Residence
1.1.1. Residential Use and Non-residential Use

★	
★	15% or less
★★	-
★★★	15% to 30%
★★★★	-
★★★★★	30% or more

1.2. Land Use
1.2.1. Efficient Land Use

★	
★	30% or less is used
★★	30% to 50% is used
★★★	50% to 90% is used
★★★★	90% or more is used
★★★★★	Floor area ratio exceeds the standard floor area ratio by applying a system/method. 90% or more of the standard floor area ratio is used, and a system/method for n

1.3. TOD (Transit Oriented Development)
1.3.1. City Development Centered on Public Transportation

★	
★	There are no upper-level plans. However, a system for their formulation has been established
★★	There are no upper-level plans. However, a system for their formulation has been established, and prospects for their formulation are clear
★★★	There are upper-level plans.
★★★★	Projects are in place based on upper-level plans
★★★★★	Projects are in place based on upper-level plans, and a system/method to disseminate the plans has been established

2. Buildings
2.1. Energy Saving Construction
2.1.1. Thermal Insulation Performance

★★★★★	
★	There are no systems or criteria in place. However, a system for their formulation has been established.
★★	There are no systems or criteria in place. However, a system for their formulation has been established, and prospects for their formulation are clear.
★★★	There are systems and criteria in place.
★★★★	There are systems and criteria in place, which have been implemented.
★★★★★	There are systems and criteria in place, which have been implemented. In addition, there are subsidy systems and incentive systems to accelerate implementation, or have legal binding force.

2.1.2. Energy Saving Equipment Performance

★★★★★	
★	There are no systems or criteria in place. However, a system for their formulation has been established.
★★	There are no systems or criteria in place. However, a system for their formulation has been established, and prospects for their formulation are clear.
★★★	There are systems and criteria in place.
★★★★	There are systems and criteria in place, which have been implemented.
★★★★★	There are systems and criteria in place, which have been implemented. In addition, there are subsidy systems and incentive systems to accelerate implementation, or have legal binding forces.

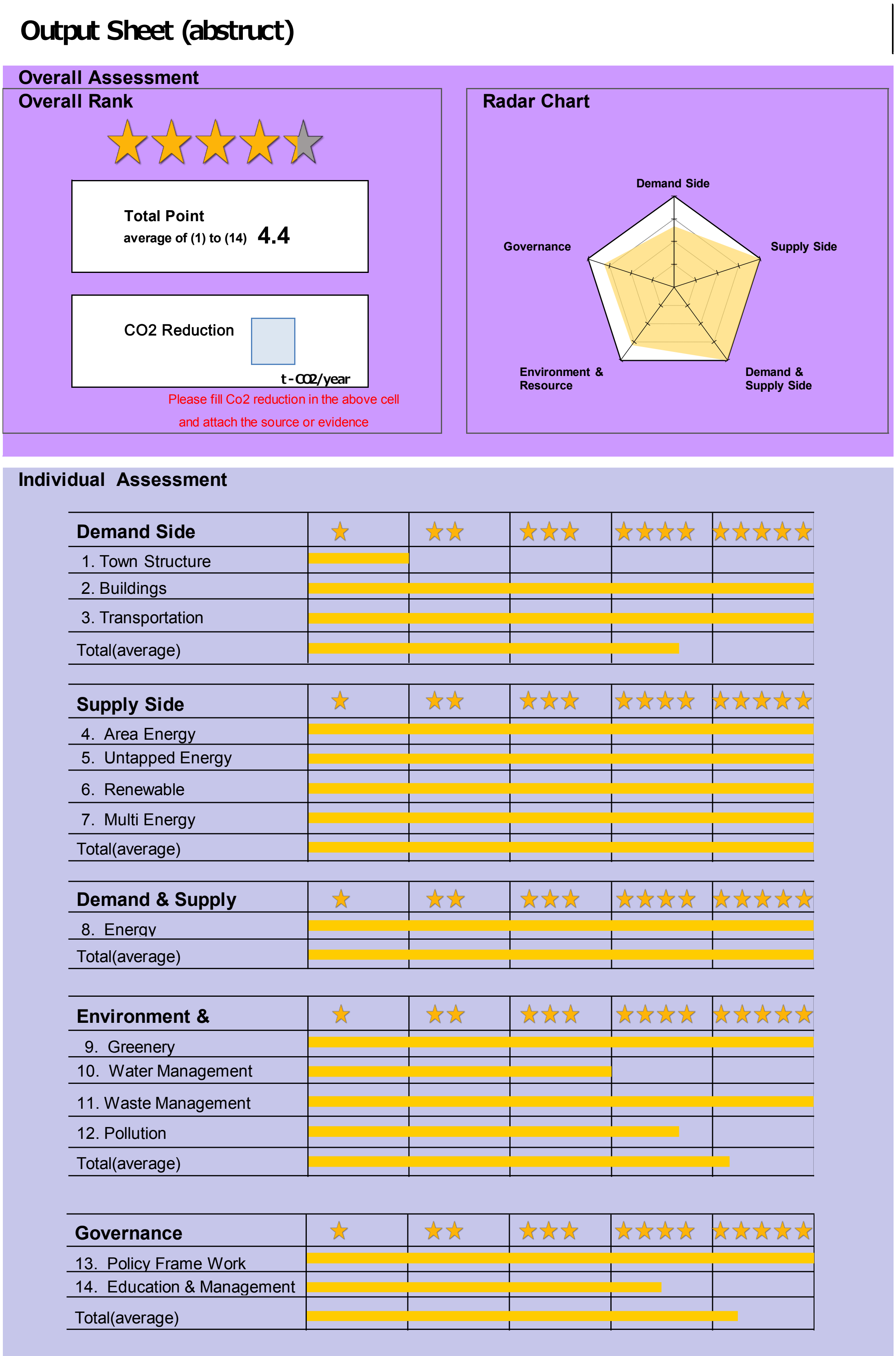
2.1.3. Natural Energy

★★★★★	
★	There are no systems or criteria in place. However, a system for their formulation has been established.
★★	There are no systems or criteria in place. However, a system for their formulation has been established, and prospects for their formulation are clear.
★★★	There are systems and criteria in place.
★★★★	There are systems and criteria in place, which have been implemented.
★★★★★	There are systems and criteria in place, which have been implemented. In addition, there are subsidy systems and incentive systems to accelerate implementation, or have legal binding force.

2.2. Green Construction
2.2.1. Green Construction Guidelines

★★★★★	
★	There are no guidelines in place. However, systems for their formulation have been established.
★★	There are no guidelines in place. However, systems for their formulation have been established, and prospects for their formulation are clear.
★★★	There are guidelines in place.
★★★★	There are guidelines which have been implemented.
★★★★★	There are guidelines which been implemented. In addition, subsidy and incentive systems to disseminate the guidelines have been established.

③ Output sheet (image)



Output Sheet (datail)

Special Economic Zone (SEZ) Bitung, Indonesia

evaluation sheet						
				★★★★		4.4
Demand Side				★★★		3.7
1. Town Structure			-	★		1.0
	1.1. Adjacent Workplace and Residence		-			
		1. Residential Use and Non-residential Use	★		1	
	1.2. Land Use		-			
		1. Efficient Land Use	★		1	
	1.3. TOD (Transit Oriented Development)		-			
		1. City Development Centered on Public Transportation	★		1	
2. Buildings			-	★★★★★		5.0
	2.1. Energy Saving Construction		-			
		1. Thermal Insulation Performance	★★★★★		5	
		2. Energy Saving Equipment Performance	★★★★★		5	
		3. Natural Energy	★★★★★		5	
	2.2. Green Construction		-			
		1. Green Construction Guidelines	★★★★★		5	
3. Transportation			-	★★★★★		5.0
	3.1. Promotion of Public Transportation		-			
		1. Easy-to-Use Public Transportation	★★★★★		5	
		2. Comprehensive Transportation Measures	★★★★★		5	
	3.2. Improvement in Traffic Flow		-			
		1. TDM (Transportation Demand and Management)	★★★★★		5	
		2. Transportation Infrastructure Planning	★★★★★		5	
	3.3. Introduction of Low Carbon Vehicles		-			
		1. Introduction of Low Carbon Vehicles	★★★★★		5	
	3.4. Promotion of Efficient Use		-			
		1. Support for eco-driving	★★★★★		5	
Supply Side				★★★★★		5.0
4. Area Energy System			-	★★★★★		5.0
	4.1. Area Energy		-			
		1. Introduction of Area Energy	★★★★★		5	
5. Untapped Energy			-	★★★★★		5.0
	5.1. Untapped Energy		-			
		1. Introduction of Renewable Energy	★★★★★		5	
6. Renewable Energy			-	★★★★★		5.0
	6.1. Renewable Energy		-			
		1. Introduction of Renewable Energy	★★★★★		5	
7. Multi Energy System			-	★★★★★		5.0
	7.1. Multi Energy		-			
		1. Introduction of a Multi Energy system	★★★★★		5	
Demand & Supply Side				★★★★★		5.0
8. Energy Management			-	★★★★★		5.0
	8.1. Energy Management of Buildings/Area		-			
		1. Energy Management of Buildings/Area	★★★★★		5	
		2. AEMS (Area Energy Management System)	★★★★★		5	
		3. Smart Micro Grid	★★★★★		5	
Environment & Resource				★★★★		4.2
9. Greenery			-	★★★★★		5.0
	9.1. Securing Green Space		-			
		1. Formation of Green Shade	★★★★★		5	
		2. Formation of Greening	★★★★★		5	
10. Water Management			-	★★★		3.0
	10.1. Water Resources		-			
		1. Water Usage	★★★★★		5	
		2. Water Reuse	★		1	
11. Waste Management			-	★★★★★		5.0
	11.1. Waste products		-			
		1. Reduction of waste products	★★★★★		5	
		2. Reuse of waste products	★★★★★		5	
12. Pollution			-	★★★		3.7
	12.1. Air		-			
		1. Air Pollution	★		1	
	12.2. Water Quality		-			
		1. Water Pollution	★★★★★		5	
	12.3. Soil		-			
		1. Soil contamination	★★★★★		5	

④ Questionnaire sheet

questionnaire

1) Do you understand the purpose of LCT-I?

◉ Yes ○ No

2) Do you agree that the evaluation method (5 levels) is suitable?

○ Strongly agree ○ Agree ◉ Neutral ○ Disagree ○ Strongly disagree

If you have any other comments, please fill them in.

3) Do you agree that the evaluation target fields for TIER1 are suitable?

○ Strongly ○ Agree ○ Neutral ○ Disagree ○ Strongly disagree

If you have any other comments, please fill them in.

4) Do you agree that the evaluation target fields for TIER2 are suitable?

○ Strongly ○ Agree ○ Neutral ○ Disagree ○ Strongly disagree

If you have any other comments, please fill them in.

5) Do you agree that the TIER3 evaluation contents are suitable?

○ Strongly ○ Agree ○ Neutral ○ Disagree ○ Strongly disagree

If you have any other comments, please fill them in.

6) Do you agree that the number of TIER3 evaluation items is sutiable?

○ Strongly ○ Agree ○ Neutral ○ Disagree ○ Strongly disagree

If you have any other comments, please fill them in.

7) Are there some TIER3 evaluation items which are difficult? (If so, please list each one and why it is difficult.)

○ Yes (List each specific evaluation item and reason)

○ No

8) Are there evaluation indexes or guidelines currently being used in your country? (If so, please provide the specific name of each one and if possible attach the data when you respond to this questionnaire.)

○ Yes (List each specific evaluation item and reason)

○ No

9) Are there CO_2 calculation guidelines currently being used in your country? (If so, please provide the specific name of each one and if possible attach the data when you respond to this questionnaire.)

○ Yes (List each specific evaluation item and reason)

○ No

10) What are the advantages and disadvantages of using LCT-I?

11) How can LCT-I be used to help your town become more of an LCT? (For example, creating an awards system, creating a judgement system for giving preferential loan treatment, publishing it on the APEC homepage, or any other specific actitivities that you can think of.)

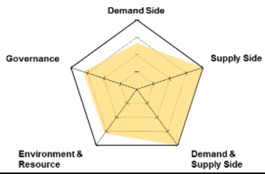
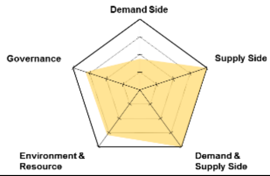
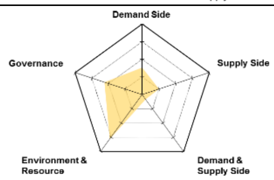
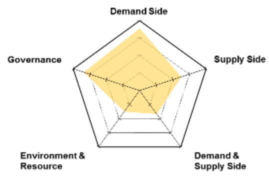
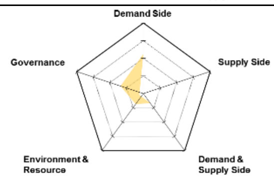
12) If you have any other comments or suggestions regarding LCT, please give them here.

2. The result of Trial

1) Overall result (as of December 1, 2015)

① Trial town

Economy	Town	Area	Type of Town
Indonesia	Bitung	534ha	Urban(Commercial Oriented Town)
Indonesia	South Jakarta	10,000ha	Urban(Residential Oriented Town)
Peru	San Borja	1,000ha	Urban(Residential Oriented Town)
China	Yujiapu	464ha	Urban(CBD)
Vietnam	Danang	3911.78ha	Urban(CBD)

Economy	Town	Overall rank*	Radar Chart
Indonesia	Bitung	4.4	
Indonesia	South Jakarta	4.2	
Peru	San Borja	2.9	
China	Yujiapu	3.5	
Vietnam	Danang	1.9	

These numbers are merely the results of a trial, and do not have any effect on efforts regarding APEC or the individual economies. In addition, these numbers are not for comparison with other economies.

② Comments by trial town

Demand Side	
1.Town Structure	
1.1 Adjacent Workplace and Residence	
1.1.1 Residential Use and Non-residential Use	
Bitung	The area is relatively greenfield development for industrial activities used
South Jakarta	-
San Borja	San Borja district is mostly residential
Yujiapu	building area : 9713500.4m2 residential area : 2317966m2
Danang	-
1.2 Land Use	
1.2.1 Efficient Land Use	
Bitung	The area is mostly coconut plantation area.
South Jakarta	-
San Borja	Approximately 80% is built within the district area.
Yujiapu	As at the construction stage, the overall floor area ratio is unknown, five point scale is given temporarily.
Danang	-
1.3 TOD	
1.3.1 City Development Centered on Public Transportation	
Bitung	There is a system of public transportation established by local government, and run by private sector.
South Jakarta	-
San Borja	-
Yujiapu	-
Danang	BRT (Bus rapid transit) project's implementing.
2. Buildings	
2.1 Energy Saving Construction	
2.1.1 Thermal Insulation Performance	
Bitung	There is no standard applied for energy saving system.
South Jakarta	-
San Borja	-
Yujiapu	The buildings in Yujiapu are green buildings, meet the requirements of the local energy saving standard.
Danang	Auditing energy of some buildings to give energy saving solutions.
2.1.2 Energy Saving Equipment Performance	
Bitung	There is no system applied in this area.
South Jakarta	-
San Borja	-
Yujiapu	The buildings in Yujiapu are green buildings, meet the requirements of the local energy saving standard.
Danang	-
2.1.3 Natural Energy	
Bitung	There is no existing system in place.
South Jakarta	-
San Borja	They have developed guidelines on the design of sustainable buildings. But still we not have a particular system
Yujiapu	The buildings in Yujiapu are green buildings, daylight and natural ventilation have been considered.
Danang	-
2.2 Green Construction	
2.2.1 Green Construction Guidelines	
Bitung	There is no guideline in place
South Jakarta	-
San Borja	San Borja currently only has an ordinance
Yujiapu	There is green construction guide.
Danang	Decision 41/2008/QĐ-UBND dated 21/8/2008 by People 's Committee of Da Nang City about PROJECT "BUILDING DA NANG - CITY ENVIRONMENT"

Demand Side	
3. Transportation	
3.1 Promotion of public transportation	
3.1.1 Easy-to-use Public Transportation	
Bitung	Public transit is operated by private sector and covered less than 30% of the area.
South Jakarta	-
San Borja	There are campaigns and guidelines established, however are only in the planning stage
Yujiapu	There is a bus station in a radius of 500m of each building.
Danang	-
3.1.2 Comprehensive Transportation Measures	
Bitung	Limited efforts to improve and measure for public transportation.
South Jakarta	-
San Borja	It has movement awareness and education around new transportation alternatives
Yujiapu	-
Danang	BRT project 's implementing
3.2 Improvement in traffic flow	
3.2.1 TDM	
Bitung	Limited efforts to improve transportation management
South Jakarta	-
San Borja	One of the objectives of the "San Borja bike" is to encourage the use of bicycles as the main form of transport and thus help counter the high demand for motor vehicles
Yujiapu	Intelligent driving system; Intelligent traffic monitoring system; Taxi intelligent operation management system; Intelligent traffic management; Reduce the vacancy rate of the bus; Improve the use efficiency of public transportation line; Intelligent control system for transit vehicles.
Danang	-
3.2.2 Transportation Infrastructure Planning	
Bitung	There are a plan and some parts on going developing infrastructure for transportation.
South Jakarta	-
San Borja	Currently the district has implemented 25 km of bike paths. Besides being part of the districts benefiting from the early stages of planning public transport and Metro Metropolitan Lima will be.
Yujiapu	-
Danang	BRT project 's implementing
3.3 Introduction of low carbon vehicles	
3.3.1 Introduction of Low Carbon Vehicles	
Bitung	There is a subsidy system has established by national government.
South Jakarta	-
San Borja	-
Yujiapu	There is national policy.
Danang	Electric cars for tourists
3.4 Promotion of Efficient Use	
3.4.1 Support for eco-driving	
Bitung	There is a plan to support eco-driving.
South Jakarta	-
San Borja	-
Yujiapu	There are no plans for introduction of eco-driving support devices in Yujiapu.
Danang	-
Supply Side	
4. Area Energy System	
4.1 Area Energy	
4.1.1 Introduction of Area Energy	
Bitung	So far there is no plan for area energy system.
South Jakarta	-

San Borja	-
Yujiapu	-
Danang	-
5. Untapped Energy	
5.1 Untapped Energy	
5.1.1 Introduction of Untapped Energy	
Bitung	There is a plan to introduce renewable energy specifically related to solar system.
South Jakarta	-
San Borja	-
Yujiapu	-
Danang	-
6. Renewable Energy	
6.1 Renewable Energy	
6.1.1 Introduction of Renewable Energy	
Bitung	Introducing solar system to communities
South Jakarta	-
San Borja	The Kallpa Wasi (power house) has renewables development of some energy. However there isn't currently a major development plan.
Yujiapu	-
Danang	-
7. Multi Energy System	
7.1 Multi Energy	
7.1.1 Introduction of a Multi Energy System	
Bitung	The concept of multi energy system not in place
South Jakarta	-
San Borja	-
Yujiapu	-
Danang	-
Demand & Supply Side	
8. Energy Management	
8.1 Energy Management of Buildings / Area	
8.1.1 Energy Management of Buildings / Area	
Bitung	The concept not in place however the local government have a plan to do so.
South Jakarta	-
San Borja	-
Yujiapu	-
Danang	-
8.1.2 AEMS	
Bitung	-
South Jakarta	-
San Borja	-
Yujiapu	-
Danang	-
8.1.3 Smart Micro Grid	
Bitung	-
South Jakarta	-
San Borja	-
Yujiapu	There are no plans for introduction in Yujiapu.
Danang	-

Environment & Resource		
9. Greenery		
9.1 Securing Green Space		
9.1.1 Formation of Green Shade		
	Bitung	The concept for greening the area covering half of the total area plan.
	South Jakarta	-
	San Borja	Most of our streets and avenues have a lot of trees to ensure shade and thermal comfort
	Yujiapu	-
	Danang	-
9.1.2 Formation of Greening		
	Bitung	-
	South Jakarta	-
	San Borja	Greening plan includes planting trees and shrubs along roadways, boulevards, residential streets and incorporated green infrastructure.
	Yujiapu	-
	Danang	-
10. Water Management		
10.1 Water Resource		
10.1.1 Water Usage		
	Bitung	Water management plan have formulated
	South Jakarta	-
	San Borja	-
	Yujiapu	-
10.1.2 Water Reuse		
	Bitung	Absence of recycling rainwater used
	South Jakarta	-
	San Borja	San Borja is located with in a desert, and in a desert all water (especially drinking water) is precious. San Borja wants to stop using drinkable water for irrigation and instead re-use wasted water, also known as "greywater". In addition to its system to use canals for irrigation San Borja currently has two bio filtration facilities.
	Yujiapu	-
	Danang	-

Environment & Resource		
11. Waste Management		
11.1 Waste Products		
11.1.1 Reduction of waste products		
	Bitung	Plan to reduce waste products.
	South Jakarta	-
	San Borja	San Borja has an area called "San Borja recycled" where a large number of initiatives generated in coordination with neighbors to generate a responsible waste products.
	Yujiapu	-
	Danang	-
11.1.2 Reuse of waste products		
	Bitung	-
	South Jakarta	-
	San Borja	In "San Borja recycles" the neighbors are encouraged to separate their solid waste, which are then collected by city staff to proceed to recycle them.
	Yujiapu	-
	Danang	-
12. Pollution		
12.1 Air		
12.1.1 Air Pollution		
	Bitung	Air pollution is become priority in the planning documents.

South Jakarta	-
San Borja	Sustainable mobility plans (San Borja Bike), are designed to help reduce air pollution.
Yujiapu	Kitchen fume, with fume purification equipment
Danang	-
12.2 Water Quality	
12.2.1 Water Pollution	
Bitung	Water pollution is a priority setting up by local government
South Jakarta	-
San Borja	-
Yujiapu	Domestic sewage, the summary of the sewage treatment plant discharge standards
Danang	-
12.3 Soil	
12.3.1 Soil Contamination	
Bitung	Soil contamination is priority attention have stated in planning documents
South Jakarta	-
San Borja	-
Yujiapu	No solid pollution
Danang	-

Governance	
13. Policy Framework	
13.1 Efforts toward a Low carbon town	
13.1.1 Efforts towards a Low carbon town	
Bitung	There are policies that needed to translate into concrete program and activities of related local government institutions.
South Jakarta	-
San Borja	-
Yujiapu	-
13.1.2 Budget for Policies / Business Plans to create a Low carbon town	
Bitung	Related policies are required enough supported local budget.
South Jakarta	-
San Borja	There is no fixed budget for a plan of Low Carbon Town, but if there are a number of programs driven by the municipality to fulfill that purpose
Yujiapu	-
13.2 Efforts toward sustainability	
13.2.1 B / LCP Plan	
Bitung	There is a need to develop a concept and plan towards sustainability.
South Jakarta	-
San Borja	-
Yujiapu	-
13.2.2 Development with less influence	
Bitung	-
South Jakarta	-
San Borja	-
Yujiapu	In the area of Yujiapu, the original place is the waste area, without the need to consider the impact of the development of the construction of the original environment.
Danang	-

14. Education & Management	
14.1 Life cycle management	
14.1.1 Enlightenment and Education for Energy-savings and a low carbon town	
Bitung	Need efforts to support LCT concept integrated into the curriculum of primary schools up to universities.
South Jakarta	-
San Borja	Programs aimed at spreading Eco-days a healthier environment for the district.
Yujiapu	
Danang	-
14.1.2 Area Management toward an Energy-saving and low carbon town	
Bitung	Supporting in education system and developing institutions to implemented LCT by all stakeholders.
South Jakarta	-
San Borja	The municipality has the management environment and energies house where everything related to low emissions is managed. Just as with the presence of various NGO partners.
Yujiapu	
Danang	-

③ Questionnaire

Response of 4 town : South Jakarta, Sna Borja, Yujiapu, Da Nang

Q.1 Do you understand the purpose of LCT-I?

YES (4) NO (0)

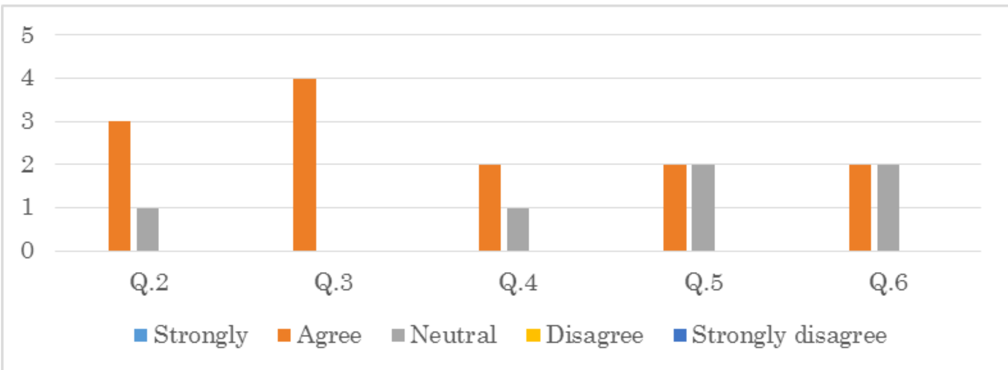
Q.2 Do you agree that the evaluation method (5 levels) is suitable?

Q.3 Do you agree that the evaluation target fields for TIER1 are suitable?

Q.4 Do you agree that the evaluation target fields for TIER2 are suitable?

Q.5 Do you agree that the TIER3 evaluation contents are suitable?

Q.6 Do you agree that the number of TIER3 evaluation items is suitable?



Q.7 Are there some TIER3 evaluation items which are difficult? (If so, please list each one and why it is difficult.) – Non-response

Q.8 Are there evaluation indexes or guidelines currently being used in your economy? (If so, please provide the specific name of each one and if possible attach the data when you respond to this questionnaire.) - Non-response

Q.9 Are there CO2 calculation guidelines currently being used in your economy? (If so, please provide the specific name of each one and if possible attach the data when you respond to this questionnaire.)

- 【Da Nang, Vietnam】Yes(IPCC 1966)

Q.10 What are the advantages and disadvantages of using LCT-I?

- 【Da Nang, Vietnam】 Disadvantages : Capital investment

Q.11 How can LCT-I be used to help your town become more of an LCT? (For example, creating an awards system, creating a judgment system for giving preferential loan treatment, publishing it on the APEC homepage, or any other specific activities that you can think of.)

- 【Da Nang, Vietnam】 Publishing it on the APEC homepage

Q.12 If you have any other comments or suggestions regarding LCT, please give them here.

- 【Da Nang, Vietnam】APEC supported desire urged investors to Da Nang

2) Result of each Town

⑦ Bitung, Indonesia

LCT-I Evaluation Input Sheet 1

Abstruct of your town

■the name of target area	Special Economic Zone (SEZ) Bitung, Indonesia	
■address	Bitung City, North Sulawesi, Indonesia	
■standerd building coverage ratio		%
■standerd floor area ratio		%
■whole area	534.0	ha
■building area		㎡

Please fill in the sheet

Type of Town

■select type of your town

◉ Urban ○ Rural — Commercial Oriented Town

Please select from the pull-down menu (Urban or Rural)

Output Sheet (abstruct)

Overall Assessment

Overall Rank

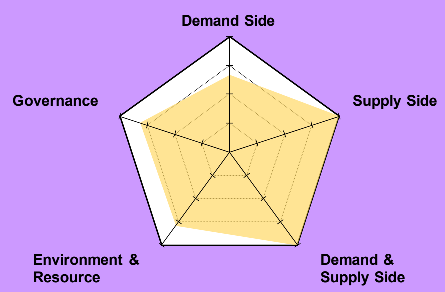
Total Point
average of (1) to (14) **4.4**

CO2 Reduction

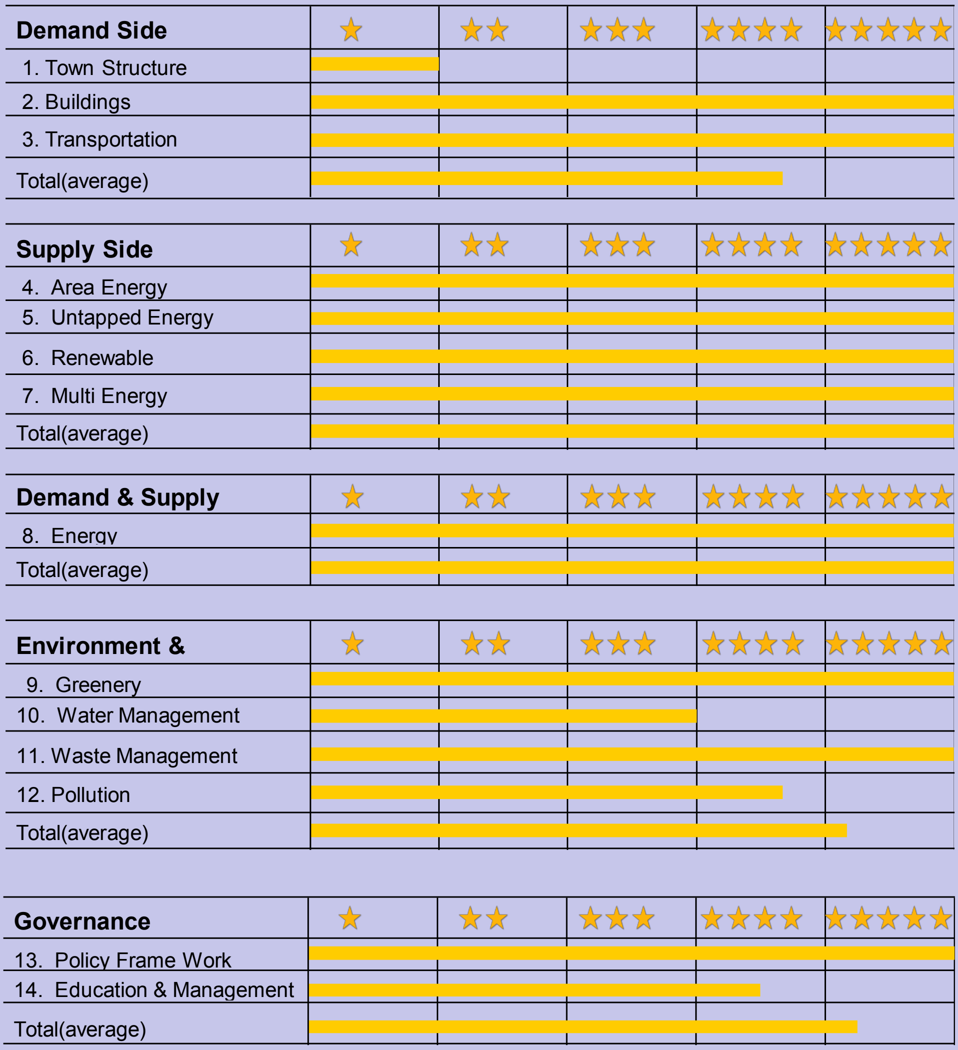
t-CO2/year

Please fill Co2 reduction in the above cell
and attach the source or evidence

Radar Chart



Individual Assessment



Output Sheet (datail)

Special Economic Zone (SEZ) Bitung, Indonesia

evaluation sheet		
		★★★★
Demand Side		★★★
1. Town Structure	-	★
1.1. Adjacent Workplace and Residence	-	
1. Residential Use and Non-residential Use	★	
1.2. Land Use	-	
1. Efficient Land Use	★	
1.3. TOD (Transit Oriented Development)	-	
1. City Development Centered on Public Transportation	★	
2. Buildings	-	★★★★★
2.1. Energy Saving Construction	-	
1. Thermal Insulation Performance	★★★★★	
2. Energy Saving Equipment Performance	★★★★★	
3. Natural Energy	★★★★★	
2.2. Green Construction	-	
1. Green Construction Guidelines	★★★★★	
3. Transportation	-	★★★★★
3.1. Promotion of Public Transportation	-	
1. Easy-to-Use Public Transportation	★★★★★	
2. Comprehensive Transportation Measures	★★★★★	
3.2. Improvement in Traffic Flow	-	
1. TDM (Transportation Demand Management)	★★★★★	
2. Transportation Infrastructure Planning	★★★★★	
3.3. Introduction of Low Carbon Vehicles	-	
1. Introduction of Low Carbon Vehicles	★★★★★	
3.4. Promotion of Efficient Use	-	
1. Support for eco-driving	★★★★★	
Supply Side		★★★★★
4. Area Energy System	-	★★★★★
4.1. Area Energy	-	
1. Introduction of Area Energy	★★★★★	
5. Untapped Energy	-	★★★★★
5.1. Untapped Energy	-	
1. Introduction of Renewable Energy	★★★★★	
6. Renewable Energy	-	★★★★★
6.1. Renewable Energy	-	
1. Introduction of Renewable Energy	★★★★★	
7. Multi Energy System	-	★★★★★
7.1. Multi Energy	-	
1. Introduction of a Multi Energy system	★★★★★	
Demand & Supply Side		★★★★★
8. Energy Management	-	★★★★★
8.1. Energy Management of Buildings/Area	-	
1. Energy Management of Buildings/Area	★★★★★	
2. AEMS (Area Energy Management System)	★★★★★	
3. Smart Micro Grid	★★★★★	

Item				Rating	Category rating
Environment & Resource					★★★★
9. Greenery				-	★★★★★
	9.1.	Securing Green Space		-	
		1.	Formation of Green Shade	★★★★★	
		2.	Formation of Greening	★★★★★	
10. Water Management				-	★★★
	10.1.	Water Resources		-	
		1.	Water Usage	★★★★★	
		2.	Water Reuse	★	
11. Waste Management				-	★★★★★
	11.1.	Waste products		-	
		1.	Reduction of waste products	★★★★★	
		2.	Reuse of waste products	★★★★★	
12. Pollution				-	★★★
	12.1.	Air		-	
		1.	Air Pollution	★	
	12.2.	Water Quality		-	
		1.	Water Pollution	★★★★★	
	12.3.	Soil		-	
		1.	Soil contamination	★★★★★	
Governance					★★★★
13. Policy Framework				-	★★★★★
	13.1.	Efforts toward a Low carbon town		-	
		1.	Efforts toward a Low carbon town	★★★★★	
		2.	Budget for Policies/Business Plans to create a Low Carbon Town	★★★★★	
	13.2.	Efforts toward sustainability		-	
		1.	B/LCP Plan	★★★★★	
		2.	Developments with Less Influence	★★★★★	
14. Education & Management				-	★★★
	14.1.	Life cycle management		-	
		1.	Enlightenment and education for energy-savings and a low carbon t	★★	
		2.	Area Management toward an Energy-saving and Low Carbon Town	★★★★★	

② South Jakarta, Indonesia

LCT-I Evaluation Input Sheet 1

Abstract of your town

■the name of target area	South Jakarta city	
■address	darsyah Raya 66-C, Kebayoran Baru, Jakarta 12160	
■standerd building coverage rati	40.0	%
■standerd floor area ratio		%
■whole area	10000.0	ha
■building area		m^2

Please fill in the sheet

Type of Town

■select type of your town

◉ Urban — Residential Oriented Town

○ Rural

Please select from the pull-down menu (Urban or Rural)

Output Sheet (abstruct)

Overall Assessment

Overall Rank

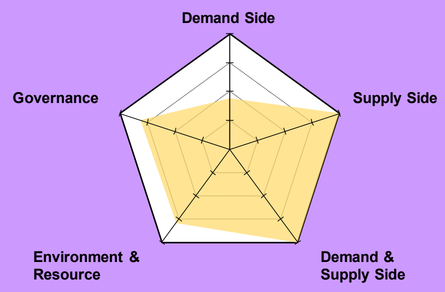
Total Point
average of (1) to (14) **4.2**

CO2 Reduction

t-CO2/year

Please fill Co2 reduction in the above cell
and attach the source or evidence

Radar Chart



Individual Assessment

Demand Side	★	★★	★★★	★★★★	★★★★★
1. Town Structure					
2. Buildings					
3. Transportation					
Total(average)					

Supply Side	★	★★	★★★	★★★★	★★★★★
4. Area Energy					
5. Untapped Energy					
6. Renewable					
7. Multi Energy					
Total(average)					

Demand & Supply	★	★★	★★★	★★★★	★★★★★
8. Energy					
Total(average)					

Environment &	★	★★	★★★	★★★★	★★★★★
9. Greenery					
10. Water Management					
11. Waste Management					
12. Pollution					
Total(average)					

Governance	★	★★	★★★	★★★★	★★★★★
13. Policy Frame Work					
14. Education & Management					
Total(average)					

Output Sheet (datail)

South Jakarta city

evaluation sheet				
		★★★★		4.2
Demand Side		★★		2.8
1. Town Structure	-	★		1.0
1.1. Adjacent Workplace and Residence	-			
1. Residential Use and Non-residential Use	★		1	
1.2. Land Use	-			
1. Efficient Land Use	★		1	
1.3. TOD (Transit Oriented Development)	-			
1. City Development Centered on Public Transportation	★		1	
2. Buildings	-	★★		2.3
2.1. Energy Saving Construction	-			
1. Thermal Insulation Performance	★		1	
2. Energy Saving Equipment Performance	★★★		3	
3. Natural Energy	★		1	
2.2. Green Construction	-			
1. Green Construction Guidelines	★★★★		4	
3. Transportation	-	★★★★★		5.0
3.1. Promotion of Public Transportation	-			
1. Easy-to-Use Public Transportation	★★★★★		5	
2. Comprehensive Transportation Measures	★★★★★		5	
3.2. Improvement in Traffic Flow	-			
1. TDM (Transportation Demand Management)	★★★★★		5	
2. Transportation Infrastructure Planning	★★★★★		5	
3.3. Introduction of Low Carbon Vehicles	-			
1. Introduction of Low Carbon Vehicles	★★★★★		5	
3.4. Promotion of Efficient Use	-			
1. Support for eco-driving	★★★★★		5	
Supply Side		★★★★★		5.0
4. Area Energy System	-	★★★★★		5.0
4.1. Area Energy	-			
1. Introduction of Area Energy	★★★★★		5	
5. Untapped Energy	-	★★★★★		5.0
5.1. Untapped Energy	-			
1. Introduction of Renewable Energy	★★★★★		5	
6. Renewable Energy	-	★★★★★		5.0
6.1. Renewable Energy	-			
1. Introduction of Renewable Energy	★★★★★		5	
7. Multi Energy System	-	★★★★★		5.0
7.1. Multi Energy	-			
1. Introduction of a Multi Energy system	★★★★★		5	
Demand & Supply Side		★★★★★		5.0
8. Energy Management	-	★★★★★		5.0
8.1. Energy Management of Buildings/Area	-			
1. Energy Management of Buildings/Area	★★★★★		5	
2. AEMS (Area Energy Management System)	★★★★★		5	
3. Smart Micro Grid	★★★★★		5	

Item	Level	Rating	Score	Average
Environment & Resource		★★★★		4.2
9. Greenery	-	★★★★★		5.0
9.1. Securing Green Space	-			
1. Formation of Green Shade	★★★★★		5	
2. Formation of Greening	★★★★★		5	
10. Water Management	-	★★★		3.0
10.1. Water Resources	-			
1. Water Usage	★★★★★		5	
2. Water Reuse	★		1	
11. Waste Management	-	★★★★★		5.0
11.1. Waste products	-			
1. Reduction of waste products	★★★★★		5	
2. Reuse of waste products	★★★★★		5	
12. Pollution	-	★★★		3.7
12.1. Air	-			
1. Air Pollution	★		1	
12.2. Water Quality	-			
1. Water Pollution	★★★★★		5	
12.3. Soil	-			
1. Soil contamination	★★★★★		5	
Governance		★★★★		4.3
13. Policy Framework	-	★★★★★		5.0
13.1. Efforts toward a Low carbon town	-			
1. Efforts toward a Low carbon town	★★★★★		5	
2. Budget for Policies/Business Plans to create a Low Carbon Town	★★★★★		5	
13.2. Efforts toward sustainability	-			
1. B/LCP Plan	★★★★★		5	
2. Developments with Less Influence	★★★★★		5	
14. Education & Management	-	★★★		3.5
14.1. Life cycle management	-			
1. Enlightenment and education for energy-savings and a low carbon	★★		2	
2. Area Management toward an Energy-saving and Low Carbon Town	★★★★★		5	

③ San Borja, Peru

LCT-I Evaluation Input Sheet 1

Abstract of your town

■the name of target area	San Borja	
■address	Center area of Lima – Perú	
■standerd building coverage rati	80 of land use	%
■standerd floor area ratio		%
■whole area	1000.0	ha
■building area	8.65	m²

Please fill in the sheet

Type of Town

■select type of your town

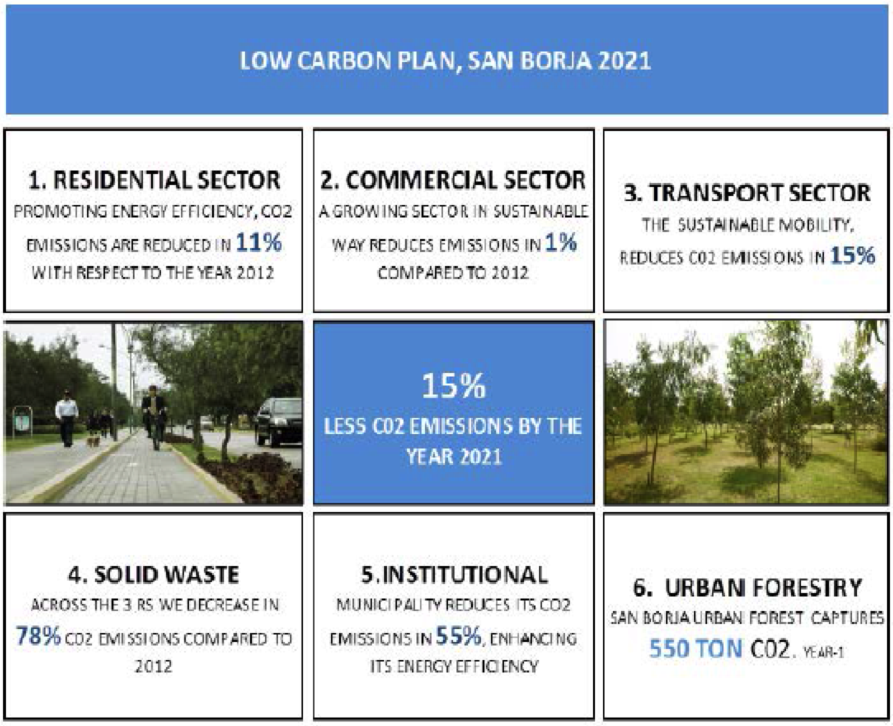
◉ Urban CBD

○ Rural

Please select from the pull-down menu (Urban or Rural)

Map pf your town

Please paste the area map or the image (future) plan



Output Sheet (abstruct)

Overall Assessment

Overall Rank

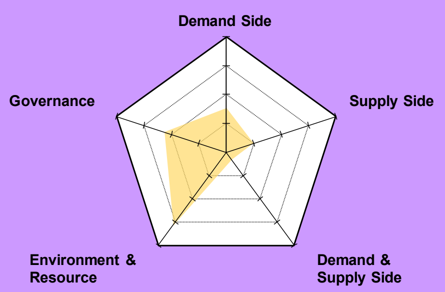
Total Point
average of (1) to (14) **2.9**

CO2 Reduction

t-CO2/year

Please fill Co2 reduction in the above cell
and attach the source or evidence

Radar Chart



Individual Assessment

Demand Side	★	★★	★★★	★★★★	★★★★★
1. Town Structure					
2. Buildings					
3. Transportation					
Total(average)					

Supply Side	★	★★	★★★	★★★★	★★★★★
4. Area Energy					
5. Untapped Energy					
6. Renewable					
7. Multi Energy					
Total(average)					

Demand & Supply	★	★★	★★★	★★★★	★★★★★
8. Energy					
Total(average)					

Environment &	★	★★	★★★	★★★★	★★★★★
9. Greenery					
10. Water Management					
11. Waste Management					
12. Pollution					
Total(average)					

Governance	★	★★	★★★	★★★★	★★★★★
13. Policy Frame Work					
14. Education & Management					
Total(average)					

Output Sheet (datail)

San Borja

evaluation sheet				
		★★		2.6
Demand Side		★★		2.5
1. Town Structure	-	★★★		3.7
1.1. Adjacent Workplace and Residence	-			
1. Residential Use and Non-residential Use	★★★★★		5	
1.2. Land Use	-			
1. Efficient Land Use	★★★		3	
1.3. TOD (Transit Oriented Development)	-			
1. City Development Centered on Public Transportation	★★★		3	
2. Buildings	-	★		1.8
2.1. Energy Saving Construction	-			
1. Thermal Insulation Performance	★★		2	
2. Energy Saving Equipment Performance	★★		2	
3. Natural Energy	★★		2	
2.2. Green Construction	-			
1. Green Construction Guidelines	★		1	
3. Transportation	-	★★		2.2
3.1. Promotion of Public Transportation	-			
1. Easy-to-Use Public Transportation	★★		2	
2. Comprehensive Transportation Measures	★★★		3	
3.2. Improvement in Traffic Flow	-			
1. TDM (Transportation Demand Management)	★★★		3	
2. Transportation Infrastructure Planning	★★★		3	
3.3. Introduction of Low Carbon Vehicles	-			
1. Introduction of Low Carbon Vehicles	★		1	
3.4. Promotion of Efficient Use	-			
1. Support for eco-driving	★		1	
Supply Side		★★		2.0
4. Area Energy System	-	★		1.0
4.1. Area Energy	-			
1. Introduction of Area Energy	★		1	
5. Untapped Energy	-	★		1.0
5.1. Untapped Energy	-			
1. Introduction of Renewable Energy	★		1	
6. Renewable Energy	-	★★★		3.0
6.1. Renewable Energy	-			
1. Introduction of Renewable Energy	★★★		3	
7. Multi Energy System	-	★★★		3.0
7.1. Multi Energy	-			
1. Introduction of a Multi Energy system	★★★		3	
Demand & Supply Side		★		1.3
8. Energy Management	-	★		1.3
8.1. Energy Management of Buildings/Area	-			
1. Energy Management of Buildings/Area	★		1	
2. AEMS (Area Energy Management System)	★★		2	
3. Smart Micro Grid	★		1	

Item	Rating	Category rating	Score	Category score
Environment & Resource		★★★★		4.1
9. Greenery	-	★★★★★		5.0
9.1. Securing Green Space	-			
1. Formation of Green Shade	★★★★★		5	
2. Formation of Greening	★★★★★		5	
10. Water Management	-	★★★		3.5
10.1. Water Resources	-			
1. Water Usage	★★★★		4	
2. Water Reuse	★★★		3	
11. Waste Management	-	★★★★★		5.0
11.1. Waste products	-			
1. Reduction of waste products	★★★★★		5	
2. Reuse of waste products	★★★★★		5	
12. Pollution	-	★★★		3.0
12.1. Air	-			
1. Air Pollution	★★★		3	
12.2. Water Quality	-			
1. Water Pollution	★★★		3	
12.3. Soil	-			
1. Soil contamination	★★★		3	
Governance		★★★		3.3
13. Policy Framework	-	★★★		3.5
13.1. Efforts toward a Low carbon town	-			
1. Efforts toward a Low carbon town	★★★		3	
2. Budget for Policies/Business Plans to create a Low Carbon Town	★		1	
13.2. Efforts toward sustainability	-			
1. B/LCP Plan	★★★★★		5	
2. Developments with Less Influence	★★★★★		5	
14. Education & Management	-	★★★		3.0
14.1. Life cycle management	-			
1. Enlightenment and education for energy-savings and a low carbon t	★★★		3	
2. Area Management toward an Energy-saving and Low Carbon Town	★★★		3	

④ Yujjipau, China

LCT-I Evaluation Input Sheet 1

Abstract of your town

■the name of target area	Yujiapu Central Business District	
■address	Tianjin Binhai New Area	
■standerd building coverage rati	83.2	%
■standerd floor area ratio	209.3	%
■whole area	464.0	ha
■building area	9713500	m²

Please fill in the sheet

Type of Town

■select type of your town

◉ Urban CBD

○ Rural

Please select from the pull-down menu (Urban or Rural)

Map pf your town

Please paste the area map or the image (future) plan

Output Sheet (abstruct)

Overall Assessment

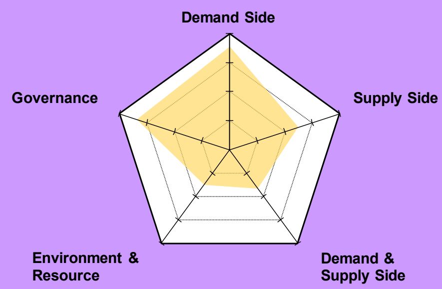
Overall Rank

Total Point
average of (1) to (14) **3.5**

CO2 Reduction
t-CO2/year

Please fill Co2 reduction in the above cell
and attach the source or evidence

Radar Chart



Individual Assessment

Output Sheet (datail)

Yujiapu Central Business District

evaluation sheet		★★★		3.5
Demand Side		★★★★		4.6
1. Town Structure	-	★★★★★		5.0
1.1. Adjacent Workplace and Residence	-			
1. Residential Use and Non-residential Use	★★★★★		5	
1.2. Land Use	-			
1. Efficient Land Use	★★★★★		5	
1.3. TOD (Transit Oriented Development)	-			
1. City Development Centered on Public Transportation	★★★★★		5	
2. Buildings	-	★★★★		4.5
2.1. Energy Saving Construction	-			
1. Thermal Insulation Performance	★★★★★		5	
2. Energy Saving Equipment Performance	★★★★★		5	
3. Natural Energy	★★★★		4	
2.2. Green Construction	-			
1. Green Construction Guidelines	★★★★		4	
3. Transportation	-	★★★★		4.2
3.1. Promotion of Public Transportation	-			
1. Easy-to-Use Public Transportation	★★★★★		5	
2. Comprehensive Transportation Measures	★★★★★		5	
3.2. Improvement in Traffic Flow	-			
1. TDM (Transportation Demand Management)	★★★★★		5	
2. Transportation Infrastructure Planning	★★★★★		5	
3.3. Introduction of Low Carbon Vehicles	-			
1. Introduction of Low Carbon Vehicles	★★★★★		5	
3.4. Promotion of Efficient Use	-			
1. Support for eco-driving	-		0	
Supply Side		★★★		3.5
4. Area Energy System	-	★★★★★		5.0
4.1. Area Energy	-			
1. Introduction of Area Energy	★★★★★		5	
5. Untapped Energy	-	★★★		3.0
5.1. Untapped Energy	-			
1. Introduction of Renewable Energy	★★★		3	
6. Renewable Energy	-	★★★		3.0
6.1. Renewable Energy	-			
1. Introduction of Renewable Energy	★★★		3	
7. Multi Energy System	-	★★★		3.0
7.1. Multi Energy	-			
1. Introduction of a Multi Energy system	★★★		3	
Demand & Supply Side		★★		2.7
8. Energy Management	-	★★		2.7
8.1. Energy Management of Buildings/Area	-			
1. Energy Management of Buildings/Area	★★★★		4	
2. AEMS (Area Energy Management System)	★★★★		4	
3. Smart Micro Grid	-		0	

Item	Rating	Category rating	Score	Category score
Environment & Resource		★★		2.5
9. Greenery	-	★★★		3.5
9.1. Securing Green Space	-			
1. Formation of Green Shade	★★★		3	
2. Formation of Greening	★★★★		4	
10. Water Management	-	★★		2.5
10.1. Water Resources	-			
1. Water Usage	★★★		3	
2. Water Reuse	★★		2	
11. Waste Management	-	★★		2.0
11.1. Waste products	-			
1. Reduction of waste products	★★		2	
2. Reuse of waste products	★★		2	
12. Pollution	-	★★		2.0
12.1. Air	-			
1. Air Pollution	★★★		3	
12.2. Water Quality	-			
1. Water Pollution	★★★		3	
12.3. Soil	-			
1. Soil contamination	-		0	
Governance		★★★★		4.4
13. Policy Framework	-	★★★		3.8
13.1. Efforts toward a Low carbon town	-			
1. Efforts toward a Low carbon town	★★★★★		5	
2. Budget for Policies/Business Plans to create a Low Carbon Town	★★★★★		5	
13.2. Efforts toward sustainability	-			
1. B/LCP Plan	★★★★★		5	
2. Developments with Less Influence	-		0	
14. Education & Management	-	★★★★★		5.0
14.1. Life cycle management	-			
1. Enlightenment and education for energy-savings and a low carbon	★★★★★		5	
2. Area Management toward an Energy-saving and Low Carbon Town	★★★★★		5	

⑤ Da Nang City, Vietnam

LCT-I Evaluation Input Sheet 1

Abstract of your town

■the name of target area	Ngu Hanh Son District	
■address	Danang City, Vietnam	
■standerd building coverage rati		%
■standerd floor area ratio		%
■whole area	3911.78	ha
■building area		m²

Please fill in the sheet

Type of Town

■select type of your town

◉ Urban — CBD

○ Rural

Please select from the pull-down menu (Urban or Rural)

Map pf your town

Please paste the area map or the image (future) plan

Output Sheet (abstruct)

Overall Assessment

Overall Rank

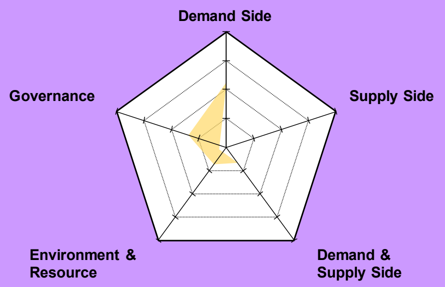
Total Point
average of (1) to (14) 1.9

CO2 Reduction

t-CO2/year

Please fill Co2 reduction in the above cell
and attach the source or evidence

Radar Chart



Individual Assessment

Demand Side	★	★★	★★★	★★★★	★★★★★
1. Town Structure					
2. Buildings					
3. Transportation					
Total(average)					

Supply Side	★	★★	★★★	★★★★	★★★★★
4. Area Energy					
5. Untapped Energy					
6. Renewable					
7. Multi Energy					
Total(average)					

Demand & Supply	★	★★	★★★	★★★★	★★★★★
8. Energy					
Total(average)					

Environment &	★	★★	★★★	★★★★	★★★★★
9. Greenery					
10. Water Management					
11. Waste Management					
12. Pollution					
Total(average)					

Governance	★	★★	★★★	★★★★	★★★★★
13. Policy Frame Work					
14. Education & Management					
Total(average)					

Output Sheet (datail)

Ngu Hanh Son District

evaluation sheet				
		★		2.0
Demand Side		★★★		3.3
1. Town Structure	-	★★★		3.0
1.1. Adjacent Workplace and Residence	-			
1. Residential Use and Non-residential Use	★★★		3	
1.2. Land Use	-			
1. Efficient Land Use	★		1	
1.3. TOD (Transit Oriented Development)	-			
1. City Development Centered on Public Transportation	★★★★★		5	
2. Buildings	-	★★★		3.8
2.1. Energy Saving Construction	-			
1. Thermal Insulation Performance	★★★★		4	
2. Energy Saving Equipment Performance	★★★★★		5	
3. Natural Energy	★		1	
2.2. Green Construction	-			
1. Green Construction Guidelines	★★★★★		5	
3. Transportation	-	★★★		3.0
3.1. Promotion of Public Transportation	-			
1. Easy-to-Use Public Transportation	★		1	
2. Comprehensive Transportation Measures	★★★		3	
3.2. Improvement in Traffic Flow	-			
1. TDM (Transportation Demand Management)	★★★		3	
2. Transportation Infrastructure Planning	★★★		3	
3.3. Introduction of Low Carbon Vehicles	-			
1. Introduction of Low Carbon Vehicles	★★★★		4	
3.4. Promotion of Efficient Use	-			
1. Support for eco-driving	★★★★		4	
Supply Side				0.8
4. Area Energy System	-			-
4.1. Area Energy	-			
1. Introduction of Area Energy	-		0	
5. Untapped Energy	-	★★★		3.0
5.1. Untapped Energy	-			
1. Introduction of Renewable Energy	★★★		3	
6. Renewable Energy	-			-
6.1. Renewable Energy	-			
1. Introduction of Renewable Energy	-		0	
7. Multi Energy System	-			-
7.1. Multi Energy	-			
1. Introduction of a Multi Energy system	-		0	
Demand & Supply Side		★		1.7
8. Energy Management	-	★		1.7
8.1. Energy Management of Buildings/Area	-			
1. Energy Management of Buildings/Area	★★★		3	
2. AEMS (Area Energy Management System)	★★		2	
3. Smart Micro Grid	-		0	

Environment & Resource			★		1.8
9. Greenery		-			-
9.1. Securing Green Space		-			
1.	Formation of Green Shade	-		0	
2.	Formation of Greening	-		0	
10. Water Management		-	★		1.5
10.1. Water Resources		-			
1.	Water Usage	★★★		3	
2.	Water Reuse	-		0	
11. Waste Management		-	★		1.5
11.1. Waste products		-			
1.	Reduction of waste products	★★★		3	
2.	Reuse of waste products	-		0	
12. Pollution		-	★★★★		4.0
12.1. Air		-			
1.	Air Pollution	★★★★		4	
12.2. Water Quality		-			
1.	Water Pollution	★★★★		4	
12.3. Soil		-			
1.	Soil contamination	★★★★		4	
Governance			★★		2.4
13. Policy Framework		-	★		1.8
13.1. Efforts toward a Low carbon town		-			
1.	Efforts toward a Low carbon town	★★★		3	
2.	Budget for Policies/Business Plans to create a Low Carbon Town	★		1	
13.2. Efforts toward sustainability		-			
1.	B/LCP Plan	★★		2	
2.	Developments with Less Influence	★		1	
14. Education & Management		-	★★★		3.0
14.1. Life cycle management		-			
1.	Enlightenment and education for energy-savings and a low carbon t	★★★		3	
2.	Area Management toward an Energy-saving and Low Carbon Town	★★★		3	

Appendix 5　APEC Low-Carbon Town Indicators (LCT-I) Evaluation Sheet (Draft)

Please find the attached “LCT-I Evaluation Input Sheet 1 and 2 in the APEC LCT-I Evaluation Sheet (Microsoft Excel Worksheet).

INDEX for Part I

INDEX for Part II

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