About Low Carbon City Development Guidance

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<Outline>

1. Background of Low-carbon City Development
   ①Current Conditions of Global Warming and Urban Activities in Japan
   ②Relationship between Urban Structure and CO2 Emission

2. Urban Development Policies against Global Warming
   ①Major Actions to reduce CO2 emission in Japan (related to urban development)
   ②Legislative Framework of Urban Planning on Global Warming Issues
   ③Kyoto Protocol Target Achievement Plan
   ④Central Government New Growth Strategy
   ⑤Growth Strategy of Ministry of Land, Infrastructure, Transport and Tourism

3. Low Carbon City Development Guidance
   ①Introduction
   ②Basic Concept and Policy
   ③Menu of Actions
   ④Example of Actions (urban structure and transport, energy, greenery)
   ⑤Target Setting of CO2 Reduction and Absorption and its Monitoring
   ⑥Impact Analysis of each Action (urban structure and transport, energy, greenery)
1. ① Global Warming and Urban Development Activities

60% of the total CO2 emissions in Japan comes from residential sector, business sector such as offices and commercial activities that largely contribute to socioeconomic activities in a city, and transportation sector such as cars and railways.

Breakdown of CO2 emissions (FY2008)

Source: Greenhouse gas emissions in FY2008 (definite value) (the Environment Ministry)

1. ② Relationship between urban structure and CO2 emission

Even though area and population of Maebashi city and Kochi city are almost the same, Maebashi city is more dependent on cars, for the city is less intensive. CO2 emissions per capita in passenger transportation sector of Maebashi city and Kochi city are 1.21 tons and 0.87 tons, respectively, the former is about 40% higher than the latter.

- Transformation to an urban structure brings about a major impact on the traffic pattern. Once public transportation, which has less CO2 emissions by travel distance, becomes the major means of traffic, bicycle and foot traffics will also be facilitated.
- Transformation to an intensive urban structure sets right conditions to facilitate switch to a highly efficient and low-carbon energy system in a city.

Reference: “Chronological analysis of CO2 emissions from automobiles from the viewpoint of urban structure” by Mamoru Taniguchi
Collection of papers on city planning No.43-3, October 2008

Source: Environmental white paper in FY2006
2. Major actions to reduce CO₂ emissions in Japan

Japan made various efforts to achieve the goal of Kyoto Protocol in the global trend of reducing CO₂. “Development of a low-carbon city and region” was set as a target in Kyoto Protocol Target Achievement Plan.

![Diagram of an intensive city]

<Image of an intensive city>

- Design of a low-carbon city and region
  It is possible to expect a large impact of making improvement in energy use efficiency at a city, where energy load density is high. Therefore, improve energy environment of a city with Area Energy Network and heat island countermeasures etc. and extend the durable life of houses, buildings and infrastructures. In addition, lower environmental burden where people can enjoy their life by walking (compact city) by intensifying functions of a city to facilitate the development of low-carbon cities and regions.

- Realize an intensive and low-carbon city structure
  Secure appropriate location for a large-scaled customer attracting facilities etc. to realize an intensive city structure where urban functions are concentrated and a public transport plays a major role in traffic. Promote centralization of urban functions by the development and activation of a city center, and Comprehensive Urban Transportation Strategy. In addition, support the formulation of effective CO₂ reduction plan which includes CO₂ reduction simulation, in order to promote the use of public transport and district-scale use of unused energy and natural capital.

- Measures taken at a town/district level
  By taking opportunities of urban development and under public and private partnership, promote the development of a low-carbon city on a town/district level by introducing pilot measures targeting the whole area or complex buildings, which have big potential of drastically reducing CO₂ emission.

- Promotion of Area Energy Network
  It is possible to expect a large impact of drastic CO₂ cutback at a town, through efficient energy supply and interchange of energy between multiple facilities and buildings, utilization of unused energy and Area Energy Network. Accordingly, intensively introduce new energy utilization facilities and actively promote the use of environmentally district heating and cooling at a town, district and/or buildings, by taking into consideration of characteristics of the region, a main player in the initiative, feasibility of measures and so on.

- Creation of a low-carbon city through heat environment improvement by taking measures like greening to cope with heat island

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**Global warming countermeasures and policies of Target Achievement Plan of Kyoto Protocol**

**Creation of low-carbon region, city, structure and socioeconomic system**

- Positioning of “Design of a low-carbon region and city”
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- Positioning of “Creation of low-carbon region and city”
- Positioning of “Creation of low-carbon city and region”

2. Kyoto Protocol Target Achievement Plan (fully revised on March 28th 2008)

- Measures taken at a town/district level
- Promotion of Area Energy Network
- Creation of a low-carbon city through heat environment improvement by taking measures like greening to cope with heat island
### 2. ③ Law on Promotion of Global Warming Countermeasures (Revised in Jun. 2008)

- **Formulation of “Regional Action Plan of Local Government against Global Warming” (New Action Plan)**

  Local Government (prefectures and designated large cities) are obliged to formulate “New Action Plan” in the Law on Promotion of Global Warming Countermeasures
  - Use of natural energy
  - Actions to reduce GHG emission to be taken by enterprises and citizens.
  - Promotion of public transport, greenery development in urban area, other regional environmental improvement
  - Reduce of waste and recycling society.

- **“Law on Promotion of Global Warming Countermeasure “ Article 20-3, Item 4**

  Prefectures and designated large cities shall always consider GHG reduction and coordinate with “New Action Plan” when they formulate urban planning, regional agricultural development plan, and other policies related to global warming, in order to promote global warming countermeasures.

### 2. ④ New growth strategy of Japan (Approved by Cabinet in June 2010)

- **Reference to an city planning and an urban structure etc. in the growth strategy**

  **(1) Strategy to become a major environment/energy power based on green innovation**

  In order to transform Japanese cities to “green cities”, which emit less greenhouse gases, clarify mid and long-term environmental standard and thoroughly review city planning, renewal and redevelopment, from the viewpoint of environment and low-carbon emission.

  - Develop “a green city” by facilitating rebuilding/improvement of antiquated buildings

  (A model that local regions take the lead in achieving transformation of socioeconomic structure)

  Support the efforts of developing eco-friendly society, such as the development of low-carbon structure in cities and regions by promoting the use of public transport etc., development of renewable energy and smart grid that supports it, full-scaled implementation of appropriate resource recycle, use of telecommunication technologies and realization of zero emission of houses etc.
2. Encourage relocation of houses in a city and a compact city

- Support relocation of urban functions to a city center.
- Formulate “Low-carbon city development guidance” that contributes to the area CO₂ reduction and implement deregulation etc. to realize unused energy utilization.

3. Low Carbon City Development Guidance—Outline

Purpose of the guidance
Present the following concept and support the efforts of municipalities.
1. Basic concept of the creation of a low-carbon city
2. Methodology and numeric information necessary to understand the effect of policies to create a low-carbon city

Scope of the guidance
1. Greenhouse gas subject to the guidance is energy derived “CO₂”, which is dominant greenhouse gas emitted in Japan and deeply related to an urban structure.
2. Subject both tangible and intangible measures in extensive areas of traffic/urban structure, energy and greenery, related to city planning that contributes to the reduction of CO₂.

When to apply the guidance
- Review creation of a low-carbon city in times of revising city planning master plan etc.
- Reflect the perspective of low-carbon in the formulation of Comprehensive Urban Transportation Strategy, urban traffic infrastructure development, redevelopment project and facility development for urban planning.
- Review city development measures in times of formulating a new action plan.
- Analysis on the impact of measures of creating a low-carbon city.

Relationship with “new action plan”
Municipalities implement global warming countermeasures through “new action plan” which is based on the Law Concerning the Promotion of the Measures to Cope with Global Warming. Achievement of the guidance is assumed to be actively incorporated into “new action plan”, while reflecting achievements of “a manual for new action plan.”
3. Low Carbon City Development Guidance

Outline

- Concept and policy for the development of a low-carbon city
- Overall Framework and Concept

3.1 Measures of urban and greening areas

Policy 1 Realize intensive urban structure
- Shift to an intensive urban structure
- Realize compact urban structure and traffic measures (shift from offensive urban structure to intensive urban structure)

Policy 2 Promote measures to address traffic
- Road improvement for smooth automobile traffic
- Traffic demand management

Policy 3 Promote the use of public transport
- Development of public transport system

Policy 4 Restoration to energy saving buildings that contributes to low-carbon society
- Realizable energy efficiency by using opportunities of building renewal as part of efforts to realize intensive structure

Policy 5 Area Energy Network
- Promotion of local energy network by seeing opportunities of holistic urban function renewal etc.

Policy 6 Utilization of unused/renewable energy
- Adjustment of stock and demand of unused energy
- Utilization of renewable energy
- Incentives of stock and demand of unused renewable energy in terms of urban development

Policy 7 Renewable Energy
- Urban renewable energy (use of wood-based biomass)

Policy 8 Promote the use of wood-based biomass
- Wood-based biomass energy (wood-based biomass in cities)

Policy 9 Improve urban environment with fresh green/biome measures
- Make fresh green/biome measures of various scales
### 3. Low Carbon City Development Guidance

#### Menu of measures and the case examples are shown in the guidance for each area of traffic/urban structure, energy and greenery

<table>
<thead>
<tr>
<th>Area</th>
</tr>
</thead>
<tbody>
<tr>
<td>Land use</td>
</tr>
<tr>
<td>Urban function</td>
</tr>
<tr>
<td>Energy</td>
</tr>
<tr>
<td>Greenery</td>
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</table>

#### Land use

<table>
<thead>
<tr>
<th>Menu</th>
<th>Details</th>
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</thead>
<tbody>
<tr>
<td>1. Shift to an intensive urban structure</td>
<td></td>
</tr>
<tr>
<td>2. Road improvement for smooth automobile traffic</td>
<td></td>
</tr>
</tbody>
</table>
| 3. Grade separation
   | Realization of land use greenery. |

#### Urban function

<table>
<thead>
<tr>
<th>Menu</th>
<th>Details</th>
</tr>
</thead>
</table>
| 1. 
   | Improve environment for bicycle riding |
| 2. 
   | Transit mall |
| 3. 
   | Transit grandfather (traffic demand management) |

#### Energy

<table>
<thead>
<tr>
<th>Menu</th>
<th>Details</th>
</tr>
</thead>
</table>
| 1. 
   | Promote the use of public transportation |
| 2. 
   | Reduce energy load |
| 3. 
   | Utilization of renewable energy |

#### Greenery

<table>
<thead>
<tr>
<th>Menu</th>
<th>Details</th>
</tr>
</thead>
</table>
| 1. 
   | Preservation and proper management of large scaled green areas |
| 2. 
   | Green tax/donation system |
| 3. 
   | Measures to manage and grow greenery |
| 4. 
   | Natural reclamation project |

### 3. Low Carbon City Development Guidance — Examples

#### Transport and Urban Structure Measures

<table>
<thead>
<tr>
<th>Title of a measure</th>
<th>Details of a measure</th>
</tr>
</thead>
<tbody>
<tr>
<td>Encourage location of residential areas in the vicinity of traffic hub</td>
<td></td>
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<tr>
<td>Under “Project to promote locating residential areas along public transport routes in Toyama city”, Toyama city encourages residents to locate their houses along public transport lines, while activating public transport systems, and started providing assistance to houses newly constructed in the vicinity of railroad stations and major bus stops in FY2007. Combined with “Project to promote living in a city” which subjects city center, the city designates 50% of specific use zones subject to the assistance.</td>
<td></td>
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</tbody>
</table>

**Areas subject to promote relocation of residential areas along public transport lines**
- Within the radius of about 500m from railroad stations
- Within the radius of about 300m from bus stops with high operation frequency (around 60 or more per day)
- District for specified use (Excludes industrial area and exclusive industrial District)

**Details of assistance**
- Assistance for the citizen (Project to promote acquisition of homes along public transport lines)
  - Provide subsidy of 300,000 yen at the maximum per house
- Assistance for business operators (Project to promote construction of apartment houses along public transport lines)
  - Provide subsidy of 35million yen at the maximum (Project to assist regional superior houses for rent)
3. Low Carbon City Development Guidance — Examples

<Transport and Urban Structure Measures>

Toyama city is developing the network of public transport based on the core traffic of railroad/LRT and feeder bus, which is a terminal traffic connecting main stations and residential areas.

<table>
<thead>
<tr>
<th>Title of a measure</th>
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<tbody>
<tr>
<td>LRT (Light Rail Transit)</td>
<td>This is a system that advanced surface car to a new traffic system, that enables operation of surface car in any places, above the ground, an elevated road and underground. Since the course can be selected depending on regional features, the system can directly contribute to smooth road traffic and activation of local regions.</td>
</tr>
<tr>
<td>BRT (Bus Rapid Transit)</td>
<td>Designate road exclusively used by buses, thereby enhance the quality of the service. In addition to the use of existing roads, new roads can be developed for this purpose and both surface roads and grade separated roads can be designated. BRT (Bus Rapid Transit) is an urban transport system that enables the operation of large capacity vehicles like articulated bus on the designated roads.</td>
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</table>

<Transport and Urban Structure Measures>

3. Low Carbon City Development Guidance — Examples

<Energy>

<table>
<thead>
<tr>
<th>Title of a measure</th>
<th>Details of a measure</th>
</tr>
</thead>
<tbody>
<tr>
<td>Waste heat of garbage processing plant</td>
<td>Case examples... Makomanai district of Sapporo city, Chiba New Town district, Tokyo Waterfront Area, Hikarigaoka district, Yaocho district of Shinagawa and Morinomiya district of Osaka city</td>
</tr>
<tr>
<td>Unused energy generated at sewage facility</td>
<td>Case examples... West exit of Minamisuka station (use of untreated water), Chiba Tomyacho (use of gray water), Korakuen 1 chome (use of untreated water), Makuhari New City High tech business district (use of treated waste water), Bancho district of Takamatsu city (use of gray water), Shimokawabata redevelopment district (use of gray water)</td>
</tr>
<tr>
<td>Energy generated by temperature difference of rivers and oceans</td>
<td>Case examples of using river water temperature... Hakozaki district (Tokyo), Kita district of Toyama station (Toyama city, Toyama prefecture), Nakanoshima 3 chome (Osaka city, Osaka prefecture), Terni namba 1 chome (Osaka city, Osaka prefecture), Okawabata River City (Tokyo)</td>
</tr>
</tbody>
</table>

Case examples of seawater heat use... Chubu Centrair International Airport island district (Tokoname city, Aichi prefecture), Osaka Nanko Cosmos Square (Osaka prefecture), Sumitomo Takamatsu district (Takamatsu city, Kagawa prefecture), Seaside Momocho (Fukuoka city, Fukuoka prefecture)
### 3. Low Carbon City Development Guidance — ④Examples

#### Energy

<table>
<thead>
<tr>
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</thead>
<tbody>
<tr>
<td>① Energy generated by temperature difference of underground water</td>
<td>Bancho district of Takamatsu city and Chuo district of Takasaki city take advantage of underground water heat in regional level. Takasaki city pumps up groundwater from 120m deep aquifer for heat utilization and return used water to underground with a water return well.</td>
</tr>
<tr>
<td>② Waste heat from factories</td>
<td>Case examples...District in front of Hitachi station (rotary kiln waste heat collection for air conditioning and hot-water supply), Marita City district of Wakayama (use of extracted steam at a power station), Saigo district (use of extracted steam at a power plant).</td>
</tr>
<tr>
<td>③ Waste heat from subway/underground shopping malls</td>
<td>Case examples...West district of South exit of Shinjuku, redevelopment district at North exit of Sapporo station.</td>
</tr>
<tr>
<td>④ Cold temperature of ice and snow</td>
<td>There are relatively many cases of introducing the system at a construction level, but regional heat supply system using Turbikita (Snow Melting Tank) (Snow Melting Tank of 4,000㎥) at the north exit of Sapporo Station is the only one introduced at a regional level.</td>
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</table>

#### Greenery

Roles of green expected to be played for the creation of a low-carbon city include: ① realization of an intensive urban structure, ② reduction of CO₂ in the atmosphere as a carbon sink, ③ reduction of CO₂ emissions by using wood-based biomass and ④ alleviation of heat island phenomenon by improving surface ground conditions.
3. Low Carbon City Development Guidance — Target Setting of CO2 Emission Reduction and Absorption and Its Monitoring

<Setting the target figure for the reduction of CO2 and carbon sink based on the guideline>
Setting the target figure for CO2 reduction and carbon sink increase as a whole city by policy, and the application will be done in the following steps.

<Estimation of emissions>
- Estimate the current CO2 emissions by measure (estimate absorption for green)
- Estimate CO2 emissions reduction in the future (short/medium-term) (estimate absorption for green)

<Set the target figure>
- Accumulate the amount of reduction (absorption for green) and set the target figure
- Coordinate with related authorities in case adjustment with the new action plan is needed
- Set the target figure for CO2 emissions reduction, based on the review above

<Application of the target>
- Reflect the set target to an urban planning master plan, an urban facility plan and so on.
- Outcome of the guideline is reflected to “the new action plan” together with the outcome of “manual for the new action plan”

<Monitoring>
- Properly understand the effect of CO2 emissions reduction (absorption for green) of a measure to achieve low-carbon city and analyze the impact of the measure
- Control progress status of a measure to achieve low-carbon city and improve the measure based on the status

3. Low Carbon City Development Guidance — Impact Analysis of Measures

<Transport and Urban Structure Measures>

<Calculation method of CO2 emissions in the area of traffic and urban structure>
Automobile is the major source of CO2 emissions in transport sector and makes up 90% of emissions in the sector. Accordingly, reduction of CO2 emissions from automobile is positioned as a measure to develop low-carbon city in the area of traffic/urban structure.

CO2 emissions = traffic volume × travel distance (trip length) × emission intensity

<Analysis on the effect in the area of traffic/urban structure and the selection of method to forecast the effect>

3 methods to forecast the effect in the area of traffic/urban structure

<table>
<thead>
<tr>
<th>Method</th>
<th>Calculation</th>
</tr>
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<tbody>
<tr>
<td>1</td>
<td>Calculation based on person trip survey data</td>
</tr>
<tr>
<td>2</td>
<td>Calculation based on census OD survey data</td>
</tr>
<tr>
<td>3</td>
<td>Calculation of the effect of a special individual measure</td>
</tr>
</tbody>
</table>

※ Set necessary preconditions for respective measures for evaluation, because past record on the impact of such measure is quite limited
3. Low Carbon City Development Guidance — Impact Analysis of Measures

<Transport and Urban Structure Measures>

An example of simulation based on the assumption that a bold measure was taken:

1) Total population/social structure of urban area in Sendai:
   - Estimate population (right, day), employment rate by area and generation structure
2) Urban structure measures (intensive urban structure):
   - Encourage relocation from the suburbs to peripheral areas and city centers

Targeted Sendai urban area to assume population/social structure, urban structure measures and traffic measures (traffic network, TDM measure) in 2050, and found that CO2 emissions can be reduced by 12.0% compared to BAU in 2050 based on the calculation of the effect of measures related to a city.

Result of estimation:
- CO2 emissions from traffic in an intensive city in 2050 is:
  1. Reduced by 24.0% compared to the current level
  2. Effect of intensive urban structure: 12.0%
  3. Effect of traffic measures: 4.9%
  4. Effect of TDM measures: 1.2%

CO2 emissions from general household in an intensive city in 2050:
- Reduced by 24.6% compared to the current level
- Effect of energy efficiency due to intensive urban structure: -8.1%
- Effect due to population decrease: -17.9%
- Further reduction is possible by replacement with energy saving equipment at a time of building renewal

3. Low Carbon City Development Guidance — Impact Analysis of Measures

<Energy>

Since energy area targets reduction of CO2 emissions from buildings as a measure to create a low-carbon city, floor area ratio is adopted as active mass for understanding CO2 emissions.

Calculation formula of CO2 emissions in energy area

\[ \text{CO}_2 \text{ emissions} = \text{Gross floor area} \times \text{energy load of a building per unit area} \times \text{the overall energy efficiency of heat reservoir} \times \text{emission factor by the type of energy} \]

4 directions in energy area

1. Reduce energy load of a building
   - Lower “energy load per unit area” by constructing buildings which require smaller amount of heat for cooling/heating

2. Improve energy use efficiency of buildings, a district and a town.
   - Improve “the overall energy efficiency of heat reservoir” by introducing highly energy efficient facilities

3. Utilize unused energy as an energy source of a city
   - Lower “emission factor by the type of energy” through replacement of fossil fuel with unused energy

4. Utilize renewable energy as an energy source of a city
   - Lower “emission factor by the type of energy” through replacement of fossil fuel with renewable energy
### 3. Low Carbon City Development Guidance — Impact Analysis of Measures

#### 3.1 Energy

**Assumption for the estimation: factors of change in 2025**

- Year: 2025
- Target: Central districts of Metropolitan area (Otemachi, Marunouchi and Yurakucho)
- Factors of change from the present
  - Floor area
  - CO2 emission factor of electricity

**Result of the estimation**

- Otemachi, Marunouchi and Yurakucho
  - Reduction of 15% compared to the current level
  - Reduction of 40% compared to BAU in 2025

**Calculation method of CO2 fixation/absorption in green area**

Green in a city is the only means of addressing carbon sink in a city. Since data on fixation and absorption of high trees is fully available, it is possible to directly quantify the effect of fixation/absorption of CO2 through measures to make a low-carbon city, in other words, preservation/creation of green in a city.

**Calculation formula of CO2 fixation/absorption in green area**

\[
\text{Effect of CO2 fixation/absorption} = \text{active mass} \times \text{absorption coefficient}_1 + \ldots + \text{active mass} \times \text{absorption coefficient}_n
\]

**Process of effect analysis**

1. **Target for the evaluation of low-carbon effect**
   - Fixation and absorption of CO2

2. **Understand the active mass**
   - Select proper unit depending on the type of activities and basic data (the number of high trees, green area etc.)

3. **Selection of an evaluation method**
   - Gather/summarize data such as the number of high trees and green area, necessary for quantitative evaluation

4. **Quantitative evaluation**
   - Estimate low-carbon effect after multiplying active mass by absorption coefficient

5. **Utilization of evaluation result**
   - Reflect the estimation result to target setting, progress status management and improvement of measures
After calculation of absorption amount due to preservation/creation of green spaces in Metropolitan area, as an example, CO₂ absorption amount was found to increase 3 times more than that of the current level. Also, it is possible to expect greater CO₂ emissions reduction by indirect effect of biomass energy use and rooftop gardening.

Precondition of the estimation:
- Target: Metropolitan area (Built-up area, suburban development area)
- Factors of change from the present
  - Calculate CO₂ emissions reduction effect from the following viewpoint:
  1. "Creation" of green area
  2. "Preservation" of green area

Areas where CO₂ emissions reduction can be expected ("utilization" of green area)
- Use biomass generated by proper management of wood land as wood-based pellet and bioethanol.
- Reduce cooling load with rooftop gardening.

Thank you very much for your kind attention.