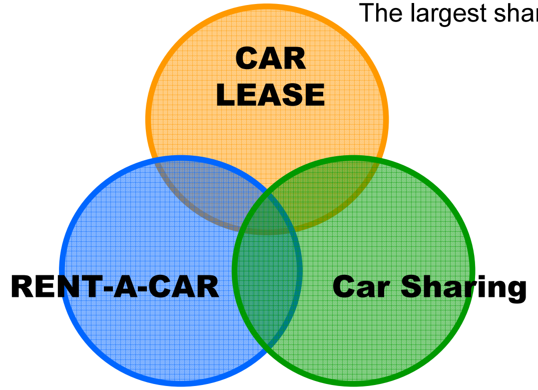
Business Summary of ORIX Car Sharing

ORIX Auto Corporation

□th MAY, 2011

Our Business Concept



Overview（As of March, 2009）

Company Overview

- Establishment : June, 1973
- Representative : Eiji Mitani
- Share Holder : ORIX Corporation 100%
- Number of employees : 2,930

Number of Operation

- Auto Lease Office : 59
- Car Rental Counter/Shop : 788
- Car Sharing Station : 209
- Used Car Retail Shop : 7
- Used Car Tender Center : 6

Unit Number of Purchase and Sale (FY in March 2009)

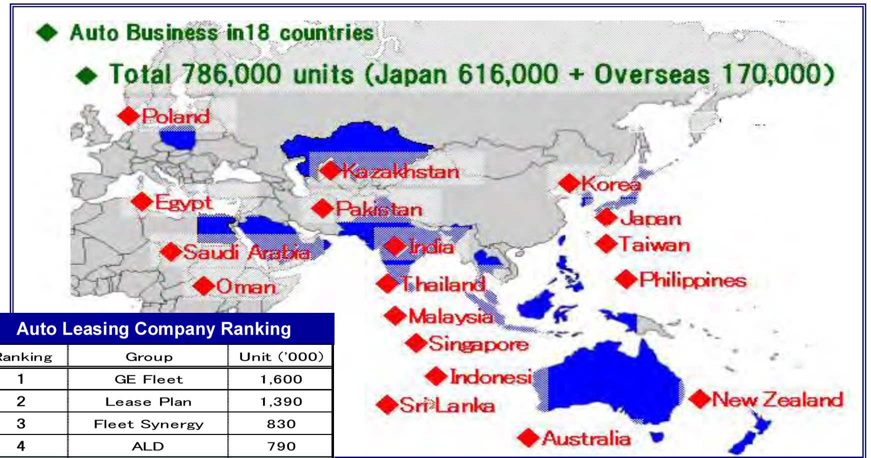
- Vehicle Purchase : 90,000
- Annual Disposal : 85,000

Fleet Size (Unit)

- Total in Japan 616,000
  - Auto Lease 601,000 (including lease to car rental franchisees)
  - Car Rental 44,000

Global Auto Business

- ORIX Group is the 5th biggest auto service group in the world. (based on our own research.)
- ORIX Group develops the businesses mainly in Asia Pacific region.



Auto Leasing Company Ranking

Ranking	Group	Unit ('000)
1	GE Fleet	1,600
2	Lease Plan	1,390
3	Fleet Synergy	830
4	ALD	790
5	ORIX	786

Our Car Sharing Business History

Sep-1999 The national experiment of Car Sharing(using electric vehicles) began in Yokohama-city.

↓

Feb-2002 The establishment of CEV Sharing Corporation which succeeded on the experiment above.

↓

Apr-2005 ORIX group acquired all the stocks of CEV Sharing CO.

↓

Jan-2007 Took over "Rincuru-Car Sharing" business in Nagoya.

↓

Apr-2007 ORIX Auto merged CEV Sharing.

↓

Oct-2007 Began Car Sharing operation in Kyoto

↓

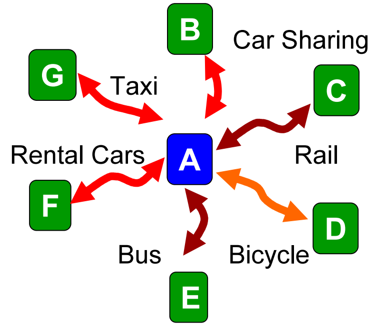
Jan-2010 Began Car Sharing operation in Osaka

Role of Car Sharing (ORIX's Concept)

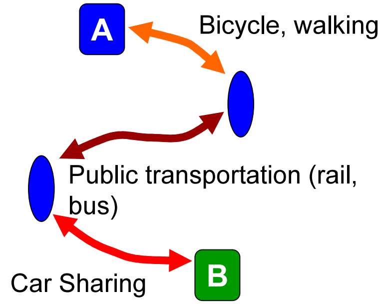
- Transportation mode to interpolate public transportation

1. Diverse modes of transportation (multimodal)

2. Connection to public transportation (intermodal)



Selection of optimal transportation mode



Use of efficient mode of transportation

Definition of Car Sharing System

Two founding concepts

City cars and public cars
- Owned by public institutions and companies
- Spread of electric and low-emission vehicles
- Hi-tech, urban transportation system

Organized car sharing
- Shared on small-scale by peers
- Organized from naturally occurring instances
- Lo-tech, small-scale community level

Differences between these two are shrinking -> Diversification

Public transportation system using cars

Broad-sense car sharing (shared use)

Note: in England,
Car Sharing = Car Pooling
⇒ Shared Use = "Car Club" in Japanese

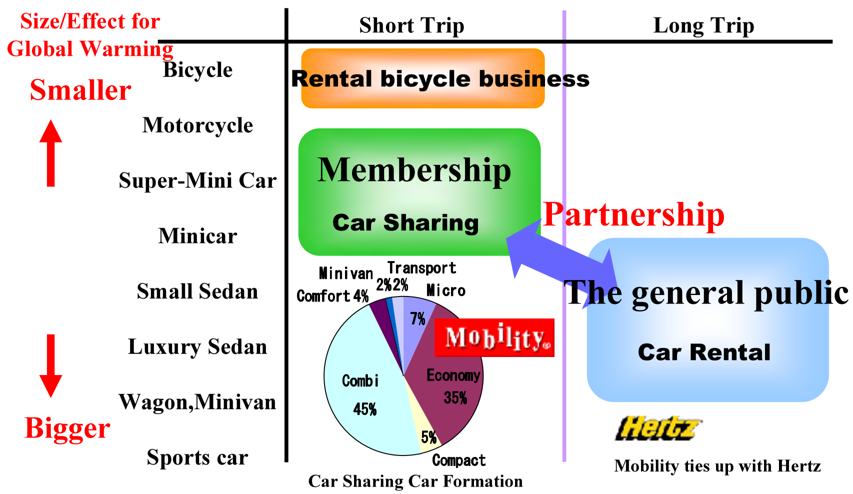
Difference from rental cars

Drivers can feel like they are using their own cars by car sharing system

	Car Sharing	Rental Cars
Users	Members	Unspecified customers
Usage time	Short (can borrow for 24 hrs.) available 24 hours a day	On hourly or daily basis (can borrow within office hours)
Dispatched location	Nearby parking lot	Rental office
Payment	Deferred	Prepaid
Lease agreement	Only at the time of member registration	New agreement every time
Leasing	Unattended	Attended
Fuel/Insurance	Fuel and insurance fees included	Fuel charges separate, insurance fees extra
Refueling	Electric vehicles: no refueling Gas vehicles: refill when tank is at less than 1/3 (with refilling card)	Returned with full tank

Car Sharing needs differs from Car Rental needs

Corporation:The most optimal way for users & city environment

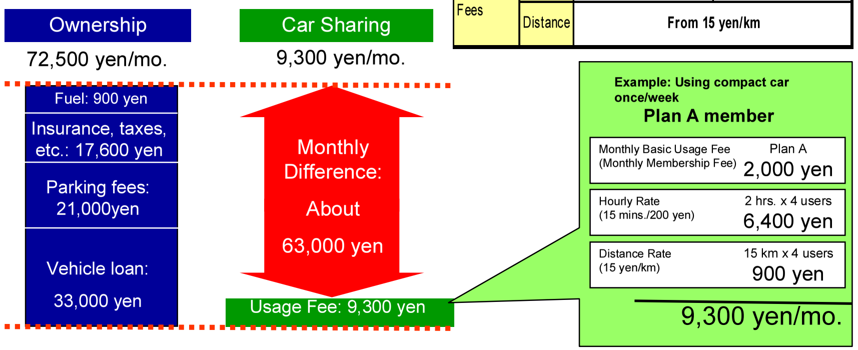


ORIX CarShare — Expense Comparison (Payment by users individually)

- Selectable payment plans based on frequency of use
- Parking, gas, insurance and taxes are included
- No need for vehicle inspections or routine maintenance

Plan		Plan A	Plan B
Registration Fee		5,250 yen	
Monthly Usage Fee		2,000 yen	1,000 yen
Usage Fees	Time	From 200 yen/15 mins.	From 300 yen/15 mins.
	Distance	From 15 yen/km	

Reductions in Automotive



* A total of 8 hours and 60 km driving per month was assumed for the Plan A which does not include usage registration fee (5,250 yen) or IC Card issuing fee (1,000 yen per card).

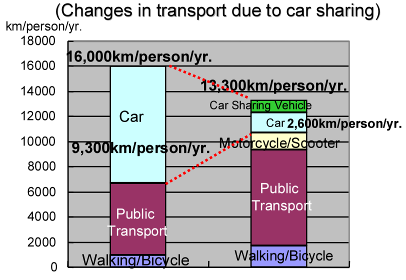
ORIX CarShare — Controlling Unnecessary Car Use

Benefits

1. Reduces urban traffic congestion
2. Stimulates public transportation (complements transportation services)
3. Contributes to environmental issues such as improvement of urban air quality
4. Global warming countermeasures (through reducing energy consumption)
5. Resolves urban parking issues

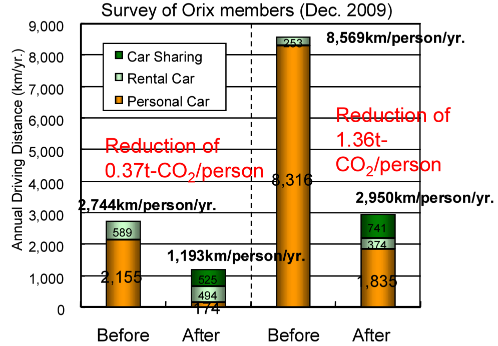
Global Warming Countermeasures
I. Reducing driving distances
II. Increasing use of public transportation (modal shift)
III. Downsizing
IV. Utilizing low emission vehicles

e.g. Car Sharing Survey in Switzerland (Changes in transport due to car sharing)



Source: Energy 2000/Muheim 1998

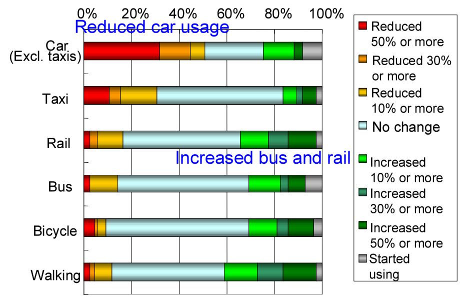
Survey of Orix members (Dec. 2009)



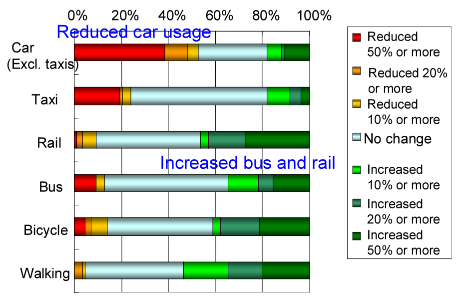
ORIX CarShare — Modal Shift

- Increased use of public transportation
  Users compare the costs of different modes of transportation and lower cost rail and buses as a result.
- Bicycles and walking mode also have increased

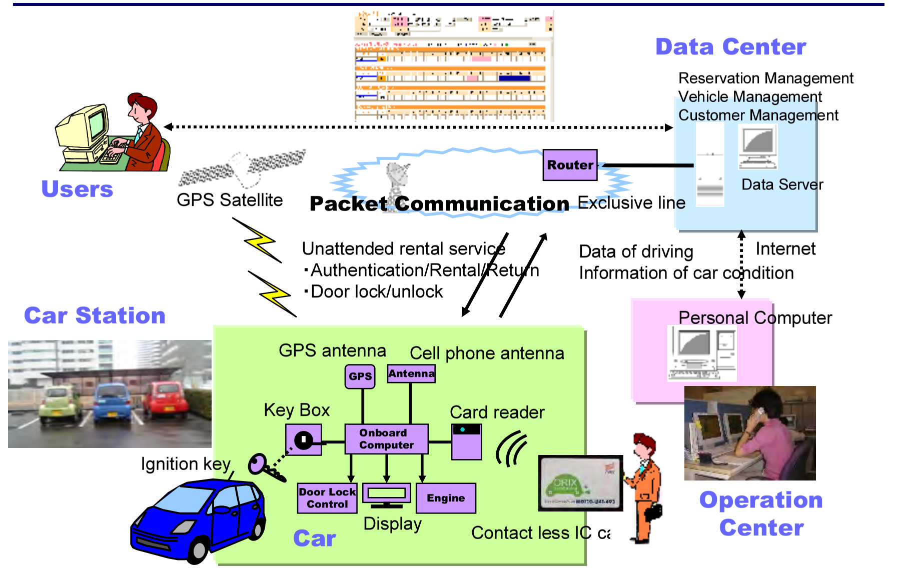
Member Survey Results (n=121, Tokyo area)



Member Survey Results (n=91, Nagoya area)



ORIX CarShare — Overview of Our System

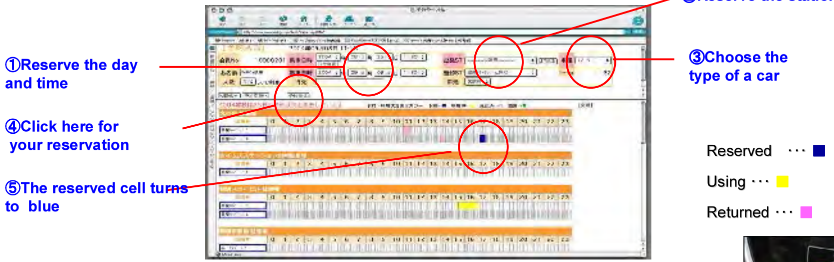


Using Car Sharing Vehicle

1) Reservation

http://www.orix-Car Sharing.com/

・Reserve by your PC, cellphone site or telephone(available 24 hours).
・Minimum of 30 minutes and maximum of 4 days. Reservation available from 2 weeks before the using date.
The rate is charged for each 15 minutes.



※You can use the car from 15 minutes before the reserved time. You cannot shorten the reservation time after you start to use the car.

2) Pick up the vehicle

・User's identification and unlocking the door by IC card.
・The ignition key is in the glove box. Turn it to (Pick-up) and pull it out.

3) Driving

・When you park the car during your reservation time, lock and unlock the door using the ignition key.

4) Returning the vehicle

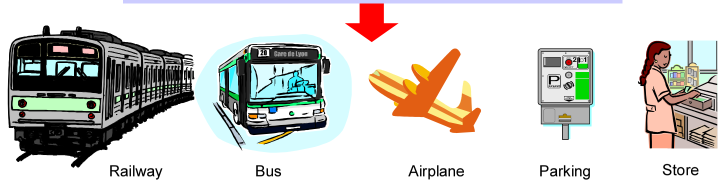
・When you return the vehicle to the station, insert back the ignition key into the key box and turn it to (return).
・Get out of the car and lock the doors using your IC card.

Contactless IC Card "FeliCa"

■Function of Management / Key / Individual Authentication by one card
■For ID confirmation, Credit card and Cell phones with FeliCa are available

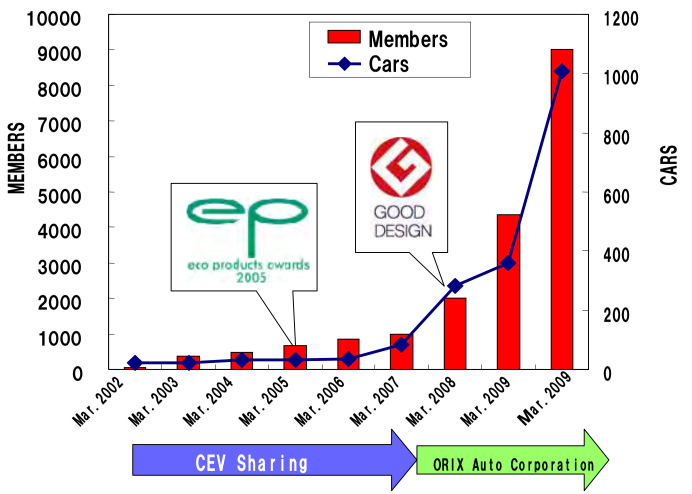
Contactless IC card (FeliCa) for vehicle key of members. PASMO can be also used as the vehicle key from April 2008. (PASMO: digital cash and commuter pass for public transportation such as railways and buses.)

You will be able to use our vehicle key in many situations in the future



Car Sharing Members

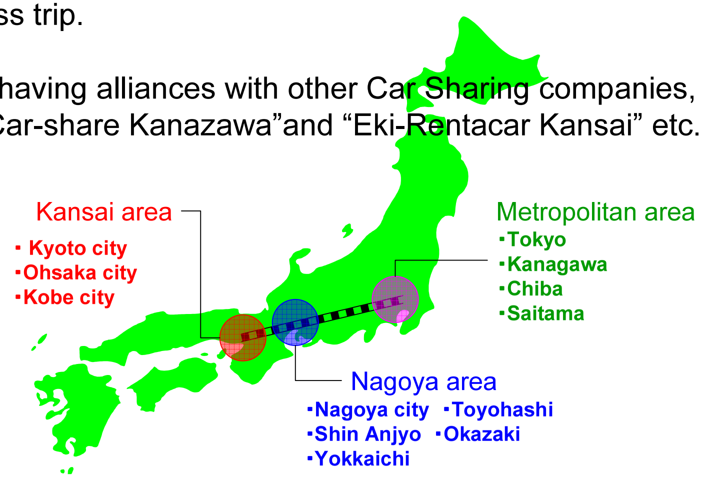
■**10,000 Members, 736 stations, 1006 Cars (30/4/2010)**



Car Sharing Network

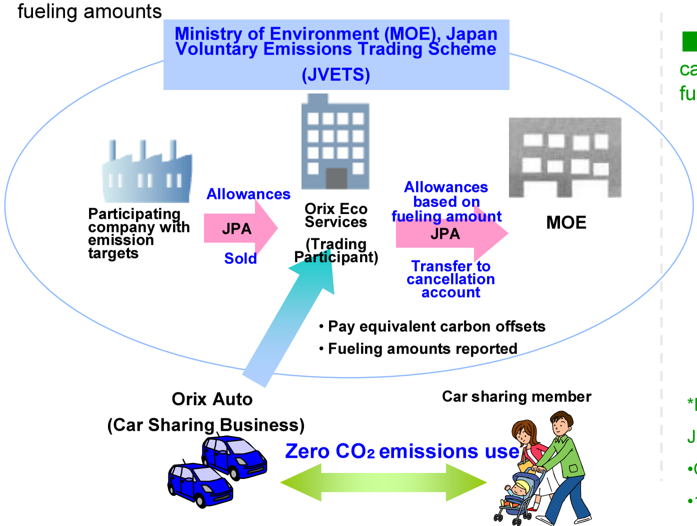
■Car sharing available in Kyoto and Nagoya which is useful for business trip.

■We are having alliances with other Car Sharing companies, such as "Car-share Kanazawa"and "Eki-Rentacar Kansai" etc.



Carbon Offsetting

For offsetting, we acquire carbon allowances equivalent to CO_2 emissions based on quarterly fueling amounts



■ CO_2 emissions calculated from fueling amounts

||

669,374kg in CO2 emissions

||

Total offset expenses 1,341,224 yen

*Period:

Jul. 2008 – Mar. 2010

•Calculation:

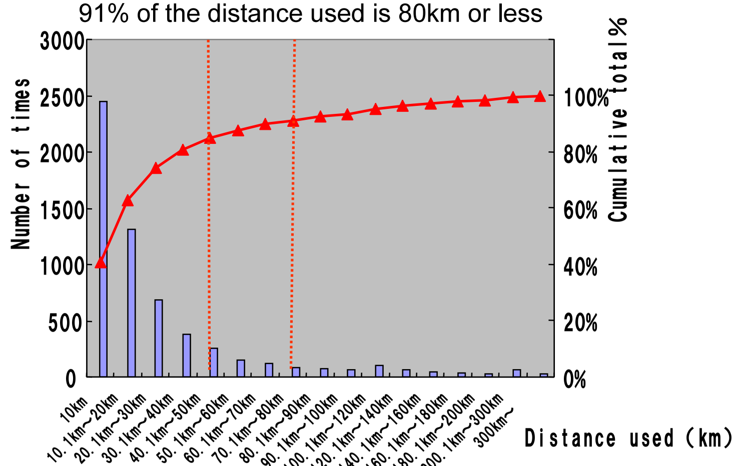
•1kg - CO2 =2 yen

How the members use the Car sharing vehicles

Mainly short time and short distance

85% of the distance used is 50km or less

91% of the distance used is 80km or less



Apr. 2009

EV Sharing with Tokyo Arakawa Ward Government

■Car sharing between Government uses and residential use
Weekdays:for the use of the staff and the residents of Arakawa ward
Holidays:for the use of the residents of Arakawa ward

■2 electic vehicles "i-MiEV" (at Arakawa Eco-Center)

■Period :Mar.24.2010～Mar.31.2012

Arakawa Ward Government → (Operative Trust) → ORIX Auto Company → (Proceeds) → Arakawa Ward Government

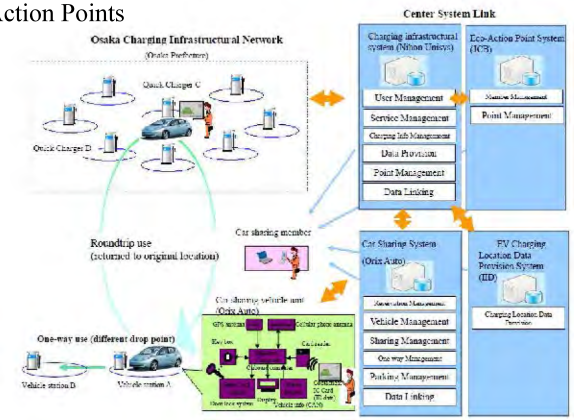
ORIX Auto Company → (Rent vehicles) → Residents of Arakawa Ward

Launch of Osaka Prefectural Electric Vehicle Sharing Project

MOE "Japanese Autolib Technical Development with Electric Vehicles"

- Car sharing system with the EV Nissan Leaf
- Uses the Osaka Charging Infrastructural Network
- System to award Eco-Action Points
- Data provision system

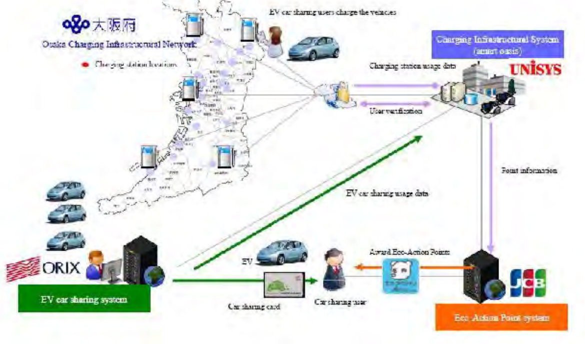
■Participants
Orix Auto
Nihon Unisys
IID
JCB
Osaka Prefecture



ORIX CarShare — Awarding Eco-Action Points to Charging Service Users

This service awards electric vehicle (EV) users Eco-Action Points based on usage information from charging stations installed in commercial facilities and other locations.

- •Nihon Unisys: Charging infrastructural system
- •JCB: Eco-Action Point platform



ORIX CarShare — Charging Location Data Provision System

Information of charging locations is provided on smartphones
1) Confirms driving distance from point of departure to destination
2) Displays charging locations along the driving route
3) Allows users to post reviews of EV charging stations (ease of use, accessibility, free or charge, etc.) and compiles database of information
4) Charging stand availability information

ORIX CarShare — Preventing Failed Introduction of EVs and Car Sharing

1. Plan to introduce EVs and car sharing system without any field survey (preceding image)
⇒Service usage rates would be low, making it difficult to continue the service.

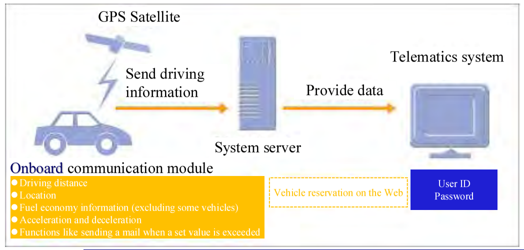
2. There is no practical, feasible plan for introducing EVs.
⇒It is essential to solve the issues preventing the spread of EVs (price, driving range, charging infrastructure).

3. There is not sufficient understanding by users regarding EV use
⇒Understand current usage condition of users and promote proper service.

Field survey (telematics) ⇒ Promote proper allocation and service

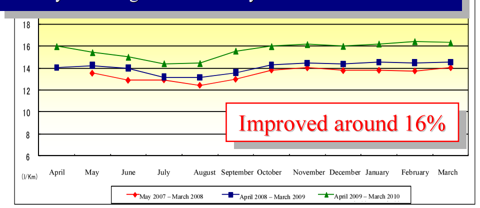
Telematics Services

Telematics is a system that uses an onboard communication device to make driving information which are normally difficult to understand more visible and improve important vehicle and driving issues.



- ●Eco-drive <Eco-drive diagnosis>
  Enables reduction of fuel consumption, which will help to reduce CO_2 emission and fuel cost.
- ●Safety <Dangerous behavior information>
  Enables reduction of dangerous behaviors (sudden braking, sudden acceleration, overspeed), which will be helpful as precautionary measures against accidents.
- ●Positioning information <Driving record>
  Enables to investigate driving records and respond to an emergency by grasping the present location.
- ●Vehicle operational status <Reservation system>
  Enables to use vehicles effectively by reserving shared vehicles, also helps to grasp the optimal number of vehicles to own.

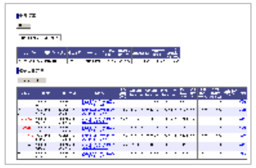
3-year averaged fuel economy data for Orix vehicles



Pre-testing EV Introduction with Telemetrics

Vehicle dynamic survey by introducing telemetrics

Driving distance (range) check



Obtain daily driving distances

Select a suitable EV

Promoting alternatives in green vehicles

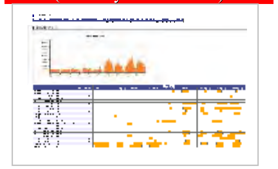
Driving route and positioning check

Obtain vehicle positioning information

Locations with multiple vehicles

Install charging stations in optimal locations

Usage check (time/days of the week)



Understand vehicle usage patterns

Optimal usage plan for leased/shared/rented vehicles

Optimal vehicle deployment

Building a plan to introduce optimal EVs (green vehicles)

ORIX CarShare Reference: Expansion of Car Sharing Service as a Political Measures in Paris City

■ National and Paris city support
- Law promoting car sharing enacted in May 2006
- Paris city enacts law promoting car sharing in February 2007
- Grenelle I Bill approved in October 2008. Promotes car sharing.
- Grenelle II Bill obliges businesses to reduce CO_2 (reduce company cars, begin car sharing)

■ Five businesses (three car sharing companies, two car rental companies)

Paris City Car Sharing Standards
1) Services must be provided fairly
2) Stations must be set up in locations easily accessible by walking, bicycle, or public transportation
3) Must be able to reserved right before use (15 minutes), and available 24 hours a day
4) Payment must be made electronically
5) Metered charges based on usage required, with base rates for car sharing services optional
6) Rates are proportional to reserved time, or calculated based on distance driven. Rates made in consideration of fuel, insurance, maintenance and repairs.
7) To keep up with user demands, car sharing businesses are required to cover 80% of reservations made at least four hours in advance.
8) Car sharing businesses must thoroughly maintain especially safety devices to ensure proper vehicle function
9) Vehicles must meet all European (environmental) standards
10) Car sharing businesses must work with other businesses so that users will use public transportation and other environmentally friendly mode of transportation

Roadside car sharing station

Paris installed car sharing station signage for free

ORIX CarShare Reference: Paris Autolib Plan

autolib'

■ Overview

Success of community cycle "Velib" ⇒ Paris mayor plans service availing use of electric vehicles

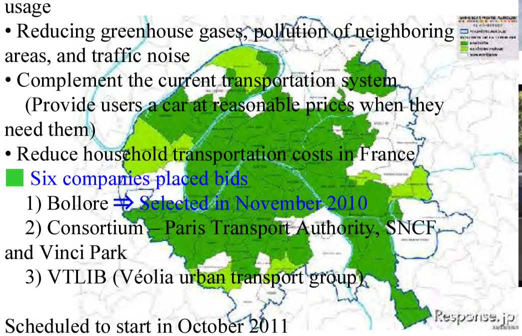
(1) Autolib association: Paris and 27 communes
(2) 3,000 electric vehicles that can freely be used for one-way trip
(3) 1,000 car sharing stations (700 in central Paris)

■ Objective
- Improving environmental issues caused by urban car usage
- Reducing greenhouse gases, pollution of neighboring areas, and traffic noise
- Complement the current transportation system (Provide users a car at reasonable prices when they need them)
- Reduce household transportation costs in France

■ Six companies placed bids

1) Bollore ⇒ Selected in November 2010
2) Consortium – Paris Transport Authority, SNCF and Vinci Park
3) VTLIB (Véolia urban transport group)

Scheduled to start in October 2011



Bluecar (4 seats, L: 3.65m, W: 1.70m, H: 1.61m)

Capacity Development and Institutional Strengthening for GHG Mitigation
August 25 , 2011

Low Carbon City Development Guidance

Yamakawa Osamu
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City Bureau,
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JAPAN

< Outline >

1. Background of Low Carbon City Development

2. Urban Development Policies against Global Warming

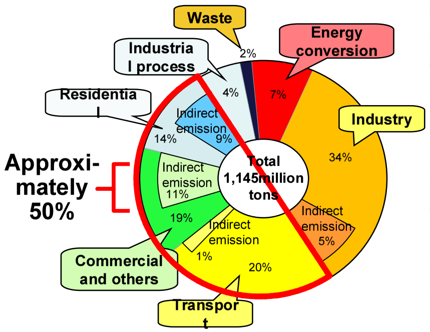
3. Framework of Low Carbon City Development Guidance

1. (1) Global Warming and Urban Development Activities in Japan

<Current status of the global warming and activities of a city>

Approximately 50% of the total CO_2 emissions in Japan comes from activities in a city, and transportation sector.

Breakdown of CO_2 emissions (FY2009)



		The base year of Kyoto Protocol (share)	FY2008 (compared to the base year)	Rate of change from the previous fiscal year)	FY2009 (compared to the base year)
	Total	1,144 [100%]	1,215 (+6.2%)	<-5.8%>	1,145 (+0.03%)
Energy derived emissions	Sub total	1,059 [92.6%]	1,138 (+7.5%)	<-5.5%>	1,075 (+1.5%)
	Industrial sector (factory etc.)	482 [42.1%]	419 (-13.1%)	<-7.3%>	388 (-19.5%)
	Transport sector (automobile/ship etc.)	217 [19.0%]	235 (+8.1%)	<-2.5%>	229 (+5.4%)
	Commercial and others (commerce/service/office etc.)	164 [14.4%]	235 (+43.0%)	<-6.8%>	220 (+33.6%)
	Residential sector	127 [11.1%]	171 (+34.2%)	<-5.5%>	162 (+26.9%)
	Energy conversion sector (power plant etc.)	67.9 [5.9%]	78.1 (+15.4%)	<+0.7%>	78.8 (+16.2%)
Other sources of CO_2 emissions	Sub total	85.1 [7.4%]	76.2 (-10.4%)	<-9.1%>	69.3 (-18.5%)
	Industrial process	62.3 [5.4%]	50.3 (-10.2%)	<-13.7%>	43.4 (-30.4%)
	Waste (incineration etc.)	22.7 [2.0%]	25.9 (+14.3%)	<-0.1%>	25.9 (+14.1%)
	Leak from fuel	0.04 [0.0%]	0.04 (+3.2%)	<-7.1%>	0.04 (-4.0%)

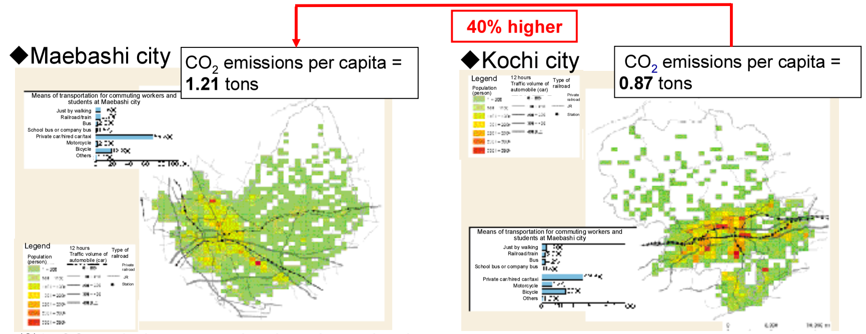
(unit: million tons of CO_2)

Source: Greenhouse gas emissions in FY2009 (preliminary estimates):(Ministry of the Environment)

1. (2) Relationship between urban structure and CO_2 emission

< Urban structure have a strong correlation with CO_2reductoin>

Both cities have similar areas and populations. Maebashi City has a sprawling low-density urban area and a higher share of passenger cars. Therefore, the annual CO2 emission per capita in the transport sector is 40% higher than that of Kochi City's.



※1 CO_2 emissions per capita above is restricted to passenger transportation sector

Source: Environmental white paper in FY2006

2. (1) Major actions to reduce CO_2 emissions in Japan

<Efforts to reduce CO_2 in Japan>

December 1997 : Adoption of Kyoto Protocol　Japan committed the reduction of 6%

April 2005 : Formulation of Kyoto Protocol Target Achievement Plan
→ Positioning of "the creation of region/ urban structure and socio economic system that produces less CO_2"

March 2008 : Amendment to the Kyoto Protocol Target Achievement Plan
→ Positioning of "Low-carbon urban/regional Designs"

June 2008 : Amendment to the Law Concerning the Promotion of the Measures to Cope with Global Warming
Obliged the formulation of Local government action plan to cope with global warming (District measures) (called new action plan hereinafter) (Prefectures and specially designated city and beyond)

May 2010 : The growth strategy of Ministry of Land, Infrastructure, Transport and Tourism

June 2010 : Government's new growth strategy ~Scenario to revive "energetic Japan"~

The Low Carbon city Development Guidance was formulated in order to determine detailed actions and set target indicators.

5

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

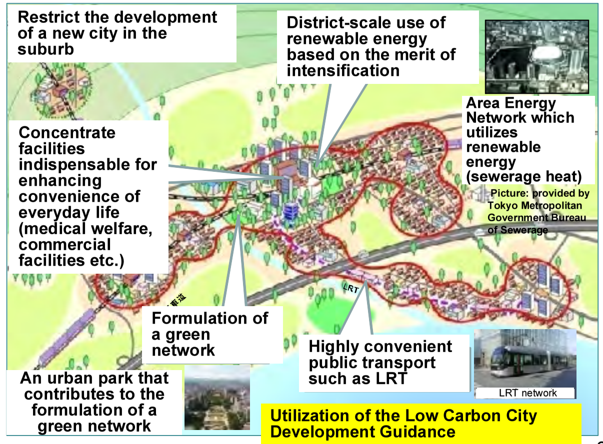
<Formation of low-carbon Urban/Regional structures, and socio-economic systems>

➢**Low-carbon Urban/Regional Designs**

○Realization of compact, low-carbon urban structure

○Promotion of Area-wide Energy Usage

○ Decarbonization of Urban Areas through improving the thermal environment by urban greening and other heat island countermeasures



<Image of an compact city>

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2. (3)Law Concerning the Promotion of the Measures to Cope with Global Warming

■ Formulation of "Action Plan of Local Government" (New Action Plan) against Global Warming

Local Government (prefectures and designated cities) are obliged to formulate "New Action Plan" under the Law Concerning the Promotion of the Measures to Cope with Global Warming

Action aim to･･･

•Use natural energy
•Reduce GHG emission to be taken by enterprises and citizens.
•Promote public transportation, conserve green area in urban area and promote greenery
•Reduce wastes and recycle-oriented society.

■ "Law Concerning the Promotion of the Measures to Cope with Global Warming " Article 20-3, Item4

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

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<Purpose and scope of the guidance >

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

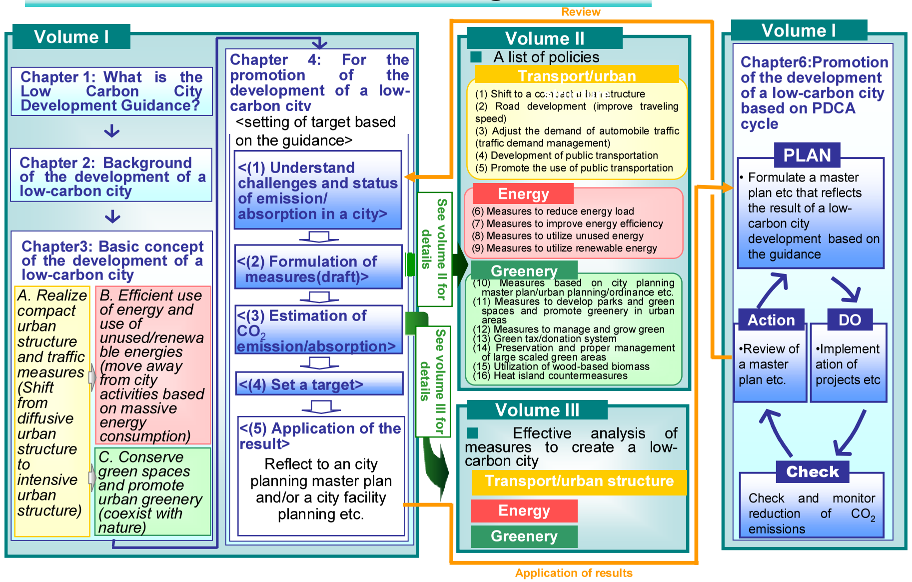
(1) Greenhouse gas covered by the guidance is “CO_2”, which is derived from energy resourced deeply related to an urban structure namely.

(2) Cover both tangible and intangible measures in extensive areas of transport/urban structure, energy and greenery, related to city planning that contributes to the reduction of CO_2.

When to apply the guidance

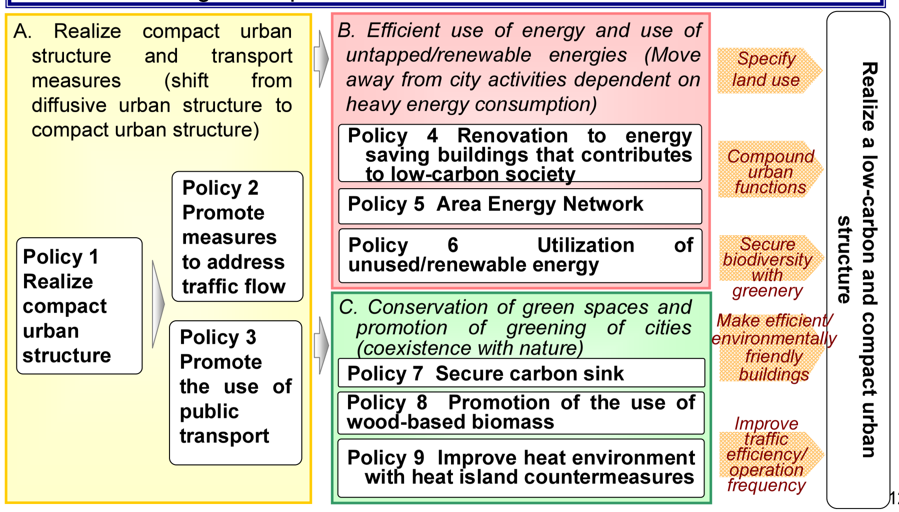
- When revising city master plan etc .
- When formulating Comprehensive Urban Transportation Strategy, urban traffic infrastructure development, redevelopment project and facility development for urban planning .
- When analyzing impact of measures of creating a low-carbon city.

<Structure and contents of the guidance>



<Concept and policy for the development of a low-carbon city>

Since transformation of an urban structure is highly relevant to low-carbonization, achieving the transformation to the compact urban structure while addressing are important.



3. Low Carbon City Development Guidance – (3) Policy Menu

<Plicy Menu : Transport/urban structure,Energy,Greenery>

Land use / Urban functions / Greenery / Building / Traffic/ travel

Transport/urban structure

Menu 1
Shift to a compact urban structure

Menu 2
Road development (improve traveling speed)

Menu 3
Adjust the demand of automobile traffic (traffic demand management)

Menu 4
Development of public transportation

Menu 5
Promote the use of public transportation

Energy

Menu 6
Measures to reduce energy load

Menu 7
Measures to improve energy efficiency

Menu 8
Measures to utilize unused energy

Menu 9
Measures to utilize renewable energy

Greenery

Menu 10
Measures based on city planning master plan/city planning/ordinance etc.

Menu 11
Measures to develop parks and green spaces and promote greenery

Menu 12
Measures to manage and grow greenery

Menu 13
Impose green tax/donation system

Menu 14
Conserve and properly manage large green areas

Menu 15
Implement of wood-based biomass

Menu 16
Heat island countermeasures

Intensify / *Complex* / *Nature friendly* / *Efficient Environment friendly* / *Improve efficiency/ operation frequency*

Realize low-carbon compact urban structure

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3. Low Carbon City Development Guidance – (4) <Transport and Urban Structure Measures>

Relationship between the calculation formula of CO_2 emissions in traffic area and the measure

CO_2 emissions ＝traffic volume
× travel distance（trip length）
× emission intensity

In order to reduce CO_2 emission, it is necessary to introduce policies that will change each factor in this formula.

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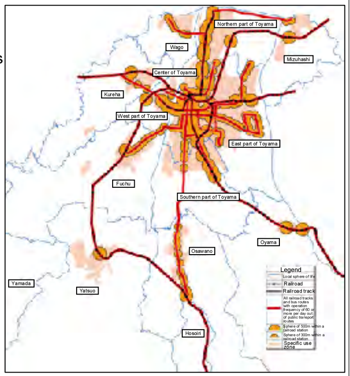
3. Low Carbon City Development Guidance – (4) Examples
<Transport and Urban Structure Measures(1)>

<Menu 1：Shift to a compact urban structure>

measure	Details of a measure
Encourage location of residential areas in the vicinity of traffic hub	"Project to promote locating residential areas along public transport routes in Toyama city <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 <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] **<Areas along public transport lines>** 

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3. Low Carbon City Development Guidance – (4) Examples
<Transport and Urban Structure Measures(2)>

<Menu 4: Development of public transportation (1)>

measure	Details of a measure
LRT (Light Rail Transit)	 Toyama light rail  Feeder bus connected to light rail
BRT (Bus Rapid Transit)	 Fujisawa city, Kanagawa prefecture 18m-long, non-step coupled bus, "Twin liner"

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3. Low Carbon City Development Guidance – (4) <Energy measures>

Relationship between the calculation formula of CO_2 emissions in energy area and the measure

CO_2 emissions ＝ Gross floor area
× energy load of a building per unit area
÷ the overall energy efficiency of heat reservoir
× emission factor by the type of energy

4 directions in energy area

In order to reduce CO_2 emission, it is necessary to introduce policies that will change each factor in this formula.
(1) Reduce energy load of a building
(2) Improve energy use efficiency of buildings, a district and a town.
(3) Utilize untapped energy as an energy source of a city
(4) Utilize renewable energy as an energy source of a city

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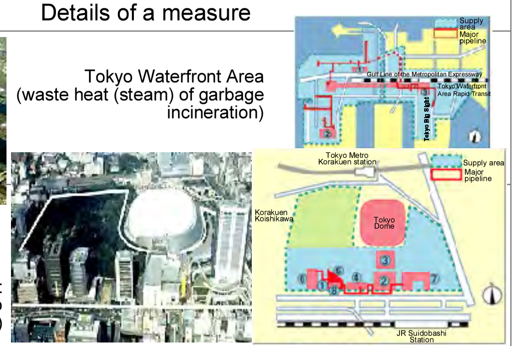
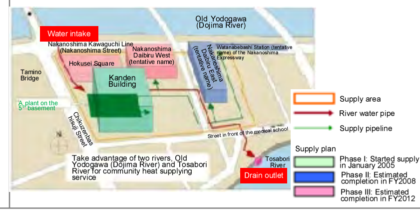
3. Low Carbon City Development Guidance – (4) Examples <Energy(1)>

<Menu 8: Measures to utilize unused energy>

measure	Details of a measure
(1) Waste heat of garbage processing plant	Tokyo Waterfront Area (waste heat (steam) of garbage incineration)
(2) Untapped energy generated at sewerage facility	Koraku Ichome district In Tokyo (use of untreated water)
(3) Energy generated by temperature difference of rivers and oceans	Nakanoshima 3 chome district in Osaka (use of river water)



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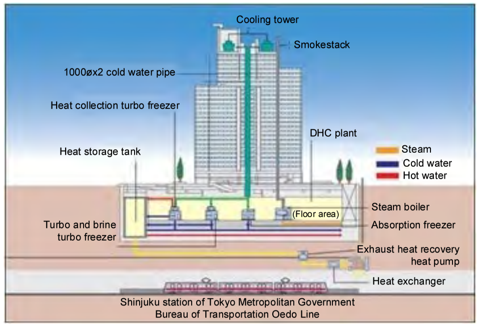
3. Low Carbon City Development Guidance – (4) Examples <Energy(2)>

<Menu 8: Measures to utilize unused energy >

measure	Details of a measure
(4) Energy generated by temperature difference of underground water	Takasaki city pumps up groundwater from 120m deep aquifer for heat utilization and return used water to underground with a water return well.
(5) Waste heat from factories	Case examples…District in front of Hitachi station (rotary kiln waste heat collection for air conditioning and hot-water supply)
(6) Waste heat from subway/underground shopping malls	Case examples…West district of South exit of Shinjuku
(7) Cold temperature of ice and snow	Case examples…North exit of Sappolo station



West district of South exit of Shinjuku (use of waste heat from underground)

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3. Low Carbon City Development Guidance – (4) <Greenery>

Relationship between the calculation formula of CO_2 fixation/sink in Greenery area and the measure

Effect of CO_2 fixation/sink ＝
＋ activity volume1 × sink coefficient 1
＋ …
＋ activity volume n × sink coefficient n

In order to increase CO_2 sink , it is necessary to introduce policies that will enhance each factor in this formula.

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3. Low Carbon City Development Guidance – (4) Examples <Greenery>

<Effect and image of making low-carbon society>

Roles of greenery for the creation of a low-carbon city include;
(1) realization of an intensive urban structure,
(2) reduction of CO_2 in the atmosphere as a carbon sink,
(3) reduction of CO_2 emissions by using wood-based biomass and
(4) alleviation of heat island phenomenon by improving surface ground conditions.

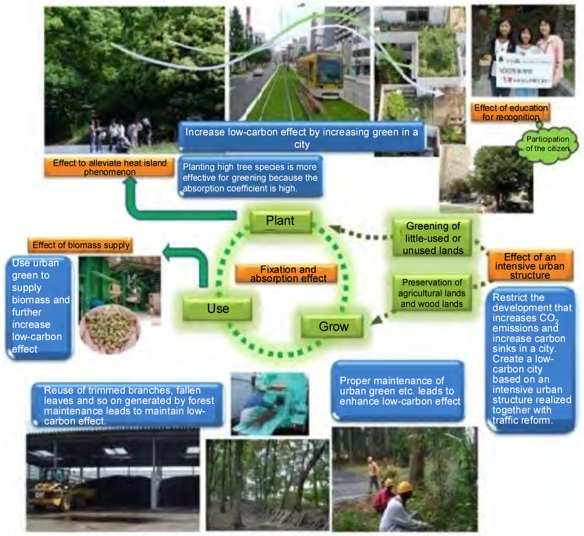


Image of low-carbon effect of urban greenery

3. Low Carbon City Development Guidance – (5) Impact Analysis of Measures <Transport and Urban Structure Measures(1)>

Relationship between the calculation formula of CO_2 emissions in traffic area and the measure

CO_2 emissions ＝traffic volume
× travel distance（trip length）
× emission intensity

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

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

- Method 1: Calculation based on person trip survey data
- Method 2: Calculation based on census OD survey data
- Method 3: Calculation of the effect of a special individual measure

3. Low Carbon City Development Guidance – (5) Impact Analysis of Measures <Transport and Urban Structure Measures(2) - 1>

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

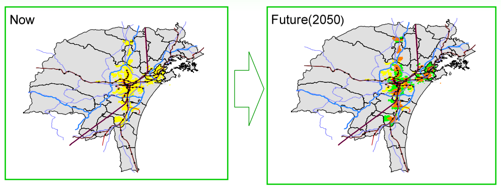
<Precondition for the estimation; Factors of change in 2050>

1) Total population/social structure of urban area in Sendai
⇒ Estimate population (night, day), employment rate by sex and generation structure

2) Urban structure measure(Intensive urban structure)
⇒Encourage relocation from the suburbs to near stations and city center

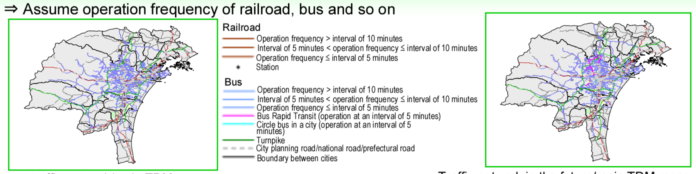
Residential population

Residential population density
A:City center 78→120 persons/ha
B: Hub 50→80 persons/ha
C: Core traffic point 46→60persons/ha
D: Outskirts 40→20persons/ha
E: Suburbs 3.3→0.9persons/ha



3)-1 Traffic measures contribute to decrease CO_2(traffic network)
⇒ Assume improvement of railroad and road

3)-2 Traffic measures contribute to decrease CO_2 (TDM measure)
⇒ Assume operation frequency of railroad, bus and so on



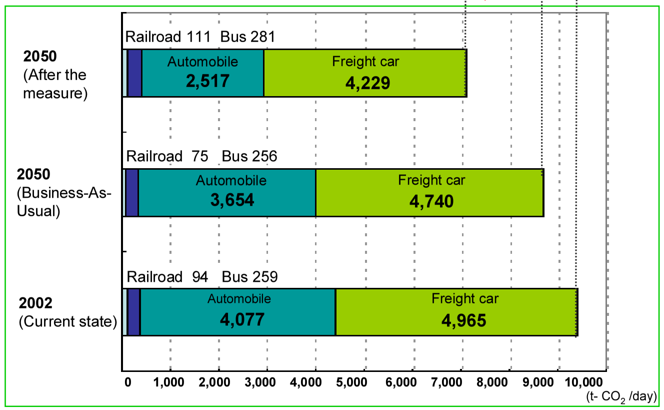
Current traffic network/main TDM measures　　Traffic network in the future/main TDM measures

Next page

3. Low Carbon City Development Guidance – (5) Impact Analysis of Measures <Transport and Urban Structure Measures(2) - 2>

< Result of estimation >

CO_2 emissions from traffic in an intensive city in 2050 is:
(1) Reduced by **24.0%** compared to the current level
Effect of intensive urban structure :12.0%
Effect of population reduction : 7.1%
Effect of traffic measures : 4.9%
(traffic infrastructure development: 3.8%)
Effect of TDM measure : 1.2%
Reduced by **18.2%** compared with BAU of 2050



Relationship between the calculation formula of CO_2 emissions in energy area and the measure

CO_2 emissions ＝ Gross floor area

× energy load of a building per unit area

÷ the overall energy efficiency of heat reservoir

× emission factor by the type of energy

4 directions in energy area

Set 4 directions below in energy area for the creation of a low-carbon city, based on the assumption that floor area ratio improves other factors related to CO_2 emissions.

(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

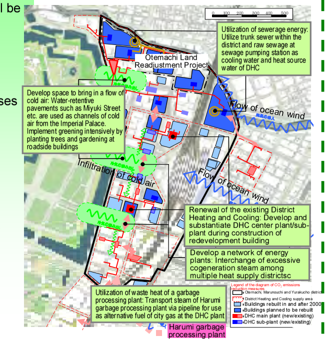
An example of estimating the effect of measures in energy area

<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

＜Floor area of the future＞
・Building floor area：
（2000） **600ha⇒(2025) 900ha**
※ Estimated that a half of floor area remains to be used in 2025 and the other half will be renewed (floor area is doubled), which is 1.5 times larger than the area in 2000
・Improvement of CO2 emissions coefficient of power system：
(2000) 0.334 →(2025) 0.28

＜Assumption of a menu of CO2 reduction measures＞
◇Measures to individual buildings
•50%（based on floor area）of the existing buildings will be renewed and energy saving performance will improve.
◇**District/town-scale measures**
●Area Energy Network
•Improve cooling efficiency
→Improvement in the existing DHC performance increases the total efficiency from 0.75 in 2000 to 1.05 in 2025
→ Connection and network of DHC plants
・Introduction of a large-scaled cogeneration and sewage heat utilization system
●District-scale rooftop gardening
•Implement district-scale rooftop gardening of redevelopment buildings based on concentration of heat source equipment (cooling tower)
●Introduction of renewable energy
•Set photovoltaic power generator on top of buildings
•Biogas generated from food waste of surrounding restaurants is used as fuel for DHC plant
●Heat (steam) from Harumi garbage processing plant is transmitted
・Used as heat source of DHC plant



Next page

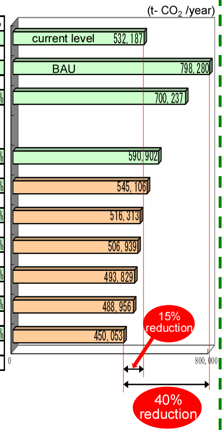
<Result of the estimation>

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

※Assume that floor area increases by about 50% by 2025

	Classification of measures	Content/measure	Reduction volume	Ratio
2000	Baseline			
2025	Increase in floor area		－	－
	System power measure	Emission coefficient improvement	98, 042	28. 2%
	Measures for individual buildings	Redevelopment building	109, 336	31. 4%
	Area Energy Network	Enhance cooling efficiency	45, 796	13. 2%
		Large scaled cogeneration	28, 793	8. 3%
	District-scale rooftop gardening	Redevelopment building etc.	9, 373	2. 7%
	Introduction of renewable energy	Photovoltaic power generation	13, 110	3. 8%
		Food scraps biomass	4, 873	1. 4%
	Heat (steam) from Harumi garbage processing plant		38, 903	11. 2%
	Total volume of reduction		348, 227	100%

Measures cto reduce CO2 on district-scale
41% of reduction



Relationship between the calculation formula of CO_2 fixation/sink in green area and the measure

Effect of CO_2 fixation/sink ＝
＋ activity volume 1 × sink coefficient 1
＋ …
＋ activity volume n × sink coefficient n

<Process of effect analysis>

(1) Understand the activity volume
• Select proper unit depending on the type of activities and basic data (the number of tall trees, green area etc.)

↓

(2) Selection of an evaluation method
• Gather/summarize data such as the number of tall trees and green area, necessary for quantitative evaluation

↓

(3) Quantitative evaluation
• Estimate low-carbon effect after multiplying activity volume by sink coefficient

↓

(4) Utilization of evaluation result
• Reflect the estimation result to target setting, progress status management and improvement of measures

An example of estimating effect of measures in green area

<Precondition of the estimation>

- Target Metropolitan area
- Factors of change from the present
  ~Calculate CO_2 emissions reduction effect from the following viewpoint~

a. "Increase " of greenery

Set the target of increasing green surface in a city to 30% (9% in Metropolitan area at present), and achieve the coverage of forest up to 50%. Set the target of turning 50% of lands possibly abandoned of cultivation※ in the suburbs (suburban development area, coordination area) to wood lands (※about 18,000ha in Metropolitan area at present)

b."Preservation" of green area

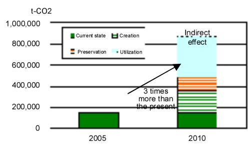
Enhance function as carbon sink by properly managing wood land in the suburbs

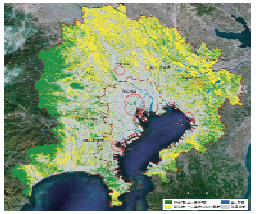
※ Indirect effect
"utilization" etc. of green area

<Result of estimation>

With "creation" + "preservation" of green area, CO_2 fixation/sink amount increases 3 times more than that of the current level

Areas of potential CO_2 absorption
- ・Creation of green areas in a city
- ・Development of wood land
- ・Increase absorption through proper maintenance
- ・Forest management (Present level)





Areas where CO_2 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

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Thank you very much for your kind attention.

Capacity Development and Institutional Strengthening for GHG Mitigation
August 25 , 2011

Low Carbon City Development Guidance

Case Study of Effectiveness Analysis

[Case of A City]

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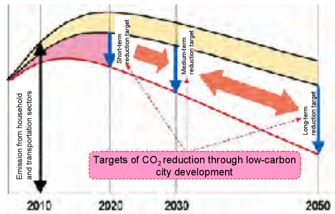
Ministry of Land, Infrastructure, Transport and Tourism, JAPAN

1. Outline of Case Study (p1 of the material distributed in advance)

Table 1-1 Contents of Case Study

	Estimation
Current state (2007)	● Calculation based on the New Action Plan Manual (all CO_2 related sectors) ● Calculation in the Guideline method ① Traffic (automobiles): Calculation based on Census OD survey data ② Energy (Commercial and residential): Calculation based on the floor area by use of building ③ Greenery: Calculation based on the number of existing tall trees in city parks
BAU (trend) (2030)	● Current emissions adjusted with the future population growth rate etc.
Effectiveness of measures (2030)	● Followings understood through the Guideline method
Traffic and urban structure sector	① Promotion of utilization of public transportation + mobility management ② Effect of consolidation of functions along public transportation lines ③ Evaluation of individual specific measures (bicycle rental and fringe parking)
Energy sector	① Effect of compact urban structure ② Area energy network + utilization of unused energy (on the assumption of urban redevelopment) ③ Utilization of renewable energy (solar panels)
Greenery sector	① Effect of green space development based on the Master Plan for Parks and Open Spaces



3. Future Estimation (2030): Understanding of BAU (Business-As-Usual) Case (p17 of the document distributed in advance)

[BAU calculation method in the New Action Plan Manual]

- According to the following formula for the calculation of CO_2 emissions, future volume of activities shall be estimated on the assumption that the basic unit and carbon intensity will remain at the same level.

[Amount of emissions] = [Activity data] x [basic unit] x [carbon intensity]

- The volume of future activities shall be calculated as follows.

① Use estimation data provided by local authorities, the national government, industry groups etc.
② Use the values estimated by local authorities and prefectural governments based on the "macroeconomic model".
③ Use population as an alternative indicator for volume of activities (simplified version of New Action Plan Manual).

3. Future Estimation (2030): Understanding of BAU (Business-As-Usual) Case (p17 of the document distributed in advance)

- Industrial sector and private business and residential sector: Calculation based on the future population* growth compared with the current year etc.
- Traffic sector (automobile): Calculation with the growth rates of future traffic volume (2030) specified in the Road Traffic Census

* Future population has been calculated with reference to the estimate values provided by the government of A City and the National Institute of Population and Social Security Research.

Table 3-1 Future Growth Rates

Year	Population		Automobile traffic volume
Current state (2007)	507,140 (Oct 2007)		926,488 automobiles/day
Future (2030)	490,000	(Assumption)	957,621 automobiles/day
(Reference)	491,501*	National Institute of Population and Social Security Research	(Estimated volume of traffic leaving from/arriving in A City in 2030 in the Road Traffic Census)
	Approx. 490,000	A City Comprehensive Plan	
Growth rate	-3%		3%

*Population Projections by Prefecture (estimated in Dec 2008)

2. Low Carbon City Development Guideline – Policy Menu

In the guideline, menus and examples of measures for the transportation and urban structure sector, the energy sector, and the greenery sector are provided.

Land use / Urban functions / Greenery / Building / Traffic/ travel

Transport/urban structure

Menu 1
Shift to a compact urban structure
(1) Location of public facility/service facility etc. and houses in a hub

Menu 2
Road development (improve traveling speed)
(1) Road improvement for smooth automobile traffic
(2) Grade separated intersection
(3) Measures against bottleneck railroad crossing .
(4) Promotion of ITS (Intelligent Transport System)

Menu 3
Adjust the demand for automobile traffic (traffic demand management)
(1) P&R, P&BR
(2) Transit mall
(3) Car sharing
(4) Car pooling
(5) Improve environment for bicycle riding
(6) Telework
(7) Mobility management
(8) Parking management (fringe parking, parking supply control, parking fee control)

Menu 4
Development of public transportation
(1) Development of railroad, LRT, BRT
(2) Introduction of community bus
(3) Enhancement of bus lane
(4) Enhancement of traffic junction like open space in front of stations

Menu 5
Promote the use of public transportation
(1) Figure out a better way of setting fare
(2) Improve service frequency
(3) Improve the service at bus stops
(4) Utilization of IT (IC card introduction etc)

Energy

Menu 6
Measures to reduce energy load
(1) Large-scaled renovation of antiquated buildings
(2) Area Energy Management Systems (AEMS)

Menu 7
Measures to improve energy efficiency
(1) Area energy network (a. district heating and cooling, b. Interchange of heat among buildings)
(2) Complex use of land (mixed use)

Menu 8
Measures to utilize unused energy
(1) Waste heat of garbage processing plant
(2) Unused energy of sewerage facilities
(3) Energy generated by temperature difference of rivers and oceans
(4) Energy generated by temperature difference of underground water
(5) Waste heat of factories
(6) Waste heat of subway/underground shopping mall
(7) Cold energy power generation from ice and snow

Menu 9
Measures to utilize renewable energy
(1) Use of solar energy (a. Power generation b. Heat generation)
(2) Utilization of soil heat
(3) Utilization of biomass energy

Greenery

Menu 10
Measures based on city planning master plan/city planning/ordinance etc.
(1) Greenery measures linked to public transportation and land use
(2) Green belts (3) Effective use of arable land
(4) Greening of vacant space

Menu 11
Measures to develop parks and green spaces and promote greenery
(1) Tree planting projects
(2) Social & Environmental Green Evaluation System (SEGES)

Menu 12
Measures to manage and grow greenery
(1) Green-shaded road projects (2) Citizens' forests

Menu 13
Impose green tax/donation system
(1) Prefectural green tax (2) Green tax ordinance (3) Greening subsidy
(4) Corporate sponsors

Menu 14
Conserve and properly manage large green areas
(1) Nature restoration projects (2) Wood-based resources recycling system

Menu 15
Utilize of wood-based biomass
<As a source of renewable energy>
(1) Forest management and timber utilization project (2) Promotion of forest measures and use of wood biomass (3) Wood biomass gasification power generation project
<Use as compost or woodchips>
(1) Greening of expressways (2) Green tax ordinance (3) Greening subsidy
(4) Corporate sponsors

Menu 16
Heat island countermeasures
<Wide-area scale>
(1) Macro-simulation (2) Grand design of urban environment infrastructure
(3) Special green space conservation districts
<Urban scale>
(1) Urban environment climate maps (2) Greening area system (3) Water and greenery networks (4) Water and greenery networks taking account of wind paths, etc.
<District scale>
(1) Development taking account of wind paths, etc. (2) Green curtains
(3) Converting schoolyards to grass (4) Greening ratios (5) Formation of green shade

Intensify / Complex / Nature friendly / Efficient Environment friendly / Improve efficiency/ operation frequency

Realize low-carbon compact urban structure

2. Estimation of Current State: Greenery Sector (p14 of the document distributed in advance)

[Procedures for CO_2 fixation estimation]

① Setting of amount of activities (number of tall trees and green area)

・As the number and height of existing trees in city parks are known, such data has been used. (In the estimation formula on next page, trees that will be managed at a height of 3 meters or more are defined as tall trees.)

② Setting of CO_2 sink coefficient (intensity)

・Intensity for the "case where the number of tall green trees in the target city can be identified" has been used.

③ CO_2 sink in all the city parks in the whole city calculated by multiplying ① by ②

*As for green spaces other than city parks, such data as forest management area is now being investigated. CO_2 absorption will be calculated with the investigation result.

2. Estimation of Current State: Greenery Sector (p15 of the document distributed in advance)

Table 2-9 Selection of Sink Coefficient and Estimation Formula for CO_2 Fixation and Sink (1)

Conditions	Absorption coefficient and estimation formula
Case where the number of tall trees in the target city can be identified	0.0356t-CO_2/tree・year (in Hokkaido) x no. of trees **0.0334t-CO_2/tree・year (outside Hokkaido) x no. of trees**
Case where the number of tall trees in the target city cannot be identified	See the table, "Selection of Sink Coefficient and Estimation Formula for CO_2 Fixation and Sink (2)"

Table 2-10 Selection of Sink Coefficient and Estimation Formula for CO_2 Fixation and Sink (2)

Forms of urban greenery	Conditions	Absorption coefficient and estimation formula
Urban greenery in the form of woodland	Case where such maintenance as thinning and replanting is not conducted	1.54t-CO_2/ha・year x area of the section (ha)
	Case where such maintenance as thinning and replanting is conducted	4.95t-CO_2/ha・year x maintenance area (= area of the section) (ha)
	Case where such maintenance as thinning and replanting is partially conducted	1.54t-CO_2/ha・year x (area of the section - maintenance area (ha)) + 4.95t-CO_2/ha・year x maintenance area (ha)
	New woodland	14.25t-CO_2/ha・year x area of the section (ha)
City parks etc.	With 200 or more trees/ha per unit green area	10.04t-CO_2/ha・year x green area (ha)
	With less than 200 trees/ha per unit green area	Investigate the actual number of trees and make estimation.

2. Estimation of Current State: Greenery Sector (p16 of the document distributed in advance)

[Estimation result: CO_2 absorption by greenery (current state)]

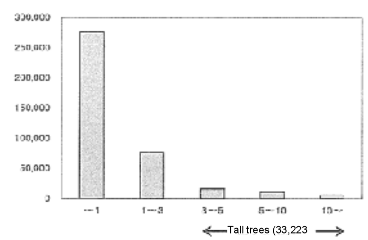
・CO_2 fixation has been calculated by multiplying the number of existing tall trees in city parks by the sink coefficient.

1,110 [t-CO_2/year] = 33,223 [trees] x 0.0334 [t-CO_2/no. of trees・year (Sink coefficient)]

Table 2-11 Number of Existing Trees in City Parks by Tree Height

Tree height (m)	No. of trees	No. of ID
~1	276,487	14,234
1~3	75,882	13,405
3~5	16,419	8,593
5~10	11,092	7,187
10~	5,712	3,250
Unknown		6,874
	385,572	53,553

Tall trees (3m or taller)	33,223



*Based on the data A City currently has, 3 meter or higher trees are defined as tall trees.

3. Future Estimation (2030): Greenery Sector
(p42 of the document distributed in advance)

[Details of the measure]

Current state (2007) 531.2ha → Future (2030) 660.5ha

Fig. 3-11 Area of City Parks (in the whole city)

3. Future Estimation (2030): Greenery Sector
(p43 of the document distributed in advance)

[Calculation procedures]

①Setting of Activity (number of tall trees and area of green space)

Setting based on the area of city parks

- As the number and height of existing trees in city parks are known, such data has been used. (In the estimation formula on p17, trees that will be managed at a height of 3 meters or more are defined as tall trees.)
- Future sink is estimated based on the no. of trees per ha calculated by multiplying the number of existing trees per ha by the future area of city parks.

② Setting of CO_2 sink coefficient

Use the intensity for the "case where the number of tall trees in urban greenery in the target city can be identified" described on the table of coefficients on p17.

③ Calculation of CO_2 sink in all the city parks in the whole city by multiplying ① by ②

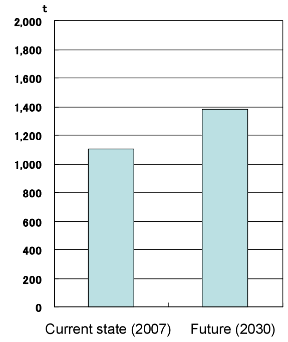


Fig. 3-12 Current and Future CO_2 Sink

3. Future Estimation (2030): Greenery Sector
(p43 of the document distributed in advance)

[Data used (no. of trees in city parks)]

Fig. 3-17 Number of Trees by Height

Tree height (m)	No. of trees
-1	276,487
1-3	75,862
3-5	16,419
5-10	11,092
10-	5,712
Unknown	
	385,572

Tall trees (3m or above) 33,223 (*1)

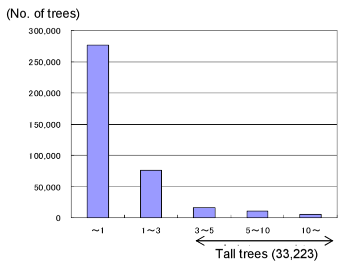


Fig. 3-13 Number of Trees by Height

[Calculation result]

Future sink 1,381t-CO_2/year

=33,223 trees (*1)/531ha (current value) x 661ha (target value) x 0.0334t-CO_2/tree･year

(Note: Assume the current tall tree density in city parks x target maintenance area in city parks = no. of tall trees in city parks in the future. Calculate the future sink by multiplying the target value by the coefficient described in the Guideline.)

2. Estimation of Current State: Traffic Sector
(p3 of the document distributed in advance)

■ Estimation of Current State in Traffic Sector (automobiles)

CO2 emission (g) = ΣCO_2 emission by OD (g) = Σ(Σ (OD traffic volume by automobile type (per car) x distance between OD zones (km) x CO_2 emission intensity by automobile type (g/car/km)))

[Procedures for CO_2 emission estimation]

Road Traffic Census OD
- 1) Identification of OD traffic volume between zones
- 2) Determination of distance between zones

→ 3) Calculation of traveler kilometers of internal travel OD by automobile type

Annual Report of Road Transport Statistics
- 4) Calculation of fuel consumption by automobile type
- 5) Calculation of travel kilometers by automobile type

→ 6) Calculation of CO_2 emission intensity per distance by automobile type

→ 7) Calculation of CO_2 emission of internal travel OD by automobile type

2. Estimation of Current State: Traffic Sector (p4 of the document distributed in advance)

Calculation of internal OD traveler kilometer by automobile type

Internal OD traveler kilometer by automobile type
= Σ{(OD traffic volume between zones x distance between zones) + (internal traffic volume in zone x distance within zone)}

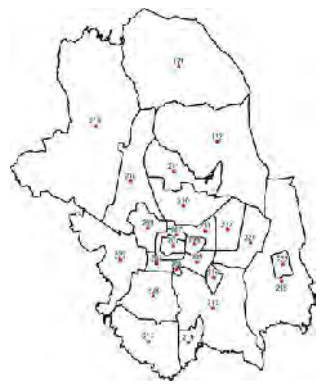


Fig. 2-2 Census Zones and Zone Centers in A City

Unit: no. of automobiles/day

O \ D	0010	0011	0012	…
0010	35,000	4,500	12,000	
0011	12,000	23,000	22,000	
0012	4,000	3,000	1,000	
…				

A

Unit: km

O \ D	0010	0011	0012	…
0010	0.5	1.2	2.2	
0011	1.2	0.5	3.5	
0012	2.2	3.5	0.5	
…				

B

2. Estimation of Current State: Traffic Sector (p6 of the document distributed in advance)

Calculation of internal travel OD CO_2 emission by automobile type

CO_2 emissions = Σ(traveler kilometers by automobile type x CO_2 emission intensity per distance by automobile type) x 365 days

[Estimation result]

Table 2-3 CO_2 Emissions from Internal Traffic Volume in A City

Automobile type	Road Traffic Census OD: Traffic volume (no. of automobiles/day)	Road Traffic Census OD: Traveler kilometers (km/day)	Emission intensity: Fuel consumption in the region of XX Transport Bureau (kl/year): Gasoline	Diesel oil	LPG	Heating value by fuel type (MJ/l): Gasoline	Diesel oil	LPG	Carbon emission factor by fuel type (tC/TJ): Gasoline	Diesel oil	LPG	CO_2 emissions in the region of XX Transport Bureau (t-CO_2 /year)	Travel kilometers in the region of XX Transport Bureau (1000 km/year)	CO_2 emission factor in the region of XX Transport Bureau (kg-CO_2 /km)	CO_2 emissions (t- CO_2 /year)
	a	b	c			d			e			f=Σ(c×d×e×44/12)	g	h=f/g	i=b×h×365/1000
Automobiles	450,382	2,226,343	–	–	–	–	–	–	–	–	–	–	–	–	–
Passenger cars	–	2,181,816	11,510,908	255,676	805,025	34.60	37.70	29.46	18.30	18.70	16.10	28,785,555	111,680,333	0.258	205,262
Buses	–	44,527	—	398,560	—							1,030,263	1,354,899	0.760	12,358
Small freight cars	86,141	393,449	1,016,402	900,317	–							4,687,026	17,211,329	0.272	39,108
Mid-size freight cars	24,085	125,995	68,022	4,174,626	–							10,949,179	19,745,659	0.555	25,501
Total	560,608	2,745,787	–	–	–	–	–	–	–	–	–	–	–	–	282,229

*The traveler kilometers of buses are assumed to be 2% of that of automobiles.

Table 2-4 CO_2 emissions from Traffic Leaving from/Arriving in A City

Automobile type	a CO_2 emissions from internal OD (t-CO_2/year)	b=c−a CO_2 emission from inter-zone OD (t-CO_2/year)	c Overall CO_2 emission* (t-CO_2/year)
Passenger cars	205,262	321,251	526,513
Buses	12,358	26,925	39,283
Small freight cars	39,108	77,368	116,476
Mid-size freight cars	25,501	285,021	310,522
All types	282,229	710,564	992,793

*Based on New Action Plan

2. Estimation of Current State: Traffic Sector (p6 of the document distributed in advance)

Calculation of CO_2 emission intensity per distance by type of automobile

CO_2 emission intensity per distance by type of automobile
= Σ(fuel consumption by type of automobile x unit heating value x carbon emission factor x 44 ÷ 12 ÷ travel kilometers by type of automobile)

- CO_2 emission by type of automobile has been calculated with fuel consumption by type of automobile multiplied by unit heating value by fuel type (gasoline, diesel oil or LPG), carbon emission factor and 44/12.
- CO_2 emission intensity per distance has been calculated with CO_2 emission by type of automobile divided by travel kilometers by type of automobile.
  (② See emission factors in the table of estimation results.)

Table 2-2 Calorific Value and Emission Factor by Fuel Type

	Gasoline	Diesel oil	LPG
Calorific value (GJ/kl)*1 *2	34.6	37.7	50.8
Carbon emission factor (tC/GJ)*2	0.0183	0.0187	0.0161
CO_2 emission factor (kg-CO_2 /l)	2.32	2.58	1.74

*1 Unit for LPG is GJ/t. (Calorific value per kl has been calculated with the density of LPG of 0.58kg/l (20 degrees Celsius)).
*2 Calorific value and carbon emission factor data are from "List of Calculation Methods and Emission Factors in the Calculation, Report and Publication System", Ministry of the Environment (Revised in March 2010).

2. Estimation of Current State: Traffic Sector (p8 of the document distributed in advance)

■ Estimation of Current State in Traffic Sector (Railway)

[Procedures for CO_2 emission estimation]

CO_2 emissions from the target railway companies of the calculation publication system (①)

Ratio of operating kilometers of the target railway companies (A City/all distance) (②)

CO_2 emissions from Railway companies (A City) (③=①x②)

[Estimation result]

Table 2-5 CO_2 Emissions from Railways

	XX Railway: Operating distance (km)	XX Railway: CO_2 emissions (t-CO_2/year)	XY Electric Railway: Operating distance (km)	XY Electric Railway: CO_2 emissions (t-CO_2/year)	A City total: CO_2 emission (t-CO_2/year)
Whole company	7,406	2,120,000	463	372,993	
A city	46.5	13,296.9	7.8	6,239.4	**19,536**

3. Future Estimation (2030): Traffic and Urban Structure Sector (p18 of the document distributed in advance)

The effects of the following urban measures have been calculated according to the method in the Guideline.

① Effect of promotion of use of public transportation + mobility management

•Effect of the improvement of PTPS (Public Transportation Priority System) and mobility management (MM) has been calculated with census OD data (future 2030).

② Effect of consolidation of functions along public transportation lines

•Effect of compact urban structure has been calculated with the PT survey data.

③ Effect of individual specific measures

•Effects of individual specific measures such as fringe parking and bicycle rental have been calculated.

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3. Future Estimation (2030): Traffic and Urban Structure Sector (p19 of the document distributed in advance)

■ Promotion of the use of public transportation + mobility management

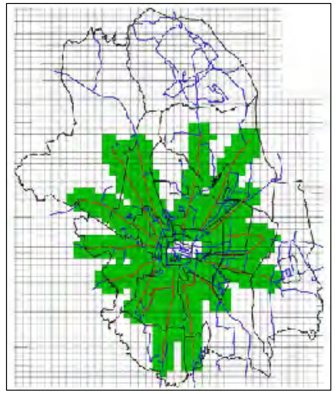

Fig. 3-1 500m mesh of 1km radius from the MM target lines

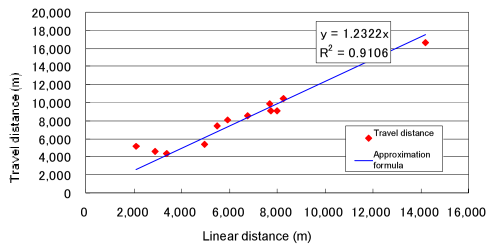

Fig. 3-2 Relation between Actual Travel Distance and Linear Distance

18

3. Future Estimation (2030): Traffic and Urban Structure Sector (p20 of the document distributed in advance)

Calculation of the total amount of reduction related to the mesh in the influenced area

<Prediction formula>

CO_2 emission reduction [t-CO_2/year]
= <OD traffic volume related to the central mesh [no. of cars]> (③)
x <conversion rate [%]> (④)
x <distance from each zone to the central zone [km]> (⑤)
x <CO_2 emission intensity from automobile [kg-CO_2/car・km]> (⑥)

19

3. Future Estimation (2030): Traffic and Urban Structure Sector (p21 of the document distributed in advance)

Table 3-2 CO_2 Emission Reduction Effect of MM Measures

Scope of measure	Traveler kilometers		Conversion rate through measure	CO_2 emission intensity (g/car/km)	CO_2 emissions in the city (t-CO_2 /year)		
	OD from each mesh to the center	OD from the center to each mesh			Before reduction	After reduction	Reduction amount
Less than 1km from a MM target bus route	282,066	275,584	8%	258	52,514	48,313	4,201
1km or more from a MM target bus route	116,023	111,987	0%	258	21,472	21,472	0
Total	398,089	387,571	–	–	73,986	69,784	4,201

See pp4-5 for CO_2 emission intensity.

Fig. 3-4 City Census Zone and Road Network

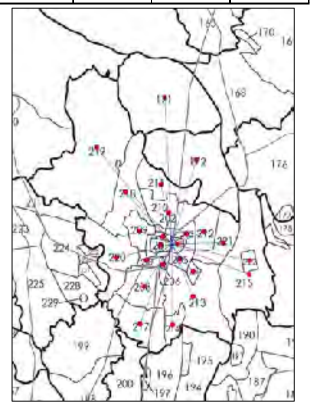

Fig. 3-5 Zones for Estimation and Zone Centers

20

3. Future Estimation (2030): Traffic and Urban Structure Sector (p22 of the document distributed in advance)

■ Effect of consolidation along public transportation lines

[Method and procedures for effectiveness analysis]

<Input conditions>
- ① Assumption of population distribution after changes of residence
- ② Network conditions after improvement of public transportation

PT data ⇩
- •Formula to estimate attracted traffic volume
- •OD distribution and OD distance of PT survey etc.

<Output items>
- CO_2 emission reduction amount etc.

Legend
- City center
- Area along public transportation line
- Surrounding urban area
- Urbanization-restricted area (suburban green area)
- Railway
- Arterial bus route

Fig. 3-6 Basic Concept of Compact Urban Structure of A City

3. Future Estimation (2030): Traffic and Urban Structure Sector (p23 of the document distributed in advance)

[Prediction procedures]

1) Assumption of population distribution based on compact urban structure

Setting of geographical distribution of future population, employees, students and workers in the tertiary industry

2) Estimation of traffic volume by zone and by purpose (Higher proportion of traffic volume generated along public transportation lines)

[Estimation formula (example)]
(Formula for generated traffic volume by purpose based on the current state of traffic in A City and through regression analysis)

(Commuting-to-work traffic) = 0.4109 x (population) - 85.731
(Commuting-to-school traffic) = 0.9320 x (no. of students) - 9.404
(Going-home traffic) = 1.0404 x (population) - 266.003
(Business traffic)
= 0.2440 x (population) + 0.5185 x (no. of workers) – 100.528
(Private traffic) = 0.5346 x (population) + 0.4805 x (workers in tertiary industry – 438.110

3) Calculation of automobile traffic volume generated in the future by zone (Automobile traffic will be reduced as the share of automobiles will be low in the areas along public transportation lines.)

Automobile traffic volume generated in the future by zone
= generated traffic volume by purpose x share of automobiles by purpose

Allocation of future traffic volume according to the current distribution pattern based on PT data

3. Future Estimation (2030): Traffic and Urban Structure Sector (p23 of the document distributed in advance)

4) Calculation of distributed automobile traffic volume (OD)

Unit: no. of automobiles/day

O \ D	0010	0011	0012	・・・
0010	35,000	4,500	12,000	
0011	12,000	23,000	22,000	
0012	4,000	3,000	1,000	
・・・				

A

5) Estimation of distance between ODs

Unit: km

O \ D	0010	0011	0012	・・・
0010	0.5	1.2	2.2	
0011	1.2	0.5	3.5	
0012	2.2	3.5	0.5	
・・・				

B

6) Estimation of total traveler kilometers: C

A×B

7) Estimation of CO_2 emissions from automobiles by multiplying CO_2 emission intensity

C x CO_2 emission intensity*
(*See pp4-5 for emission intensity.)

Amount of CO_2 reduced through promotion of revitalization of public transportation and implementation of compact urban structure

	2007	2030	Unit
① CO_2 emissions	992, 793	910, 000	t-CO_2/year
② CO_2 reduction		-82, 793	t-CO_2/year
③ Reduction rate		-8. 3%	

3. Future Estimation (2030): Traffic and Urban Structure Sector (p25 of the document distributed in advance)

■ Evaluation of individual specific measures (effect of introduction of fringe parking)

<Prediction formula>

CO_2 emission reduction [kg-CO_2/year]
= <No. of cars using fringe parking (= reduced no. of cars running in the city center) [no. of cars/day]>
x <average travel distance in the city center [km]>
x <emission intensity per car and per km [kg–CO_2/car･km]>
x 365 [days/year]

3. Future Estimation (2030): Traffic and Urban Structure Sector (p25 of the document distributed in advance)

Table 3-3 Estimation Result of Effect of Introduction of Fringe Parking

○ Indicators (preconditions)

No.	Item	Value	Unit	Note
1	No. of cars eligible for fringe parking	1000	no. of cars/day	
2	Average turnover	2		
3	No. of operating days	365	days/year	
4	Average travel distance in the city center	1.0	km	0.5km/day one-way
5	CO_2 emission intensity for automobiles	0.258	kg-CO_2/car･km	

○ Year: 2030

○ How to calculate CO_2 reduction amount

No. of cars eligible for fringe parking [1,000 cars/day] × Average turnover [2] × No. of operating days [365 days/year] × Average travel distance in city center [1.0 km] × CO_2 emission intensity for automobiles in city center [0.258 kg-CO_2/car･km]

(No. of cars using fringe parking)

= CO_2 reduction amount [188,340 kg-CO_2/year] = CO_2 reduction amount [188 t-CO_2/year]

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3. Future Estimation (2030): Traffic and Urban Structure Sector (p25 of the document distributed in advance)

■ Evaluation of individual specific measures (effect of introduction of bicycle rental)

<Prediction formula>

CO_2 emission reduction [t-CO_2/year]
= <no. of rented bicycles> x <utilization rate>
x <no. of operating days (days/year)>
x <utilization rate in and outside the city center [%]>
x <average travel distance per day [km/bicycle]>
÷ <fuel consumption of automobile [km/l] x <CO_2 emission intensity per liter of gasoline> [kg – CO_2/l]>
x <rate of conversion from automobile [%]>

Both formulas mean the same.

CO_2 emission reduction [t-CO_2/year]
= <no. of rented bicycles> x <utilization rate>
x <no. of operating days (days/year)>
x <utilization rate in and outside the city center [%]>
x <average travel distance per day [km/bicycle]>
x <emission intensity per km per car [kg-CO_2 /car･km>
x <conversion rate from automobile [%]>

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3. Future Estimation (2030): Traffic and Urban Structure Sector (p26 of the document distributed in advance)

Table 3-4 Estimation Result of Effect of Introduction of Bicycle Rental

○ Indicators (preconditions)

No.	Item	Value	Unit	Note
1	No. of rental bicycles	150	no. of bicycles	15 locations, 270 racks for bicycle parking
2	Average turnover	2	no. of turnover/bicycle	
3	No. of operating days per year	300	days	
4	Percentage of users from areas outside city center	50	%	
5	Average travel distance of users from areas outside city center	10	km/day	
6	Percentage of uses from city center	50	%	
7	Average travel distance of users from city center	4	km/day	
8	Automobile fuel consumption	10	km/l	
9	CO_2 emissions per liter of gasoline	2.32	kg-CO_2/l	
10	Conversion rate from automobile	10%		

○ Year: 2030

○ How to calculate CO_2 reduction amount

① Reduction of CO_2 emission from areas outside city center

No. of rental bicycles [150 bicycles] × Operating rate [2 turnover/bicycle] × Operating days [300 days] × Usage rate in areas outside city center [50%] × Average travel distance [10 km/day] = [450,000 km]

② CO_2 reduction amount in city center

No. of rental bicycles [150 bicycles] × Operating rate [2 turnover/bicycle] × Operating days [300 days] × Usage rate in city center [50%] × Average travel distance [4 km/day] = [180,000 km]

①+②

Reduced travel distance per year [630,000 km] × Conversion rate from automobile [10%] / Fuel consumption [10 km/ℓ] × CO_2 emission intensity [2.32 kg-CO_2/ℓ] = CO_2 reduction amount [14,616 kg-CO_2 /year] = CO_2 reduction amount [15 t-CO_2 /year]

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2. Estimation of Current State: Energy Sector (p9-10 of the document distributed in advance)

■ Calculation method based on the floor area by use of building (method of the Guideline)

[Concept of estimation (See III-p10 of the Guideline]

CO_2 emission = Σ (floor area by use of building of local authorities x CO_2 emission factor by use of building)

[Estimation result]

Table 2-6 Estimated CO_2 Emissions Calculated based on Floor Area by Use of Building

Use of building	a GIS building area (m²)	b Average no. of stories	c=a × b Floor area (ha)	d=c × z Floor area (after adjustment with no. of stories) (ha)	e CO_2 emission intensity *2 (kg-CO_2 /year/m²)	d × e Private business (t- CO_2 /year)	d × e Private residents (t- CO_2 /year)
1 Business facilities	1,260,243	2.3	290	175	108.98	190,218	
2 Commercial facilities	1,570,834	1.8	283	170	182.28	310,360	
3 Lodging facilities	101,571	2.2	22	13	167.47	22,535	
4 Amusement facilities	74,767	2.2	16	10	182.28	18,055	
5 Play facilities	235,345	1.6	38	23	182.28	41,332	
6 Complex facilities for commercial purpose	209,152	1.6	33	20	182.28	36,732	
7 Detached houses	13,378,013	1.9	2,542	1,531	36		551,024
8 Collective housing	2,076,246	2.7	561	338	29.5		99,584
9 Houses combined with shop	1,056,075	2.2	232	140	36		50,367
10 Collective housing combined with shop	199,582	2.2	44	26	29.5		7,800
11 Collective housing combined with work place	144,785	1.9	28	17	29.5		4,887
12 Government facilities	331,985	1.8	60	36	108.98	39,216	
13 Education and welfare facilities (A)	570,448	2	114	69	139.15	95,599	
14 Education and welfare facilities (B)	1,367,650	1.7	233	140	68.53	95,946	
15 Transportation and storage facilities	976,302	1.4	137	82			
16 Heavy industry facilities	0	1.6	0	0			
17 Light industry facilities	2,822,841	1.6	452	272			
18 Service industry facilities	462,563	1.6	74	45			
19 Household industry facilities	21,270	1.6	3	2			
20 Hazardous-materials storage and disposing facilities	77,595	1.4	11	7			
21 Agricultural and fishery facilities	2,586,463	1.2	310	187			
22 Others	113,948	1	11	7			
Total	29,637,679		5,493 (x)	3,308		849,992	713,661 (A)
				(Estimates through the method of the New Action Plan Manual)		852,070	730,475 (B)
				(A)/(B)		0.998	0.977

CO_2 emissions from No. 15 to 22 have not been calculated as they are industrial facilities.

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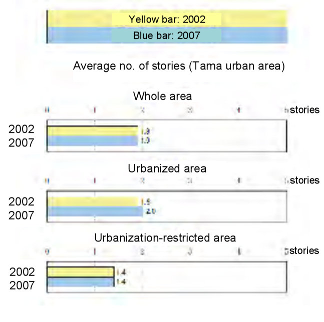
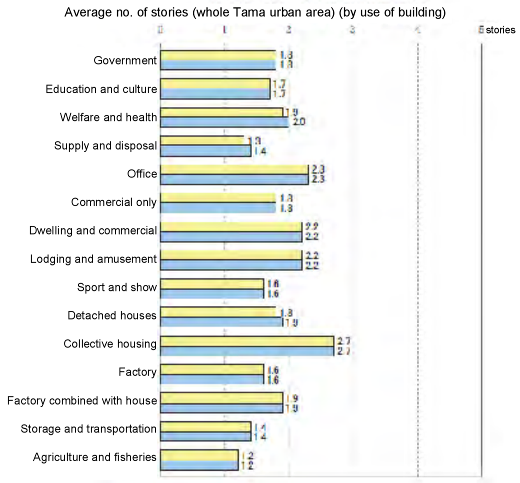
2. Estimation of Current State: Energy Sector (p13 of the document distributed in advance)

(Reference material) Average Number of Stories by Use of Building

● Data of Tama urban area, Tokyo





Source: Land Use in Tokyo 2007 –Tama and Island Areas (Survey of Current Land Use)

3. Future Estimation (2030): Energy Sector (p27 of the document distributed in advance)

CO_2 emission amount in the base year
CO_2 emission from buildings calculated based on the floor area of existing buildings for private use

↓

CO_2 emission (BAU) in the medium-term target year
Calculation of business-as-usual CO_2 emission amount from buildings based on the trend

← Reduction through measures for individual buildings

← Accumulated reduction through low-carbon measures to be carried out as urban measures (①-③ of this case study)
①Effect of compact urban structure
②Area energy network + utilization of unused energy through redevelopment in city center
③Utilization of renewable energy

↓

Medium-term target for CO_2 emission
Based on reduction through measures for individual buildings and accumulated reduction through low-carbon measures, set medium term target for CO_2 emission to be achieved through the promotion of low-carbon city development.

Fig. 3-7 Procedures for Setting CO_2 Emission Medium-term Target

3. Future Estimation (2030): Energy Sector (p28 of the document distributed in advance)

■ Effect of compact urban structure

Table 3-5 Future Population Settings (2030)

Classification	Land use zone	Population density (a)	Area (b)	Population (a x b)	Concept for setting
City center	Commercial district Neighboring commercial district	80 per ha (assumption)	470 ha	37,600	Set by reference to the data of 80 people/ha in other types of areas in residential districts specified in the City Planning and Operation Guidelines (Population density in DID of A City in 1965 population census: 85.0 per ha)
Current state		60 per ha		28,000	
Urban areas along public transportation lines	Category II residential district Part of category I residential district	60 per ha (assumption)	2,700 ha	162,000	Set by reference to 60 per ha, desirable minimum population density in the residential district of the size specified in the City Planning and Operation Guidelines.
Current state		44 per ha		118,800	
Surrounding urban areas	Other purposes	8 per ha	38,514 ha	290,400	
Current state		9 per ha		360,300	
Current state	Whole city	12 per ha	41,684ha	507,100	(Oct 2007)
	Urbanized areas	46 per ha	9,199ha	422,800	

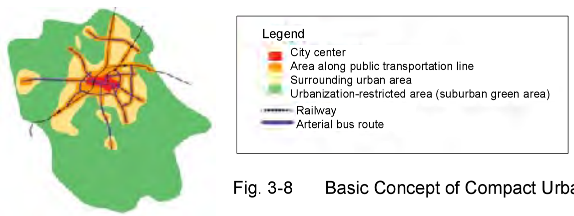


Fig. 3-8 Basic Concept of Compact Urban Structure of A City

3. Future Estimation (2030): Energy Sector (p29 of the document distributed in advance)

Table 3-7 Details of Estimated Amount of CO_2 Reduced through Consolidation in Housing Sector (Introduction of Collective Housing) in A City

	a	b	c	d=c-a	e=c-b	f1#	f2#	g1#	g2#	h1#	h2#	i=h1+h2
	Current population	Future BAU population	Future population in compact structure	Population moved to city center etc.		Increased no. of households (compared with current no.)		Increased no. of households (compared with BAU case)		Increase/decrease of CO_2 emissions (compared with current state) (t-CO_2/year)		
Type of area	2007	2030	2030	Increase from current state	Increase compared with BAU case	Collective housing	Detached houses etc.	Collective housing	Detached houses etc.	Collective housing	Detached houses etc.	Total emissions
A City center	28,000	20,680	37,600	9,600	16,920	2,954	738	5,206	1,302	5,185	3,360	8,545
B Areas along public transportation lines	118,800	94,500	162,000	43,200	67,500	13,292	3,323	20,769	5,192	23,331	15,121	38,453
C Surrounding areas	360,300	374,820	290,400	-69,900	-84,420	-8,254	-18,631	-9,968	-22,501	-14,487	-84,779	-99,266
Total	507,100	490,000	490,000							14,029	-66,297	-52,268
CO_2 emissions *1 (t-CO_2/year)	693,001	669,633										640,733 (t-CO_2/year)
CO_2 emissions (after adjustment) *2	**714,000**	**689,923**										**660,148**
	A	B										

Reduction rate		
	(vs. current state)	-7.5% (i/A-1)
	(vs. BAU case)	-4.3% (i/B-1)

*1: Current and future CO_2 emissions from residences have been calculated with the ratio of collective housing in the whole city of A and size of households (Appendix 2) and the emission intensity in Appendix 1.
• CO_2 emissions = [population x ratio of collective housing in the whole city of A/size of households in collective housing] x 1755.3 + [population x (1 – ratio of collective housing)/size of households in detached houses] x 4550.4
*2: Adjusted based on the current total emissions of 714,000t-CO_2/year from private households (714/693)
#f, g: ratio of collective housing in A and B Areas are set at 80%, at the same level as the central areas of Tokyo and Fukuoka City. (Appendix 2)
• Ratio of collective housing among households moved out from C Area are set at 30.7%, at the same level as that of the whole country.
• f1 = d x ratio of collective housing (80% for A and B, 30.7% for C) / size of households (2.6) [same for g1]
• f2 = d x (1 – ratio of collective housing) / size of household (2.6) [same for g2]
#h:
• h1 = f1 x 1755.3 [kg-CO_2/year/household]
• h2 = f1 x 4550.4 [kg-CO_2/year/household]
• Emission intensity for collective housing and detached houses has been set based on the data in the table below.

(Appendix 1) Grounds for Setting of CO_2 Emissions from Houses

	Average floor area (m^2)/household *3	kg-CO_2/year・m^2 *4	kg-CO_2/year・household
Detached house	126.4	36	4550.4
Collective housing	59.5	29.5	1755.3
Difference in emission intensity between detached house and collective housing			2795.2 kg-CO_2/year・household

(Appendix 2) Ratio of Collective Housing and Size of Household in Each City

City	Ratio of collective housing (to population) %	Size of households in collective housing (people/household)	Size of households in detached houses (people/household)	Average household size (people/household)
Whole country	30.7	2.00	2.99	2.57
Whole city of A	26.1	1.81	3.02	2.56
DID in A City	31.8	1.81	2.89	2.42
DID in Chuo Ward, Sapporo	78.2	1.71	2.54	1.84
Whole city of Sendai	44.6	1.84	2.97	2.32
DID in Aoba Ward, Sendai	55.0	1.62	2.73	1.98
Chiyoda Ward, Tokyo	71.5	1.95	2.51	2.08
Chuo Ward, Tokyo	81.3	1.66	2.49	1.77
Minato Ward, Tokyo	80.6	1.69	2.49	1.8
Naka Ward, Nagoya	73.0	1.60	2.71	1.79
Chuo Ward, Osaka	75.8	1.49	2.6	1.65
Kita Ward, Osaka	77.8	1.72	2.61	1.84
Chuo Ward, Fukuoka	83.8	1.67	2.56	1.77

National Census 2005

*3: National average in FY2003 (Housing and Land Census). The percentage of rentable floor area of collective housing excluding hallways, staircases and other common-use space is set at 80%. (47.6/0.8 = 59.5).
*4: Used the data of CO_2 emission intensity concerning the operation of CASBEE for home (detached house) and CASBEE for new construction (collective housing)

3. Future Estimation (2030): Energy Sector (p31 of the document distributed in advance)

■ Area energy network + utilization of unused energy through redevelopment in the city center

Table 3-8 Development Assumed in the Case Study

Location	Assumed building purpose	Floor area (ha)
①	Commercial (merchandising)	7.8
⑦	Hotel	0.7
	Residence	1.0
④	Hotel	0.85
⑫	Office	3.0

Use water of the river flowing alongside the area as unused energy.

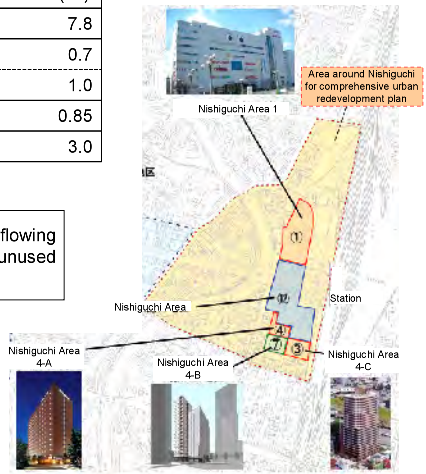
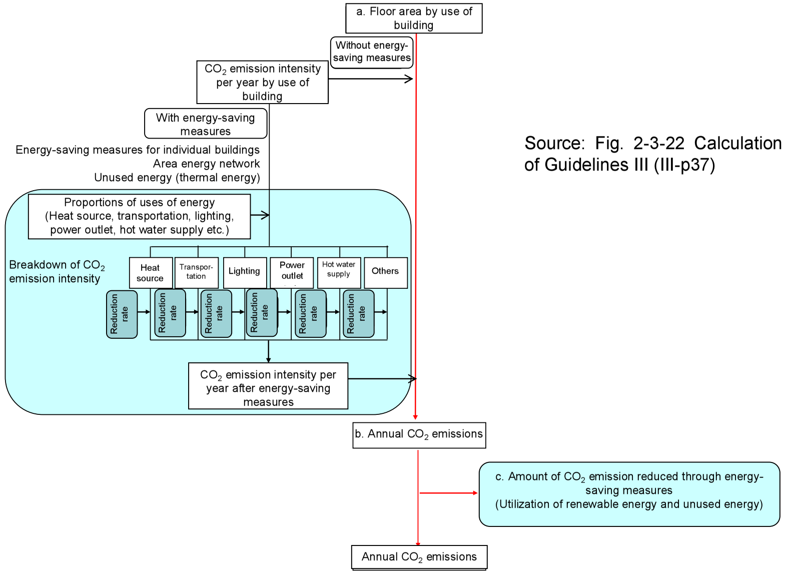


Fig 3-9 Locations of Redevelopment Projects near Station (assumption)

3. Future Estimation (2030): Energy Sector (p32 of the document distributed in advance)



Source: Fig. 2-3-22 Calculation Flow of Guidelines III (III-p37)

Fig. 3-10 Flow of Effectiveness Analysis

3. Future Estimation (2030): Energy Sector (p33 of the document distributed in advance)

Effect of building energy-saving measures

CO_2 emission intensity with energy-saving measures
= CO_2 emission intensity by use of existing building
x (breakdown of emission x (1 - reduction rate by breakdown item))

Table 3-10 Sample Setting of CO_2 Emission Intensity Reduction through Energy-Saving Measures by Use of Building

Sample setting of current CO_2 emission intensity

	CO_2 emission intensity *1 Kg-CO_2/m²/year
Office	108.98
Commercial (merchandizing)	182.28
Hotel	167.47

*1: Data from Comprehensive Assessment System for Built Environment Efficiency (CASBEE for new construction 2008)

Breakdown of energy excretion, future reduction rates and CO_2 emission intensity

		Heat source	Heat transfer	Hot water supply	Lighting	Power outlet, motive power etc.	CO_2 emission intensity (after reduction)	Reduction rate from the current state
Breakdown of energy excretion *2	Office	31.1%	12.0%	0.8%	21.3%	34.8%		
	Commercial (merchandizing)	30.6%	9.2%	3.2%	28.9%	28.1%		
	Hotel	28.6%	19.6%	9.9%	14.7%	28.2%		
Reduction rate *3		23.8%	17.6%	11.1%	11.2%	0.0%		
Emission intensity (kg-CO_2/m² year)	Office	25.83	10.78	0.78	20.61	37.93	95.92	−12.0%
	Commercial (merchandizing)	42.50	13.82	5.19	46.78	51.22	159.51	−12.5%
	Hotel	36.50	27.05	14.74	21.86	47.23	147.37	−12.0%

*2: Data from Energy Conservation Center
*3: Green Assessment and Green Renovation Standards and Explanations

3. Future Estimation (2030): Energy Sector (p34 of the document distributed in advance)

[House]
Sample Setting of current of CO_2 emission intensity

	Detached house	Collective housing
CO_2 emission intensity (kg- CO_2/m²/year) *4	36	29.5

*4: CO_2 emission intensity concerning the operation of CASBEE for home (detached house) and CASBEE for new construction (collective housing)

	Heating	Cooling	Hot water supply	Kitchen	Lighting, motive power etc.	CO_2 emission intensity (after reduction)	Reduction rate from the current state
Breakdown of energy excretion *5	23.6%	3.2%	25.5%	5.6%	42.1%		
Reduction rate *6	30%	49%	16%		36%		
Emission intensity for newly constructed collective housing (kg-CO_2/m²/year)	4.87	0.48	6.32	1.65	7.95	21.27	−27.9%

*5: Annual Report on the Environment in Japan 2004
*6: See next page.

							Reduction rate from the current state
Emission intensity for newly constructed detached house (kg-CO_2/m²/year)	5.95	0.59	7.71	2.02	9.70	25.96	−27.9%

3. Future Estimation (2030): Energy Sector (p37 of the document distributed in advance)

Effect of the introduction of DHC (district heating and cooling) and use of unused energy of river water

CO_2 reduction rate = 1 - (overall efficiency of heat source equipment before measures / overall efficiency of heat source equipment after measures)

Table 3-13 (reference material) Current State of Overall Efficiency of Heat Source Equipment in Existing District Heating and Cooling System

Type of heat source system		Discrete heat source	District heating and cooling
1. Cold water and steam (high-temperature water) supply system	• General system	0.569	0.636
	• Utilization of waste heat from cogeneration	0.606	0.699
	• Utilization of unused energy	-	0.916
	(Average)	(0.570)	(0.688)
2. Cold water and heated water supply system	**• General system**	**0.694**	**0.954**
	• Utilization of unused energy	**-**	**1.019**
	(Average)	-	(0.977)
3. Cold water, steam and heated water supply system	• General system	0.690	0.753
	• Utilization of waste heat from cogeneration	0.696	0.772
	• Utilization of unused energy	-	0.798
	(Average)	(0.693)	(0.768)
Overall average	All	0.675	0.749
	General system	-	0.750
	Utilization of heat from cogeneration	-	0.724
	Utilization of unused energy	-	0.850

Source: Survey Report on Promotion of Suitable Sites for Utilization of Unused Energy and Area Energy Network FY2007 by Agency for Natural Resources and Energy, Ministry of Economy, Trade and Industry
*The overall efficiency of the utilization of cogeneration waste heat includes effect of power generation.

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3. Future Estimation (2030): Energy Sector (p38 of the document distributed in advance)

[Estimation result]

Table 3-14 Effect of Area Energy Network etc.

			Office	Commercial	Hotel	Collective housing	Total	Unit
a	BAU	Floor area	30,000	78,000	15,500	10,000	133,500	m^2
b	(Without energy-saving measures for buildings)	CO_2 emission intensity	108.98	182.28	167.47	29.50	-	kg-CO_2/m²/year
c=a×b		CO_2 emission	3,269	14,218	2,596	295	20,378	t-CO_2/year
d	① Effect of energy-saving measures (new construction)	CO_2 emission intensity	95.92	159.51	147.37	21.27	-	kg-CO_2/m²/year
		CO_2 reduction	391.94	1,776.38	311.54	82.26	2,562.12	
e=a×d		CO_2 emission	2,877	12,441	2,284	213	17,816	t-CO_2/year
e/c−1		Reduction rate from BAU case	12.0%	12.5%	12.0%	27.9%	12.6%	%
g	② Effect of DHC (district heating and cooling)	% of emission from heat source	31.1%	30.6%	28.6%	23.6%		%
h		Reduction rate	27.3%	27.3%	27.3%	27.3%		%
i=e×g×h		CO_2 reduction	244	1,039	178	14	1,476	t-CO_2/year
j=e−i		CO_2 emission	2,633	11,402	2,106	199	16,340	t-CO_2/year
k=j/c−1		Reduction rate from BAU case	19.5%	19.8%	18.9%	32.5%	19.8%	%
l=i/e−1		Reduction rate from ①	8.5%	8.4%	7.8%	6.4%	8.3%	%
g	③ Effect of utilization of unused energy (river water)	% of emission from heat source	31.1%	30.6%	28.6%	23.6%		%
m		Reduction rate	6.4%	6.4%	6.4%	6.4%		%
n=j×g×m		CO_2 reduction	52	223	39	3	317	t-CO_2/year
o=j−n		CO_2 emission	2,581	11,179	2,067	196	16,023	t-CO_2/year
p=o/c−1		Reduction rate from BAU case	21.1%	21.4%	20.4%	33.5%	21.4%	%
q=o/j−1		Reduction rate from ②	2.0%	2.0%	1.8%	1.5%	1.9%	%
	Total reduction amount		689	3,039	528	99	4,355	
	Reduction rate		21.1%	21.4%	20.4%	33.5%	21.4%	

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3. Future Estimation (2030): Energy Sector (p40 of the document distributed in advance)

■ Utilization of renewable energy (installation of solar panels at houses, public facilities etc.)

<Prediction formula>

CO_2 emission reduction (kg- CO_2 /year)
= rated power of solar energy generation [kW] x area of panels required per unit rated power [m²/kW] x average amount of solar radiation at the optimum angle [MJ/m²·year] ÷3.6 [MJ/kWh] x correction coefficient x CO_2 equivalent emission of electricity

*The conversion efficiency is assumed to be 12% and the solar battery loss to be 25%.

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3. Future Estimation (2030): Energy Sector (p29 of the document distributed in advance)

Table 3-15 Sample Calculation of CO_2 Emission Reduction Effect through Introduction of Solar Panels

● **Conditions for calculation**

- CO2 emission intensity — Electricity — 0.418kg-CO_2/kWh …① Ref. 1)
- Total irradiance in A City (facing south, 30 degrees)*1 — 5271.5 MJ/m²/year …③
  - *1 Weather data: Expanded AMeDAS Weather Data (solar radiation data in A City in standard year)
- Power generation efficiency (efficiency of 1kW incoming radiation per m²) — 12% …④ Ref. 2) sample calculation
- Solar battery loss — 25% …④' Ref. 3) sample calculation
  - (Percentage of electricity lost due to power conditioner loss, dirt on receiving surface, temperature, shade, wiring and circuit loss etc.)

Annual electrical power output per area of solar panel — 132 kWh/m²/year …⑤ =(③x1000/3600)x④x(1-④')
Area required for 1kW of rated output* of solar panel — 8.3 m²/kW …⑥ = 1m²/kW÷④
Annual electrical power output per kW of rated output* of solar panel — 1,098 kWh/kW/year …⑦ =⑤x⑥
(*Rated output is the maximum power output with solar radiation of 1kW per square meter perpendicular to the solar panel.)

Roof area of a house should be 63m² if it is about half of the total floor area of a detached house described in the reference data 4).
Installable in the area of 31m², about half of the roof area — Panels with generation capacity of 3.5kW …⑧
Calculation on the assumption that panels will be installed in the area of 29.2m² …⑨

● Details of the measure to install solar panels in A City and assumptions for the calculation of effectiveness (from a document of A City)

Carry out dissemination and enlightenment activities for residents and offices.
Subsidize the installation cost for households.

a. Introduction to houses

	2005	2013	2020	2030	(2050)	Note	
No. of houses where solar panels will be installed		2,375	13,575	29,575	61,575	1,600 per year	…⑩

b. Introduction to public facilities

	2005	2013	2020	2030	(2050)	Note	
No. of facilities where solar panels will be installed		7	50	100	280	280 facilities according to the regional promotion plan	…⑪

*Panels with capacity of 30kW per building will be installed in and after 2020.

● Amount of CO_2 emission reduced through the installation of solar power generation system

a. Introduction to houses

	2005	2013	2020	2030	(2050)	Note	
Generation capacity kW		8,313	47,513	103,513	215,513	3.5kW per installation	…⑫ =⑩x⑧
Electrical power output kWh		9,129,030	52,179,613	113,680,447	236,682,113		…⑬ =⑫x⑦

↑ Including installations carried out from 2005 to 2009

b. Introduction to public facilities

	2005	2013	2020	2030	(2050)	Note	
Generation capacity kW		403	1,693	3,193	8,593	30kW per installation in 2020 and later.	…⑭ =($⑪_n$-$⑪_{2013}$)x30-$⑭_{2013}$
Electrical power output kWh		442,586	1,859,302	3,506,646	9,437,083		…⑮ =⑭x⑦

↑ Including installations carried out from 2005 to 2009

■ CO_2 emission reduction by item (t-CO_2)

	2005	2013	2020	2030	(2050)	Note	
Reduction through a.		3,816	21,811	47,518	98,933		…⑯ =⑬x①/1000
Reduction through b.		185	777	1,466	3,945		…⑰ =⑮x①/1000
Total				48,984	102,878		

■ CO_2 emission reduction by type of usage (t-CO_2)

	2005	2013	2020	2030	(2050)	Note
Household (a)		3,816	21,811	47,518	98,933	
Business (b)		185	777	1,466	3,945	

In 2030
a. Reduction through installation of solar panels at 29,575 houses — 47,518t-CO_2
b. Reduction through installation of solar panels at 100 public facilities — 1,466t-CO_2

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4. Estimation Results (Current State, BAU and Effect of Measures) (p44 of the document distributed in advance)

Table 3-18 CO_2 Emissions from A City at the Present Time and in the Future (BAU and after implementation of urban measures)

Unit: 1,000t-CO_2/year

Sector		Current state (2007)		Future (2030)					
				BAU (business-as-usual)	Reduction through urban measures		2030 estimate	Vs. current state	Vs. BAU
Industry		1,892		1,834			1,834	−3.1%	0%
Traffic		1,013		1,042	Mobility management etc.	−4.2	955	−5.7%	−8.4%
	Railway		20		Consolidation along public transportation lines	−83.0			
	Automobile		993		Individual measures	−0.2			
Energy		1,564		1,516			1,433	−8.4%	−5.5%
					Consolidation	−29.8			
	Business		850		Area energy network through redevelopment of area near station	−4.4			
	Household		714		Renewable energy	−49.0			
Greenery		−1.1		−1.1		−0.3	−1.4		
Total		4,467		4,392		−171	4,220	−5.5%	−3.9%

4. Estimation Results (Current State, BAU and Effect of Measures) (p44 of the document distributed in advance)

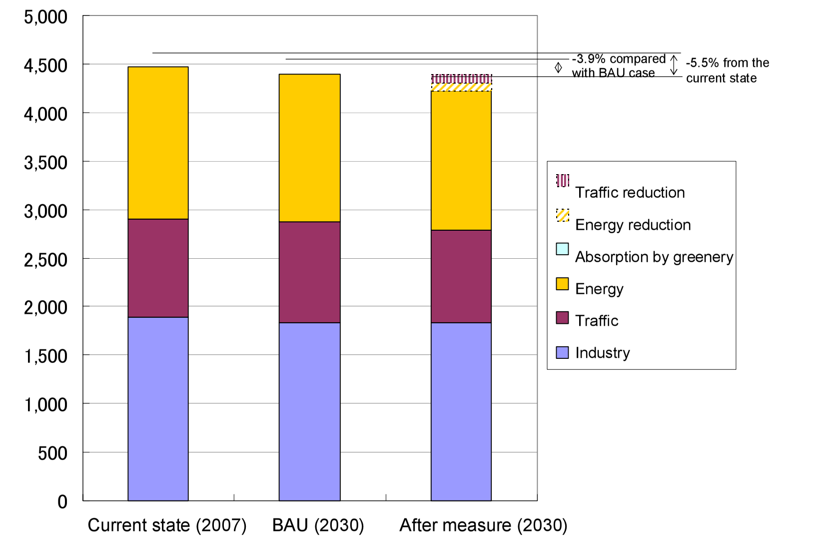

Fig. 3-1 CO_2 emissions by Sector at the Present Time and in the Future (BAU and after measures)

5. Summary—Procedure for utilization of the guideline

<Setting of CO2 reduction/fixation future (target) value using this guideline>

Setting of target value of whole city using estimated CO2 reduction/fixation by each measure follows the procedure shown below;

<Estimation of current and future CO2 emission>

- Estimate current CO2 emission (CO2 fixation in greenery sector) by measures.
- Estimate short-term and mid-term future CO2 emission (CO2 fixation in greenery sector)

<Set the future (target) value>

- Integrate the estimated reduction values and set the future (target) value
- If necessary, discuss among relevant institutions and divisions.
- If you need re-calculation, choose different measures and repeat the procedure
- Based on the procedure above, set the future (target) value through urban measures.

<Apply the estimated value and measures>

- Apply the estimated value and measures to the urban master plan and urban facility plan.

<Monitoring>

- Monitor actual CO2 reduction (CO2 fixation in greenery sector) appropriately and analyze the effect of low carbon measures
- Apply the result to the progress management of low carbon measures and improvement of them

Institute for Global Environmental Strategies
Towards sustainable development - policy oriented, practical and strategic research on global environmental issues

Status and Issues of MRV process in the CDM

Akiko Fukui
Market Mechanism Group
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Outline

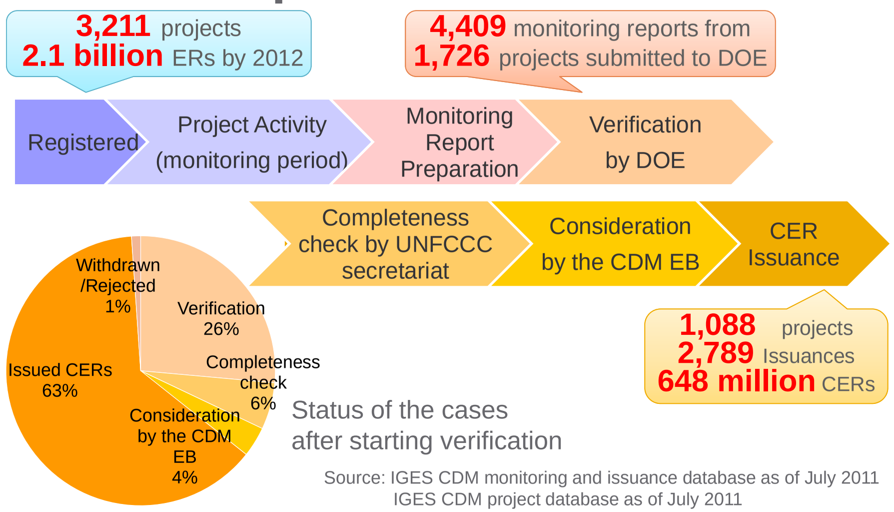
- MRV system in the CDM
- MRV process and status
- Length of MRV process
- Improvement of procedures for CER issuance
- Difference of issuance status in project size
- Difference of the MRV status in project type
- Issues in MRV in the CDM

The CDM has build-in MRV system

Emission Reductions = **Baseline Emissions** - **Project Emissions**

◆ Baseline and project emissions need to be **Monitored** by project participant.
◆ Collected and recorded data is **Reported** to designated operational entity (DOE).
◆ Those data including procedures is **Verified** by the DOE (and also Certified).

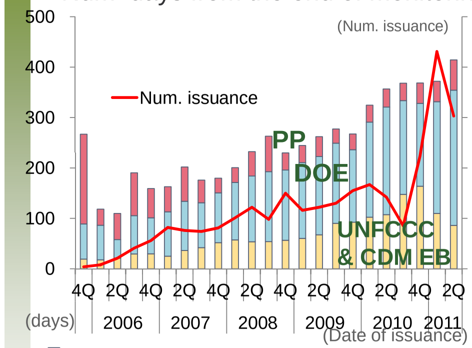
MRV process in the CDM

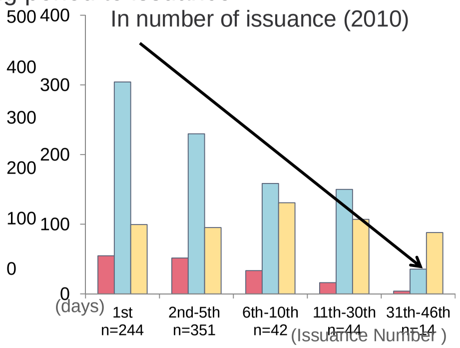


Source: IGES CDM monitoring and issuance database as of July 2011
IGES CDM project database as of July 2011

- 2/3 of registered projects **not** received issued CER
- Relatively **small num. requests for issuance**

How long it takes for MRV in the CDM?





Monitoring report preparation period: the end of monitoring period-the date of monitoring report completion
DOE verification period: the date of monitoring report completion - the date of request for issuance by DOE
UNFCCC secretariat & the CDM EB consideration period: the date of request for issuance by DOE- the date of issuance

Source: IGES CDM monitoring and issuance database as of June 2011

➢UNFCCC secretariat and CDM EB consideration period has been in **increase,** but **shifted to decrease since 2010** (Left fig.)

➢As a learning process, monitoring report preparation period and DOE verification period becomes **shorter** (Right fig.)

5

Improvements for the procedure

Adoption of New Guidelines and Publication in 2010
•Procedures for requests of issuance of CERs
•Procedure for review of requests for issuance of CERs
•Completeness Check list and Information and Reporting Check list
•The standardized format for monitoring report
•Assessing compliance with the calibration frequency requirements

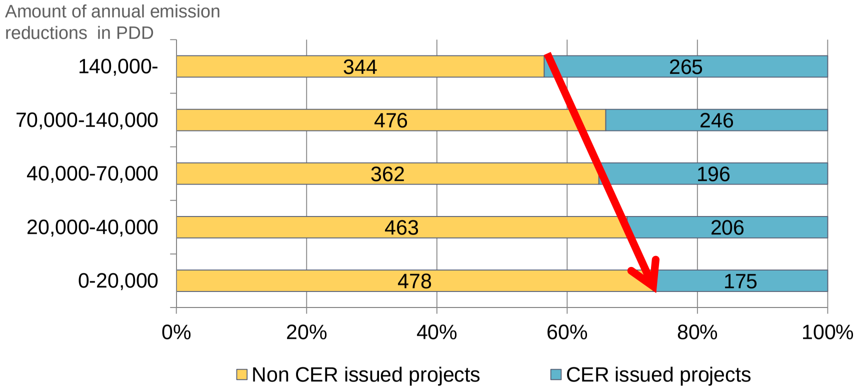
Changes in the Procedure for CER Issuance
•Removal of limitation for number of accepting request for issuance
•Acceptance only request for issuance passed through the Completeness check and the Information & Reporting check.
•Assessment by RIT only in the review conducting stage
•Secretariat became to be involved in the review assessment
•Highlighting policy issues in the review assessment and bringing them to EB

➢It was long process in each stage, but **improved** to enhance issuance as a whole.

6

Any differences in project size?

The Share of issued projects by project size



Source: IGES CDM Monitoring and issuance database as of June 2011

➢ **Small** emission reductions projects tend to be large share in **"no issued CERs"**.

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Issuance rate & length of MRV process by project type

Type of project	Num. isseued project/ Num. resgistered project	Num. issued projects	Num. issuance per project	Qt. of pages in monitoring report	Qt. of pages in verification report	Monitoring report preparation period *	DOE verification period*	UNFCCC & CDM EB considerati on period*
HFC reduction/avoidance	90%	19	11.8	33	31	18	89	75
Fuel switch	53%	40	1.2	21	35	66	148	100
N2O decomposition	48%	31	3.3	37	53	23	119	95
Cement	44%	15	0.7	32	37	129	244	71
Waste gas/heat utilization	43%	85	1.0	18	38	47	193	91
Biomass	40%	136	1.0	15	31	72	191	72
Transportation	40%	2	1.4	19	46	79	241	64
Methane recovery & utilization	37%	82	1.0	25	49	23	225	91
Energy efficiency	34%	35	0.6	20	30	107	232	94
SF6 replacement	33%	3	0.3	27	64	16	108	217
Wind Power	33%	221	0.7	11	30	46	159	88
Hydro Power	32%	314	0.6	12	36	38	173	89
Biogas	24%	85	0.7	17	30	34	222	74
Other renewable energies	24%	13	0.4	31	39	58	223	72
Leak reduction	20%	1	0.2	25	59	71	222	136
Methane avoidance	9%	6	0.1	27	54	21	146	149
Total	**34%**	**1088**	**0.9**	**19**	**36**	**43**	**171**	**85**

Source: IGES CDM monitoring and issuance database as of 2011

* Average number of days

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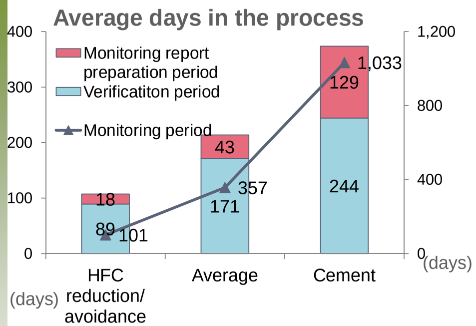
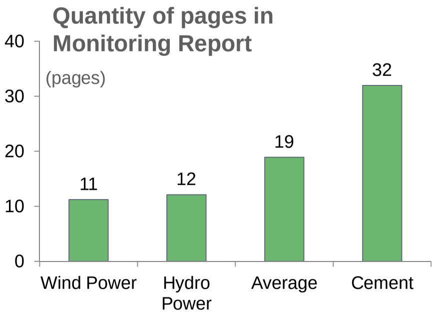
Different Burdens in Project Types





Short monitoring report prep & verification period	Small qt. of pages in monitoring report
HFC reduction/avoidance •Experienced in issuance •Short monitoring period /issuance	Wind & Hydro Power •Simple monitoring methodology (a few parameters to be monitored)

Long monitoring report prep& verification period / huge qt. of pages in monitoring report

Cement
•Long coverage monitoring period /issuance
•Complicated monitoring methodology (many parameters to be monitored)

Source: IGES CDM monitoring and issuance database as of July 2011

Key issues of MRV in the CDM

Reasons of obstacle of CERs issuance

1. Changes in the project
2. Discontinuation of monitoring
3. Rejection by DOE's
4. Rejection by EB

Project Participant's Burden

◆Economic burden
◆Difficulty of calibration & calculation of parameters
◆Gap between planning and project activity results

DOE's Burden

◆Required to be strict verification by Validation & Verification Manual
◆Owing liability indemnities

Experience from CDM on MRV

➢ Strict monitoring methods may **constrain** project participants to prepare monitoring reports, which also **leads to delay** DOEs to verify/certificate them.

➢ **Regardless of the project size**, projects are required to apply **same procedures** of MRV

➢ Complex MRV procedure may **lose** the incentive of project participants' to reduce GHG emissions.

➢ It is important to put **experience of MRV in the CDM** to use in the new mechanisms and for institutional designs in proper mitigation activity in developing countries.