

Global Environmental Research Fund (GERF/S-3-1)

Japan-UK Joint Research Project “a Sustainable Low-Carbon Society (LCS)”

## “a Dozen of Actions towards Low-Carbon Societies (LCSs)”

# The Details of Actions

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“2050 Japan Low-Carbon Society” scenario team

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The original report and its press release on May 22, 2008 can be downloaded from <http://2050.nies.go.jp/>.



# 1. Comfortable and Green Built Environment

## Future Objectives

[Solar and Wind Utilization Design] Architectural technologies and designs that are suitable for the climate of each region, using passive design layout for introducing sunlight and natural wind into the building, are widely disseminated. In addition, the individual levels of insulation technologies, screen technologies, ventilation technologies have been improved drastically, thereby enabling reduction of energy consumption while retaining comfort within residences and buildings. Consequently, the demand for energy per household will decline by about 40% from 2000 levels; also, the energy demand per unit area of non-residential building floor space will decrease by 40%. Furthermore, for the walls and roof in each building, installation of solar water heaters and solar power generators will be standardized. In particular, most of low rise housing will become zero carbon residences through the combination of high insulation, passive design, and solar energy use.

[Household Finance-friendly Environmental Efficiency] For newly built or renovated buildings, reduction and exemption scheme of real estate tax and loan interest rates in response to certification results of household environmental efficiency (CO<sub>2</sub> emissions and energy consumption) becomes available. The scheme provides incentives for purchasing of residences with high environmental efficiency. For existing residences, low cost environmental efficiency consulting services are provided. The services offer advices on the structural alteration of the building in order to enhance environmental efficiency and act as an intermediary for alteration expense discount programs and favorable loan interest rates. As such, a framework system for the entire society to place a high value on the level of environmental efficiency of residences is in place. Therefore, even citizens with low environmental awareness choose residences with superior environmental efficiency.

[Nurturing of Worker Skills; Information Transmission] Designers and architects who are highly skilled in bonding architectural designs that make use of local and regional climate and the use of leading edge equipment are nurtured in each area; their know-how will be handed over to the next generation. Moreover, long-life buildings such as "200-year homes" have become widespread, limiting unnecessary consumption of resources and energy.

## Implementation Barriers and Strategic Steps

[Standardization Period] Currently, at the time of purchasing or contract leasing of residences and buildings, since there is no requirement in general for the presentation of information regarding environmental efficiency, this has not been an item of importance. Also, even today, although it is possible to evaluate the environmental efficiency of residences and buildings, the number of people capable of performing these complex calculations have not been sufficient, hindering its widespread practice. Accordingly, the proposed strategy promotes the establishment of simplified evaluation method for building efficiency according to use in consultation with existing building evaluation methods (CASBEE, etc.) and evaluation methods implemented in Europe and other countries. At the same time, it continues to make progress on nurturing practitioners for the diagnosis of energy-saving efficiency and CO<sub>2</sub> reduction efficiency. Furthermore, lectures for craftsmen on building technology will be established in universities and other educational institutions, and by organizing in each region training classes and events intended for construction workers, foundations will be created for passing on the knowledge of energy-efficient building technologies and designs.

[Environmental Efficiency Labeling Introduction Period] A labeling system for residences and buildings will be commenced based on the newly-developed evaluation methods. Long-term energy-saving target values (upward in incremental steps) will be set for each type of building usage. Certification and registration of labeling will be mandatory at the time of purchase for newly-built residences, at the time of renovation for existing buildings, and at certain intervals for leased and business buildings. Those failing to meet the lowest-rank standard will receive guidance to attain the acceptable standard values through the introduction of high-efficiency equipment, solar power generator, solar thermal equipment and so forth. In addition to the annual energy consumption of the average household and CO<sub>2</sub> emissions, the environmental efficiency labels will include the economic figures for the buildings such as the average annual energy cost, enabling comparisons of initial investments and running costs. Furthermore, through combination of tax breaks and low interest financing loans that correspond to the environmental efficiency label, incentives will be provided to owners and users of buildings to select residences or buildings on a long-term basis.

Contribution of Building Owners

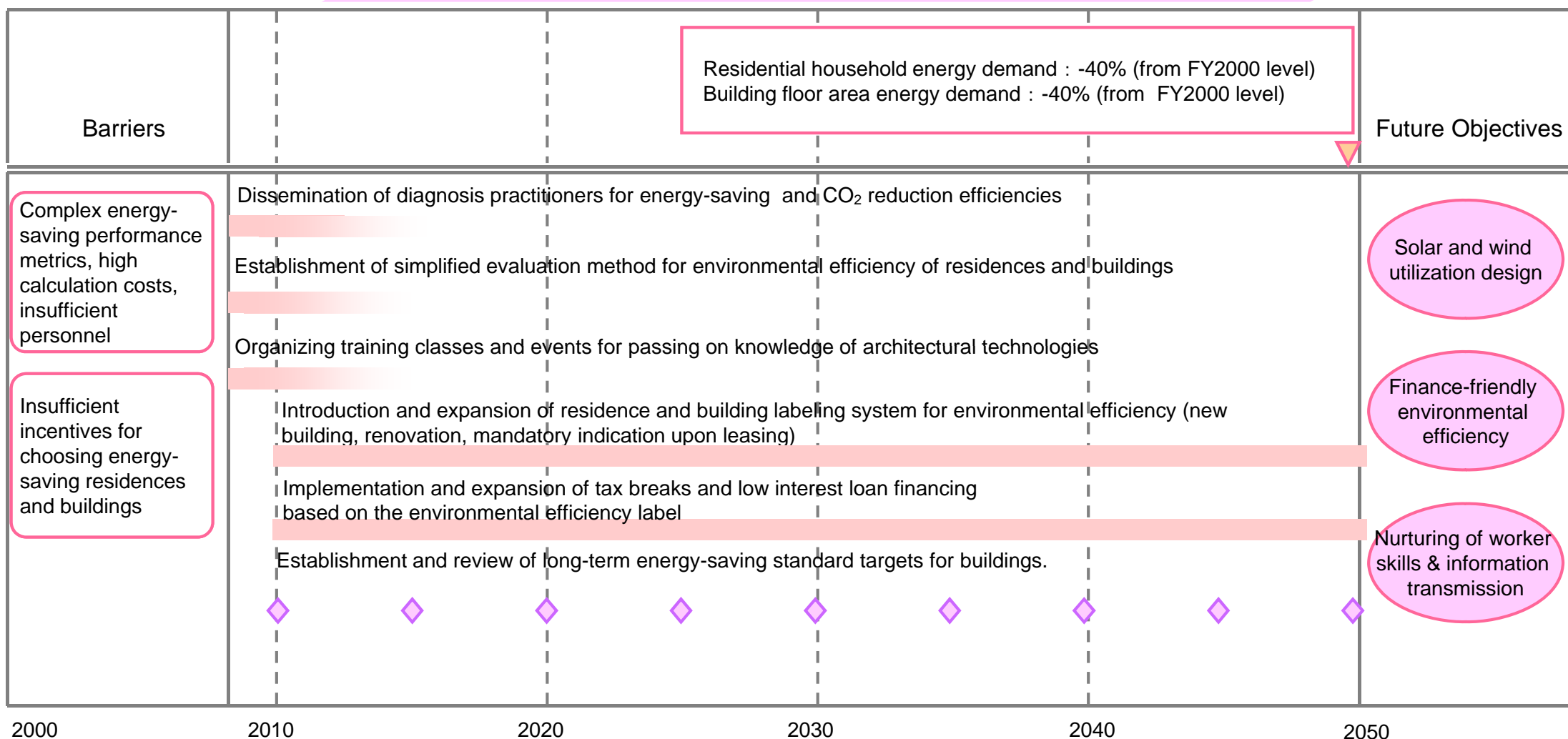
Selection of residential buildings with high environmental efficiency.  
Commission of low carbon design to architects and construction companies.

Contribution of Architects, etc.

Development of low carbon architectural design methods. Investing for technology development in insulation technologies, etc. Sustenance of regional worker skills.

Standardization  
Period

Environmental Efficiency Labeling Introduction Period



2000

2010

2020

2030

2040

2050

## 2. Anytime, Anywhere Appropriate Appliances

### Future Objectives

[Dissemination of Energy-saving and Control Technologies] As a result of technological competition for energy saving on home appliances and business equipment, the energy efficiency of all equipments is greatly improved, enabling efficient use of energy with minimal waste. Also, practical use of information communication technology (ICT) has made it possible for autonomous operation and control of equipments to automatically suspend the operation in spaces and periods of time when people are not present.

[Service Consumption Lifestyle] Air-conditioning equipment and hot water heaters are leased rather than sold, with a charging system in response to the volume of usage. The charging system for electricity and gas is such that the leasing companies are charged, causing them to make efforts for reduction of energy costs by improving the efficiency of equipments through continual equipment repairs and exchange of parts as well as updating to the latest high-efficiency equipments. Furthermore, more effective use of resources is performed as post-use equipments are sent back to the leasing companies to make the collection process of unnecessary equipment easy.

[Leading the world] Japan has the highest global technological levels, and this advancement elevates the appeal of the country throughout the world. These technologies are exported throughout the world, thus besides supporting Japan's economy they contribute to the creation of a low carbon society.

### Implementation Barriers and Strategic Steps

[System Revision Period] The top-runner system has been a system with great results. Based on this experience, the scope for its application will be expanded with the focus on business affairs. Moreover, the evaluation method for the top-runner standard values will be reviewed so as to appropriately evaluate the energy-saving efficiency attained by autonomous control of air-conditioning and lighting equipments.

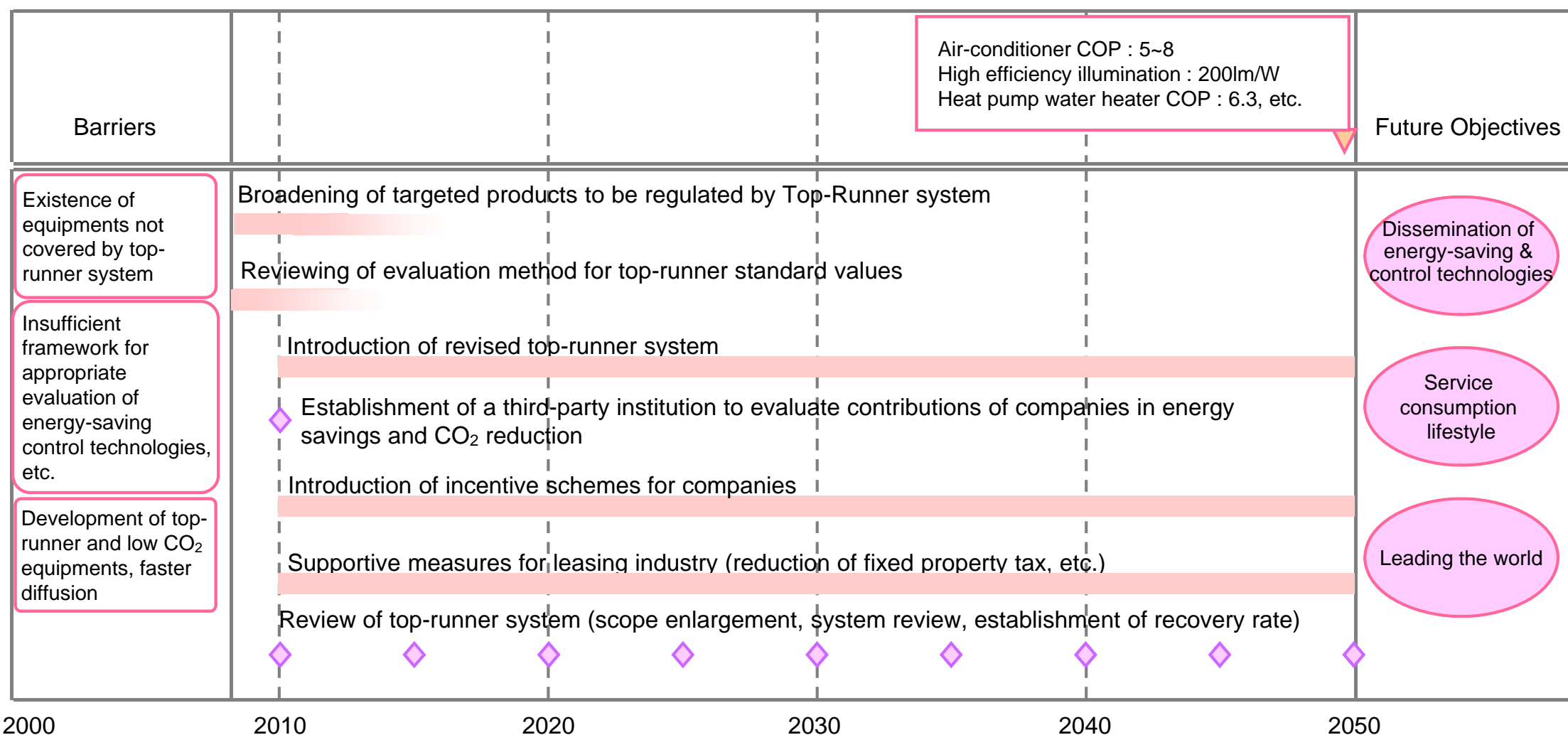
[Business Model Conversion Period] Under the revised top-runner system, efficiency improvement of each equipment item will be promoted. Simultaneously, in corporation with industry organizations, a third-party system will be established to evaluate the contribution level of each company for equipment efficiency, energy savings and CO<sub>2</sub> emission reduction, publicly announcing and recognizing those companies with superior contribution in each year. Moreover, strategic initiatives will be taken to make Japanese technologies and evaluation techniques into international standards. A shift from the retail style to the leasing business style will be encouraged by establishing lowest recovery rates and by incrementally tightening the standards. Furthermore, for leasing companies, supportive measures will be in place, including provision of incentives such as reduction of fixed property tax for the top-runner equipments and CO<sub>2</sub> emission reduction equipments (solar power generators, solar water heaters, etc.) that they own.

Contribution of Product Users      Selection of equipment high in energy savings and low in CO<sub>2</sub> emission

Contribution of Companies (manufacturers)      Positive performance of R&D on energy savings products. Appeals for environmental efficiency of their products.

System Expansion Period

Business Model Conversion Period



# 3. Promoting Seasonal Local Food

## Future Objectives

[Raising of Low Carbon Agriculture by Consumers] At the time of selecting foodstuffs in supermarkets and restaurants, the advertising of health related information and CO<sub>2</sub> emissions will increase the popularity of low carbon agricultural produce. Specifically, consumers prefer seasonal produce and other vegetables grown using solar thermal or biomass even if they were grown in greenhouses, thus farmers make various innovations to ensure lower carbon emissions. Also, supermarkets and other stores support their efforts to promote low carbon produce by introducing eco-points and similar other incentives.

[Low Carbonization of Production Process] While production and consumption of produce in season have become more prevalent, there has been a large decrease in greenhouse cultivation which consumes a large amount of energy. Even with its implementation, farmers actively utilize solar thermal, biomass and local small- and medium-sized hydroelectric power generation. As a result, per yield CO<sub>2</sub> emissions for vegetables and fruits have declined to less than half the current figures. Moreover, biofuels made from irregular agricultural produce and agricultural waste are used as fuels for agricultural machineries, contributing to the low carbonization of production process for agricultural produce.

[Agricultural Fields and Pastures without Greenhouse Gas Emission] Through engagement in new agricultural production methods, technological development, breed improvement and so forth, emissions of N<sub>2</sub>O, CH<sub>4</sub>, etc. from agricultural fields and pastures have declined greatly.

## Implementation Barriers and Strategic Steps

[Verification Period] Farmers who desire certification in low carbon agriculture will be recruited to participate in verification tests for agricultural produce labeling. In collaboration with participants in the verification tests, discussions will be held to improve the policy towards low carbon agriculture, thereby accumulating the experience and knowledge of low carbon agriculture. Simultaneously, low carbon agriculture advisors with adequate experience in the field will be nurtured.

[Diffusion Period] The target areas of agricultural produce labeling system and low carbon agriculture certification system will be expanded to include the whole country. However, in some cases introduction of high-efficiency equipment, solar water heater, biomass boiler, etc. are necessary, thus for these equipments, the municipalities will establish systems for lending (leasing) and giving out subsidies. Also, in order to assure the acceptance of low carbon agricultural produce by consumers, guarantee of taste and safety will be given to certified produce, in addition to active appeals made both within and outside Japan through government publicity. In addition, systems will be constructed so that certified results can be mutually confirmed with major trading partners of agricultural produce, broadly spreading the knowledge of low carbon agriculture that Japan has so as to contribute to the realization of a low carbon society.

[Establishment Period] Low carbon agriculture will become the standard method because consumers can easily select low carbon produce, and because producers will have lower running cost with reduced usage of heavy oil and so forth. Thus, various government and municipal subsidies should be gradually reduced to promote independence.

Contribution of Consumers: Selection of seasonal food products and low carbon items based on environmental and safety information of food.

Contribution of Farmers: Seasonal item cultivation. Use of low carbon energy in greenhouses as much as possible.

Verification Period

Diffusion Period

Establishment Period

CO<sub>2</sub> emissions per yield of vegetables and fruits : Less than half

Barriers

Future Objectives

Insufficient knowledge and experience of low carbon agriculture

Verification testing of low carbon agriculture

Nurturing of low carbon agriculture advisors

Raising of low carbon agriculture by consumers

Cost of equipment introduction is high. Lack of appropriate equipment

Introduction/expansion of low carbon agriculture certification system

Leasing and financial subsidies for agricultural machines and solar thermal equipments

Low carbonization of production process

Introduction of international certification system

Government publicity for low carbon agriculture (safety/taste evaluation, low carbon agriculture promotion)

Fields & pastures without greenhouse gas emission

Demand for and supply of low carbon produce need to match

2000

2010

2020

2030

2040

2050



# 4. Sustainable Building Materials

## Future Objectives

[Life Surrounded by Trees] In addition to low-rise residences, the popularity of wooden residence has spread widely to medium-rise residences as well. Building construction using lumber with high strength and fire resistance (such as large-section laminated lumber) has become popular even for schools, hospitals, other public buildings, low-rise large-scale stores and factories, with the percentage of wooden buildings exceeding 70%. Also, the use of wood for furniture and fittings has greatly increased, and wood is used for various applications including civil engineering, architectural foundations, guardrails and sound-proof walls.

[Revival of Forestry Business] Due to the introduction of service road networks and usage of advanced machineries, labor productivity of forestry has increased by 5 times the 2000 average level. Also, due to the establishment of effective application technology for wood biomass, over 9,000,000 BDT (Bone Dry Tonne) of remaining materials in the forest are used annually. Log production volume has expanded to 50,000,000m<sup>3</sup>, and timber self sufficiency has surpassed 65% to allow for increasing exportation of wood overseas (in 2006, the domestic log production volume was 17,480,000m<sup>3</sup>, with the timber self sufficiency of 20.3%, according to "2006 Chart of Lumber Demand and Supply" by the Forestry Agency). However, clear cutting is limited to old growth forests with declining growth rate. Together with proper reforestation done using low-cost afforestation technologies, sustainable forestry business is established.

## Implementation Barriers and Strategic Steps

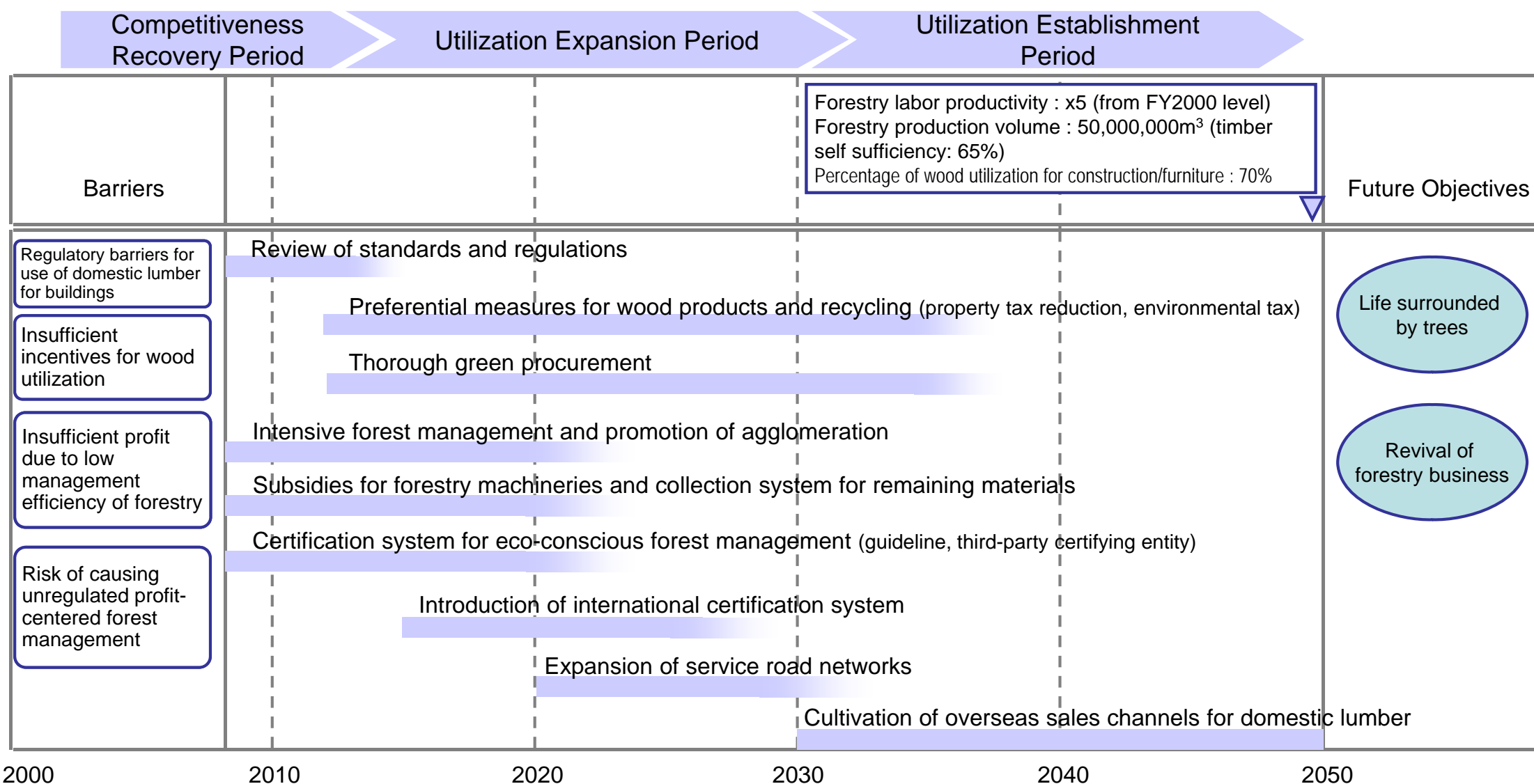
[Competitiveness Recovery Period] In order to achieve maximum utilization of usable domestic lumber, existing standards and restrictions regarding wood products will be reviewed. For current forestry, from the profit perspective, the incentives for forest owners are extremely insufficient to implement thinning and clear cutting. One of the factors is that the unit of forestry business is too small to achieve efficient management of forests. Accordingly, low-cost log production will be realized through intensification of forest management (collaborative business implementation) and subsidies to promote mechanization of log production. At the same time, political measures will be taken to achieve expansion of forestry management units by promoting small-scale forest owners to either sell or commission their forests for a long term to forest entities (such as forest associations) which can properly manage their forests. Furthermore, the remaining materials in the forest are currently not fully utilized at all because of their high supply costs, high moisture content and irregular shapes. In order to increase their utilization, the government will implement supportive measures for the development and introduction of necessary equipments for collection of the remaining materials as well as for the transportation of the materials.

[Utilization Expansion Period] Utilization of wood will be promoted by thorough procurement of natural resources for construction of public infrastructures. In addition, for the use of wood and their material cycles, property tax reduction measures and environmental taxes will be introduced to promote wood utilization further. On the other hand, for prevention of profit-centered unregulated logging due to the increase in demand for wood, forestry guidelines will be created, by which third-party organizations are designated to certify business entities that implement sustainable forest management and pro-environmental logging. Simultaneously, systems will be constructed so that certified results can be mutually confirmed with major trading partners of lumber, suppressing illegal logging and other activities overseas. Furthermore, development of new machineries will be necessary due to the increase in tree age and size, and consequently, it will be necessary to construct large-scale service road networks on which large trucks can drive.

[Utilization Establishment Period] Various kinds of utilization have been established for Japanese cedar wood, and the percentages of wood utilization for buildings and furniture approach 70%. Together with this, the competitiveness of eco-conscious wood products reach a global level. From then on, support will be given to the forestry industry so that new channels for sale of national lumber can be cultivated abroad. By this time, demand for biomass resources will outgrow supply of remaining materials from the forests, thus it will be necessary to commence production of biomass resources with short harvest intervals.

Contribution of Forest Owner: Proper forest management, or sales/commissioning of their forests to a forest association

Contribution of Forest Industry: Disclosure of CO<sub>2</sub> emissions of lumber to consumers. Establishment of construction technologies for medium-rise and large-scale wooden buildings.



# 5. Environmentally Enlightened Business and Industry

## Future Objectives

[Minimum 40% Efficiency Improvement] Through continual efforts of enterprises and social systems supporting them, the energy consumption per actual production volume in each industry has declined by a minimum of 40% in comparison to 2000 (equivalent to an annual reduction rate of 1% in each section).

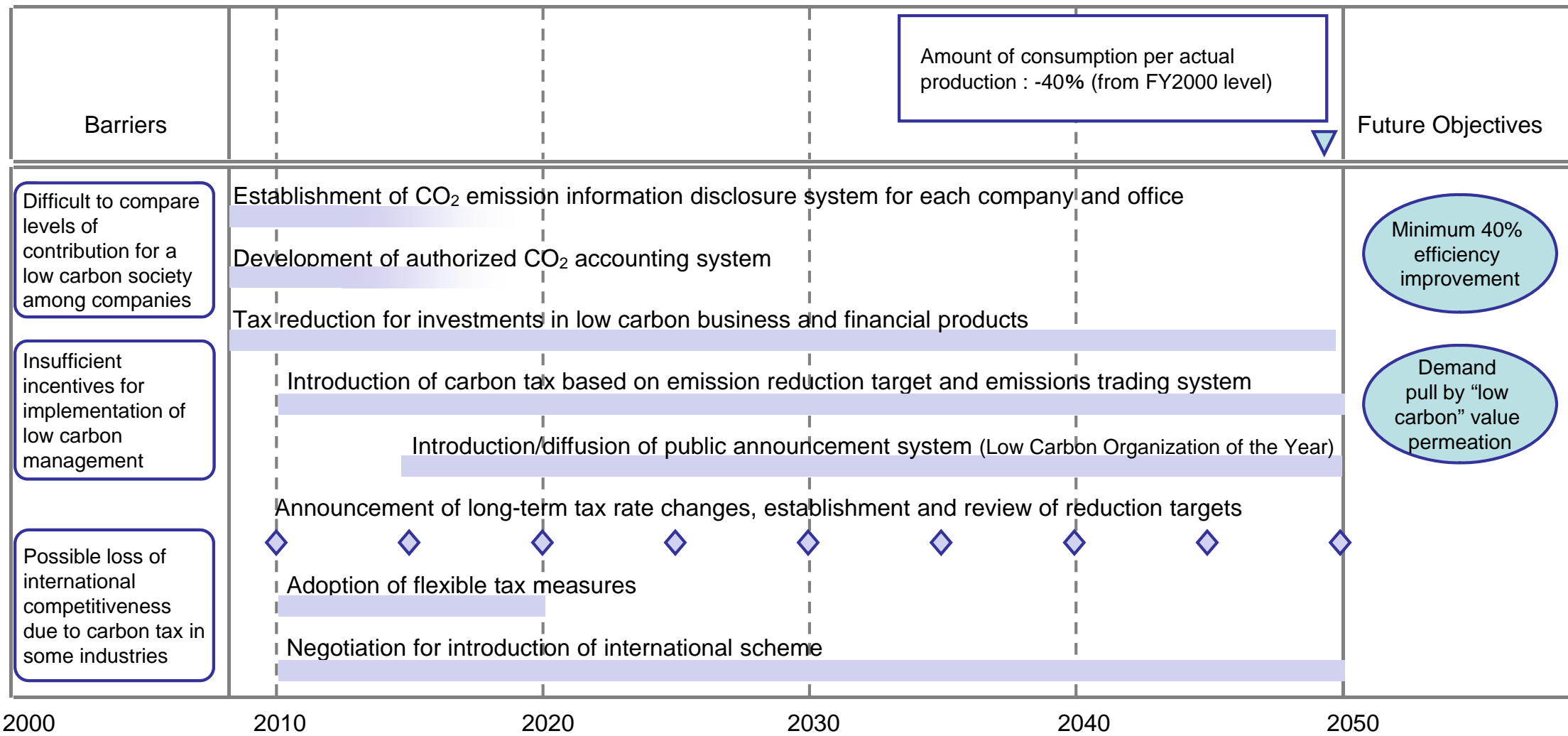
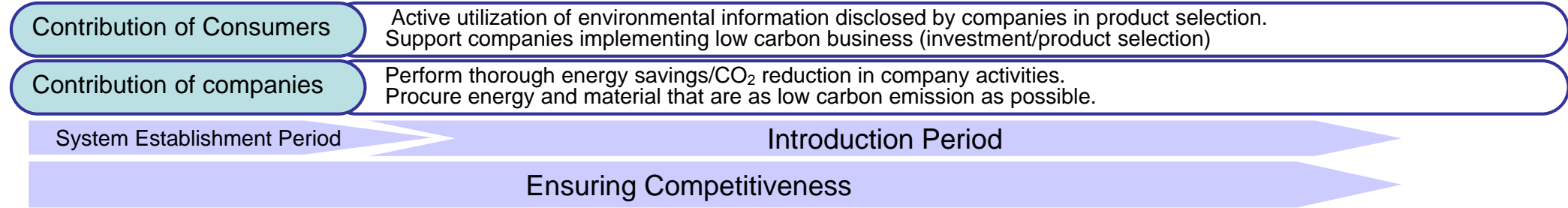
[Demand Pull by "Low Carbon" Value Permeation] Consumers have come to prefer low carbon products and services, and accordingly, companies are increasing their development investment in low carbonization of their manufacturing technologies and services. In addition, since monetary investment on companies actively implementing low carbonization is on the increase, low carbonization of company activities has become an important element from the viewpoint of corporate competitiveness. Consequently, a number of revolutionary technologies have been put into practice, such as iron-making technologies that use hydrogen as the reducing agent.

## Implementation Barriers and Strategic Steps

[System Establishment Period] In order to objectively apprehend companies' efforts toward low carbon targets, a system for publicizing the CO<sub>2</sub> emissions of each company and office in a unified (standardized) format will be established. Moreover, another system for publicizing these companies' efforts toward a sustainable society will be in place. To provide the companies with a third party certification for their emissions and efforts, a system for authorized CO<sub>2</sub> accounting will be introduced. On the other hand, the policy for implementing eco-conscious "socially-responsible investment behavior" will be clearly addressed to financial institutions. Those achieving a certain rate of loan assets for low carbon businesses will be announced, thereby providing support for low carbon businesses. Moreover, a system to concentrate money on companies with low carbon management will be constructed by introducing preferential measures, such as tax reductions, for low carbon investments and financial products.

[Introduction Period] Based on the CO<sub>2</sub> emission data of companies from "disclosure" schemes, systems for supporting companies that conduct low carbon management will be introduced. To be specific, a carbon tax will be imposed on the emission of CO<sub>2</sub> caused by company activities. On the other hand, incentives (large scale tax reduction measures and technological development support for attaining CO<sub>2</sub> reduction targets) will be given to companies which have achieved the CO<sub>2</sub> reduction targets regarding which they had made an agreement with the government. CO<sub>2</sub> reduction targets are evaluated by third-party organizations, and the incentives including tax reduction measures and technology development subsidies will be differentiated depending on the degree of achievement. Also, in parallel with the introduction of environmental taxes, a system for emissions trading will be introduced so as to create a systems framework that can minimize the companies' CO<sub>2</sub> reduction cost and the risk of not achieving their targets. Regarding the rate of the carbon tax, although it will be gradually increased, the long-term changes in the tax rate will be made public so that companies can make long-term management plans and technology development investment plans while taking future tax rates into account. Furthermore, for companies with particularly advanced activities, large scale public acknowledgement such as "Low Carbon Organization of the Year" will be given. Through these measures, companies will be encouraged to convert to low carbon production technologies and services.

[Ensuring Competitiveness] Regarding some industries easily exposed to international competition, the introduction of carbon tax and such measures could lower their international competitiveness. Also, the burdens placed on manufacturing companies could lead to an exodus of manufacturing industry to overseas. Accordingly, through international negotiation, government will work with each country in the world to adopt an international framework (sectoral approach, border tax, etc.) in order to prevent significant disadvantages to some industries. Although flexible tax measures will be adopted until a sufficient scheme is constructed, these special tax measures will be repealed by 2020.



# 6. Swift and Smooth Logistics

## Future Objectives

- [Thorough Removal of Waste by SCM] The idea and practice of “supply chain management” are widely accepted to optimize the overall business processes, where the flow of commodities from source of supply to final demand (consumption) including procurement of materials and parts, inbound logistics, production, outbound logistics and sales is captured as a “supply chain”. In SCM, information is shared and managed jointly among companies participating in supply chains using advanced information communication technology. Through this, supply and demand are synchronized to promote reduction of inventory of goods and goods-in-process and swift flow of materials. As a result, production of unnecessary items are limited, thereby making industries more efficient.
- [Enhancement of Infrastructure for Railroad and Marine Logistics and Realization of Seamless Logistics Networks] Large-scale cargo logistic networks by ships and railroad between major centers are fully developed, and systems and infrastructures are constructed to enable smooth cargo transfer between different transportation modes at major unloading sites. As a result, long-distance logistics networks with low carbon emissions and high efficiency are in place.
- [Local Logistics by High-efficiency Vehicles] Local logistics are based on motorized and hybrid cargo vehicles. Within central areas of urban cities, trolleys are also actively employed for collection and distribution of goods.

## Implementation Barriers and Strategic Steps

- [SCM Promotion Period] For realization of overall optimization of business process following the introduction of SCM, it is necessary for all related companies to share necessary information. However, in some cases, due the cost of system introduction and resistance against the presentation of internal company information to other companies, only a limited number of companies participate to result in insufficient optimization. Therefore, cases of SCM will be evaluated in an investment-versus-result format, and superior cases will be announced. At the same time, the introduction of systems for sharing SCM on a network will be supported to decentralize and lower the investment expenses in order to enable participation of small- and medium-sized businesses. Furthermore, by implementing strategic approaches for rendering the Japan-borne intra-and inter-business standards of electronic information into international standards, system cost will be reduced, further promoting their diffusion.
- [Infrastructure Preparation Period] Various systems will be introduced to remove barriers among multiple transportation means, such as development and unification of new railroad containers with identical dimensions as the international standard (ship containers). At the same time, public subsidies will be given for construction of necessary infrastructures such as expansion of freight railways and terminals, purchasing of carrier trucks and expansion of container yard for empty containers at ports. Also, various tax reductions will be performed on railroad and shipping real estate tax among others. These measures will encourage infrastructure construction of arterial networks for cargos.
- [Low Carbon Logistics Realization Period] By broadening the scope of target for Top-Runner Law to include not only all automobile vehicles but also other transportation modes, the efficiency of all logistics transport modes will be continuously improved. Moreover, in order to enhance the competitiveness of low carbon logistic modes, imposed taxation will be proportionate to the percentage of carbon content of the transportation energy used. As well, by supporting diffusion of a real-time browsing system for vacancy conditions, CO<sub>2</sub> emissions, cost, lead-time, etc., of each available logistics mode, and by promoting widespread use of labeling systems such as Eco Rail Mark, “visualization” of greenhouse gas emissions caused by cargo transport will be advanced further, thereby providing cargo owners with an environment in which they can easily obtain information for selecting an appropriate logistics modes and companies.

Contribution of Manufacturing and Logistics Industries

Active introduction of SCM to strengthen partnerships with other related companies. Presentation of all necessary information for overall optimization.

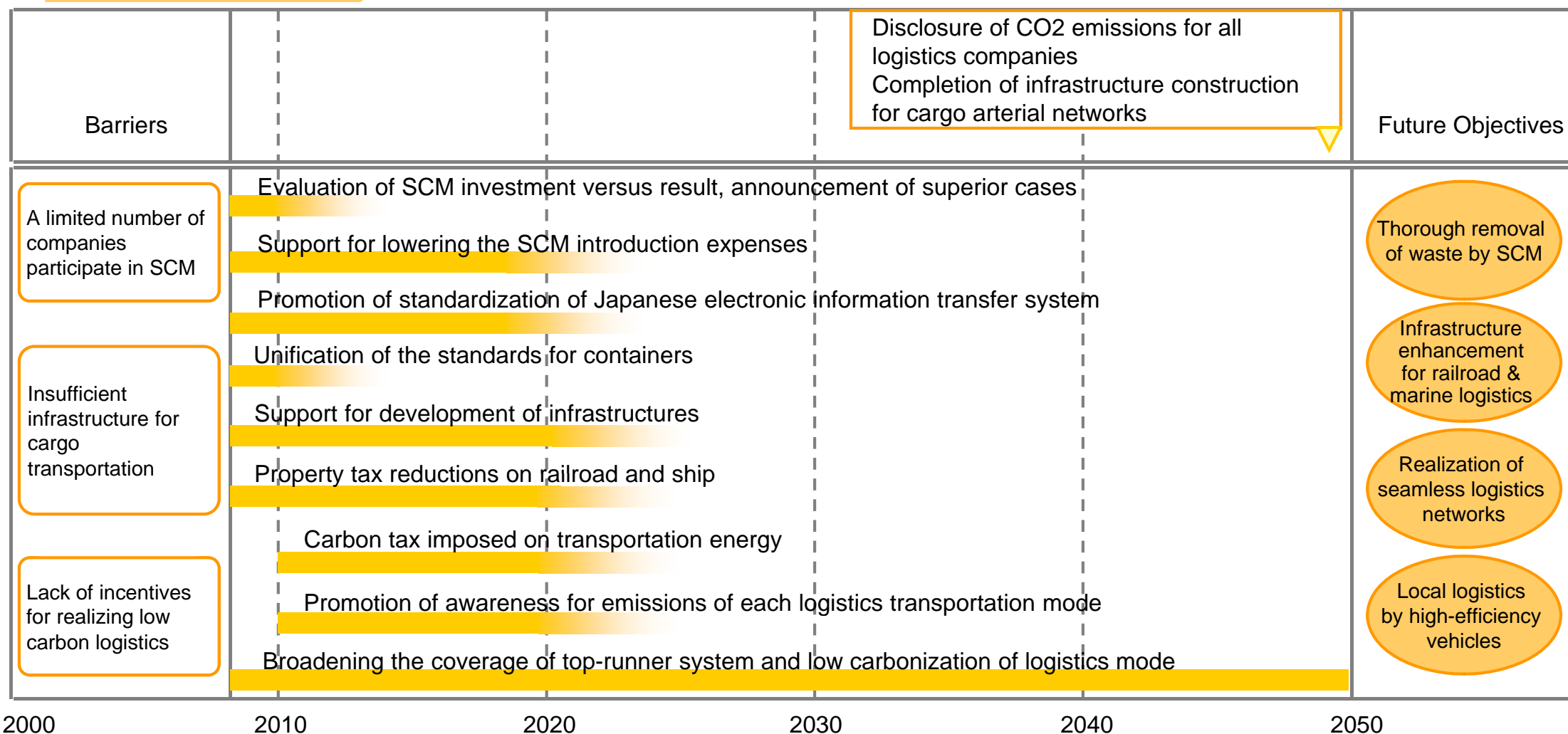
Contribution of Cargo Owners

Selection of transportation means with as low CO<sub>2</sub> emissions as possible

Infrastructure Preparation

SCM Promotion Period

Low Carbon Logistics Realization Period





# 7. Pedestrian Friendly City Design

## Future Objectives

[Public Transport Linking Central Urban Areas] Facilities with high frequency of usage are located within central urban areas, while others with low frequency of usage are located somewhat away from those areas, assuring convenient city structures in each region. In addition, the central areas of all regions are connected with each other by public transportation networks, allowing for convenient use of public transportation.

[Safe Walking Areas] Areas open to pedestrians and cyclists throughout the day are established in many sections of cities and suburbs. Since through traffic of cars and trucks are prohibited within these areas, persons in wheelchair and "senior car" (electric assistant scooter) can safely and comfortably travel.

[Lightweight Electric Passenger Vehicles] Automobile vehicles are primarily driven in areas with relatively low-density land use, being used in combination with public transportation, park-and-ride, shared-taxi, carsharing and other approaches. Moreover, the standard types of vehicles are motor driven cars with batteries or fuel cells. The energy storage devices (secondary batteries, hydrogen storage devices) for these electric vehicles are highly advanced. This, together with the lightening of car bodies realized by the development of high-tensile steel, has greatly improved the operational energy efficiency of these cars. Many of the battery-car users perform quick charging at home, but there are some users who frequently use an exchange service for pre-charged car batteries for convenience.

## Implementation Barriers and Strategic Steps

[Planning Period] In order to make citizens understand the public nature of land and to carry out city planning that is based on a medium to long term perspective, in cooperation with the citizens, the government needs to establish a plan for land use and transportation with a clear statement about the shift towards concentrated land use appropriate for a low carbon society and declining population. In addition, through establishing it as the master plan for city planning and as a comprehensive plan, improvements on land use and transportation infrastructure, that reflect low carbon perspective, will be made. Moreover, in order to promote the widespread use of motor driven cars, researches will be performed to develop energy storage devices (high-efficiency secondary batteries, hydrogen storage devices, etc.) and lighter car bodies as well as to improve the efficiency of public transportation.

[City Structure Reform Period] Special tax reduction measures will be introduced to central urban areas to induce effective land use and to accumulate facilities with high frequency of usage in areas within close proximity of public transportation. In addition, by adopting the vertical separation method that separates construction and maintenance of infrastructure from its operation, financial support will be distributed to many regional cities to promote introduction of commercial Light Rail Transit (LRT) and so forth. Moreover, for transportation by car, incentives for low carbonization will be given to car owners in various aspects including the introduction of the green tax system, that promotes selection of vehicles with low environmental load throughout their lifecycle, as well as the establishment of priority lanes and parking spaces for these cars. For widely popular motor driven cars, strategies will be formed to ensure the supply of necessary amount of rare metals for secondary batteries, fuel cells and motors, while simultaneously conducting researches for alternative materials.

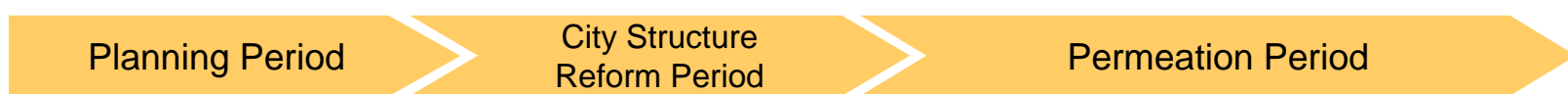
[Permeation Period] In some areas, the possibility for realizing a low carbon community will become clear, and its charm will attract people to move into the areas when they need to rebuild their houses, thereby forming concentrated residential areas. Regarding means of personal transportation, reduction in size and weight of the devices will improve further, expanding the market shares of such intra-urban transportation means as electric cars, electric wheelchairs, electric assisted bicycles and i-REAL.

Contribution of Citizens

Participation in the planning and execution of a medium to long term plans for land use and transportation that are appropriate for a low carbon society.

Contribution of Retailers

Active participation in reforming and process of shifting to central urban areas.



Barriers	Planning Period (2000-2010)	City Structure Reform Period (2010-2030)	Permeation Period (2030-2050)	Future Objectives		
			<div style="border: 1px solid black; padding: 5px;">                     Use of public transportation system : +10%                      Foot and other means : +10%                      Average distance of travel by car : -10%                 </div>			
Lack of consideration for low carbonization in city planning	Creation and implementation of a master plan for low carbon city planning by municipalities and citizens			Public transport linking central urban areas		
Costs including land usage fees are cheaper in suburbs	Introduction of tax systems to promote the effective use of central urban areas					
Economic aspects of public transportation	Introduction of the vertical separation method (infrastructure construction by the government and assistance on its cost)			Safe walking areas		
Various issues regarding motor driven cars	R&D support and investment for development of high-efficiency secondary batteries and lighter vehicle bodies					
	Rare metal stock assessment	Resources supply assurance, development of recycling technologies				
Lack of competitiveness against gasoline-powered cars	Green tax system to promote diffusion of vehicles with low environmental load, strengthening of fuel regulation			Lightweight electric passenger vehicles		
	Introduction and expansion of priority lanes and parking lots for vehicles with low environmental load					
	2000	2010	2020	2030	2040	2050

# 8. Low-Carbon Electricity

## Future Objectives

[Low Loss and Low Environmental Impact] In both coal-fired and natural gas power generations, combined cycles of ultra-supercritical turbines have become standard, achieving efficiency of over 55% in all power plants. There are also large-scale, advanced power plants that have achieved more than 60% efficiency. In addition, carbon capture and storage (CCS) equipments are installed to prevent as much CO<sub>2</sub> discharge into the outside air as possible. As such, the efficient systems for converting primary energy into secondary energy have become widely diffused.

[Grid network for Enhanced Utilization of Renewable Energy] Together with large-scale solar power generators and wind power generators, output power leveling equipments such as batteries and hydrogen generators are installed to control their influences on the power system to a certain degree.

[Appropriate Utilization of Nuclear Energy] Nuclear power plants are established based on agreements made between the government, electric companies and the citizens while taking into account the likely changes in the demand for and supply of electricity as well as development of other power-generating technologies. With mandatory requirement for total disclosure of safety-related information, appropriate waste management is carried out. Taking into account the perspective for the prevention of international nuclear proliferation, maintenance and operation are performed at the appropriate levels.

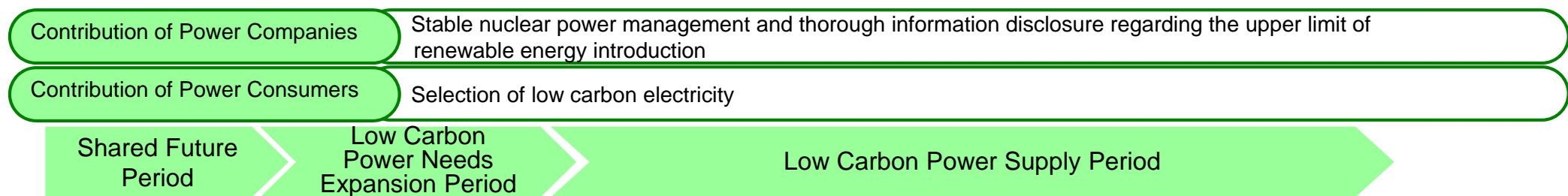
[Energy Transport Network without Loss] For the central transmission grid within a jurisdiction area, ultra-high voltage transmission grid capable of transmitting 1 million volts is laid out. For transmission lines among electric power companies and between nuclear power generation facilities and places of high demand, extra-high voltage direct-current transmission is employed to reduce as much transmission loss as possible.

## Implementation Barriers and Strategic Steps

[Shared Future Vision Period] Through partnerships among the government, electric companies and consumers, a system for having discussion on and sharing perspectives about the appropriate power supply over a medium-to-long term will be constructed. Based on these discussions, industries, academic sector, the government and the civilian sector will, in a collaboration with each other, promote the development of various technologies (ultra-supercritical turbines, ultra-high voltage electricity supply technology, CCS with low loss, technologies for management of electricity quality and so forth) that are essential for realizing the future objectives. Simultaneously, supply of low carbon electricity will be prescribed by some political measures such as guidelines and incentives to actors other than the pre-existing electric companies for entry and cooperation. Regarding nuclear power generation, the operation and maintenance practice in cooperation with safety-assurance organizations and under the watch of appropriate information disclosure system will be strengthened. Moreover, efforts will be made to achieve proper awareness of nuclear power generation among the general public through communication with non-specialists. Furthermore, concerning the burden share of maintenance fees for quality electricity caused by introduction of renewable energy, the fee charging system for electricity will be reviewed thoroughly so as to pass on the maintenance fees to consumers while minimizing its influence on those with low income.

[Low Carbon Power Needs Expansion Period] To enable individuals to directly select an electric company, revisions will be made in the regulatory regime. At the same time, taxation systems related to electricity will be modified to become pro-environment. Through this, needs for low carbon electricity among consumers will increase, resulting in added values of low carbon power plants and transmission loss reduction. Technological developments will take place to realize practical applications of the CCS technology, ultra-high efficiency power generating technology and ultra-high voltage transmission technology roughly during this period. Based on long term guidelines, at the timing of upgrading infrastructure equipments of the power systems, electric companies will make progress on conversion to transmission lines with low loss, introduction of long distance direct current power lines as well as on capacity expansion of the transmission systems, thereby creating electricity distribution networks that are with low energy loss and can readily accept renewable energies.

[Low Carbon Power Supply Period] At the same time as promoting the diffusion of various highly efficient technologies that have been developed and verified until now, CO<sub>2</sub> reduction technologies will be introduced to all of the newly-built power plants.



Barriers	Strategic Steps	Future Objectives
Lack of mechanism to pass on the costs to create and introduce high-efficiency technologies	<ul style="list-style-type: none"> <li>Agreement on the necessity of low carbon power supply (prescribed by political measures)</li> <li>Fundamental review of charging system for power and cost allocation among different consumer groups</li> </ul>	Low energy loss & low environmental impact
Verification of storage stability and safety through CO <sub>2</sub> storage test	<ul style="list-style-type: none"> <li>Introduction of system for selection of electric company by individuals</li> <li>Development and safety evaluation of CCS technology</li> <li>Promotion of CCS installation to thermal power generation stations</li> </ul>	Grid network for utilization of renewable energy
Loss caused by existing power transmission networks	<ul style="list-style-type: none"> <li>Technology development for ultra-high voltage transmission and extra-efficient power generation</li> <li>Staged high-voltage transmission network</li> </ul>	Appropriate Utilization of nuclear energy
Influence on quality of power systems due to installed renewable energy facilities	<ul style="list-style-type: none"> <li>Expansion of distribution capacity</li> </ul>	Energy transport network without loss

2000      2010      2020      2030      2040      2050

# 9. Local Renewable Resources for Local Demand

## Future Objectives

[Life Supported by the Sun] Low cost photovoltaic systems are installed in all residences and buildings. Since they are designed not to spoil the aesthetic aspect, it is possible to install them on various parts of buildings including the roof, walls and windows. In many cases, photovoltaic are installed in not only residences and buildings but also in fallow lands for the purpose of selling the generated power.

[Regional Symbol Wind Power] On land, installation of large scale windmills have become common practice at locations with favorable wind conditions including the coastlines, plateaus, arable lands, and grazing lands. Having been introduced with serious consideration for the eco-system, in some regions they have become regional symbols. On the oceans, large scale ocean wind farms comprising relatively large windmills are in place, converting the generated energy into a storable and transportable form such as hydrogen which then is collected regularly.

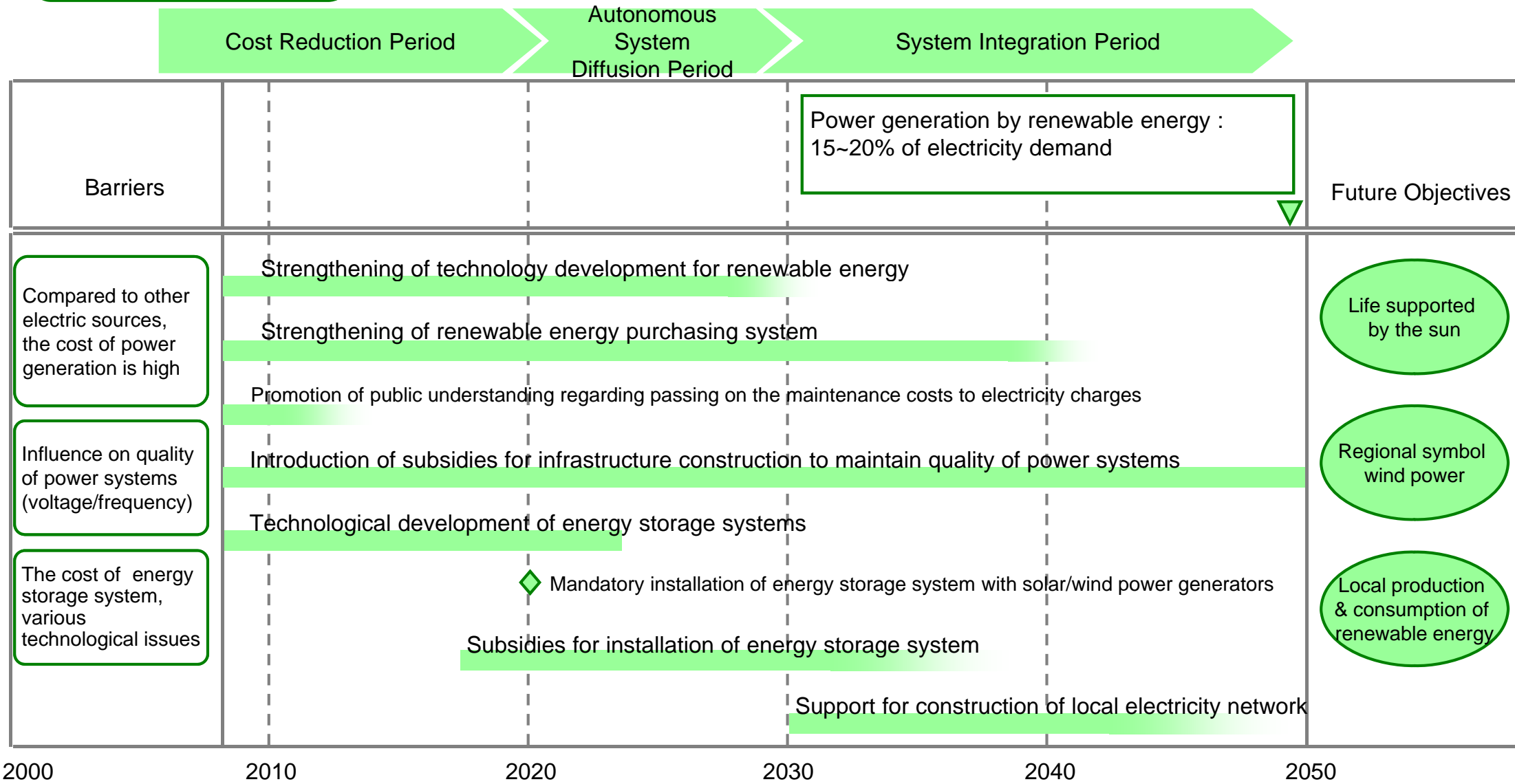
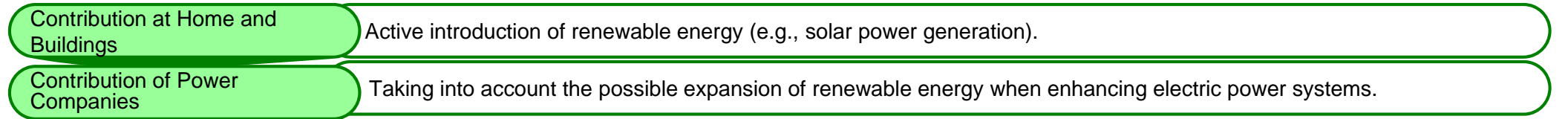
[Local Production and Consumption of Renewable Energy] Solar power generators and wind power generators are equipped with energy storage devices, enabling stable electricity supply. A part of generated electricity is used for the hydrogen production, which in turn is supplied to fuel cells in residences and offices and even to fuel cell vehicles. Also, beyond individual energy storage systems, some regions have their own electricity supply systems that adjust demand and supply of electricity within the regions by joint utilization of solar, wind, biomass, hydrogen, geothermal power generations as well as small and medium scale hydropower. As a result, the volume of power generation from renewable energy has reached approximately 15%~20% of total electricity demand.

## Implementation Barriers and Strategic Steps

[Cost Reduction Period] For the diffusion of renewable energy including solar power generation and wind power generation, various kinds of technology development programs will be reinforced in order to address the greatest immediate challenge of cost reduction. Also, for cost reduction to realize, scale merits of mass diffusion is also effective. To support this end, electric companies' purchasing price for generated electricity (or excess electricity) from renewable source will be increased. Installation will be supported further by ensuring the purchasing price at the time of installation for a fixed period (e.g., 15-25 years). Even though the purchasing price will be reduced annually due to reduction of various system costs, reductions will be performed following a clear announcement of long-term changes in the purchasing price so that renewable energy generation companies can make safe capital investment. On the other hand, the large scale introduction of renewable energy may possibly cause influence on voltage and frequency of power systems. Thus, technology development for storing energy will be promoted to support the establishment of electricity storage technology and hydrogen production technology that are low in cost, small in size and high in quality. Furthermore, certain amount of subsidies will be given to electric companies when they enhance electric lines and make other capital investments to improve quality of power systems. At the same time, publicity activities will be performed to promote public understanding of passing on the additional maintenance costs of high quality electricity to consumers through electricity charges.

[Autonomous and grid-independent System Diffusion Period] For new installation of solar power generators and wind power generators, while making it mandatory to install them in combination with energy storage systems, subsidies will be given for installation of the energy storage systems. By doing so, diffusion of autonomous and grid-independent system for renewable energy generation will be promoted while minimizing its influence on existent power systems.

[System Integration Period] In addition to the individual energy storage systems equipped onto solar power generators and wind power generators, deliberations will be made as to what the most appropriate combination may be with other distributed power sources and hydrogen energy systems, while taking into account the regional climate as well as local energy demand and supply. By supporting the construction of an appropriate electric power supply network in each region to accommodate local electricity generation, efforts will be made to reduce the overall system cost.





# 10. Next Generation Fuels

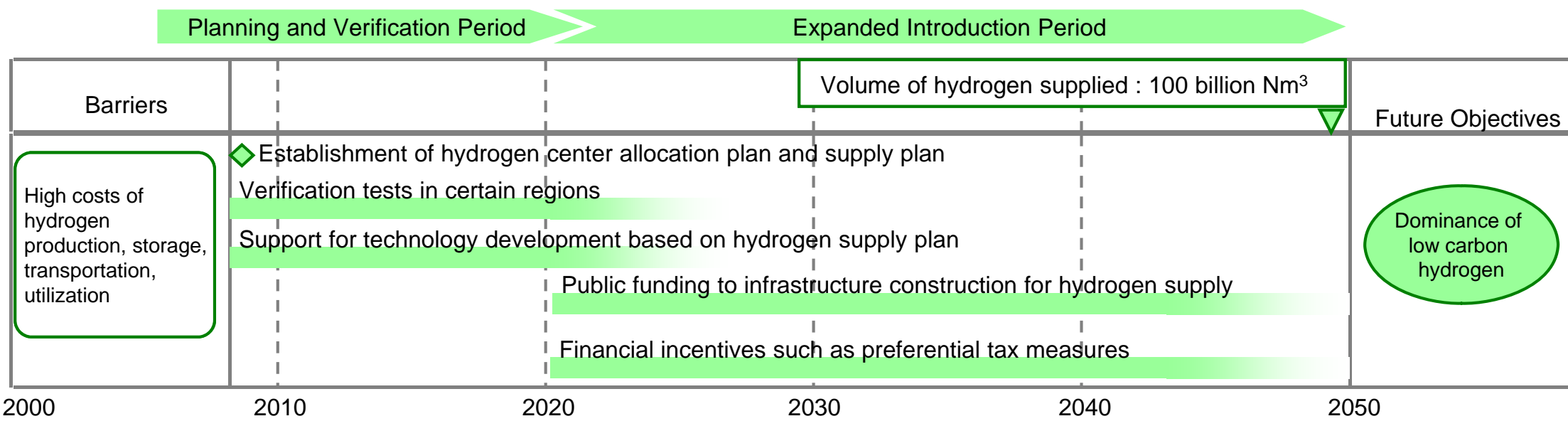
## Future Objectives 1

[Dominance of Low Carbon Hydrogen] In addition to by-product hydrogen generated by industrial processes, hydrogen is produced at reforming plants with CCS and by electrolysis at ocean wind farms. The production methods that do not cause greenhouse gas emissions have become dominant. In addition, the hydrogen produced is transported mainly through pipelines to be used for logistics, power supply adjustment and fuel for fuel cells.

## Implementation Barriers and Strategic Steps 1

[Planning and Verification Period] With future hydrogen demand in mind, plans will be made for hydrogen supply and production center allocations, taking into account the regions with high demand so that the necessary infrastructures can be minimized. First, some areas in which the use of hydrogen is relatively easier will be chosen; they need to have pre-existing hydrogen production facilities, such as by-product hydrogen source from some existing plants. Within these limited areas, necessary infrastructures for hydrogen transportation and storage will be constructed, and supply of hydrogen will be commenced. As one of the supply destinations, fuel cell buses will be in operation around these regions. Simultaneously, hydrogen utilization technologies will be improved further to achieve lower cost and higher efficiency. Furthermore, based on the hydrogen supply plan, support will be given to the development of technologies that are necessary from a long-term perspective, including hydrogen production from renewable energy, hydrogen storage and transportation technologies.

[Expanded Introduction Period] At the same time as expanding the hydrogen-supply areas based on the hydrogen production center allocation plan, support will be given to encourage the connectivity among these areas. For example, public funding will be provided for preparation of infrastructures for arterial hydrogen transport pipelines between a hydrogen production center and large consumption areas. On the other hand, low carbon hydrogen production will be made dominant by introducing financial incentives such as preferential tax measures according to the emission units of hydrogen produced.



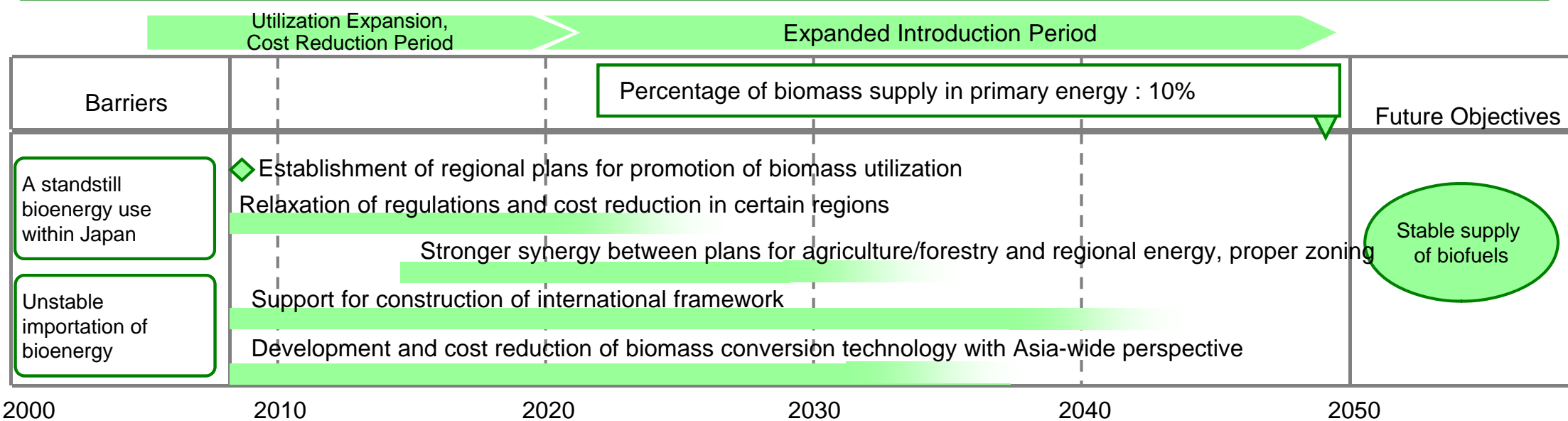
## Future Objectives 2

[Stable Supply of Biofuels] Biomass production and utilization plans suitable for each region are created, and food, lumber, animal feed and so forth are produced according to the plans. At the same time, the waste-type biomass generated within each region is also utilized to the full extent. Although shortfall within Japan is covered by importation from overseas, an international agreement on the management of biomass resources is concluded to ensure pro-environmental production method and low environmental load. In cases where liquid fuels are desired, as in fuels for logistics, liquid fuels derived from biomass are used on a priority basis. Moreover, the market share of bioenergy for heat and electricity is on the increase.

## Implementation Barriers and Strategic Steps 2

[Utilization Expansion, Cost Reduction Period] Although expansion of biomass utilization is sought in many regions, the high costs of collecting and transporting the materials and energy conversion make it difficult. To add to that, the existing restrictions hinder the utilization of low quality bioenergy and energy production by mixed processing of biomass. Along with lowering of the costs and relaxing of the regulations, it is necessary to assure that energy is supplied in a sustainable way by the use of Life Cycle Assessment (LCA) methods and so forth.

[Expanded Introduction Period] The synergy between a region's agricultural and forestry plan and energy demand/supply plan will be strengthened. Through zoning with consideration for land application, the self-sufficiency for food, lumber and energy of the region will be increased, thereby introducing an additional value of local sustainability to the products. Development and cost reduction of biomass-conversion technologies should be performed on a perspective that includes biomass utilization in not only Japan but entire Asia. Although shortfall within Japan is covered by importation from overseas, support will be given for construction of an international framework to properly evaluate the environmental load during the production processes.





# 11. Labeling to Encourage Smart and rational Choices

## Future Objectives

[Visualization of Energy-saving Efficiency] For residences and offices, digital meters (smart meters) for electricity and gas usage are introduced widely, enabling accurate and real-time calculation of energy consumption and CO<sub>2</sub> emissions for usage of each device. In addition, all newly-built houses and offices come with LCS navigation system. Besides performing automatic control of air-conditioning and lighting equipments, this system displays obtained information in a user-friendly way, providing advices for enhanced energy savings and CO<sub>2</sub> reduction in accordance with the activity pattern and lifestyle of each consumer. Many of these systems are provided in combination with various services including functions for assuring security and comfort of the elderly and monitoring functions for security at homes and offices.

[Visualization of Environmental Information of Products] At the time of purchasing a product, consumers can retrieve easy-to-read information regarding each product's environmental efficiency (such as lifecycle environmental load) and various merits of selecting the product by scanning its tag using a mobile terminal. Moreover, for electric appliances, their operational conditions are sent to their manufacturers via a network so that the owners can receive appropriate directions (advices for repairs, upgrading, disposal methods, etc.) from the manufacturers.

## Implementation barriers and Strategic Steps

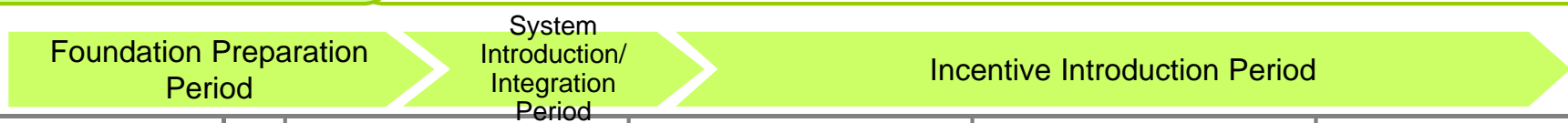
[Foundation Preparation Period] In order to achieve widespread installation of smart meters that form the foundation for the LCS navigation system, a clear diffusion target (such as installation to all residences and offices within 5 years, etc.) will be established, followed by publicity campaigns to consumers and financial support for introduction costs to electricity companies. On the other hand, in collaboration with retailers including convenience stores, supermarkets, co-ops and electronic stores, displaying of lifecycle environmental load information (carbon labeling) will be done on those products for which information can be easily obtained (such as products designed by the retailers). At the same time, manufacturers willing to participate in these systems will be recruited widely to steadily increase the range of products for displaying environmental information, thereby progressing the accumulation of necessary data and know-how for labeling. For the system planning, standards for the calculation method for environmental load and the details of labeling display will be created. Furthermore, a carbon labeling certification system operated by a third party will be in place to ensure that the consumers can compare environmental loads of multiple products with unified indices.

[System Introduction and Integration Period] For development of the LCS navigation system that integrates and displays various information, it is crucial to thoroughly comprehend the needs of the users from the developmental stage. Thus, potential system users will be selected for hearing sessions to grasp their needs. Based on these needs, discussion sessions for a number of developers, experts and users will be held. Based on the specifications determined in these sessions, system developers will be recruited openly. While giving incentives for developing the system to the system developers by grasping the needs of users and ensuring a certain level of demand, efforts will be made to pursue the realization of system designs with desired functions, price, and entertainment features. Furthermore, for home electronics and office equipments, manufacturers will be obligated to equip their products with an information communication function to transmit environmental information, and the unification of systems will be promoted so that information of all equipments will be available on the LCS navigation system.

[Incentive Introduction Period] Through utilization of the carbon labeling system and LCS navigation system, the government and companies will introduce incentive systems for reduction of environmental load of individuals and businesses. The resulting enhancement in environmental awareness among individuals and businesses will then permeate low carbon lifestyles and business-styles.

Contribution of System Users: Active introduction of LCS navigation system, practicing low carbon lifestyle.

Contribution of System Developers: Develop a product that matches users' demand.



Barriers	2010	2020	2030	2040	2050	Future Objectives
				Introduction rate of LCS Navigation System in home and office : 100%		
Data collection of energy consumption and CO <sub>2</sub> emissions for each activity	Promotion for widespread use of smart meters (publicity campaigns, financial support for installation)					Visualization of energy-saving efficiency
Integration of data on energy consumption and CO <sub>2</sub> emissions from various devices		Planning and development of technological features of LCS navigation system				Visualization of environmental information of products
		◆ Obligation of IC device installation on home appliances and office equipments				
	Empirical introduction of carbon labeling and recruiting of companies for participation					
	Standardization of product environmental information, introduction of carbon labeling certification					
		Introduction of incentives for environmental load reduction based on visualization				

# 12. Low Carbon Society Leadership

## Future Objectives

- [Nurturing of Specialists] With the number of researchers and specialists of global warming who belong to a university, graduate school or research institute reaching nearly ten thousand, understanding about countermeasure technologies against global warming have advanced. Moreover, "low carbon advisors" are professionally active in the society; they have extensive knowledge about global warming and provide multifaceted advices to reduce CO2 emissions at home and in business activities. The number of persons with this certification exceeds fifty thousand.
- [Sharing of Knowledge and Information] The basic knowledge of global warming and its various countermeasures are disseminated to persons of all generations through environmental education at school, training sessions at companies and so forth. In addition, all types of media including TV broadcasting and newspapers always provide new information such as findings gained through the latest researches. Other than that, by organizing various environmental events and online information exchanges regarding practice of eco-life, information and knowledge for establishing a low carbon lifestyle and business-style are being shared to a greater extent.
- [Permeation of Low Carbon Lifestyle and Business-style] It has become natural for even the general public to have correct science-based awareness about global warming and to practice a low carbon lifestyle or business-style based on that knowledge. Furthermore, an increasing number of people are making voluntary actions to realize a low carbon society, actively participating in city planning and local administration of their own and neighborhood regions.

## Implementation Barriers and Strategic Steps

- [Education Style Establishment Period] Educational materials and curricula will be created to match the age of learners. Moreover, to cause child-to-parent and child-to-sibling spill-over effect of dissemination of environmental awareness, educational programs that require participation of parents and children will be developed. On the other hand, to improve the knowledge level among teachers, a subject related to environmental problems will be added to the employment examination for teachers, in addition to organizing environmental training sessions for teachers. To construct the certification system for low carbon society advisors, experts will be gathered for discussions. In cooperation with NGOs and companies, provision of proper information to the general public will be achieved through holding of environmental events and training sessions as well as construction of websites for providing and exchanging information.
- [Environmental Education Permeation Period] In educational institutions from elementary, junior-high to senior-high schools, environmental education will become a compulsory subject, implementing various educational programs. Along with the introduction of certification system for low carbon society advisors, special courses for obtaining the certification will be established in universities and graduate schools. Furthermore, for companies, hiring of a certain number of low carbon society advisor certification holders will be mandatory, and directions will be given to make all the employees attend sessions by low carbon advisors regularly.
- [Stable Education Effect Period] The need for countermeasures against environmental problems will permeate to the citizens, and when introducing a new countermeasure, effective and appropriate education and publicity activities will be performed. Educational materials will be continuously revised based on new findings. Furthermore, in order to assure continuous interest of the citizens in environmental problems, opportunities will be provided for them to have discussions on environmental education, environmental administration and so forth.

Contribution of Schools, Companies and NGOs

Transmission of information based on the latest scientific findings.  
Innovations to assure continued interest in environmental problems.

Contribution of Citizens

Continuous interest in and sharing of information on environmental problems.  
Voluntary participation in creation of a low carbon society.

Education Style Establishment

Environmental Education Permeation Period

Stable Education Effect Period

