A Roadmap for Sustainable Shiga towards 2030

November, 2009
Roadmap Committee
Shiga Prefecture Sustainable Society Research Team

Introduction

In response to a request for drastic reduction in greenhouse gas (GHG) emissions on a global scale, recently in case of developed countries, a mid and long term plan towards a low carbon society is being drawn up not only at the national level, but also at regional or local community level. If we take an overview of these plans and scenarios, measures and their effects for achieving mid and long term targets are listed; however, the fact is, a roadmap of actions for their implementation is still unclear.

In the meanwhile, for Shiga prefecture (Japan), based on "Shiga's scenario towards the realization of a sustainable society" (March 2007) released by the research team, "A vision for sustainable Shiga" was drawn up in March 2008, where the challenging target of 50% reduction in GHG emissions from the 1990 level was decided. At Shiga prefecture office, preparation of a roadmap for achieving this target is going on intensively.

Taking this situation into account, the research team deliberated on the policy roadmap using a back-casting method with respect to Shiga scenario prepared earlier. Outcomes of the research have been summarized in this brochure. In the first half of brochure, premises for Shiga scenario estimations, required measures for achieving the target of 50% reduction and their effects have been summarized. The measures were classified in "City," "Transportation/Distribution," "Lifestyle," "Industry," "Energy," and "Forestry." The second half of the brochure deals with the main topic where in addition to systematizing the actions for each of the above classification categories, we also prepared a roadmap for implementation of policies.

The roadmap provided in this brochure has been prepared based on the assumptions concerning administrative capital required for each action, practicable timing, and effects of implementation. Transitions in policy packages which should be taken during the twenty years from 2010 to 2030, as well as the reduction effects are given in a quantitative and consistent manner.

Of course, this roadmap is not the one and only thing. We hope that it will serve as a springboard for further intensive discussions among all the concerned parties including the public administration, local residents and business entities in Shiga for drawing up a realistic and practicable roadmap.

November, 2009

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A Roadmap for Sustainable Shiga Towards 2030

Contents

Overview

"Sustainable Society" started from conceptualization and after going through the stage of quantitatively laying down the vision, we have finally come to the stage of writing the roadmap for achieving the goals. This brochure is a research report of backcasting done for preparing quantitative roadmap.

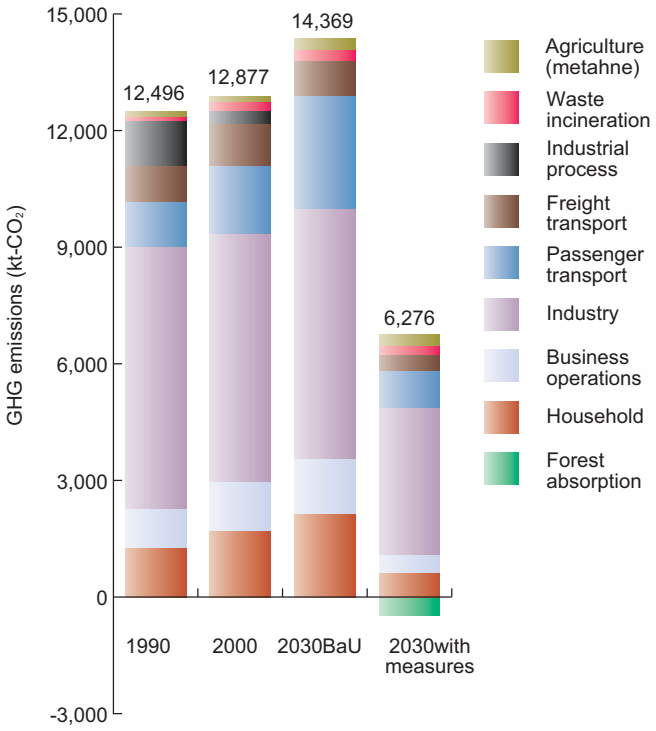
In what shape will Shiga be as a sustainable society? What should be done to achieve that? These issues call for intense debate and actions.

At Shiga Prefecture Sustainable Society Research Team, we established a method for creating the vision of sustainable society, which is perhaps the starting point of this debate, and we published it as "Shiga's scenario towards the realization of a sustainable society" (March 2007). Here we showed the vision that it is possible to achieve the goals by making the following innovative changes on both the fronts of technology and social system.

・Moderate annual economic growth of around 0.9% per person and maintaining the population at current levels

・Improving energy efficiency by promoting high energy efficient equipments, super-insulated house and buildings etc. on a national basis

・Radical improvements in energy-saving systems by regional level initiatives such as energy-saving life style, changes in transportation structure etc.



Greenhouse gas emissions

It shows GHG emissions for each emission category in Shiga in 1990, 2000, and 2030, in case no measures are taken (BaU=Business as Usual) as well as when the required measures are taken. If no measures are taken, emission will increase by another 15% in 2030 (compared to 1990); however, 50% reduction is possible by implementing various measures.

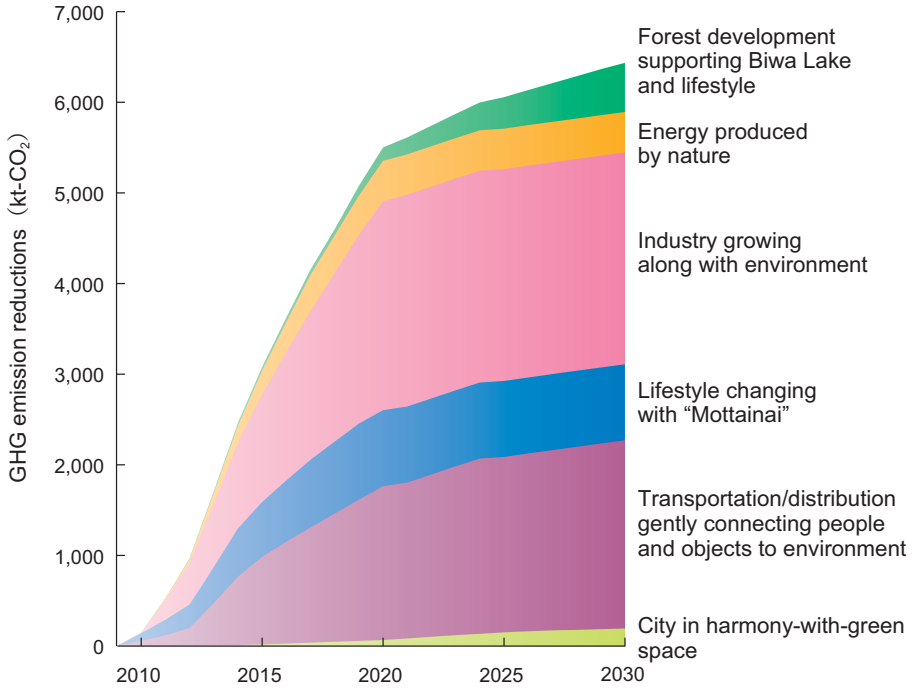
Next, it is important to shed light on actual roadmap in terms of when and who should do what for realizing the vision of society. This brochure defines the roadmap up to promotion the required amount of measures by accumulating practicable actions on the basis of estimates presented in "Shiga's scenario towards the realization of a sustainable society."

First of all, we organized the measures that should be taken to cut down the emission of GHG and processes required for the implementation of measures as basket of actions, and classified them into six policies referred to as "City," "Transportation," "Lifestyle," "Industry," "Energy," and "Forest Development."

After that, for each policy, based on the assumed administrative capital required for implementing the actions, practicable timing and benefits of implementation, we developed and applied the method for preparing the schedule that will yield maximum results and let us complete everything by the target year. Based on this, from 2010 to the target year of 2030, it would be possible to quantitatively and consistently show the year-wise implementation status of policies, GHG reductions in a form of progressive table.

In this brochure, we selected a basket of actions after considering the existing actions taken in Shiga prefecture and plans that are under preparation, and calculated based on the assumed value considered appropriate at this point in time. As a result of the calculation, we concluded that in the first half of the implementation period, actions typified by “Lifestyle” and “Industry” should be pushed as such actions are in close range to the daily life of people working in the prefecture or people residing in the prefecture. In the latter half of the implementation period, actions typified by “City” and “Forest Development” should be taken to build large scale social infrastructure in a concentrated manner. When the measures have progressed smoothly, it would be possible to achieve 85% of the final reduction targets in the middle of the implementation period, i.e. in the year 2020.

These results show only an “image” using the method for preparing a roadmap, which is the outcome of the research team. These results do not propose that this kind of content should be implemented. We hope that the outcome of this research will act as a springboard for discussing the roadmap towards sustainable society by many people.



Changes in policy-wise GHG emission reductions

Actions that will directly or indirectly lead to the reduction in GHG emissions were summarized as “Policies” for each field, and changes in the reduction amount were shown on time series plot when the measures for reducing the emissions by half are implemented. If the policies are implemented on schedule, it will be possible to already achieve 85% of targeted reduction at intermediate time (2020).

Vision of Sustainable Shiga in 2030

Environment burden is closely related to social and economic situation at that point in time. So far, after making certain assumption about social trends by 2030, we make various estimates for Shiga such as supply and demand of resources.

Here, we will present the outline of how Shiga would be in 2030, which was summarized by Shiga Prefecture Sustainable Society Research Team in “Shiga’s scenario towards the realization of a sustainable society” (March, 2007).

Social assumptions in 2030

Shiga’s socioeconomic vision in 2030 can be characterized by the following three major trends,

1. Return of population of the current level and continuous aging of society;
2. Maturation of economic growth;
3. Dramatic increase in the role of the tertiary industry; and
4. Dramatic increase in the proportion of women and elderly people in employment.

The urban population continues to increase due to the settlement of young people and migration from other prefectures. It means that the service industry will enjoy significant growth and provide employment. While many residents of cities live in collective housing in compact cities, they will participate in local traditional activities and form communities and lifestyles integrating both old and new generations. Daily shopping and amusement do not depend on large suburban shopping malls. People use shopping avenues around railway stations and in downtown areas, rejuvenating the liveliness of urban centers. Such communities have another crucial function of providing avenues for cultural leisure activities for people in both urban and rural areas.

Despite the decrease in population in agricultural and fishing areas, large scale and exceptional multifunction agriculture, forestry and fisheries industries is growing. In addition to supplying food and timber (Shiga brand products) to the prefectural market, it also contributes to watershed production, in the prefecture as well as the recharge of water resources, maintenance and enhancement of carbon sinks, supply of biomass energy, and the promotion of eco-tourism. Furthermore, village development in harmony with nature progresses as a model for the sustainable society, and villages serve as sources of leisure, welfare, nursing care, and education by using the blessings bestowed by nature through exchanges with people in urban areas.

Based on the above, we assumed the socio-economic trends of Shiga in 2030 as shown in Tables 1-2 and Figure 1.

Current status and trends of GHG emissions

Our target is to reduce GHG emissions by 50% below the 1990 level. CO_2 emissions from energy consumption (Household, commercial, industrial, passenger transportation, and freight transportation sector from classification of GHG emissions in Figure 2), the dominant source of greenhouse gases in Shiga Prefecture, were 11.1 million tons of CO_2 in 1990 and increased by 10% to 12.1 million tons of CO_2 in 2000. If measures for emission control are not taken, the emissions are estimated to grow to 13.8 million tons of CO_2 in 2030 (“2030BaU” of Figure 2). This represents around 20% increase in emissions over 1990 level.

Table 1: Socioeconomic assumptions

Population	1,380,000 in 2030 (Estimation of Shiga Prefecture as of 2006. Estimation as of 2005 was also more or less same)
Number of households	520,000 households in 2030 (Same as above. 470,000 households in 2005)
Japanese Economy	Average annual growth of 0.9% in per capita GDP
Public-sector fixed capital formation	Investment in infrastructure development, etc. After basic infrastructure development has been completed, new development is dramatically reduced and capital investment is placed mainly on maintenance and management. Total investment is lower than the current level.
Breakdown of private consumption expenditure	Breakdown of the goods and services consumed mainly in households. With longer-life products, the value of purchased goods remains unchanged. It is assumed that the shares of spending for the primary industry and personal services (education, healthcare and insurance, accommodation, etc.) increase.
Employment rate	Through the development of the welfare environment to facilitate the employment of elderly people and women, the employment rate of elderly males rises by 20% and the rate of women by 10 to 30%.
Daily time budget	The working hours of male workers are reduced by 1.5 hours per day. It is assumed that both men and women increase time for participating in social activities.
Breakdown of exports	The breakdown of goods and services delivered from Shiga to outside the prefecture. The exports of products in the manufacturing industry are assumed to remain unchanged in monetary terms.
Import ratio	The ratio of the goods and services produced outside Shiga Prefecture in the demands for goods and services in the prefecture. The import ratio of goods in the primary industry has declined, but imports of other goods and serviceshave increased.
Input coefficient	The input of raw materials needed for the production of one unit in a certain industry. It is assumed that this figure declines due to paperless operations based on the use of IT, less input of metal and cement and increase of wood products in public projects, and reduced consumption of fuel and electricity as a result of energy saving.
Labor productivity	To maintain an annual economic growth of 0.9% while the population is decreasing, it is necessary to secure high labor productivity. Labor productivity per person-hour rises by 2.7% per annum in the manufacturing industry and by 1.6% in the service industry.

Table 2: Macroeconomic indicators (billion yen)

	2002	2030	'30/'02	Average growth rate
Real GDP of Shiga Prefecture	5,884	7,677	1.30	0.95%
Per capita (10,000 yen)	433	556	1.28	0.90%
Real private consumption expenditure	2,541	3,145	1.24	0.76%
Real housing investment	245	285	1.16	0.53%
Real exports	6,004	8,132	1.35	1.09%
Real imports	5,183	7,162	1.38	1.16%
Real private capital investment	782	1,098	1.40	1.22%
Real public consumption	877	1,617	1.84	2.21%
Real public fixed capital formation	433	339	0.78	-0.87%

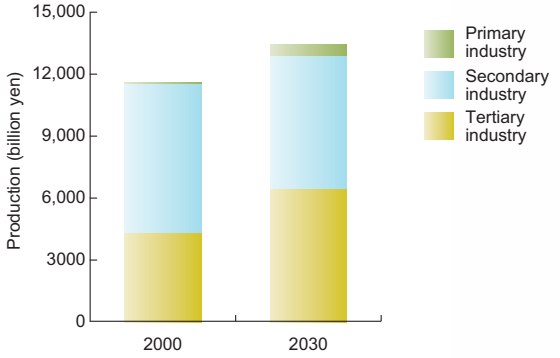


Fig. 1: Production by industry

A wide variety of measures

Based on the above socioeconomic assumption and for reducing GHG emissions by 50% in 2030 below the 1990 level, we worked out the combination of measures (Refer to Table 3 on next page). Even if the highly energy efficient technologies that might be available in 2030 are used to the maximum extent possible, and even after considering the changes in CO_2 emissions associated with changes in the energy mix of electric power consumption, it will be still impossible to achieve the target of 50% reduction. Nevertheless, with additional measures at the local level including drastic changes in transport systems, environmental friendly actions by almost all people, and introduction of renewable energy, computationally it is possible to reduce GHG emissions by 50% (66% reduction compared to BaU) (“2030 with measures” of Figure 2).

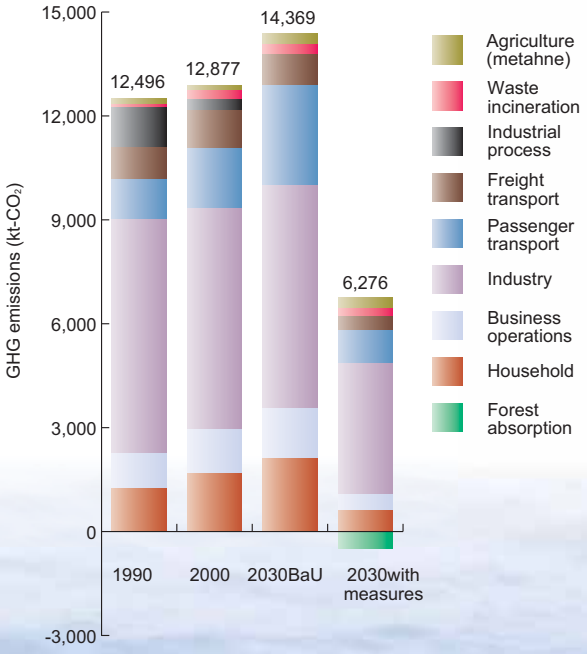


Fig. 2: GHG emissions

Table 3: List of measures

Sector	Measure	Status to be achieved by 2030	Reductions ($kt\text{-}CO_2$)
Household	Energy efficiency of equipment	Improvement of efficiency by 30% in total	551
	HEMS (home energy management system)	Penetration at 90% of houses	60
	Heat insulation level in houses	Achievement of the next-generation heat insulation level in 90% of houses	55
	Biomass heating	Penetration of wood stove at 10% of households	39
	Passive solar heating	Penetration at 10% of households	39
	Energy saving actions	Penetration at almost all households	156
	Photovoltaic power	Penetration at 20% of households	54
	Solar water heater	Penetration at 20% of households	99
	Others		89
		Total in households	1,144
Business	Energy efficiency of equipment	Improvement of efficiency by 36% in total	443
	BEMS (business energy management system)	Introduction to 90% of buildings	47
	Heat insulation level in business buildings	90% of energy saving buildings in all buildings	31
	Biomass heating	Penetration rate of 10%	19
	Energy saving actions	Penetration at almost all business establishments	43
	Photovoltaic power	Installation at 15% of buildings	12
	Others		79
		Total in business	674
Industry	Energy efficiency of equipment	Improvement of efficiency by 28% in total	846
	Fuel shift	Natural gas : 2000 8.6→25.9%, Oil : 2000 55.5%→39.4%, Coal : 2000 4.9%→0.9%, Electric power : 2000 30.9%→33.7%	883
		Total in industry	1,729
Passenger transport	Compact city	Reduction of average distance of intra-city travel by 25%	215
	Improvement of fuel efficiency of automobiles	Improvement of average fuel efficiency of passenger cars by 60% (penetration of hybrid cars at 90%)	788
	Modal shift (Public transport)	Share of public transport(bus, railway, LRT) : 37% (25% in 2000), Shares of bicycles and walking: 16%(6% in 2000), Shares of car: 45%(66% in 2000)	633
	Modal shift (bicycles and walking)		
	Biomass fuel	Penetration rate of 10%	193
	Others		36
		Total in passenger transport	1,865
Freight transport	Enhancement of logistics efficiency	Reduction of transport per production by 30%	51
	Modal shift	Substitution of railway transport for freight for 50% of road transport to distant prefectures, Substitution of lake transport for 10% of the transport within the prefecture	194
	Biomass fuel	Penetration rate of 10%	75
	Others		150
		Total freigth transport	470
Others	Reduction of CO_2 emissions per power generation		1,687
	Forest development	Management of all artificial forests in Shiga Prefecture	477
	Recycling of waste	Improvement of the recycling rate of plastic by 36%	48
Total			8,094

Six policies

Roadmap preparation is the task of systematizing the roadmap of realizing individual measures shown in Table 3. Here, first of all we will define 6 policies that are deeply related from the point of view of actions. Image of sustainable society from each policy is presented below.

1. City in harmony-with-green space

In urban areas, comfortable urban spaces have come up where residences and stores have consolidated due to advancement of planned use of land, comprehensive clusters of office space have emerged, green spaces and waterfront environments have been developed so that an opportunity of coming in contact with nature is always at hand and where people are maintaining home gardens. In villages, beautiful countryside and mountain landscapes are maintained through sound and sustained lifestyle. Most of the buildings have become modal by leveraging the benefits of super-insulated specifications and natural energy sources such as photovoltaic energy. Moreover, forest resources of local areas have been reexamined and energy-efficient and comfortable living spaces have been developed even in houses and public facilities such as schools by use of wood.

2. Transportation/distribution gently connecting people and objects to environment

Users of public transportation and bicycle will increase by improving their convenience, which has led to decline in usage of automobiles and it has resulted in a safe and comfortable transportation environment. In areas away from the central zone, electric vehicles and hybrid cars are used and highly energy-efficient operation is practiced while paying attention to ecological drive. Work place and residence are close by and common facilities and service facilities are also concentrated. Highly convenient, economic, and compact town development is under progress. Instead of transportation by trucks, convenient and comfortable large scale transportation by railway and by ship is increasingly used.

3. Lifestyle changing with “Mottainai”

Along with the spread of high quality, highly efficient and long-life products, and realization of comfortable and energy-saving living space, utilization of natural energy such as solar power generation and wood biomass is progressing in common houses. Moreover, consciousness of environmental conservation has widely permeated in people, resulting in the spread of energy-saving behaviors such as ecologically-friendly cooking techniques and green purchasing. People are adopting the lifestyle that places little burden on environment, such as thoroughly separating and collecting recyclable waste.

4. Industry growing along with environment

By the implementation of highly efficient equipments and facilities, environmental consciousness by energy conservation and profitability improvement by the reduction of manufacturing costs are growing hand in hand. In agricultural industry “environmentally friendly agriculture” has entrenched as a standard, and along with local production for local consumption, people are able to eat seasonal agricultural products. In manufacturing industry, GHG reduction is pursued with relentless efforts, and such efforts are socially recognized through release of reports and acquisition of certifications. In office, energy conservation behavior such as cool biz and warm biz as well as green purchasing has extended to almost all business locations. Usage of natural energy is also on rise.

5. Energy produced by nature

Using the forces of bountiful nature of Shiga prefecture, implementation of natural energy such as photovoltaic energy and wood biomass energy is rapidly progressing. Degree of self-sufficiency in energy is also increasing by effective distributed utilization of resources according to regional characteristics.

6. Forest development supporting Biwa lake and lifestyle

All the four seasons can be very well sensed and enjoyed. Beautiful Lake Biwa and scenery of lush green forests is still remaining. Rich prefectural land with the help of healthy and sustainable forest production has been preserved. Not only excellent wood and beautiful mountain landscape will be secured, but multiple functions of wood can be used in a sustained manner.

A roadmap towards sustainable society

Various measures are required to successfully establishing sustainable society, and several processes need to be followed for implementing these measures. Roadmap towards sustainable society was prepared by prioritizing and systematically organizing the actions necessary for achieving main targets and by finalizing implementation schedule.

Setting and systematization of actions

In addition to the measures mentioned in the vision of sustainable Shiga for reducing GHG emissions by half, items required to be done in advance or in parallel for implementing the measures as well as items that will support the measures were picked up as “actions” and the task of preparing the schedule so that everything is complete by 2030 is called “roadmap preparation.”

If the measures for reducing GHG emissions to half and reduction achieved due to these measures (refer to Table 3 on page 8) are sorted according to six policies and “improvements in system electric power,” we will get the breakdown shown in graph of Figure 3. Here the specific items of six policies were selected and arranged as an individual action. We prepared progressive table for each of them on annual basis.

Left side of Table 4 on page 12 shows the relationship between detailed “actions for reducing GHG” included in each policy and the measures shown so far. This table re-summarizes “situation which should be achieved in 2030 and reduction benefits.” In addition, required processes corresponding to individual action were extracted as “related actions.” Relationship with each of the actions can be systematized as shown on page 14.

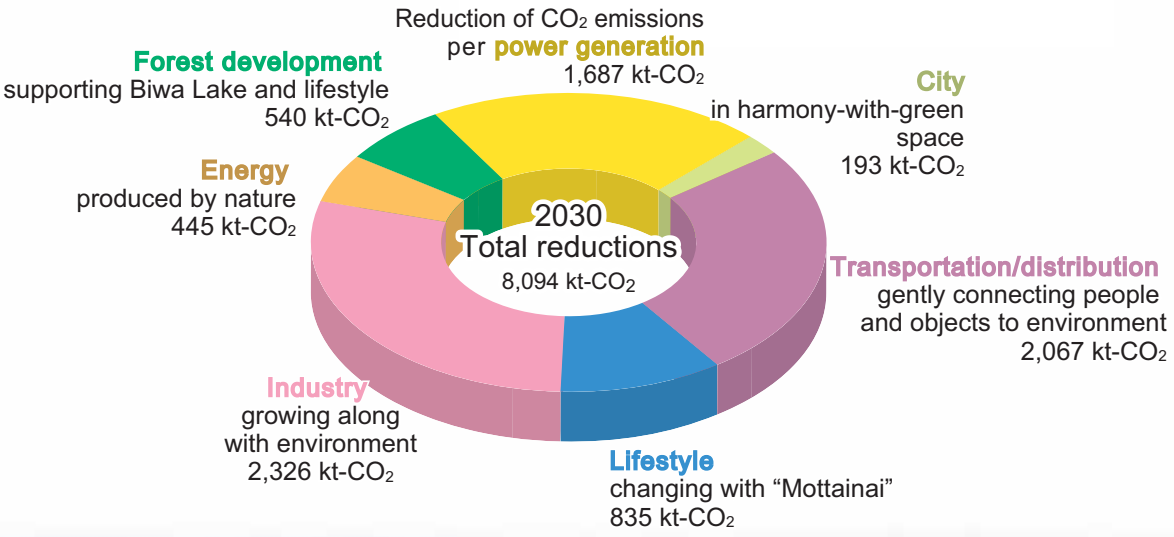


Fig. 3: Policy-wise breakdown of reductions in 2030

Roadmap for achieving the targets

For each policy, based on the assumed administrative capital required for implementing the actions, practicable timing and benefits of implementation, we developed and applied the method (refer page 22 onwards for details of method) for preparing the schedule that will yield maximum results and let us complete everything by target year. Based on this, from 2010 to the target year of 2030, it would be possible to quantitatively and consistently show the year-wise implementation status of policies, GHG reductions in a form of progressive table. Details of six policies are described from page 16 onwards.

In this brochure, we selected a basket of actions after considering the existing actions taken in Shiga prefecture and plans that are under preparation, and perform various calculations based on the assumed values considered appropriate at this point in time. Graph of Figure 4 shows GHG emissions for each policy from 2010 to 2030 based on the time schedule as per calculation results. We concluded that in the first half of the implementation period, actions typified by “Lifestyle” and “Industry” should be pushed as such actions are in close range to the daily life of people working in the prefecture or people residing in the prefecture. In the later half of the implementation period, actions typified by “City” and “Forest Development” should be taken to build large scale social infrastructure in a concentrated manner.

In the right side of Table 4, progress of various actions required to be implemented and GHG reductions achieved at year 2020 are shown. If the actions progress smoothly, in 2020, already 5,500 kiloton of CO_2 could be reduced, which is 85% of the final target.

Systematization of actions shown here is only for clarifying the contents in a concrete form. It does not mean that sustainable society would be formed by implementing each action. Reducing the use of privately owned vehicle to mitigate the environmental burden originating from transportation is closely integrated with rejuvenating the urban areas having good public transport. Moreover, invigoration of regional economy is required for many people to get-together. It is necessary to understand the connection between a wide variety of actions and prepare a structure required for implementing a wide variety of measures in organized manner.

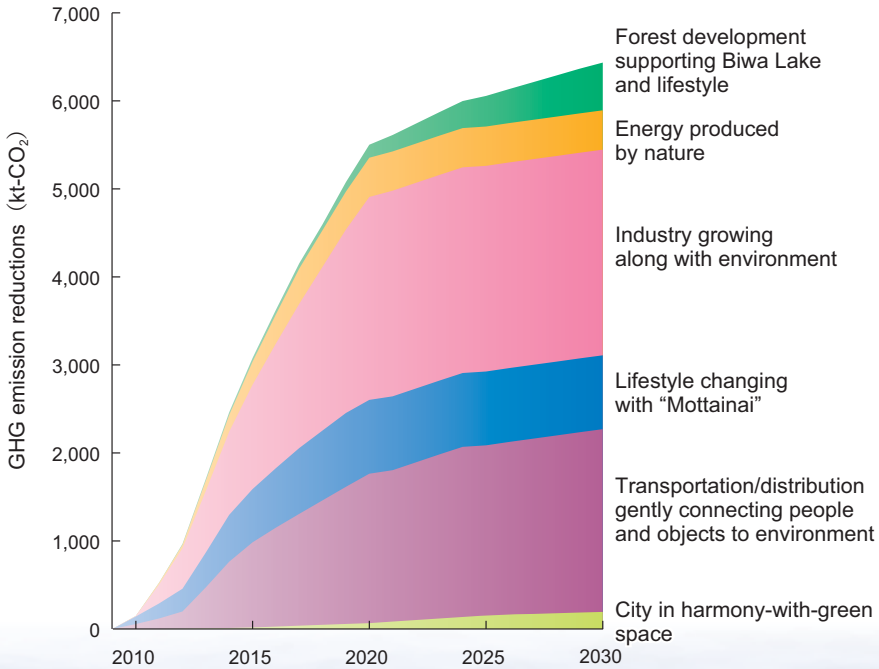


Fig. 4: Changes in GHG emission reductions by policy

※ Since “Improvement in system electric power” is outside the scope of measures taken by a region, it was included from the scope of study of roadmap.

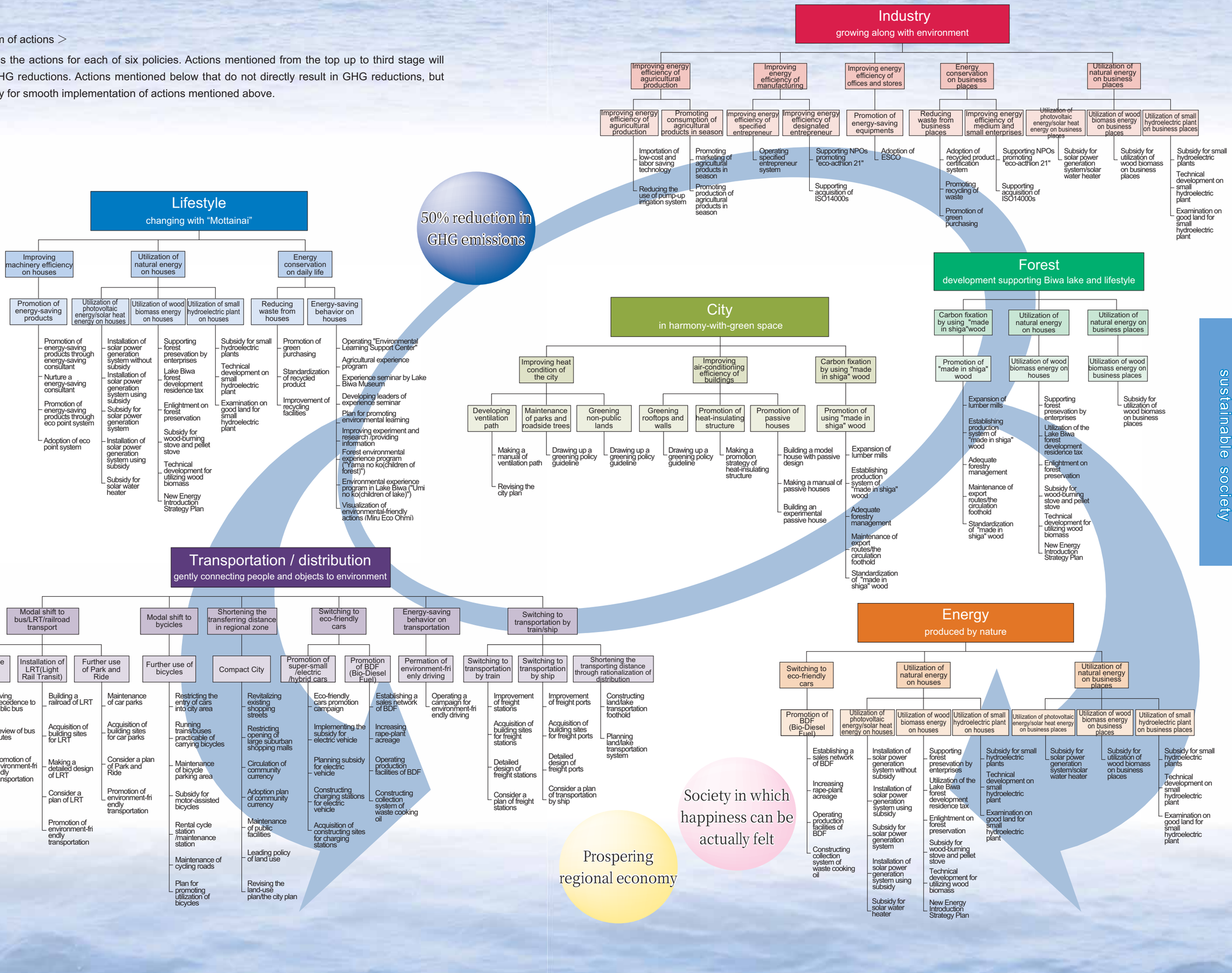
Table 4: Basket of actions assumed to be implemented up to 2030 and implementation status in 2020

Policies	Actions for reducing GHG	Measures ※	Reduction reductions(kt-CO_2) and situation which should be achieve in 2030		Related actions (required processes corresponding to individual actions)	Progress of actions required to be implemented and GHG reductions(kt-CO_2) achieved at 2020		Progress of reductions ('20/'30)
City in harmony-with-green space	Developing ventilation path	(Household) heat insulation level in houses (Commercial) heat insulation level in commercial buildings	Air conditioning demand of 90% buildings would have reduced	57	Revising the city plan, Making a manual of ventilation path	Related actions: 100% completed Developing ventilation path:Around 50% completed	29	51%
	Maintenance of parks and roadside trees			10	Drawing up a greening policy guideline	Related actions: 100% completed Maintenance of parks and roadside trees:Around 50% completed	5	51%
	Greening non-public lands			10			5	51%
	Greening rooftops and walls			10		100% completed	10	100%
	Promotion of heat-insulating structure	(Household) heat insulation level in houses (Commercial) heat insulation level in commercial buildings	90% houses with next generation heat insulation level 90% commercial buildings would be energy-saving buildings	29	Making a promotion strategy of heat-insulating structure	Related actions: 100% completed Promotion of heat-insulating structure:Extended to around 50% of houses	17	60%
	Promotion of passive houses	(Household) Passive solar heating, others (Industrial) Others	Extended to 10% of houses	79	Building an experimental passive house, Making a manual of passive houses, Building a model house with passive design	Related actions: 100% completed Promotion of passive houses:Not implemented (Promotion to start in full swing from 2021)	1	1%
			Subtotal	193		Subtotal	66	34%
Transportation/distribution gently connecting people and objects to environment	Further use of public transportation	(Passenger transport) Usage of public transportation	Share of public transportation (bus, train, LRT) increased from 25% to 37% Share of bicycles/walking increased from 6% to 16% Share of passenger cars reduced from 66% to 45%	127	Improvement of the timetable, Integrated information system regarding public transportation, The electronic pay system, Improving the convenience of terminals	100% completed	127	100%
	Further use of bus service			141	Promotion of environment-friendly transportation, Review of bus routes, Giving precedence to public bus	100% completed	141	100%
	Installation of LRT(Light Rail Transit)			144	Promotion of environment-friendly transportation, Consider a plan of LRT, Making a detailed design of LRT, Acquisition of building sites for LRT, Building a railroad of LRT	Promotion of environment-friendly transportation, Consider a plan of LRT, Making a detailed design of LRT:100% completed Acquisition of building sites for LRT:Around 40% completed Building a railroad of LRT, Installation of LRT:Not implemented	0	0%
	Further use of Park and Ride			127	Promotion of environment-friendly transportation, Consider a plan of Park and Ride, Acquisition of building sites for car parks, Maintenance of car parks	100% completed	127	100%
	Further use of bicycles	(Passenger transport) Increased usage of bicycles and increased reliance on walking		127	Plan for promoting utilization of bicycles, Maintenance of cycling roads, Rental cycle station / maintenance station, Subsidy for motor-assisted bicycles, Maintenance of bicycle parking area, Running trains/buses practicable of carrying bicycles, Restricting the entry of cars into city area	100% completed	127	100%
	Compact City	(Passenger transport) Compact city	Shortening of average transferring distance by 25% in regional zone	215	Revising the land-use plan/the city plan, Leading policy of land use, Maintenance of public facilities, Adoption plan of community currency, Circulation of community currency, Restricting opening of large suburban shopping malls,Revitalizing existing shopping streets	Revising the land-use plan/the city plan, Adoption plan of community currency, Circulation of community currency, Restricting opening of large suburban shopping malls, Revitalizing existing shopping streets:100% completed Leading policy of land use, Maintenance of public facilities, Compact City:Around 60% completed	131	61%
	Promotion of super-small /electric /hybrid cars	(Passenger transport) Improving the mileage of automobiles, others (Freight transport) Others	Average mileage of passenger cars increased 1.6 times	656	Acquisition of constructing sites for charging stations, Constructing charging stations for electric vehicle, Planning subsidy for electric vehicle, Implementing the subsidy for electric vehicle, Eco-friendly cars promotion campaign	100% completed	656	100%
	Permation of environment-frienly driving	(Passenger transport) Improving the mileage of automobiles, others (Freight transport) Others		281	Operating a campaign for environment-friendly driving	100% completed	281	100%
	Switching to transportation by train	(Freight transport) modal shift, others	Shifting 50% of truck transportation between distant prefecture to transportation by train	99	Consider a plan of freight stations, Detailed design of freight stations, Acquisition of building sites for freight stations, Improvement of freight stations	100% completed	99	100%
	Switching to transportation by ship	(Freight transport) modal shift, others	Shifting 10% of inter-prefectural truck transportation to transportation by ship	99	Consider a plan of transportation by ship, Detailed design of freight ports, Acquisition of building sites for freight ports, Improvement of freight ports	Consider a plan of transportation by ship, Detailed design of freight ports:100% completed Acquisition of building sites for freight ports:Around 70% completed Improvement of freight ports, Switching to transportation by ship:Not implemented	0	0%
	Shortening the transporting distance through rationalization of distribution	(Freight transport) Rationalization of transportation	Reduction of transportation volume per gross output by 30%	51	Planning land/lake transportation system, Constructing land/lake transportation foothold	Planning land/lake transportation system:Around 70% completed Constructing land/lake transportation foothold, Shortening the transporting distance through rationalization of distribution:Not implemented	0	0%
			Subtotal	2,067		Subtotal	1,689	82%
Lifestyle changing with "Mottainai"	Promotion of energy-saving products	(Household) Energy efficiency of equipments, HEMS, others	Overall 30% average improvement in equipment efficiency, penetration of HEMS in 90% of houses	655	Adoption of eco point system, Promotion of energy-saving products through eco point system, Nurture a energy-saving consultant	100% completed	655	100%
	Reducing waste from houses	(Others) Waste recycling	Recycle rate of plastic has increased 36%	24	Improvement of recycling facilities, Standardization of recycled product, Promotion of green purchasing	100% completed	24	100%
	Energy-saving behavior on houses	(Household) Energy-saving behavior	Practiced at almost all the houses	156	Visualization of environmental-friendly actions (Miru Eco Ohmi), Environmental experience program in Lake Biwa ("Umi no ko(children of lake)"), Forest environmental experience program ("Yama no ko(children of forest)"), Improving experiment and research /providing information, Plan for promoting environmental learning, Developing leaders of experience seminar, Experience seminar by Lake Biwa Museum, Agricultural experience program, Operating "Environmental Learning Support Center"	100% completed	156	100%
			Subtotal	835		Subtotal	835	100%
Industry growing along with enviromnent	Improving energy efficiency of aguricultural production	(Industry) Energy efficiency of equipments, switch-over in share of fuels	28% average improvement in energy efficiency for all business Fuel share (natural gas: from 8.6% to 25.9%, oil: from 55.5% to 39.4%, coal: from 4.9% to 0.9%, electricity: from 30.9% to 33.7%)	43	Reducing the use of pump-up irrigation system, Importation of low-cost and labor saving technology	100% completed	43	100%
	Promoting consumption of agricultural products in season			43	Promoting production of agricultural products in season, Promoting marketing of agricultural products in season	100% completed	43	100%
	Improving energy efficiency of specified entrepreneur			821	Operating specified entrepreneur system	100% completed	821	100%
	Improving energy efficiency of designated entrepreneur			821	Supporting acquisition of ISO14000s, Supporting NPOs promoting "eco-acthion 21"	100% completed	821	100%
	Promotion of energy-saving equipments	(Commercial) Energy efficiency of equipments, BEMS, others	Overall 36% average improvement in equipment efficiency, penetration of BEMS in buildings at 90%	265	Adoption of ESCO	100% completed	265	100%
	Reducing waste from business places	(Others) Waste recycling	Recycling rate of plastic has improved 36%	24	Promotion of green purchasing, Promoting recycling of waste, Adoption of recycled product certification system	100% completed	24	100%
	Improving energy efficiency of medium and small enterprises	(Commercial) Energy efficiency of equipment, BEMS, energy conservation behavior	Overall 36% average improvement in equipment efficiency, penetration of BEMS in building at 90%, energy-saving behavior practiced at almost all business establishments	308	Supporting acquisition of ISO14000s, Supporting NPOs promoting "eco-acthion 21"	Related actions: 100% completed Improving energy efficiency of medium and small enterprises:Around 90% completed	278	90%
			Subtotal	2,326		Subtotal	2,295	99%
Energy produced by nature	Promotion of BDF(Bio-Diesel Fuel)	(Passenger transport) Bio mass fuel (Freight transport) Biomass fuel	10% of internal combustion fuels is biomass fuel	268	Constructing collection system of waste cooking oil, Operating production facilities of BDF, Increasing rape-plant acreage, Establishing a sales network of BDF	100% completed	268	100%
	Utilization of photovoltaic energy/solar heat energy on houses	(Household) Solar power generation facility, solar heater	Penetration of solar power generation in 20% of houses Penetration of solar heater in 20% of houses	153	Subsidy for solar water heater, Subsidy for solar power generation system	100% completed	153	100%
	Utilization of small hydroelectric plant on houses	(Household) others		1	Examination on good land for small hydroelectric plant, Technical development on small hydroelectric plant, Subsidy for small hydroelectric plants	Examination on good land for small hydroelectric plant, Technical development on small hydroelectric plant:100% completed, Subsidy for small hydroelectric plants, Utilization of small hydroelectric plant on houses:Not implemented	0	0%
	Utilization of photovoltaic energy/solar heat energy on business places	(Commercial) Solar power generation facility, others	Installation of solar power plant in 15% of buildings Installation of solar heater in 10% of buildings	23	Subsidy for solar power generation system/solar water heater	100% completed	23	100%
	Utilization of small hydroelectric plant on business places	(Commercial) others		0.05	Examination on good land for small hydroelectric plant, Technical development on small hydroelectric plant, Subsidy for small hydroelectric plants	Examination on good land for small hydroelectric plant, Technical development on small hydroelectric plant:100% completed, Subsidy for small hydroelectric plants, Utilization of small hydroelectric plant on business places:Around 40% completed	0.02	41%
			Subtotal	445		Subtotal	444	100%
Forest development supporting Biwa Lake and lifestyle	Promotion of "made in shiga" wood	(Others) Forest management	Appropriate management of man-made forests, construction of wooden houses in the prefecture	477	Standardization of "made in shiga" wood, Maintenance of export routes/the circulation foothold, Adequate forestry management, Establishing production system of "made in shiga" wood, Expansion of lumber mills	Related actions:100% completed Promotion of "made in shiga" wood :Around 20% completed	84	18%
	Utilization of wood biomass energy on houses	(Household) Biomass heating	Penetration of wood-burning stoves and pellet stoves in 10% of households	44	New Energy Introduction Strategy Plan, Technical development for utilizing wood biomass, Subsidy for wood-burning stove and pellet stove, Enlightment on forest preservation, Utilization of the Lake Biwa forest development residence tax, Supporting forest presevation by enterprises	100% completed	44	100%
	Utilization of wood biomass energy on business places	(Commercial) Biomass heating	Penetration of wood-burning stoves and pellet stoves in 10% of business establishments	19	Subsidy for utilization of wood biomass on business places	100% completed	19	100%
			Subtotal	540		Subtotal	147	27%
			Total	6,407		Total	5,477	85%

※ Among the measures shown in "Table 3: GHG reduction measures assuming various implementation scenarios" on Page 8, items corresponding to each action

＜ System diagram of actions ＞

It systematizes the actions for each of six policies. Actions mentioned from the top up to third stage will directly lead to GHG reductions. Actions mentioned below that do not directly result in GHG reductions, but they are necessary for smooth implementation of actions mentioned above.



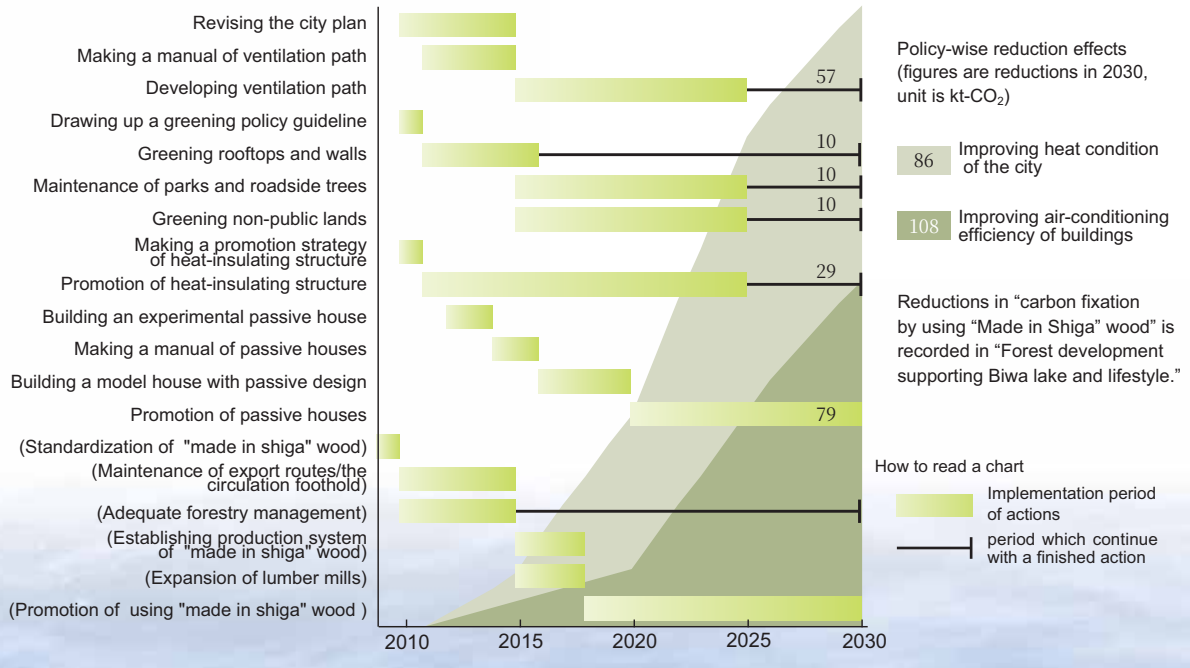
City
in harmony-with-green space

Main actions
◎ Maintenance of parks and roadside trees
◎ Promotion of passive houses etc.

In addition to parks and streets, thermal environment will be moderated by developing cities with ample greenery all over the places including land for non-public use such as car parks and walls of buildings, and also by developing “ventilation path.” Since this will call for significant revisions in urban planning, actions should be taken in parallel with “Compact city” etc. described later. Therefore, it will take time till the launch of projects, and actual actions will be completed by around 2025. However, greening of rooftops and walls can be started early, which may result in some amount of benefits.

Apart from greening of floors and walls, buildings would changeover to super-insulated specifications. Since the renewal of building will take time, it is necessary to make a promotion strategy at the earliest. This also applies to passive design houses; however, it is necessary to build an experimental house or a model house prior to promotion. Actual promotion will start after 2021.

Since these actions require large change in urban structure, GHG reductions in 2020 for the entire policy would be 34% of the target year (2030).

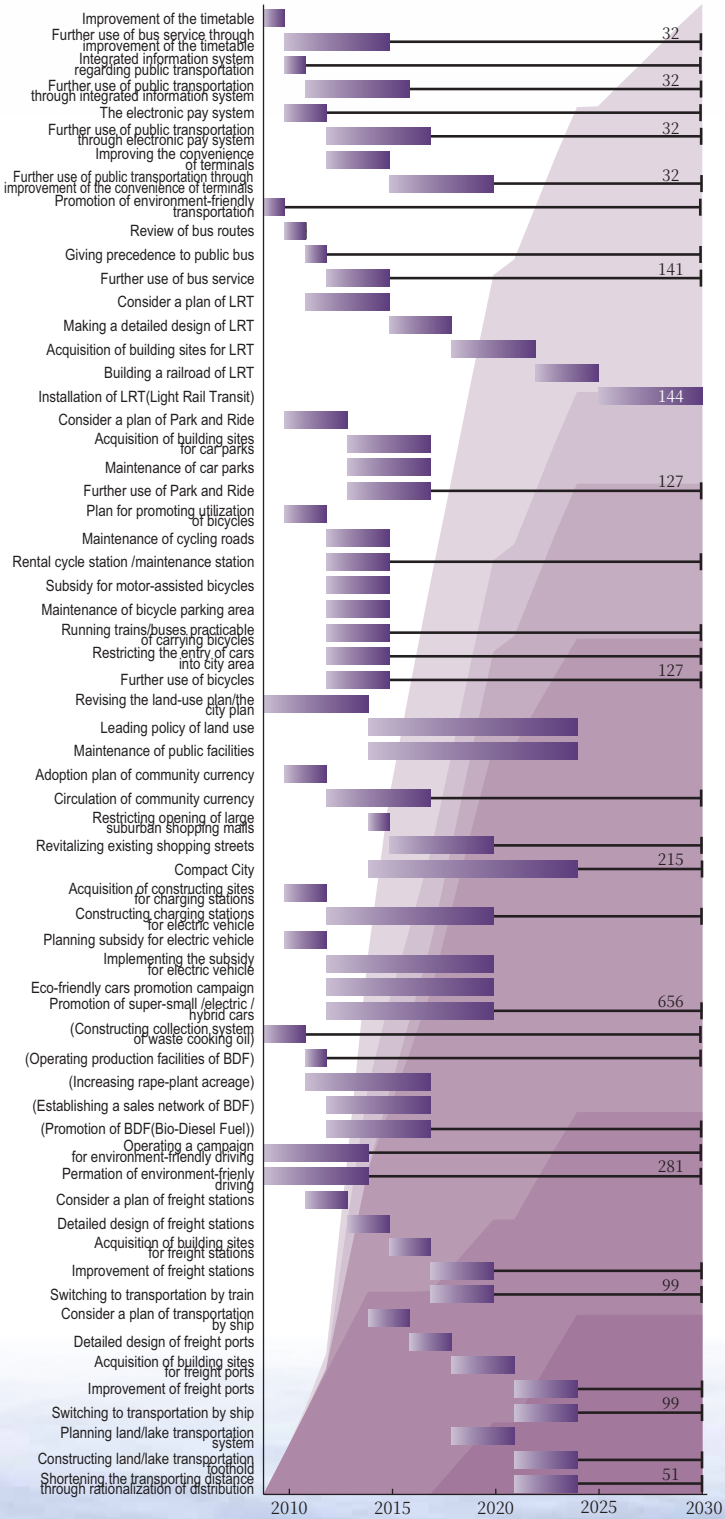


Transportation/distribution

gentry connecting people and objects to environment

Main actions

◎ Expansion of the use of public transportation
◎ Compact city
◎ Switching to transportation by ships etc.



In order to depart away from automobiles dependent passenger transportation, actions for increasing the convenience of public transportation will be implemented gradually. Actions would be quickly implemented if the focus is around existing public transportation and general targets would be achieved by 2020. However, since new mode of transportation such as LRT would need some time, their introduction would be in the final phase of targeted period. Actions for promoting the use of bicycle would also be implemented in conjunction with public transportation.

In addition, compact city will be formed by rejuvenating the local economy by spreading the use of land and community money. However, this will be a long term action and it will be completed in 2025.

Regarding automobiles, by quickly spreading ecodrive and by building recharge facilities for electric vehicles and by providing subsidies, targeted improvement in mileage would be achieved in 2020, when the cycle of replacement by new purchase would be almost over.

Freight transportation would use railway or ships in Lake Biwa. Enhancement of logistics would be achieved by smoothly connected land and lake; however, the project will start only after 2022.

By modal shift and proactive switching to ecologically friendly cars, GHG reductions in 2020 for the entire policy would reach 82% of that of target year.

Policy-wise reduction effects
(figures are reductions in 2030, unit is kt-CO_2)

538	Modal shift to bus/LRT/railroad transport
127	Modal shift to bycicles
215	Shortening the transferring distance in regional zone
656	Switching to eco-friendly cars(except as BDF)
281	Energy-saving behavior on transportation
249	Switching to transportation by train/ship

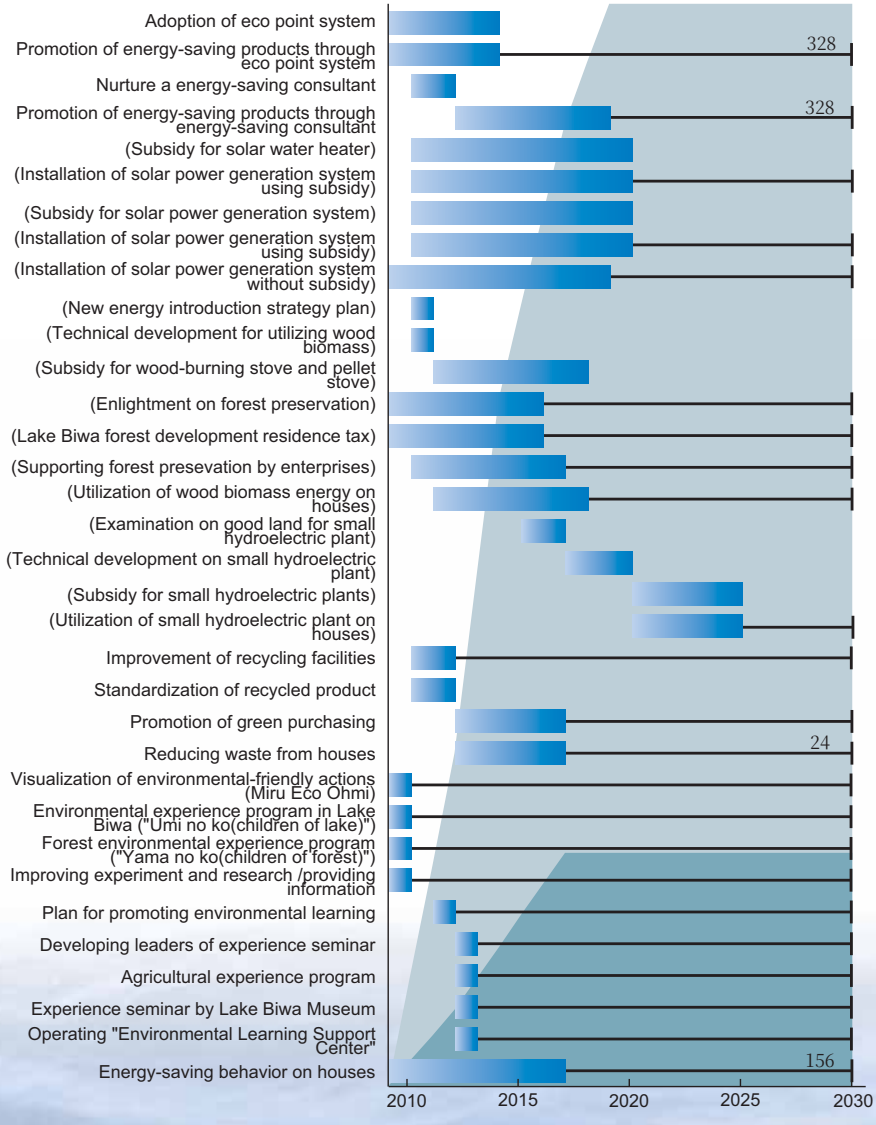
Bio-diesel fuel (BDF) related reductions included in "switching to eco-friendly cars" are recorded in "Energy produced by nature."

Lifestyle
changing with “Mottainai”

Main actions
◎ Promotion of energy-saving products through energy-saving consultant
◎ Energy conservation on houses etc.

Apart from using the ecopoint system which has already been implemented, energy-saving consultants to offer appropriate advice about energy-efficient products would also be nurtured. Because of the efforts of such consultants, all the equipments in a house would be changed to energy-efficient products by 2010. Moreover, by setting up a waste recycling facility within the prefecture at the earliest, target of household waste reduction would also be achieved around the same by standardization and promotion of green purchasing. Action for increasing every individual’s consciousness towards environment would be undertaken mainly around children education, as they will play important role in society in 2030.

Environmental consciousness in people would certainly increase due to various opportunities available for learning about local environment such as agricultural experience program and experience seminar by Lake Biwa museum, in addition to environmental experience program in Lake Biwa ("Umi no ko(children of lake)") and forest environmental experience program ("Yama no ko(children of forest)").



In addition, by the spread of visualization of environment friendly behavior, households will adopt energy-efficient lifestyle with low environment burden. Therefore, energy-efficient behavior will be practiced by all household around 2017.

Once the awareness of energy-conservation has increased in people to a certain extent, GHG reduction of the targeted year can be achieved by 2020.

Policy-wise reduction effects
(figures are reductions in 2030, unit is kt-CO_2)

655 Improving machinery efficiency on houses

180 Energy conservation on daily life

Reduction effects of “utilization of natural energy on houses” have been recorded in “Forest development supporting Biwa lake and lifestyle” and “Energy produced by nature.”

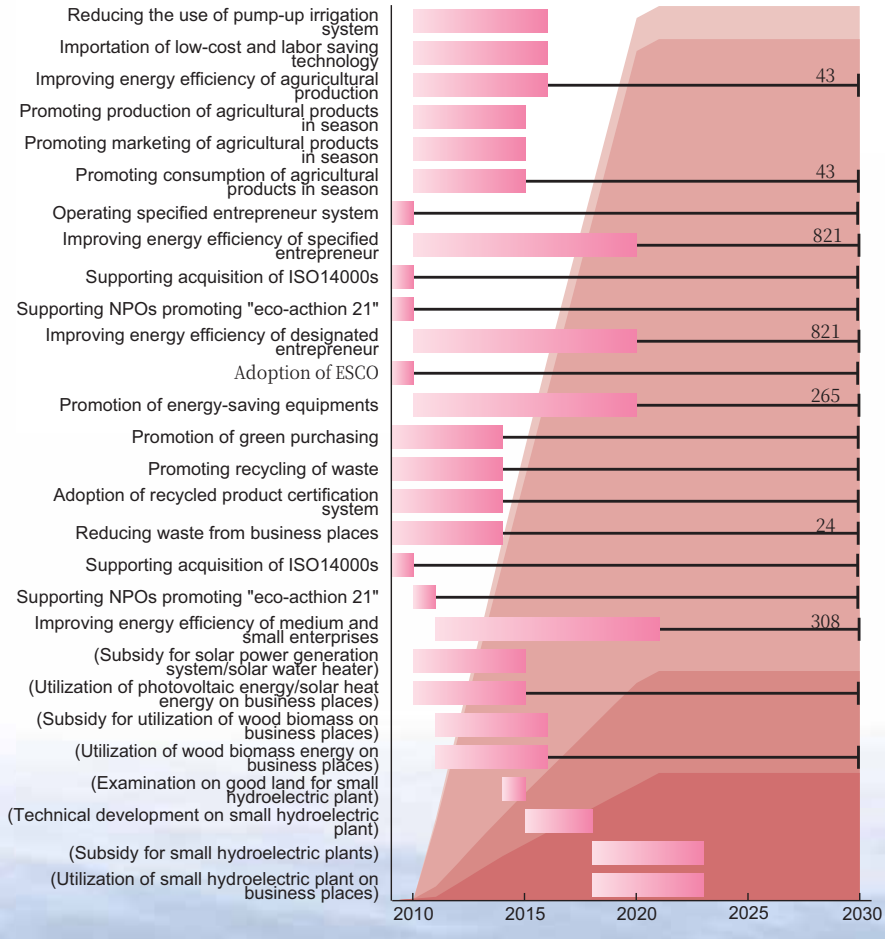
Industry
growing along with environment

Main Actions
◎ Promotion consumption of agricultural products in season
◎ Promotion of energy saving equipments etc.

Energy efficiency in agriculture can improve at early stages by going back to agriculture which is very close to conventional style of agriculture by reducing the use of pump-up irrigation system and bringing seasonal variation in production.

Facility upgrade in industrial sector or at business establishments will take long time; by quickly creating a system that encourages the submission of plans and reports concerning GHG reductions and acquisition of ESCO and ISO14000s, energy efficiency will improve by 2020 up to target level across most of the industries.

If a system that supports the environment-friendly actions of companies is put in place as soon as possible, it is possible to achieve 99% of targeted GHG reductions by 2020 itself.



Energy
produced by nature

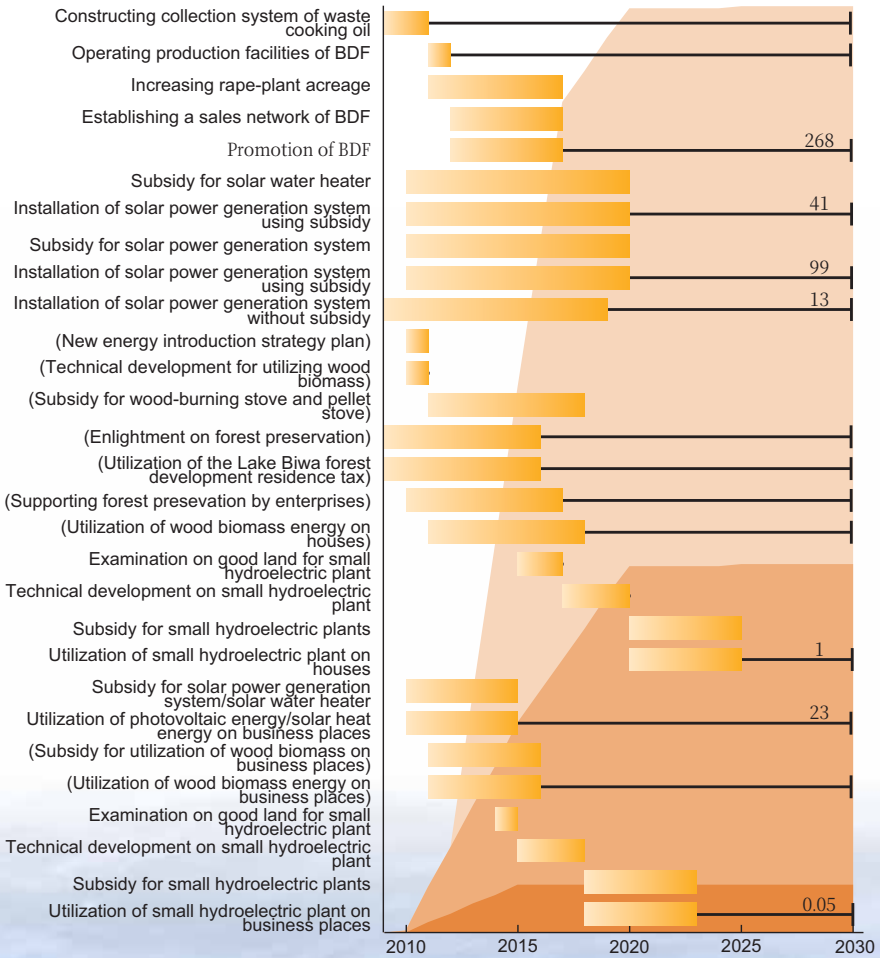
Main Actions
◎ Promotion of BDF
◎ Installation of solar power generation system using subsidy etc.

Production system of BDF can be smoothly constructed by using already available measures such as expanding the collection of waste cooking oil, which has already started in pockets, and using idle fields as rapeseed fields. In addition, BDF supply system can be adequately established around 2017 by setting up sales and distribution network.

Regarding the use of solar energy, although a certain level of expansion can be seen at present stage, number of installation targeted by 2020 would be achieved by providing subsidy for solar power generation system/solar water heater

Regarding small hydroelectric plants, actual penetration will be between the later half of 2010 and the first half of 2020, as surveys for land suitability must be extensively done at first and there may be a scope for technical improvements when it needs to be incorporated with system electric power.

By actively deploying policies concerning natural energy, it is possible to achieve almost 100% of GHG reductions target set for 2020.



Policy-wise reduction effects (figures are reductions in 2030, unit is kt-CO_2)

268 Switching to eco-friendly cars (promotion of BDF)

154 Utilization of natural energy on houses (except wood biomass)

23 Utilization of natural energy on business places and agriculture (except wood biomass)

Reductions achieved from wood biomass in “utilization of natural energy in houses” and “Utilization of natural energy in agriculture and at business places” is recorded in “Forest development supporting Lake Biwa and lifestyle.”

Forest development

supporting Biwa lake and lifestyle

Main actions

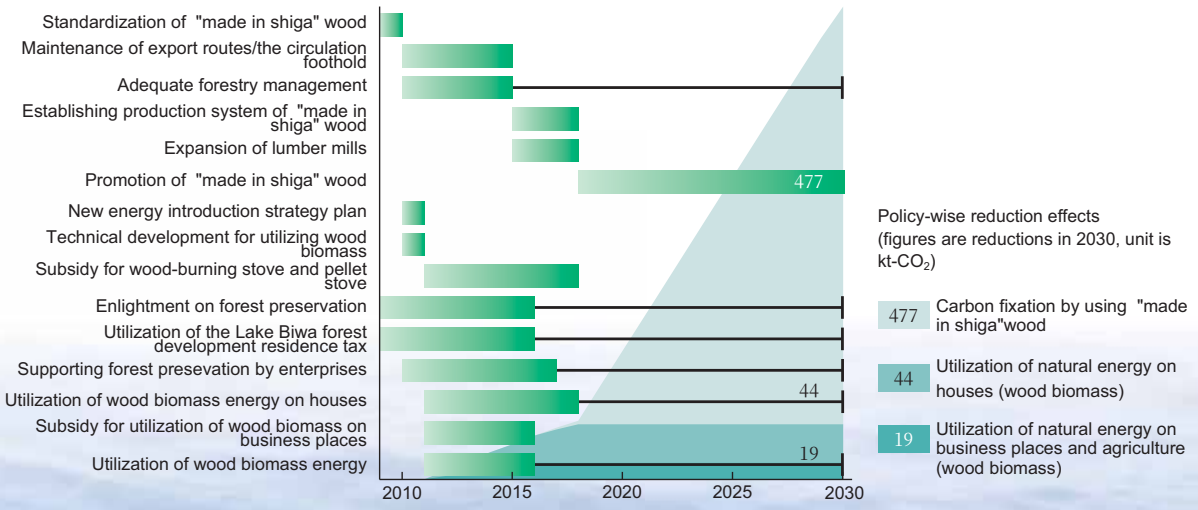
◎ Promotion of using “Made in Shiga” wood

◎ Utilization of wood biomass energy on houses etc.

For forest development, it is imperative to use locally available wood as natural resource. For promoting healthy production activities in forest industry, in addition to the standardization of "Made in Shiga" wood, production structure required for using building materials and forest environment congenial to education, work and transportation and distribution hub, must be gradually streamlined. Therefore, target for promotion of "Made in Shiga" wood around 2020 is 20% of that of the target year.

At the same time, use of wood biomass energy can be spread to common households and business establishments from relatively early stages by actively using the thinned wood generated during forestry management. Penetration target of wood-burning stove and pallet stove could be achieved around 2017 by using Lake Biwa forest development residence tax as a funding source for forestry management and by actively supporting forest preservation activities of organizations.

However, since carbon fixation effects due to increased use of "Made in Shiga" wood are large, total GHG reductions in 2020 for all the policies would only reach 27% of the target year.



Research Methodology

Overview of research methodology

The backcasting method is defined as "calculating back to the present from a specific target point." This is done "to determine the potential for future physical implementation of that target and the type of measures that will be needed to arrive at that point" (Robinson,1990). This process can be divided into two stages: envisioning of the target point, and calculating backward from that point (in other words, searching for a pathway to arrive at that target point). Fig. 5 shows a conceptual diagram of the backcasting method.

When attempting to achieve an objective such as a sustainable society which requires a major transformation of society, it is very likely that the objective cannot be achieved by starting from the present state and extending techniques that can be implemented. For this reason, first a normative envisioned scenario of the situation in which the target has been achieved is drawn out, without being constrained by current and past trends. This is used as the target point that must be reached, and one works back from that point to the present location to determine the path that must be taken. This method makes it possible to depict what a certain region would look like as a sustainable society, and also enables study of what must be done now in order to ultimately arrive at that target.

The backcasting approach itself is not particularly a unique methodology. This method of calculating backward is something that we used on a daily basis. What needs to be specifically identified here is; how this approach should be applied to a practical, quantitative and comprehensive problem that involves the whole society, such as the achievement of a sustainable society. For this reason, the backcasting method is developed as a practical method of application. This method involves dividing the process into two stages as noted above and constructing estimation tools (models) to provide the quantitative data needed at each stage, and then applying these models in the form of computer programs to Shiga prefecture. The Roadmap described in this report is the result of the application of this method.

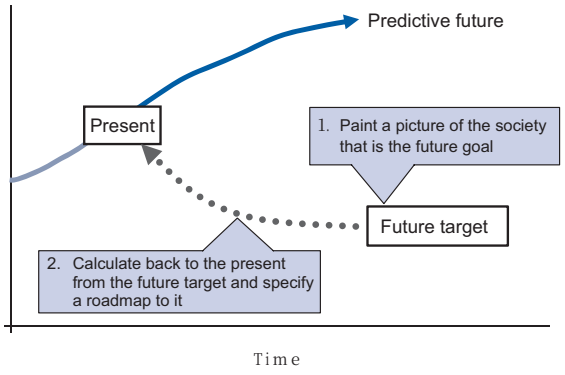


Fig.5: Idea of backcasting

Stage 1 Definning the target

(1) Establish a framework

First, determine the framework for creating the overall sustainable society scenario. This involves determining the target region, reference year, target year, target activities, environmental targets, number of scenarios and so on. The target year should be far enough in the future to achieve the necessary changes but close enough that it can be envisioned by people in the region.

(2) Envision the socioeconomic situation (scenario creation)

Before conducting a quantitative analysis, create a qualitative picture of the future society, including such factors as lifestyle patterns, industry, land use and so on. The following are some of the methods that can be used to do this.

-Existing concepts, plans and targets in each field for that region
- Interviews with influential persons, workshops etc.
- Simple extension of the present situation or freezing it in place
- Documents and plans relating to the future of the country or even larger region

A method that will be as meaningful as possible for subsequent policy deployment, considering the actual policymaking process, should be selected. Ultimately, the envisioning of the socioeconomic situation serves only as a premise for the achievement of a sustainable society. Based on this perspective, for the purposes of this study it was decided not to go into the methods used to envision specific socioeconomic situations (for example, the growth rate for a certain industry).

(3) Quantify the envisioned socioeconomic situation

Establish the indicators that will serve as the input values for estimating the society of the future based on the situation envisioned in (2). Here exogenous variables or parameters are entered as values for the ExSS model. The envisioned socioeconomic factors that are thought to have a particularly

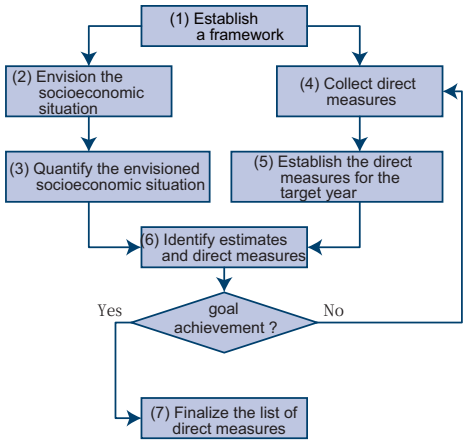


Fig.6: Flow of deffining the target

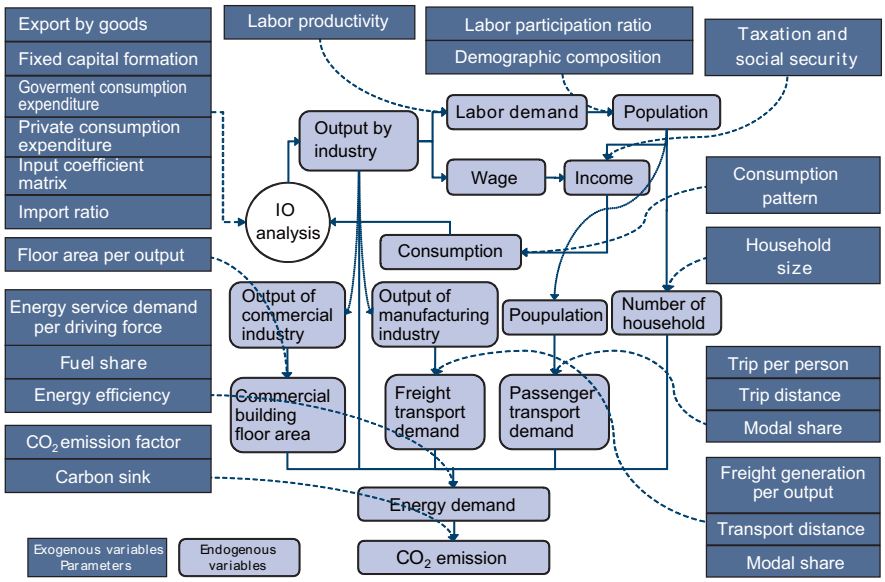


Fig.7：Calculation flow of ExSS (Extended Snapshot Tool)

great impact on greenhouse gas emissions are the economic growth rate for the nation as a whole, the exports for each industry, the population distribution and the employment rate.

(4) Collect direct measures

Collect the direct measures that you think can be introduced by the target year. In addition to energy use technologies, these might include changes to the transportation structure, renewable energy, energy-saving practices, carbon sinks and so on.

(5) Establish the direct measures for the target year

Establish the number of direct measures collected in (4) to be introduced and determine technical coefficients (energy efficiency, etc.) relating to energy demand and CO_2 emissions. Standards for determining the combination of direct measures might include cost minimization, ease of acceptance by stakeholders, technical achievability and so on.

(6) Identify estimates and direct measures

Enter the exogenous variables and parameters established in (3) and (5) and estimate the socioeconomic indicators and greenhouse gas emissions. Socioeconomic indicators include population, the added value of the region, production for each industry, transport demand and so on. If the target for greenhouse gas emissions has been achieved, proceed to step (7). If not, return to step (5) and study the number of direct measures to be introduced.

(7) Finalize the list of direct measures

Finalize the list of the direct measures whose introduction is envisioned and the reduction in emissions for each direct measure. This indicates the state of direct measures that will become the final targets at the next stage. An example of such a list is shown in Table 3 on page 8 of this brochure.

Fig. 7 shows the configuration of the ExSS model. The figure shows seven blocks, the exogenous variables and parameters that are entered in each block, and the variables that are transferred between blocks. The model is depicted as a simultaneous equations system that determines a unique solution based on the given exogenous variables and parameters. The figure focuses only on CO_2 emissions from energy consumption, but it can also be used to handle other greenhouse gases and other environmental load (for example, atmospheric pollutants).

Stage 2 Searching for a roadmap

In the second stage of the process, a roadmap leading to the society depicted in the scenario is established. The basic approach is to determine what type of measures should be implemented and when they should be implemented, in order to arrive at the dissemination rate for the direct measures in the target society. It should be recognized that achieving the dissemination rate for the direct measures in the targeted society will be no easy task. For this reason, the government must formulate a plan and implement measures in accordance with that plan in order to encourage the dissemination of direct measures. For example, a program which provides subsidy for the purchase of ecologically friendly vehicles in order to encourage the dissemination of such vehicles could be introduced.

In this stage, measures are established to disseminate the direct measures identified in the first stage, and the period of time needed for implementation of each measure in order to achieve the low carbon targets is calculated. It is also in this stage that the emissions reductions for each direct measure identified in the ExSS model are allocated to the measures for reducing greenhouse gas emissions.

(1) Establish measures

First, establish the measures which are needed to disseminate the direct measures envisioned for the targeted society. To establish measures, first think of possible barriers to the dissemination of the direct measures, and propose a measure to remove those barriers wherever they are present.

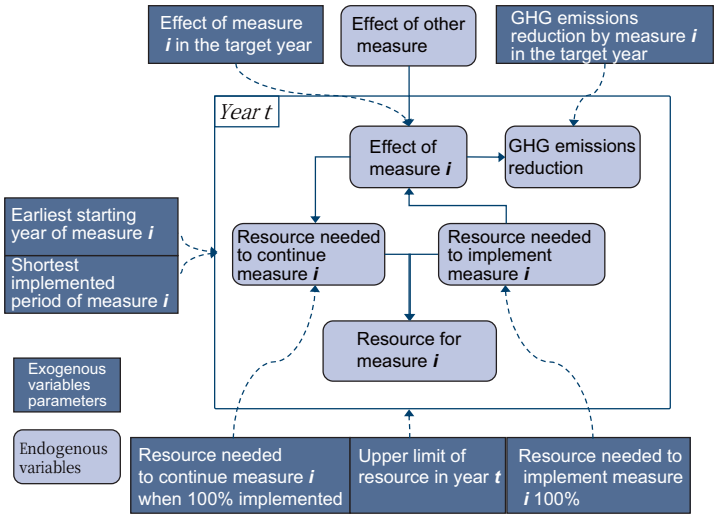


Fig.8: BCT calculation flow

Next, determine whether there will be any barriers to the implementation of that measure. Repeat this process until all barriers have been removed. If there is already a short-term plan in the target region, you may also refer to the measures in that plan.

(2) Define the requirements for measures

Define the requirements for each of the measures established in (1). The necessary requirements are as follows.

- Direct reductions in GHG emissions: The GHG reductions obtained through 100% implementation of the measure (kt-CO_2/year). Use the value estimated using the ExSS model
- Effort needed to implement measure: The effort that must be expended to begin 100% implementation of the measure (initial input).
- Effort needed to continue measure: The effort that must be expended each year in order to continue 100% implementation of the measure.
- Integrated effect of measure implementation: Effects (relative value) of measure other than direct and indirect reductions in GHG emissions during 100% implementation of the measure.
- Shortest implementation period: The shortest time thought necessary for 100% implementation of the measure.
- Earliest starting year: The earliest year in which measure implementation can begin. Implementation of the measure cannot begin prior to this year.
- Necessary prior measure: Another measure whose 100% implementation is needed prior to the implementation of a certain measure. For example, "sidewalk widening work" is a necessary pre-existing measure for "use of pedestrian transit malls."
- Necessary parallel measure: Another measure needed for 100% implementation of a certain measure. The more effective the parallel measure is, the greater the effectiveness of the measure in question will be. For example, "subsidy program for purchase of environmentally friendly vehicles" is a parallel measure for "dissemination of environmentally friendly vehicles."

An upper limit is also established for the total amount of effort that can be expended each year. The team conducted these values and established values that are thought to be appropriate at this point in time.

(3) Prepare a schedule for implementation of measures

Based on the exogenous variables and parameters established in (1) and (2), calculate the period of time needed for implementation of each measure, using the backcasting tool (BCT). The BCT establishes the difference between total effectiveness and total effort as a target function and uses mixed integer programming (MIP) to maximize this value. Fig. 8 shows the structure of a BCT.

(4) Propose a roadmap

The BCT calculates the period of time needed for implementation of all of the envisioned measures in order to arrive at the target society in the future, based on a limited amount of expendable effort. Moreover, by also incorporating benefits other than reductions in greenhouse gas emissions that result from the measures, it is able to take into consideration the priority of each measure for the local government. This makes it possible to propose this roadmap to serve as a foundation when the local government prepares actual medium- and long-term plans aimed at the achievement of a low carbon society.

Statistical data and actions

For understanding the current status of CO_2 emissions and calibration of ExSS, large amount of socioeconomic data and energy consumption/supply data would be required. Data collection is relatively easy at prefectural and city government level; however, to understand the regional characteristics for various regions or municipalities in Shiga prefecture, it is necessary to breakdown the data with indigenous process. On the basis of statistical data shown in Table 5, this committee prepared interindustry table, trade table and energy balance table for the entire Shiga prefecture as well as for eight regions in the prefecture.

Moreover, while listing up the necessary action prior

Table 5: List of statistical data used as reference

Statistic/Document	Application and reference data
National Census	Population, number of households, preparation of OD table for the purpose of commuting to school and work
Industrial Statistics Survey	Number of business establishments, shipment amount of products
Shiga prefecture industrial table	Transaction master table, import index, breakdown of final demand, self-sufficiency ratio etc.
Economic calculations for residents of Shiga	Main table (Production, expense, allotment), social burden on household budgets, receipt of social insurance, other earnings
Passenger Traffic Survey for Kyoto, Osaka and Kobe	Preparation of OD chart based on the number of trips (Segment: Male/female, age, holding the driving license or not, transportation means, starting point, destination, purpose), occupation, and number of business trips and leisure trips
Baseline research on logistics in Kyoto, Osaka and Kobe	Preparation of OD chart based on transportation volumes in ton
Annual Report of Energy Production, Demand	Amount of consumption of petroleum fuels in the prefecture (preparation of energy balance table)
LP-Gas Annual Report Facts & Figures	Amount of consumption of LP gas in the prefecture (preparation of energy balance table)
Annual Report on Japanese Gas Industry	Amount of city gas consumption (preparation of energy balance table)
Statistics of Agricultural Production	Gross production of agriculture (preparation of energy balance table)
Annual Statistics of Fishery and aquaculture	Gross fishery production (preparation of energy balance table)
The structural survey of oil consumption	Amount of industry-wise and fuel-wise consumption (preparation of energy balance table)
Annual report of construction statistics	Floor area under construction (preparation of energy balance table)
Annual report of family income and expenditure survey	Purchase volume of LP gas per household, purchase volume of heating oil per household (preparation of energy balance table)
Annual statistics of automobiles exports	Vehicle-wise fuel usage (preparation of energy balance table)
Railway transportation statistics	Usage of electricity and diesel by railways (preparation of energy balance table)
Shiga prefecture statistics	Actual demand for electric light and power, industry-wise power demand, demand for urban gas, monthly figures of number of persons using ships for various shipping routs, number of cars in each city and town, mining and manufacturing index (preparation of energy balance table)

Table 6: Outline of Tertiary Shiga Prefecture Comprehensive Environment Plan (Draft)

Theme		Specific Actions
Nurturing people and raising children towards the construction of sustainable Shiga		Environmental learning program in Lake Biwa (“Umi no ko (children of lake)”), forest environmental experience program (“Yama no ko (children of forest)”), agricultural experience program, opportunities for experiencing and learning through various means such as museums, promotion of eco-tourism etc.
Building the infrastructure for constructing sustainable Shiga society		Supporting the residents of prefecture, regional associations, NPO etc who are engaged in environment conservation, organizing Lake Biwa environment business messe, supporting promotional associations such as Eco Action 21, PR activities of environment friendly agriculture, expanding self-sufficiency of "Made in Shiga" fodder, maintaining transportation systems by combining public transportation and Lake Biwa transportation, establishing stable supply system of "Made in Shiga" wood, practicing energy-saving behavior and environment-friendly behavior in prefectural office, supporting the cities and towns which are working towards realization of low carbon society etc.
Environmental actions in various fields	Measures against global warming	“Shiga ecology/economy project”, promotion of “Miru Eco Ohmi”, enlightment and information drives at regional level by the members of anti-global warming activities promotion group, promotion of appropriate forest manage such as thinning, disseminating CO2 reduction practical examples to small and medium scale industries, installation support to households for solar power generation facility, conversion of official vehicles in prefecture to electric cars etc.
	Natural environment	Support to various regional activity groups, information dissemination regarding prefecture residence tax for lake Biwa forest regeneration etc.
	Scenic, historical environment	Supporting the activities of local residents for maintaining the landscape, such as preservation of traditional agricultural methods and facilities.
	Water and soil environment	Maintenance of forests for disaster prevention and water recharge function
	Comfortable environment of air, chemicals and other substances	Maintaining transportation systems by combining public transportation and Lake Biwa transportation etc.
	Recycling of waste and resources	Publicity of certified products (Biwa Cool Eco Products) as per Shiga prefecture recycled products certification system etc.

to the application of backcasting tool, for the current environmental actions taking place in Shiga, we referred to “Third Shiga Prefecture Comprehensive Environment Plan (draft).” This is a based plan of environmental actions to be taken by the prefecture between the planning period of 2009 and 2013. It described the direction of actions for achieving “Regeneration of Biwa Lake Environment” and “Realization of Low Carbon Society,” which are set as targets in “Social Vision of Sustainable Shiga” prepared in 2008. Of this, actions related to “Realization of Low Carbon Society” were incorporated and taken as a start line for drawing the roadmap in this brochure. Main activities mentioned in this plan are provided in Table 6.

【Reference Literature】

Robinson,J.,B. : Futures under glass A resipe for people who hate to predict, Futures, pp820-842, 1990.

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Table 7: Input-output table of shiga prefecture in 2000 (Unit：million yen)

	Agriculture, forestry and fishing	Food products and beverages	Textiles and wood products	Pulp, paper and printing	Chemistry, oil, coal products	Cement, soil, stone and ceramics	Steel and metal	Machinery	Other manufacturing and mining	Construction	Utility	Wholesale and retail trade	Finance, insurance and real estate	Transport, communication and broadcasting	Public service	Business service	Personal service	Others	Total of endogenous sector	Final demand	Export	Production by industry
Agriculture, forestry and fishing	10,450	25,362	6,994	0	1,091	7	5	0	4,054	1,938	0	82	0	0	1,935	2	6,170	0	58,090	36,998	-5,359	89,729
Food products and beverages	4,142	55,010	554	270	2,420	76	1	0	220	0	0	71	0	0	6,142	0	47,822	12	116,740	284,208	63,785	464,733
Textiles and wood products	367	865	46,530	708	2,022	2,770	2,303	9,437	6,837	48,461	350	2,630	1,519	2,628	6,762	959	3,303	803	139,254	72,901	33,710	245,865
Pulp, paper and printing	748	10,324	3,712	47,770	14,304	12,863	3,266	20,095	4,380	5,050	598	8,138	6,786	5,371	30,914	3,768	3,894	8,740	190,721	19,419	-28,099	182,041
Chemistry, oil, coal products	6,576	16,823	24,036	12,355	300,971	23,536	9,889	85,020	46,853	24,323	4,880	2,844	1,427	37,563	59,878	2,228	5,304	3,098	667,604	70,182	229,110	966,896
Cement, soil, stone and ceramics	150	2,250	1,546	190	6,699	19,361	2,414	20,950	815	58,728	223	230	34	17	1,370	343	1,187	399	116,906	-33	287,657	404,530
Steel and metal	129	17,427	9,245	258	7,908	6,411	151,003	236,531	11,378	101,648	132	1,174	197	1,101	1,805	466	1,016	708	548,537	8,227	-41,039	515,725
Machinery	18	64	415	65	2,373	1,664	3,207	921,991	652	16,764	393	694	61	3,316	10,696	22,893	437	1,104	986,807	949,315	1,337,247	3,273,369
Other manufacturing and mining	192	1,381	2,459	747	6,870	20,405	8,994	27,815	8,529	13,960	4,910	507	46	956	7,798	3,902	1,974	2,664	114,109	76,286	44,439	234,834
Construction	448	721	713	929	5,111	3,834	5,423	7,980	524	2,245	3,946	3,173	31,249	5,282	14,349	1,012	3,063	0	90,002	847,594	0	937,596
Utility	491	5,158	4,474	3,543	22,964	17,879	13,511	35,470	4,402	6,234	7,046	8,728	2,841	9,502	38,242	1,939	18,036	736	201,196	78,797	-178,228	101,765
Wholesale and retail trade	3,622	24,448	15,038	10,067	44,147	14,488	22,871	152,924	13,295	60,437	1,897	6,163	2,113	14,801	34,435	8,175	26,711	5,774	461,406	481,860	-402,320	540,946
Finance, insurance and real estate	3,998	3,311	7,482	4,173	13,820	11,566	10,918	37,158	5,329	13,630	1,816	36,749	61,025	34,212	24,455	14,405	17,362	11,817	313,226	710,970	-53,155	971,041
Transport, communication and broadcasting	3,823	11,229	8,555	6,534	24,647	15,862	17,121	55,630	18,517	59,160	4,275	33,767	14,645	50,258	41,865	8,485	17,475	4,761	396,609	218,502	-83,244	531,867
Public service	16	2,773	2,224	518	49,355	17,836	6,903	156,724	4,238	3,391	756	1,210	979	3,968	7,784	1,064	1,619	9,042	270,400	1,020,156	19,858	1,310,414
Business service	1,581	17,306	7,672	7,307	46,235	20,302	20,481	119,568	8,223	74,479	7,733	35,189	50,328	74,063	76,015	28,623	16,526	2,797	614,428	82,589	-424,870	272,147
Personal service	11	82	63	55	202	94	107	641	42	478	54	896	577	1,598	7,678	823	7,618	606	21,625	577,706	-126,984	472,347
Others	600	2,517	2,533	1,260	4,812	2,053	4,991	16,829	1,845	4,082	913	4,362	5,780	2,748	7,163	1,809	2,598	16	66,911	326	1,027	68,264
Total of endogenous sector	37,362	197,051	144,245	96,749	555,951	191,007	283,408	1,904,763	140,133	495,008	39,922	146,607	179,607	247,384	379,286	100,896	182,115	53,077	5,374,571	5,536,003	673,535	11,584,109
Total of gross value added sector	52,367	267,682	101,620	85,292	410,945	213,523	232,317	1,368,606	94,701	442,588	61,843	394,339	791,434	284,483	931,128	171,251	290,232	15,187				
Production by industry	89,729	464,733	245,865	182,041	966,896	404,530	515,725	3,273,369	234,834	9378 ,596	101,765	540,946	971,041	531,867	1,310,414	272,147	472,347	68,264				

Table 8: Input-output table of shiga prefecture in 2030 (Unit：million yen)

	Agriculture, forestry and fishing	Food products and beverages	Textiles and wood products	Pulp, paper and printing	Chemistry, oil, coal products	Cement, soil, stone and ceramics	Steel and metal	Machinery	Other manufacturing and mining	Construction	Utility	Wholesale and retail trade	Finance, insurance and real estate	Transport, communication and broadcasting	Public service	Business service	Personal service	Others	Total of endogenous sector	Final demand	Export	Productions by industry
Agriculture, forestry and fishing	61,845	22,871	5,283	0	1,021	6	4	0	3,626	2,036	0	97	0	0	3,908	0	6,037	0	106,736	69,855	354,444	531,035
Food products and beverages	24,513	53,750	495	207	2,264	70	1	0	197	0	0	84	0	0	12,535	0	42,072	18	136,205	222,336	88,496	447,037
Textiles and wood products	2,172	951	38,779	547	1,705	2,399	2,084	8,534	6,047	96,903	437	3,096	2,637	4,437	14,984	228	5,200	1,143	192,282	65,622	-59,512	198,391
Pulp, paper and printing	4,427	8,854	2,779	36,290	12,260	11,133	2,594	16,179	3,620	4,984	550	8,421	10,353	8,845	49,393	747	5,422	9,587	196,437	15,742	-69,069	143,110
Chemistry, oil, coal products	38,692	16,301	20,465	9,636	253,617	19,166	8,040	76,781	40,781	24,752	5,555	3,217	2,169	49,580	117,966	516	8,662	4,308	700,204	52,672	84,766	837,642
Cement, soil, stone and ceramics	888	2,029	1,073	146	5,843	10,226	2,141	18,913	729	47,771	288	271	40	26	2,534	81	1,402	585	94,986	2,719	196,808	294,513
Steel and metal	763	15,715	6,290	205	7,082	3,497	137,809	206,796	10,024	74,767	152	1,382	228	1,716	3,705	111	1,237	1,051	472,531	10,890	-13,305	470,116
Machinery	107	507	343	368	2,095	1,642	3,101	822,635	606	17,712	544	1,165	804	5,467	24,213	5,475	1,087	1,488	889,358	1,067,638	970,007	2,927,003
Other manufacturing and mining	1,136	1,528	1,972	575	5,257	11,842	7,883	24,024	7,524	14,669	3,937	597	86	1,864	14,628	926	3,283	3,588	105,322	73,362	21,444	200,128
Construction	2,651	684	551	719	4,393	1,862	4,964	7,124	401	2,359	4,137	3,735	34,675	9,472	26,476	240	5,322	0	109,765	875,439	0	985,204
Utility	2,357	4,627	3,081	2,278	16,307	12,007	9,761	25,963	3,072	5,637	6,550	6,665	3,168	11,764	50,383	294	18,810	971	183,693	67,908	-135,301	116,300
Wholesale and retail trade	21,436	23,363	12,002	7,859	37,612	10,175	20,820	136,147	11,748	63,506	2,167	7,255	3,522	23,109	68,405	1,940	27,605	7,823	486,493	678,447	-528,162	636,778
Finance, insurance and real estate	23,661	3,624	6,190	3,289	12,095	7,861	10,008	32,799	4,262	14,322	1,923	43,259	85,437	61,108	47,272	3,418	25,627	17,583	403,739	872,335	25,179	1,301,252
Transport, communication and broadcasting	22,625	11,873	6,903	5,858	21,974	8,519	15,892	50,898	13,902	62,389	5,136	40,560	27,872	103,925	89,741	2,116	25,967	8,435	524,588	266,867	210,955	1,002,410
Public service	95	2,549	1,855	402	45,088	14,884	6,282	142,128	3,777	3,563	781	1,424	1,751	9,030	15,577	252	2,818	13,454	265,710	2,026,001	221,774	2,513,486
Business service	9,357	15,723	6,119	5,747	40,958	15,566	18,731	106,858	7,027	78,261	9,339	41,423	85,615	133,041	147,256	6,791	26,234	4,162	758,208	110,677	-804,319	64,567
Personal service	65	118	52	44	174	68	98	571	35	502	68	1,055	802	3,793	15,700	195	13,087	902	37,329	824,256	-193,868	667,716
Others	3,551	2,319	2,052	997	4,195	1,452	4,541	14,672	1,493	4,289	1,084	5,135	8,890	5,332	13,885	429	3,566	23	77,905	411	20,248	98,564
Total of endogenous sector	220,341	187,387	116,282	75,167	473,941	132,376	254,753	1,691,022	118,872	518,423	42,649	168,839	268,048	432,509	718,563	23,759	223,439	75,123	5,741,491	7,303,177	390,583	13,435,251
Total of gross value added sector	310,694	259,651	82,110	67,943	363,701	162,137	215,363	1,235,981	81,256	466,781	73,650	467,938	1,033,205	569,901	1,794,923	40,808	444,277	23,441				
Production by industry	531,035	447,037	198,391	143,110	837,642	294,513	470,116	2,927,003	200,128	985,204	116,300	636,778	1,301,252	1,002,410	2,513,486	64,567	667,716	98,564				

Table 9: Energy consumption of household and business oprrations (Unit：ktoe)

	Household						Business oprrations					
	Oil	Natural gas	Biomass	Solar	Electric power	Total	Oil	Natural gas	Biomass	Solar	Electric power	Total
2000												
Cooling	0	0	0	0	11	11	2	3	0	0	26	32
Heating	82	21	0	0	34	137	56	7	0	0	15	78
Hot water	76	46	0	9	10	140	48	27	0	5	0	80
Kitchen	10	12	0	0	11	33	0	29	0	0	0	29
Home electronic	0	0	0	0	174	174	0	0	0	0	147	147
Total	167	79	0	9	240	496	106	66	0	5	189	366
2030BaU												
Cooling	0	0	0	0	13	13	2	4	0	0	30	36
Heating	97	25	0	0	40	163	64	8	0	0	17	89
Hot water	90	54	0	11	12	167	54	30	0	6	0	90
Kitchen	11	15	0	0	13	40	0	33	0	0	0	33
Home electronic	0	0	0	0	238	238	0	0	0	0	167	167
Private power generation				14	-5	9						
Total	199	94	0	25	310	628	120	75	0	6	214	415
2030 with measures												
Cooling	0	0	0	1	3	5	0	3	0	2	8	13
Heating	14	28	12	13	17	84	8	15	6	7	9	46
Hot water	17	17	7	16	3	59	6	11	0	5	4	26
Kitchen	3	8	2	0	11	24	0	19	2	0	1	22
Home electronic	0	0	0	2	129	130	0	0	0	0	101	101
Private power generation				52	-20	32				11	-4	
Total	34	52	21	32	164	303	14	49	9	24	119	208

Table 10: Energy consumption of transportation sector (Unit: ktoe)

	Oil	Natural gas	Biomass	Solar	Electric power	Total
2000						
Railway (passenger)	0	0	0	0	40	40
Bus	16	0	0	0	0	16
Car (passenger)	540	0	0	0	0	540
Motorcycle	3	0	0	0	0	3
Railway (freight)	0	0	0	0	1	1
Truck (freight)	380	0	0	0	0	380
Others (freight)	5	0	0	0	0	5
Total	944	0	0	0	41	985
2030 BaU						
Railway (passenger)	0	0	0	0	47	47
Bus	18	0	0	0	0	18
Car (passenger)	945	0	0	0	0	945
Motorcycle	5	0	0	0	0	5
Railway (freight)	0	0	0	0	1	1
Truck (freight)	315	0	0	0	0	315
Others (freight)	5	0	0	0	0	5
Total	1,288	0	0	0	47	1,336
2030 with measures						
Railway (passenger)	0	0	0	0	54	54
Bus	9	0	1	0	0	10
Car (passenger)	279	0	35	0	0	315
Motorcycle	2	0	0	0	0	3
Railway (freight)	0	0	0	0	12	12
Truck (freight)	134	0	18	0	0	151
Others (freight)	4	0	0	0	0	4
Total	428	0	54	0	66	548

Table 11: Energy consumption of industry sector (Unit: ktoe)

	2000						2030 BaU						2030 with measures					
	coal	Oil	Natural gas	Biomass	Electric power	Total	coal	Oil	Natural gas	Biomass	Electric power	Total	coal	Oil	Natural gas	Biomass	Electric power	Total
Agriculture and forestry	0	56	0	0	4	61	0	334	0	0	27	361	0	175	0	0	19	194
Fishery	0	3	0	0	1	4	0	17	0	0	9	25	0	11	0	0	10	22
Mining	0	4	0	0	1	4	0	2	0	0	0	2	0	1	1	0	0	2
Food products and beverages	0	55	15	0	17	86	0	50	13	0	15	78	0	20	33	0	13	66
Textiles	8	66	19	0	21	115	7	59	17	0	19	103	3	24	44	0	17	88
Paper, pulp	0	46	0	0	13	59	0	35	0	0	10	45	0	15	16	0	9	40
Chemistry	0	61	20	0	20	101	0	57	19	0	19	95	0	43	14	0	16	74
Plastic products	0	123	10	0	96	229	0	98	8	0	77	184	0	72	6	0	68	146
Cement	56	0	0	0	9	64	0	0	0	0	0	0	0	0	0	0	0	0
Ceramics, soil and stone	23	380	41	3	126	572	21	351	38	3	116	528	7	102	139	2	102	352
Metal	3	60	1	0	30	94	3	52	1	0	26	81	1	15	18	0	23	56
Steel products	0	35	4	0	30	68	0	33	4	0	28	64	0	10	15	0	24	50
Machinery	0	40	1	0	49	91	0	33	1	0	41	75	0	10	14	0	36	59
Electric machine	0	46	33	0	116	195	0	43	32	0	110	185	0	8	41	0	97	145
Transport machinery	6	34	20	0	41	101	5	29	18	0	35	87	2	8	27	0	31	68
precision machinery	0	2	0	0	3	6	0	2	0	0	3	5	0	0	1	0	2	4
Other manufacturing	0	18	2	0	23	42	0	16	2	0	20	38	0	5	8	0	18	31
Construction	0	54	0	0	2	56	0	57	0	0	2	59	0	51	0	0	3	53
Total	97	1,082	167	3	602	1,951	37	1,267	152	3	556	2,015	13	571	376	2	488	1,450

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