Future Technology and the Capability of Local Region for Green Innovation in Japan

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Abstract

The current Japanese cabinet announced new basic policy that called the "New Growth Strategy (NGS)" policy. NGS consists with two main concepts which is the "Green innovation (GI)" and the "Life Innovation (LI)". The basic idea of those strategy are involved three major matter "strong economy", "robust public finances" and a "strong social security system". The concept of GI is not only environmental issue but also strategy of enhancing of economic growth situation as well as 25% reduction of Green House Gases (GHG) by 2020. This strategy considered with our new life style in future that is including energy sector such as renewable, nuclear energy and transportation system, as well as residential sector matter such as fuel cell cogeneration, home energy management system etc. Since climate change is top priority of environmental issue, green innovation has been key of improvement and solving this cause. Also current concern in Japan is not only environmental and energy issue but also aging society, less number of children, etc that is relating our future life. Therefore it has been considering how should we make and develop it and how S&T contribute it. Many reports mentioned the low carbon society defined that the regional innovation system will be contribute reduction of CO_2 emission and also chance to development of new business as well that S&T is important of issue. We have been considering it by policy studies such as Innovation 25, Cool Earth 50, and Delphi survey, Scenario development, and capability of local regions for green innovation. Backcasting methods of future prediction is now getting popular so that S&T is more important than passed years.

Keywords: GHG, green innovation, renewable energy, future city, low carbon society

1. Introduction

The current Japanese cabinet announced new basic policy that called the "New Growth Strategy (NGS)" policy as shown in Figure 1. NGS consists with two main concepts which is the "Green innovation (GI)" and the "Life Innovation (LI)". The basic idea of those strategy are involved three major matter "strong economy", "robust public finances" and a "strong social security system". The GI consists with environmental issues and The LI innovation is mainly a measure to prepare for an aged society because Japan is one of aging society countries in the world. The concept of GI is not only environmental issue but also strategy of enhancing of economic growth situation as well as 25% reduction of Green House Gases (GHG) by 2020. This strategy considered with our new life style in future that is including energy sector such as renewable, nuclear

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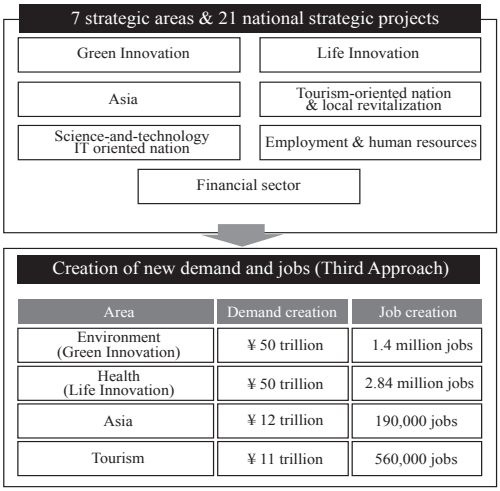


Figure 1 Concept of new growth strategy

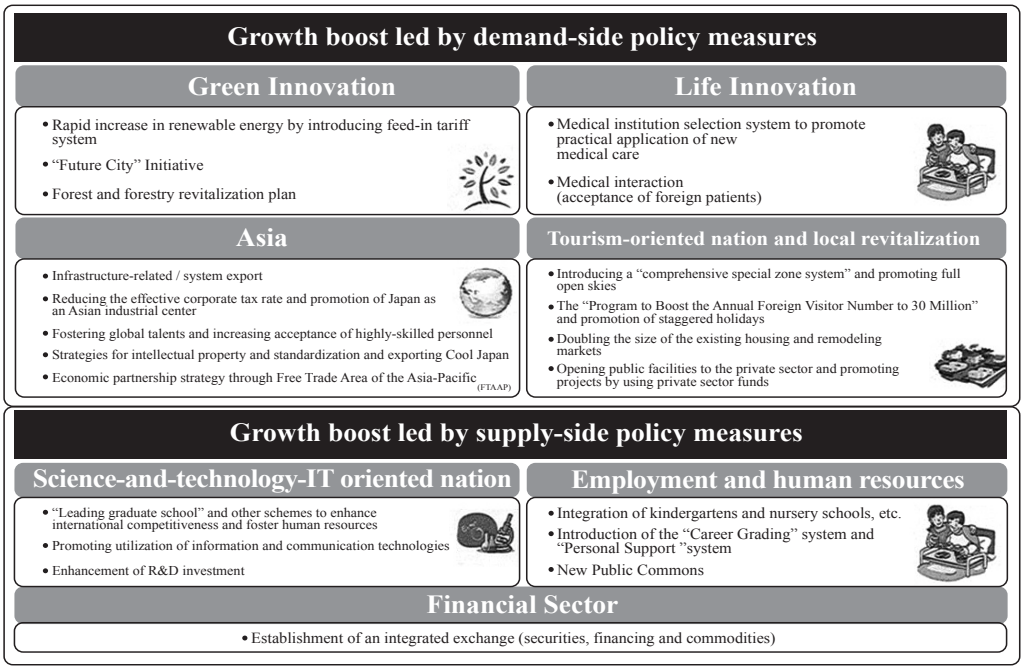


Figure 2 Growth boost led by demand-side policy measures

energy and transportation system, as well as residential sector matter such as fuel cell cogeneration, home energy management system etc as shown in Figure 2[1].

The target of GI is to reach by 2020 as follows. *1.Create over ¥50 trillion (US$1≈¥85) in new environment-related markets and 1.4 million new environment sector jobs. 2.Reduce worldwide GHG emissions by at least 1.3 billion tons of CO_2 equivalent (equivalent to the total emissions of Japan) using Japanese private-sector technology.* For promoting of the creation of a low-carbon society through a comprehensive policy package including

1) New Growth Strategy(Basic Policies) Toward a Radiant Japan, Cabinet office, http://www.kantei.go.jp/foreign/topics/2009/1230strategy_image_e.pdf

new systems and regulation, systems changes, and regulatory reform etc to support the rapid spread and expansion of our top level environmental technologies and products should be expanding to the world. Recently, Japanese smart grid is linking with electric power suppliers and electricity users via information systems and new demand through related equipment in households that is promoting this as a growth area.

2. Green Innovation

2.1 Green Innovation Policy in Japan

Japan has been deeply considering climate change issue which is based on Kyoto protocol. The former Prime Minister Abe in Japan explained "Cool earth 50" in the place of the summit in 2007 though the approach concerning the climatic variation was examined in every country in the world around the Kyoto Protocol. The detail of "Cool earth 50" is shown in Figure 3. The outline of this strategy is a measure that will reduce the greenhouse gas by half by 2050. For example, the well known Japanese technology such as energy saving system are able to contribute for reduction of 40 % of CO_2 emission in foreign countries and 60% will be promoting by the advanced high technology in Japan.

After the new administration which is The Democratic Party starts in 2009, the approach con-cerning the climatic change issue is assumed to be top priority. After it had shifted to the new administration, the promotion of economic development and employment was added at the same time as reducing though the reduction of greenhouse gases was a principal aim till then. Since this background, the concept of the green innovation has been considered at entire of countries. Green issue is relating not only environmental and energy but also infrastructure, information technologies, etc.[3)]

2.2 Scientific Publications Cited by " Green" Patents - OECD

Many articles relating green technologies have been publishing. Figures 4 and 5 show main scientific fields cited in "green" patents on inventor country between 2000-07 by OECD calculations based on Scopus Custom Data, Elsevier, in July 2009[4)]. According to those results, materials science and chemistry articles

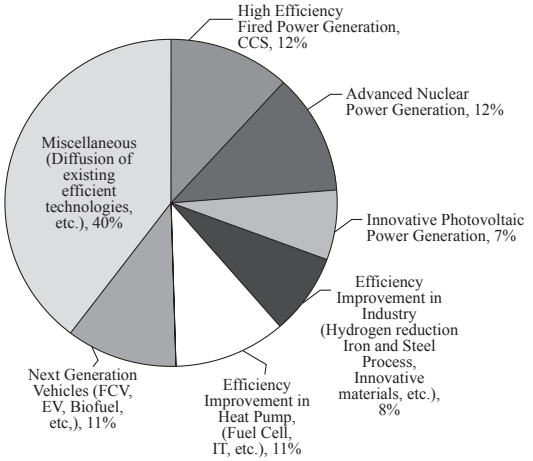


Figure 3 Cool earth 50 (source METI)[2)]

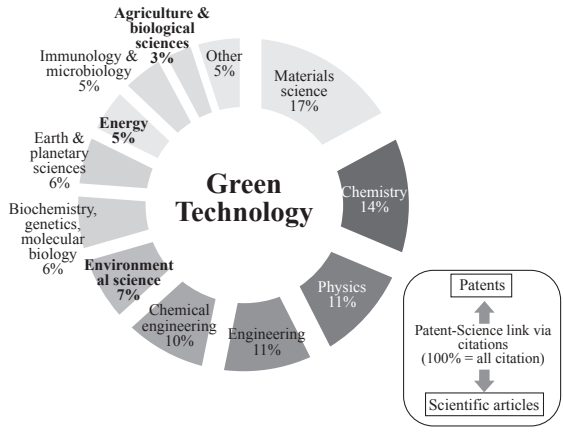


Figure 4 Main scientific fields cited in "green" patents by inventor country, 2000-07 by OECD database.

2) Cool earth, NEDO, http://www.edf.com/fichiers/fckeditor/Commun/Innovation/conference/NEDO_va.pdf
3) Cool earth 50, Cabinet office, http://www.kantei.go.jp/foreign/abespeech/2007/05/24speech_e.html
4) OECD, OECD Patent Database, January 2010; and EPO, Worldwide Patent Statistical Database, September 2009

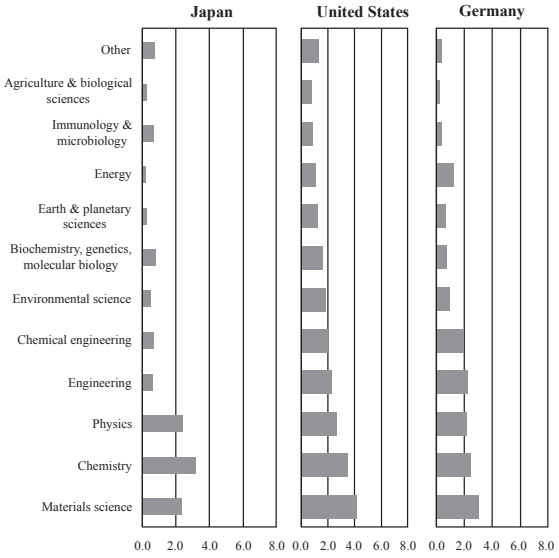


Figure 5 Comparison of main scientific fields cited in "green" patents by Japan, US and Germany, 2000-07 by OECD database.

are more contribute of green technology patents than the others.

According to this result, US and Germany show similar balance except energy, however Japan is different in Figure 5. The largest number of patents is chemistry in Japan and material science is in US and Germany. This might be indicating that several Japanese has been taking Novel prize of chemistry almost every year[5].

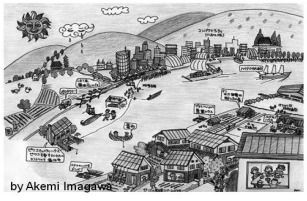
3. The Concept and Design of Future

3.1 Future City

Many report such as National Institute of Environmental Study (NIES) regarding low carbon society defined that the regional innovation system will key of reduction of CO_2 emission and also chance to development of new business as well. Especially, help as an interactive learning system in which a company and other organizations interact through a latent institutional environment.

In 2007, "2050 Japan Low-Carbon Society" scenario team in NIES reported entitled "Japan Low Carbon Society Scenarios". That is feasibility study for 70% CO_2 emission reduction by 2050 below 1990 level. It's quite well known that there are many technological potential to reduce the emissions of 70% of CO_2, which is the major greenhouse gas, by 2050 from the emission level in 1990 while satisfying the required amount of energy services in either of the two possible socioeconomic scenarios (Scenario A: Vivid / Scenario B: Slow) is as shown in Table 1[6].

Table 1 The image of future city for low carbon society by NIES.

Vision A	Vision B
Vivid, Technology-driven	Slow, Natural-oriented
Urban/Personal	Decentralized/Community
Technology breakthrough Centralized production/recycle	Self-sufficient Produce locally, consume locally
Comfortable and Convenient	Social and Cultural Values
2%/yr GDP per capita growth	1%/yr GDP per capita growth
	

Source: NIES

5) Nobel Prize home page, http://nobelprize.org/nobel_prizes/chemistry/laureates/
6) Low carbon society project, NIES, http://2050.nies.go.jp

In Scenarios A and B, the GDP per capita is estimated to increase by 2.7 and 1.6 fold, while the population will decrease by factors of 0.74 and 0.8, leading the GDP to increase by 2.0 and 1.3 fold, respectively, from the corresponding levels in 2000. There are several movements that will reduce energy service demands such as shifts to service industries, saturation of number of vehicles, and change of industrial structures through decrease of investment in social infrastructures. Various innovations, such as well insulated buildings, city structures where people can live within walking distance, and the development and spread of energy-saving devices will enable energy demand to be reduced by about 40% while satisfying the service demands. It is shown that CO_2 emissions can be reduced by 70% from the emission level in 1990 by implementing low-carbon 31 measures by energy suppliers, such as increasing the share of solar, wind power and other renewables and appropriate use of nuclear power and carbon capture and storage[7)]

3.2 Innovation 25 Technology

In 2007, former Prime Minister Abe specifically stated "Innovation 25". This innovation is something that goes far beyond technological renovation. It means to widely spread groundbreaking and revolutionary achievements to social systems and people's lives through completely new social systems, including new ideas, new frameworks and business plans. It was not desirable to have a society in which people overly indulged in technology, losing the clarity of simplicity in lifestyles and ways of thinking. In order to this statement, Cabinet office established "Innovation 25 strategy council (I25SC)". Innovation 25 is not a "dream vision" in a distant future, nor is it a mere "prediction of the future." It is "Japan's future to be created" in a cooperation between the people and the government within nearly 20 years. NISTEP has been doing Delphi survey that is future oriented methodology based on S&T so that NISTEP got order of this project.[8)]

The following three points considered for set theme up:

- Realization of new wealth in our society from the perspective of the citizens.
- Large Asia and growth by coexisting with the world.
- Society where high-spirited, highly creative people are willing to take on any risks to play an active role in society.

In Japan, the ratio of the working-age population to the population aged 65 and over was 4 to 1 in 2005, but is expected to fall to 2 to 1 in 2025. This estimated number assumed that the working power, which supports one elderly person, will decline drastically in 20 years, provided that various social systems remain unchanged.

Globalization in the future is an international competition over knowledge and the brain. It is hard to keep pace with the speed of progress in science and technology in the fields of IT, nano-technology and bio-technology by domestic human resources alone, and each country is in fierce competition to gain the brains of the world.

A safe and secure society is one of big concern in Japan because historically, we have big chance to get large scale of earthquake especially in Tokyo area. Also advances in secure and monitoring technologies that will enable children, and the elderly or handicapped to live safe, secure and comfortable life, etc.

The population explosion in many countries throughout the world is expected to continue into the future, reaching 8 billion by 2025. Out of that number, about 4.7 billion are estimated to be in Asia, including the hugely populated China and India. This topic significantly influence to environmental /energy issue but also water and food issue as well.

NISTEP and I25SC set 6 theme up as shown in Table 2.

According to statistics, Japanese has longest life

7) Japan Low Carbon Society Scenarios, NIES, http://2050.nies.go.jp/report/file/lcs_japan/2050_LCS_Scenarios_Actions_English_080715.pdf

8) Innovation 25, Cabinet office, http://www.cao.go.jp/innovation/en/pdf/innovation25_interim_full.pdf

Table 2 Theme of area for society in 2025

Theme 1	Staying healthy throughout your life
Theme 2	Information and telecommunications infrastructure to improve quality of life: benefit of ubiquitous computing
Theme 3	Assistance for activities of daily life based on the development of brain science
Theme 4	Safe and sustainable cities
Theme 5	Keeping yourself vigorous and open-minded: career choices, child-raising and diversification in seniors' lifestyles
Theme 6	Efforts against global environmental issues and toward coexistence in the world

around the world now. It will significantly influence government system such as health insurance, pension and retentive medicine tailored to an individual's needs, etc. Designating the kind of society desired and expected by the Japanese as "extending healthy life spans," discussion focused on the three major diseases (cancer, heart disease, and cerebrovascular disease), cognitive impairment, and lifestyle-related diseases, examining them from the perspectives of disease prevention, diagnosis, and treatment in Theme 1.

In Theme 2, Mutual understanding that will increase through more frequent communication between the public and people of other countries using devices, etc. The most important agenda is infrastructure improvement related to ICT, that will bring innovation.

In Theme 3, changes that will occur in people's lives through advances in brain science and cognitive science were examined. Technological seeds of brain science and cognitive science will connect with social needs such as lifestyle support through healthcare and robots. Changes in ways of working, learning, and living and in human relations were pictured.

In Theme 4, Discussions pictured sustainable city life in the future that solves environmental issues and social problems such as traffic accidents through advances in technologies related to living environments while working towards realization of "cities that respond to change and make their residents proud."

In Theme 5, Examination of desirable lifestyles was carried from the perspectives of housework, hobbies, leisure, and culture, learning and education, safety, care, movement, communication, and community life, within the frameworks of families with children, senior lifestyles, and diverse career choices. Being able to chose and change jobs during their lives based on their abilities and capabilities, etc.

In Theme 6, coexistence with Asia and the world was pictured through examination of the contributions Japanese technology can make to solving global environmental problems, especially global warming and water and energy issues. The results shows that society that contributes significantly to resolving global environmental issues and the public as well as the government and corporations make daily efforts to resolve environmental issues at the global level, etc. It's not easy to recognize of CO_2 emission so that visualization of environmental information is key of this theme. The summary of theme 6 is shown in Figure 6[9].

4. The Concept and Design of Future

4.1 Delphi Survey and Scenario Investigation

We, NISTEP has been doing foresighting of S&T which calls "Delphi survey" since 1971. This Delphi survey is one of the prediction of future technologies and an attempt was made to outline the future prospect of evolutions in major areas of science and technology, whereby the relevant areas were extracted irrespective of the existing boundaries

9) Scenario discussion based on S&T Foresight (Japanese only), March 2007 http://www.nistep.go.jp/achiev/ftx/jpn/rep101j/idx101j.html

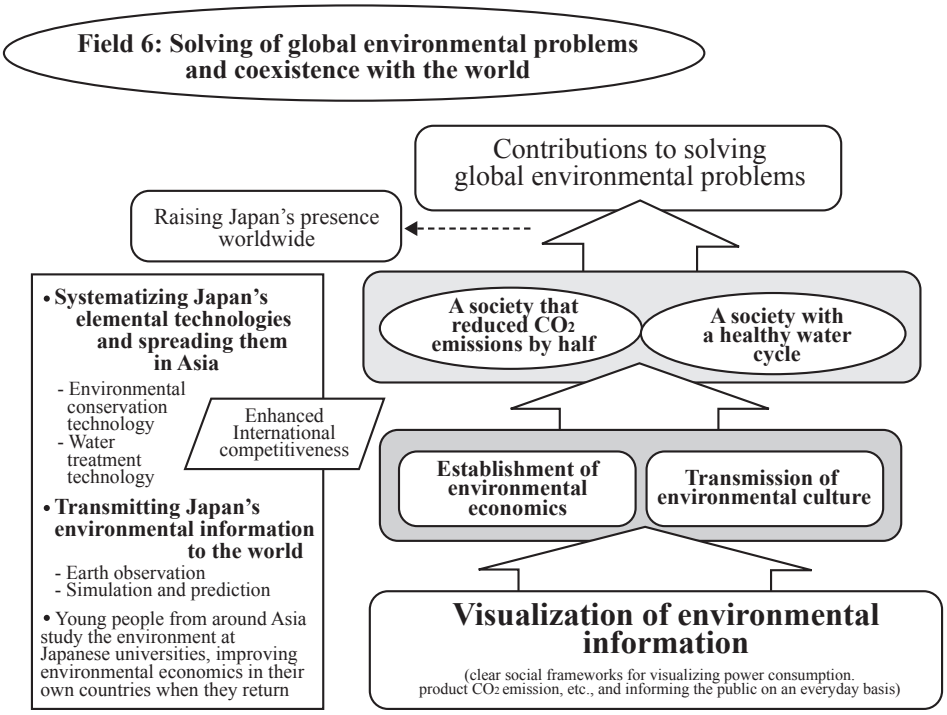


Figure 6 The summary of policy of future society based on contribution of global environmental issue.

separating the aspects of science and technology. The Delphi method iterates one or two rounds of the same questionnaire to the same panel of respondents, until the answers converge to some specific way of thinking. In the second and subsequent questionnaire, the respondents are allowed to modify their answers based on the summarized information (i.e. general trend of thinking) of the previous round. Some of the respondents modify their opinions, allowing the overall opinions to converge. The result of questionnaire is dominant by question so that the key of this Delphi survey is "how we should set question up". Also the guiding viewpoint here was to define "what we should do from now onward" to attain future goals and resolve the global and national challenges.

Therefore we normally make committee and the member of this committee must be specialist of each technology fields. The committee member through interdisciplinary discussions, the subcommittees defined the survey items and question items, and analyzed the results.

We currently published the 9th Delphi Survey result. The 9th Delphi Survey conducts 12 subcommittees as shown in Table 3. This twelve interdisciplinary subcommittees, consisting of 135 experts in total from the humanities, social sciences and natural sciences (from universities, industrial sectors, and research organizations).

Since Innovation 25, a lot of issue regarding S&T policy is more concern about future society which is no longer technology driven style of future. Therefore for this 9th Delphi survey, we also set up additional four preliminary subcommittees with technology subcommittee that were established and designated as "Security," "Safety," "Collaboration," and "Competitiveness." They involved the experts from the humanities and social sciences, as well as natural sciences, in discussion on the future targets that science and technology can help to attain, and on the global and national challenges to be resolved. Through the discussions, a selection was made with primary focus on the sciences and technologies that can contribute to resolving the global and national

Table 3 The theme and number of segments and topics of the 9th Delphi survey

Sub-committee	Viewpoint (defined by the subcommitee)	Segments	Topics
No. 1	Utilization of electronics, communication, and nanotechnology in a ubiquitous society	6	70
No. 2	Information technology including media and contents.	12	76
No. 3	Biotechnology and nanotechnology to contribute to humankind	8	58
No. 4	Medical technology to contribute to healthy lifestyles of the nation's people using IT, etc.	5	85
No. 5	Understanding of dynamics of space, earth, and life, and science and technology which expand the region of human activity	7	64
No. 6	Promotion of diverse energy technology innovations.	13	72
No. 7	Necessary resources, including water, food, minerals.	7	59
No. 8	Technologies for protecting environment and forming sustainable society	10	68
No. 9	Fundamental technologies, including substances, materials, nanosystems, processing, measurement, etc.	5	84
No. 10	Manufacturing technologies which totally support development of industry, society, and science and technology	8	76
No. 11	Strengthening of management led/required by advancement of science and technology.	8	58
No. 12	Infrastructure technologies supporting daily life base and industrial base.	5	62
Total		94	832

challenges, and with due consideration given to relationships with the critical areas[10].

The Delphi survey dominants questions so that Scenario investigation is covering of less points of Delphi survey[11].

4.2. Relating Issue of Green Innovation

It's already passed more than 30 years since we started Delphi survey in 1971 so that we are able to evaluate how much present of prediction is realized [12][13]. Figure 7 show factors impeded realization of energy related areas. The environment-related issues have shown high scores of actual implementation and those of energy-related issues are low as shown in Figure. 7. As the reasons that impeded realization, energy issue dominant and depending on situation of regulation. Because 95% of the energy resource has been imported in Japan since there is poor of natural resources in Japan. In the power generation source, such as nuclear, thermal, and water power are 30 percent respectively, and less 10 percent of other energy resources are the wind, solar, and a biomass, etc. It is greatly influenced to concern energy from such a background by an each occasion resource price and the state of driving of nuclear power generation. Therefore it is easy to predict it. Also, as the major engine leading to the realization of technologies related to energy, resources, and environment, it warrants special attention that government policies, including the basic agenda and strategy, and environmental regulations, have a huge effect on these areas of Japan where much of the resources come from abroad[14].

10) Emerging Fields in S&T for 4th S&T Basic Plan, http://www.nistep.go.jp/achiev/sum/eng/mat168e/PR11.pdf
11) Future Scenarios opened up by S&T (Japanese only), NISTEP report No. 141, http://www.nistep.go.jp/achiev/ftx/jpn/rep141j/idx141j.html
12) 8th Delphi survey (Japanese only), NISTEP report No. 97, http://www.nistep.go.jp/achiev/ftx/jpn/rep097j/idx097j.html
13) 7th Delphi survey (Japanese only), NISTEP report No. 71, http://www.nistep.go.jp/achiev/ftx/jpn/rep071j/idx071j.html
14) 9th Delphi survey (Japanese only), NISTEP report No. 140, http://www.nistep.go.jp/achiev/ftx/jpn/rep140j/idx140j.html

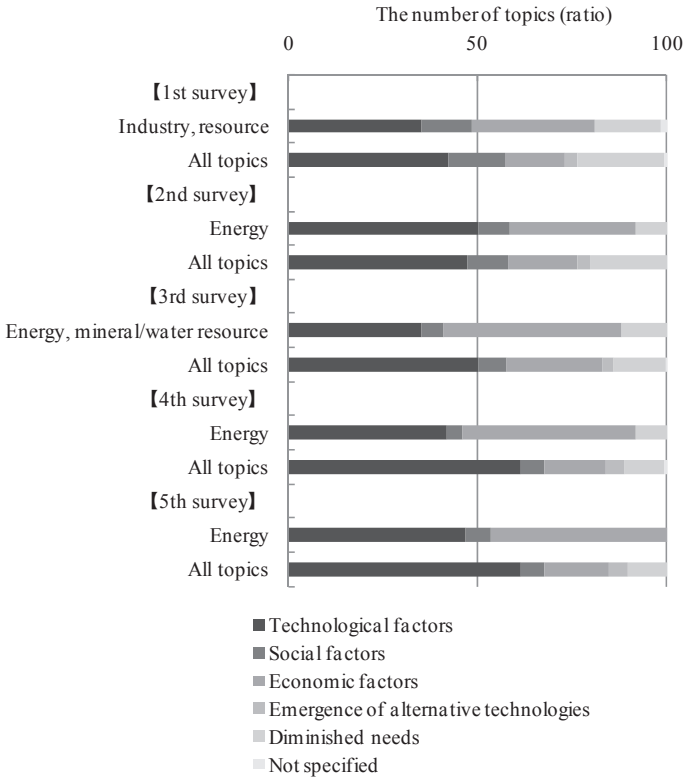


Figure 7 Factors impeded realization (Energy related areas)

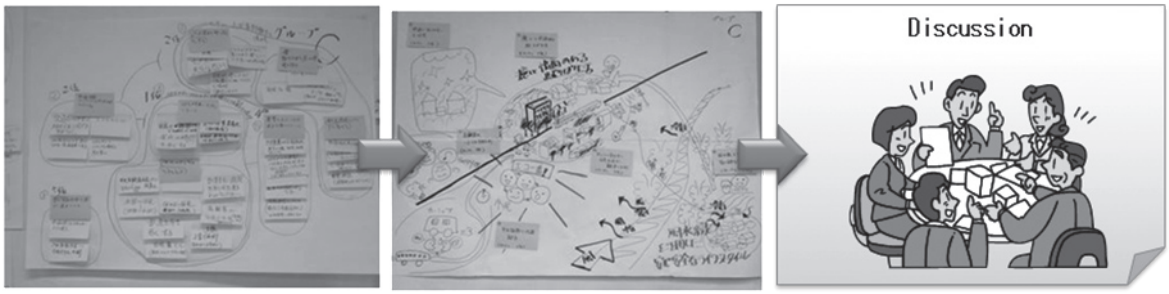
5. Capability of Local Regional for Green Innovation

5.1 Design of Workshop in Local Region

The national innovative city is a complex system related to technology, economy, society, and culture. The evaluation index system of the national innovative city is needed not only to reflect technological innovation itself, but also to demonstrate innovations of ideas, institutions, management, and social undertaking. Nevertheless, it is necessary to regard technological innovation as a foundation.

As it already mentioned that the evaluation index system is policy-oriented and should be conducive to guiding the city into taking an innovation and development road. To build a national innovative city, efforts must be made, but it is not impossible to achieve.

According to the concept of the green innovation previously described, the workshop was executed in eight places from north and south part of Japan. The purpose of this workshop was made on the ideal social model of each region to be realized in the future. As a concrete procedure, the representatives of the region — academic, industrial, local government servants, NPO and general citizens — discussed a



① Proposal of desirable assumes ideal of future.
② Summarizing of each opinion and making point.
③ Priority level credit by AHP.

④ drawing of future society.

⑤ Presentation of results of each group
⑥ Discussion.

2010 to 2050
• Desirable society
• Priority
• service and business
• contribution of S&T
etc.

AHP: Analytic Hierarchy Process

Figure 8 The discussion process in regional workshops.

wide range of issues from the viewpoint of realizing the ideal future society as shown in Figure 8. The workshop conducted 15-20 people for each workshop and set 3-4 group (4-5 each person) up and totally 129 was involved[15)16)].

5.2 Results of the Ideal Future Society Workshop in Local Region

In the concluding workshop that was set up based on the results of the regional workshops, the focus of the discussion was placed on the industries and services, as well as the science and technology relating thereto, conducive to the realization of the ideal social models.

For example, one result is "Community renovation: turning deficiencies into strengths" that projected social model to be realized in 2050 at Kuzumaki town (Iwate prefecture where in northern part of Japan). The detail of this concept is as follows.

- Energy sources from the blessings of nature (solar energy, wind, river, forest, livestock, energy-conservation, systems).
- Education, welfare, a place for people to gather (educational collaboration, place for gaining experience, ICT, medical care, community, housing, jobs, high value-added agricultural products, settlement-type nature school).
- Infrastructure and value creation (public transport infrastructure, information infrastructure, new affluence, safety and security in the Kuzumaki brand)

The results of group discussion with evaluated priority using by AHP methods as shown in Table 4.

The summary of the host regions of the regional workshops as graphically summarized in Figure 9.

5.3 Essential Industries and Services to Make the Future Social Model into Reality

In the concluding workshop at eight regions, many views were put forward, in terms of industries and services, aiming at the realization of regional ideal models of future society.

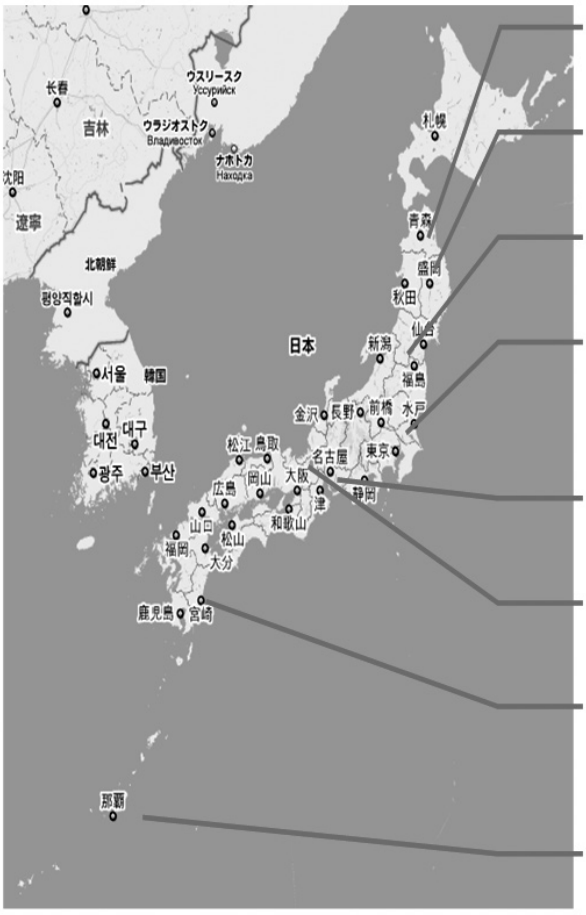
The industries and services essential for the purpose described above are broadly classified into four categories: "Effective utilization of energy," "Regional model and social infrastructure," "Health care of body and mind," and "Emerging industries and services" that based on green innovation policy. The views are listed in Table 5.

Table 4 The example results of group discussions (AHP scores are shown in [ ])

	Group A	Group B	Group C	Group D
1	Efficient use of energy [26.0]	Environment in general [21.0]	Value creation that money can't buy [12.0]	Housing and regions in harmony with nature in Kuzumaki [21.0]
2	Realization of high value-added agricultural products [24.0]	High-profit industry based on the locally available resources [17.0]	Affluent living in the province [12.0]	Availability of houses elderly people can live in safely [12.2]
3	Charming town that attracts people [14.1]	Self-sufficiency ratio of locally available renewable energy to other energy is much larger than 100 : 1 [12.6]	Utilization of resources available in Kuzumaki [2.4]	Availability of means of transportation elderly people can use comfortably [7.5]
4	Improved job opportunities [5.5]	Medical care, community renovation, education [13.0]	Making money (jobs) [2.4]	Japan's top agricultural and welfare university [4.7]

15) Capability of local regions for the green innovation (Japanese only), NISTEP report No.142, http://www.nistep.go.jp/achiev/ftx/jpn/rep142j/idx142j.html

16) Contribution of S&T to future society (Japanese only), NISTEP report No.145, http://www.nistep.go.jp/achiev/ftx/jpn/rep145j/idx145j.htm



ⓒ 2010 Google-map data
ⓒ 2010 SK M&C, Mapabc, Geocentre Consulting, ZENRIN, Europa Technologies

Shichinohe town (Aomori pref.; population: approximately 18,000)
"A convivial town that is in harmony with nature and attracts people"

Kazumaki town (Iwate pref.; population: approximately 8,000)
"Community renovation: turning deficiencies into strengths"

Kaminoyama city (Yamagata pref.; population: approximately 34,000)
"Japan's No. 1 life-long lively community"

Tsukuba city (Ibaraki pref.; population: approximately 210,000)
*Reference: Number of foreign residents: approximately 73,000
"Global-minded research and university towm with an established low-carbon lifestyle"

Nagoya city (Aichi pref.; population: approximately 2,258,000)
"Urban life compatible with nature(wind, water, and greenery)"

Tsuruga city (Fukui pref.; population approximately 68,000)
"Town full of vigor with affluent electricpower"

Miyazaki pref.(population: approximately 1,132,000)
*Miyazaki city (approximately 370,000)
"A society letting you live in affluence, with mutual independence and coexistence"

Okinawa pref. (population: approximately 1,380,000)
*Naha city (approximately 318,000)
"An affluent society blessed with bright sunshine, the wide open sea, and an assortment of new energy sources:"

Figure 9 The summary of the host regions of the regional workshops.

Table 5 The points that received recognition from other regions

Region	Effective utilization of energy:	Regional model and social infrastructure:	Health care of body and mind	Emerging industries and services:
Shichinohe	**[High diffusion ratio of new energy]**	**[Rendering historical and natural heritage into tourism/ service resources]**	**[Energy-saving oriented lifestyle]**	**[Subsidies according to the amount of CO^2 absorption]**
	Realization of new energy industry→EV town Subsidy to promote the introduction of new energy and energy saving.	Emphasis on the link with neighboring areas(e.g.Sannai-Maruyama) Route connecting Jomon ruins Highly attractive, magnificent nature→great tourist attraction Attentive preservation of nature Tsutsuji road aims to be Japan's No.1 attraction Approached nature conservation and consolidation of population	Morning-type sightseeing service	Subsidy system for emission reduction Subsidy for CO^2 absorption by the forest **[Cutting-edge technology]** Interesting concepts such as portable nuclear power, and agricultural robots.

Table 5 The points that received recognition from other regions (cont'd)

Region	Effective utilization of energy:	Regional model and social infrastructure:	Health care of body and mind	Emerging industries and services:
Shichinohe		**[High value-added food industry and agriculture]** High value-added food industry that takes advantage of the local specialty (i.e. snow) Secure and safe food supply "Agriculture with motivation"		
Kuzumaki	**[High self-sufficiency ratio of food and energy]**	**[High value-added agricultural product]**		
	Self-sufficiency ratio for food: 180%; for energy: 160% High self-sufficiency ratios for energy and food Wind-power generation Biomass↔manure↔live stock-meadow, forest, dairy farming, alcohol(wine) Respectable achievements in introduction and development of various types of clean energy Local people's understanding of clean energy	Heightening of added value during the production process: shiitake mushroom production utilizing electricity Heightening of added value in agriculture by application of new technology		Joint public-private ventures turned a profit
Kaminoyama		**[Formation of regional community]**	**[Kurort: a stay-in-nature approach for health care and preventive medicine]**	**[Various purchasing benefits(Eco-points)]**
		Emphasis on kizuna (emotional ties) **[Professionalization of guides]** Professionalization of guides Professionalization of guides for regional development and cyclical form of education	An idea of rendering nature into an exercise course Preventive medicine by field-trekking approach (Terrainkur) and health food Geological environment and local resources (i.e. hot spring) serve to promote health and create local attraction. "Terrainkur" course A health promotion approach ("health in body and mind") utilizing local resource (i.e. hot spring) Health resort therapy Medical care system without a hospital Spa therapy-a viewpoint toward longevity	Introduction of various types "Eco-points" Insurance for preventive medicine "Agricultural product eco-points" to promote local production for local consumption "Health eco-points" system
			[Health related technology]	
			New technologies inspired by the processes toward health promotion	

Table 5 The points that received recognition from other regions (cont'd)

Region	Effective utilization of energy:	Regional model and social infrastructure:	Health care of body and mind	Emerging industries and services:
Tsukuba	**[A society with fewer cars]**	**[Creation of internationally compatible town: acceptance of foreigners]**	**[Social evolution through the acceptance of overseas wisdom]**	
	Promotion of bicycle use over automobiles "Give up my car"	Internationally compatible town A town highly responsive to changes A town that embraces foreigners as community members Foreigner's stay	Analysis form an international viewpoint Tsukuba is in the process of creating an international region through proactive acceptance of wisdom form overseas. Contact with citizens and students in the open laboratories Internationally compatible (common) education Opportunities to be exposed to science and technology	
			[Creation of internationally-minded civic society]	
			Courteous greetings, and respectful attitudes Permeation of "Tsukuba people"concept Local-people concept of "Tsukuba people" Preserved countryside environment → Rich in spirit, and courteous attitude	
Nagoya		**[Well balanced city design between urban functionality and natural environment]**	**[Sense of balance]**	
		Emphasis on nature in the large city: city keywords include "wind, water, and greenery". Well balanced link between urban functionalities and the natural environment Affinity to the river (Water) Easy access to promotion locations (e.g.nature) Public relations approach for industries and local culture	Regional renovation balancing various aspects of the region Region with a sense of balance	
			[Securement of comfortable life for citizens in a large city]	
			Realization of a comfortable life for citizens in a metropolis Renewed attention to the magnitude of difference in regional characteristics between big cities and rural areas	
Tsuruga	**[Energy-source town: understanding of nuclear power generation]**	**[Compact town: zoning]**	**[Town renovation toward intercommunication across three generations]**	
	Citizen's viewpoint toward the town embracing an energy-generation facility (nuclear power plant) Community renovation focusing on the characteristics of the "electric energy town" Affluent town with the supply of nuclear power	Safety and security in a compact town Zoning concept within the town A compact city where three generations can live comfortably. An approach to area zoning.	Town renovation toward intercommunication across three generations A town that enables spiritually rich lives across three generations	

Table 5 The points that received recognition from other regions (cont'd)

Region	Effective utilization of energy:	Regional model and social infrastructure:	Health care of body and mind	Emerging industries and services:
Tsuruga	Does the large number of out-migrants threaten the establishment of research facilities? Very high local understanding and expectations of the nuclear power plant Dependency on the electric industry is similar to Nagoya's dependency on the automobile industry Self-contained town; local city that does not rely on other cities.			
Miyazaki	**[Utilization of new energy]**	**[Invigoration of primary industry and collaboration with NPO]**	**[Stabilization of intermediate and mountainous area]**	
	Solar power, small-scale hydropower	New "3K"(smart, profitable, and exciting) Primary industry: the approach of the local government to link each area to enhance the whole prefecture activities, and linkage strategy with NOPs Self-sufficiency ratio of food: 246% (ranked top in Japan) Agricultural power, self-sufficiency ratio of food	The group activities of volunteers ("Chu-sankanchi Moriage-Tai") have the effect of preventing suicides, and promoting regional activation. Disaster-tolerant region-enlivenment of intermediate and mountainous areas The problem of the high suicide rate can not be resolved only by symbiosis with nature	
Okinawa	**[Energy farm]**	**[Design of town and community]**	**[Community formation around large families: inheritance of culture and natural features]**	
	Energy farm Energy industry that considers the sea as a energy source (an idea that is impossible for Kazumaki, located in the mountains) Solar, wind, deep seawater, wave, and tidal power CO^2 fixation by marine biomass Approached leveraging the wealth of the natural environment Independence in terms of energy	Community oriented zoning: miniaturized version of a compact city Car traffic is banned within the community ARUKU (walking) community Light-rail train Fuel-free transportation network New approach for community formation	Community formation based on large families Inheritance of Ryukyu culture, and cooperation within the community	

5.4 Possibility of Collaboration with Local Region

The representative in each district met together after holding the workshop in the region, and an integrated workshop was held in Tokyo. The focus of the discussion was placed on the industries and services, as well as the science and technology relating thereto, conducive to the realization of the ideal social models.

The science and technology that are instrumental for the realization of each region's future social model, as well as the schemes for promoting them, are shown in Table 6.

6. Conclusions

Green innovation embraces all aspects of new industry and job creation accompanying the process of constructing a low-carbon society, rather than the simple idea of forming a low-carbon society as already discussed as first chapter.

In all the target regions of this survey, the need for technical development for energy with zero CO_2 emissions was commonly mentioned. Also mentioned was the importance of integration with conventional technologies, as well as the development of technology management schemes and business models. To facilitate actual realization of these technologies, a detailed discussion is necessary on the institutional bottleneck that will impede the diffusion and utilization of them.

The other key is that who will take the lead in the processes toward realizing the ideal models in society. This is the most important issue to be discussed. To build a society wherein citizens live comfortably, an essential step of the processes consists of drawing up a regional model fully compatible with the environmental conditions of the region. For this purpose, a platform for consensus building must be set up involving the general public, and social infrastructure improvements will

Table 6 Industries and services conducive to the realization of the ideal regional social model

Industries and services conducive to the realization of the ideal social model	Effective utilization of energy	Regional model and social infrastructure	Health maintenance of body and mind	New industrial service
Related keywords	LCA, agricultural produce, logistics, food factory, ICT, compact city, etc.	Traffic, tourism, agriculture, family, local time, new "3K"(dirty, dangerous, difficult jobs), lifestyle, etc.	Health, Onsen(hot spring), sports, ICT, life style, etc.	High-value added agriculture, farmstay, health maintenance, educational hub, etc.
Shichinohe town (Aomori pref.)	□●	●	□	
Kazumaki town (Iwate pref.)	□●		□●	
Kaminoyama city (Yamagata pref.)	□		□●	□●
Tsukuba city(Ibaraki pref.)	□●	●	□●	
Nagoya city(Aichi pref.)			□●	□
Tsuruga city(Fukui pref.)	□●	□●		
Miyazaki pref.	□●		●	□
Okinawa pref.	□●	●	□●	

□:Industries and services mentioned as having priority in the regional WS, from the viewpoint of "regional life style."
●:Industries and services highly evaluated by the experts in science and technology from the viewpoint of having "potential for future evolution(industry)."

have to proceed. The improvement of environmental conditions according to the needs of many citizens requires a continued investment from public resources, and this, in turn, will necessitate the securing of financial resources by such measures as the creation of new industries and services to expand job opportunities, and the enhancement of value added products of the region.

The establishment of new industries and services requires, first of all, self-reliant effort on the part of the enterprising body, and a large-scale investment may be unfeasible for some regions. To construct a society with low environmental load, it is necessary to consider the introduction of a system that allows inter-regional CO_2 cap & trade to secure financial resources, as well as support, through investment and financing, for self-sustaining growth of new industries and services. Along with the continued regional effort to establish a self-reliant social infrastructure, in terms of both energy and food, collaborations between distant regions (for example, Tohoku and Kyushu), as well as between neighboring regions, should be considered proactively in the future. In the course toward the construction of a low carbon society, yet another challenge lies in providing the social foundation that embraces an aging society.

Acknowledgment

I would like to many thanks to attendee of local workshop, the institute for future technology, and my colleague who helped this project. Also many thanks to Prof. Jen-Shih Chang, McMaster University, who gave me useful comments and discussion.

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