Foresight for Our Future Society

– Cooperative project between NISTEP (Japan) and Tekes (Finland)

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Tekes NISTEP

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About Tekes

Tekes, the Finnish Funding Agency for Technology and Innovation, is the main government financing and expert organization for research and technological development in Finland. Tekes finances industrial R&D projects as well as applied research projects in universities and research institutes. Tekes especially promotes innovative, risk-intensive projects.

About NISTEP

NISTEP, the National Institute of Science and Technology Policy, is a research institute affiliated with the Ministry of Education, Culture, Sports, Science and Technology (MEXT) in Japan. NISTEP mission is to lead planning of government S&T policies by implementing S&T policy research with a comprehensive and long-term perspective. It provides research results to the society and supports firms and related organizations in formulating strategy for R&D and innovation management. NISTEP is one of the central institutes with an international network in S&T policy research.

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Foreword

The world has required more benefits from innovation derived from science and technology. Policy planners should seek wider participation in discussions on innovation policy-setting. Foresight activities have become more important as a tool to provide evidence-based discussion in order to compose some visions with the goal of overcoming global problems and aiming at sustainable development.

The National Institute of science and technology policy (NISTEP) has long experience of Delphi-type foresight activities. Recently, it succeeded in contributing to the discussion for the establishment of the 3rd science and technology basic plan (2006–2010) in Japan. On the other hand, the Finnish Funding Agency for Technology and Innovation (Tekes) has successfully selected priority themes for Finland in FinnSight 2015 (together with the Academy of Finland in 2006) and also in the Tekes focus area report *People - Economy - Environment - Priorities for the future* (in 2008), which emphasize the formation of a social vision.

NISTEP and Tekes had carried out collaborative research in 2007 in order to develop more suitable foresight methodologies for future social trend or social needs. The processes in each country were similar, though conducted separately. They shared their various types of experience in a complementary relationship.

In this report, by comparing results between NISTEP and Tekes, it shows some solutions for an aging and safe society, a progressed digital society, and a sustainable society.

NISTEP and Tekes wish to express sincere thanks to the experts who participated in this project for their valuable contribution.

Contents

1 Overview of the collaborative foresight project

1.1 Background and goals

In spring 2007, Tekes (The Finnish Funding Agency for Technology and Innovation) and NISTEP (the National Institute of Science and Technology Policy of Japan) decided to undertake a joint foresight pilot project. The project had several goals. Developing and piloting foresight methodology that combines Delphi survey and a participatory panel process was a key objective. NISTEP's primary goal was to develop and pilot new methodologies for their next national technology foresight survey. Tekes wanted to deepen and widen foresight for some themes already identified in its own strategic focus area process, and this project provided a good platform. For both organizations, this was a pilot foresight project where societal challenges occupied a central role. International cooperation in foresight was important for both parties.

NISTEP has a long tradition in technology foresight. They conducted their 8th technology foresight survey in 2003–2004, and are now planning the 9th. NISTEP has actively developed the foresight process and methods used. On the 8th round, they widened their scope from technology to also include socio-economic analysis. They provided the basic data and materials of the 8th round to the government when it formulated the 3rd Basic Plan (2006–2010) for the promotion of science and technology. NISTEP also conduct research and analysis on trends in science and technology. The science and technology perspective and Delphi surveys form essential parts of NISTEP's approach to foresight.

Tekes has experience of many participatory foresight processes that have been linked to e.g. the Tekes strategy process. Participants include stakeholders such as Finnish companies, research institutes and public organizations that together create a view of the strategic choices for Finland. Tekes is also cooperating in foresight issues with other Finnish innovation policy actors. As an example, Tekes and the Academy of Finland conducted a joint foresight project – FinnSight 2015. Networking both multi- and cross-disciplines and using panel-type discussions are essential features of Tekes's overall approach to foresight.

The process was initiated jointly by Tekes and NISTEP and implemented independently in Finland and Japan. The work process was based on similar principles and methodology in both countries but practical implementation in details varied – and methods were also developed during the project. A common challenge was to create a process based on identified societal challenges and providing concrete policy recommendations for the future. Another challenge was to combine two different approaches used in the foresight process: Delphi survey and panel-based foresight.

One of the main ideas in the project was to take societal challenges as the starting point for foresight. Global megatrends and national challenges identified in other contexts served as background material when the decision on the themes was taken. The decision was based on the discussions between NISTEP and Tekes. Three general areas were identified in the discussions: aging, sustainability and digital society. The challenges are such that broad discussion – not just technology – is needed to meet them. These themes were discussed wider in both organizations, and before initiating the actual foresight process the themes were defined more carefully together. In any case, the final themes varied somewhat between

Finland and Japan. The joint overall themes were designated as follows:

- Theme A: Health Care and Well-being to Prepare for an Aging Society
- Theme B: Consumers, Media and Digital Convergence
- Theme C: Recycling Society for Sustainable Environment

The main purpose of the foresight process was to identify policy actions and innovation needs as well as potentials related to the selected societal themes. In Finland, the process had a practical link to the parallel strategy process in Tekes that aimed to identify future priority areas of its operations. The results of the foresight project supported the selection of focus areas at Tekes. As the project was closely linked to the core objectives of Tekes, the identified needs and potentials were linked to both Finnish society and global business opportunities. In Japan, the project was a more independent pilot that provided a learning platform.

This project included several challenges leading to an experimental and creative foresight process. Societal future challenges, as the starting point is new for both organizations. Combining the Delphi survey with the panel- and workshop-based foresight process was also a new initiative. International, simultaneously and independently conducted collaborative foresight was a new way to try to get some comparative results and deeper understanding of foresight results. Methods developed for the process to facilitate discussion in panel meetings were creative and productive, and supported both future and strategic thinking and reporting of results. These features of the process provided a good learning platform for foresight methodologies.

1.2 Overview of the themes and process implementation

This foresight was carried out as based on a cooperation agreement, signed by the National Institute of Science and Technology Policy (NISTEP) and the Finnish Funding Agency for Technology and Innovation (Tekes). It is a joint research project on science and technology foresight. Japan and Finland have experience with differing approaches to science and technology foresight. It is therefore highly significant that the National Institute of Science and Technology Policy (NISTEP) and the Finnish Funding Agency for Technology and Innovation (Tekes) are collaborating on research on current and future science and technology foresight themes and new methods.

Through discussion, the two organizations set the following three societal themes as targets for joint reseach.

- Theme A: Health Care and Well-being to Prepare for an Aging Society
- Theme B: Consumers, Media and Digital Convergence
- Theme C: Recycling Society for Sustainable Environment

The Japanese side targeted the following contents for discussion: Health and lifestyle in an aged society in Theme A, Media integration and its usage in Theme B, Towards the realization of a recycling society through the recycling, and re-utilization of resources in Theme C, respectively. In Finland, the discussions emphasized the following perspectives: Theme A: Health and well-being in aging society, Theme B: Changing media and ICT in everyday life and Theme C: A society based on energy and material efficiency. The differences in the theme descriptions reflect differences in the Japanese and Finnish societies as well as in their social systems and business organizations. In practice, the panels working on the themes enjoyed significant flexibility in defining the actual topics that were discussed.

This research aimed not only to foresight the future of each theme but also incorporated new effort in studying the methodology by which science, technology and innovation can be guided towards that future. In general, a similar process was adopted in both countries, with greater latitude given in the details of the process in the two countries and for each theme. The process tested in-

cluded meetings of expert panels, scenarios, mini-Delphi survey (online questionnaires), innovation roadmaps and workshops. Personnel in charge at NISTEP and Tekes exchanged information on the progress of the process as appropriate.

1.3 Foresight processes in Japan and Finland

(1) Common processes

The starting point of the foresight project was the implementation of a similar process in both countries. In practice, the details of the processes varied due to different persrpectives, interpretation of the role of different methods within the process as well as the overall emphasis of the project in NISTEP and Tekes. The foresight process implemented in the two countries is illustrated in Figures 1 and 2.

The following process components were used in both Japan and Finland:

- Meetings of expert panels
- Mini-Delphi survey (online questionnaires)
- Scenario creation (In Japan, individual scenario per theme)

In both countries, the expert panels for each theme met four times. Each panel included researchers, company representatives as well as representatives of NGOs with visions for the future and wide perspective of their own sectors and society. The members of the expert panels in both countries are listed at the end of this report in Appendices A-1 for NISTEP and A-2 for Tekes. Tekes invited the chairmen and 10–15 panel members for each panel to participate in the work. NISTEP also executed it in the same manner.

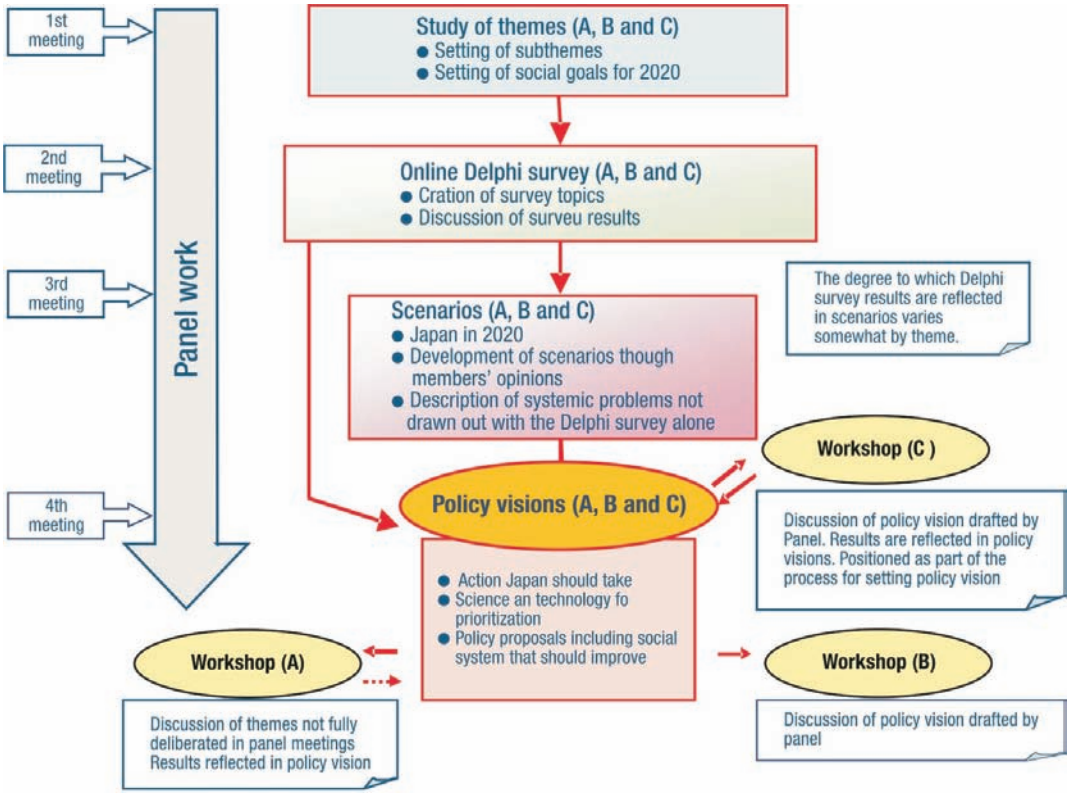


Figure 1. The Japanese foresight process

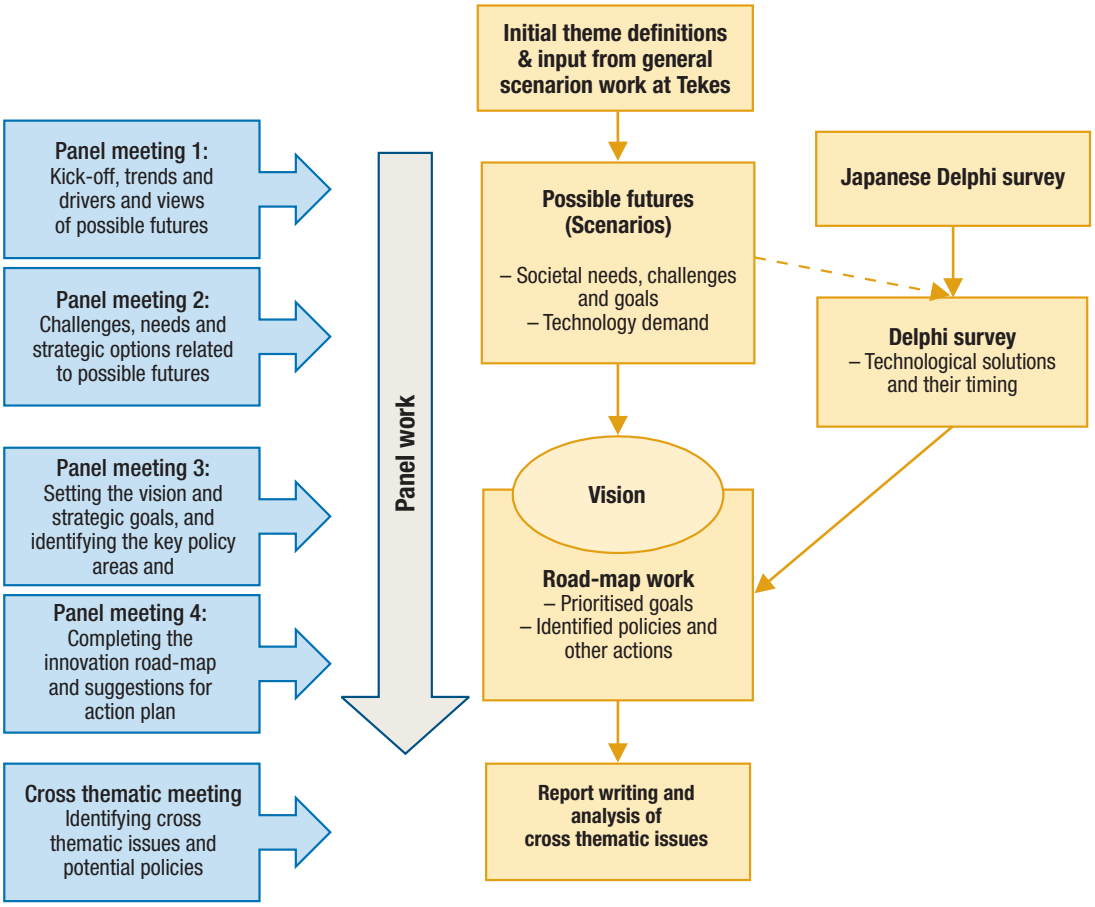


Figure 2. The Finnish foresight process

(2) Differences

On the other hand, the foresight process in Japan and Finland differed in many aspects. The methods were applied in a slightly different way and had a slightly different role in the overall process. The following sub-sections describe the key differences in the process and in the use of methods.

(i) Overall process

The sequence of the process differed in the two countries. The Japanese side intended the final deliverable of the research to be the development of detailed policy visions for S&T policy and aimed for all methods in the survey process to be used to develop such policy visions. If the process is described in a very simplified manner, it tried to identify the technological possibilities and analyse how these could be used in order to solve the societal challenges. On the other hand, in Finland the process started with the analysis of future societal development and identification of the most important societal challenges. The focus was on the societal demand for innovation. Subsequently, there was an attempt in the work to identify potential technological solutions and necessary policies that would be needed to implement the solutions. The Finnish side aimed for policy recommendations primarily for innovation activities, but also for other policy areas. Hence the panel work proceeded methodologically from future scenarios describing various possible futures to overall societal visions and further to roadmaps describing the key content areas and policy recommendations. The Delphi survey was used for supporting the development of roadmaps.

Due to slightly different policy focus, the perspective of the whole process varied to some extent. In Finland, the societal vision and its implications to innovation activities were emphasized as a basis for the policy recommendations, whilst in Japan the technological possibilities and their implications on the S&T policy vision within the selected themes were emphasized more. Despite slight differences in the process, the actual topics discussed during the process were very similar in both countries.

(ii) Foresight target dates

Initially, the year 2020 was agreed as a target year in both countries. The Japanese panels accepted 2020 as the foresight target date for each theme. In the case of Theme C (Recycling), however, 2020 was seen as too soon for major change, so foresighting was carried out for 2020 with an eye on 2035 as well. The Finnish panels set a different date for each theme in their visions, i.e.. 2030 for Theme A (Health), 2020 for Theme B (Media), and 2050 for Theme C (Recycling). However, concrete policy recommendations were set for the near future.

(iii) Delphi survey

Both countries used a mini-Delphi survey in their processes. Due to the pilot nature of the exercise, the survey was implemented in one round only, and it differed from a full-scale Delphi survey. However, the role and timing of the surveys was slightly different in Finland and in Japan.

In Japan, the expert panels developed the Delphi topics during the second panel meetings. The idea was that the Delphi surveys provide a perspective on the potential technological solutions. Hence the Delphi was integral to the creation of scenarios and policy visions.

In Finland, the Delphi survey aimed at providing information on the timing of potential technological solutions that could be used in achieving the societal vision. Hence the perspective was more demand-driven. The statements were developed primarily by Tekes representatives and the process consultant and the 8th Japanese Delphi was used as a starting point. The discussion of the Delphi topics and the results of the Delphi survey did not have an impact on the creation of scenarios or visions. The experiences suggest that both uses of Delphi method are valid, but there are implications on the process of formulating the statements and the timing of the survey in the process. In both cases, panel members must have a key role in defining the statements and there needs to be enough time for discussing the results.

(iv) Roadmaps

The Finnish panels developed societal vision statements and goals during their third panel meetings and developed roadmaps during their fourth and final meetings. The developed roadmaps describe steps that are needed in order to take identified solutions in use. The Finnish roadmaps are quite general – not detailed technology roadmaps – and provide limited guidance for the development of individual technologies. The Japanese side did not create roadmaps but policy recommendations were included in the more detailed policy visions. The Japanese experts on the panels considered that roadmaps should describe the detailed steps for technological development. Hence they hesitated to create roadmaps. The experiences suggest that developing detailed roadmaps is a challenging task in a panel process. One of the key challenges is combining societal and technological perspective.

(v) Scenarios

Both countries used scenarios in the process, but the interpretation as well as timing and role in the process were clearly different. In Finland, several trends and uncertainties describing a potential future society within each theme were identified at the beginning of the process, and then scenarios were developed in each group based on these issues. All the panels had access to common background material describing general societal trends and signals. The scenarios were built at the beginning of the process and they aimed at describing possible developments in the global and national environment, where STI and other policies in the selected themes will possibly be operating in the future. Hence scenarios formed a basis for setting the societal visions and developing roadmaps.

In Japan, one individual scenario was developed for each theme. This scenario described the potential future development path in case the identified key technologies will be realized. In Japan, Expert Panel members first created scenarios individually, and those scenarios then formed the basis for discussion. Hence the scenarios represent a key result of the processes. Due to the different meanings and roles of scenarios, the timing and exact manner of constructing them also varied significantly.

(vi) Vision

The Japanese policy visions included relatively detailed policy-oriented items, such as "Action that Japan should take (roles of industry, government, and academia)," "Science and technology that should be emphasized," and "Social systems that should be improved." It is a kind of group-based scenario. In Finland, the visions were more general societal goal statements, describing the future state of the society within the theme. The recommended policy and other actions were included in the roadmaps.

(vii) Workshops

In Japan, workshops were held on Themes A and B after the fourth meetings of the Expert Panels, in order to include people other than Expert Panel members in the study of the policy visions. Some of the results of study in the Theme A workshop were reflected in that theme's policy vision. For Theme C, the workshop was positioned as part of the policy vision development process and was held after the third panel meeting.

In Finland, no separate workshops were organized. Panel members took part in all the meetings except the cross-thematic meeting, where the panel chairmen and Tekes representatives were present.

(viii) Cross-thematic issues

An interesting and valuable part of the Finnish process was also to look for innovation potential across and between the selected themes. These issues were identified in a joint meeting with panel chairmen and Tekes representatives after the thematic panels had finished their work. Although the work represented only a small role in the overall process, the analysis and results illustrated the potential of cross-thematic discussions.

(ix) Process coordination

As with the actual process, the way of managing and coordinating the processes varied from one country to the other. In Japan, NISTEP personnel played a key role in managing the whole process, coordinating the work between panels and even moderating the panel meetings on a general level. Panel chairmen chaired the panel meetings. NISTEP made the reports with support and comments from the panel chairmen and panel members.

In Finland, Tekes was responsible for the overall management of the process. More detailed process plans were developed in close cooperation with Gaia Consulting Ltd, which served as a process consultant for the project in Finland. Details of the pilot project were planned and discussed in advance and throughout the process together with the process consultants, Tekes and the chairmen. Gaia Consulting Ltd representatives also acted as process facilitators who planned the panel meeting techniques in detail as well as supporting and facilitating the work in the panel meetings. The panel chairmen were responsible for the contents during the meeting and panel chairmen carried the main responsibility of report writing.

2 Comparison of Japanese and Finnish results

As with the foresight processes, similarities and differences between the two countries exist also in the contents of each theme. The similarities and differences in the results for each of the three themes are discussed below. The results for each theme in both countries are described in Appendix.

The themes differed slightly in the overall level and broadness. Recycling as well as health theme are very broad and challenging topics. On the other hand there are clear societal challenges and creating a national vision (goal) in these themes is important for meeting the challenges. As the challenges are broad, they are linked to many other policy areas, in addition to science technology and innovation. With the media theme, it is more difficult to identify the societal challenge. The discussions were also on a slightly different level than with the other themes. In practice, focus on user behavior and needs.

In general, it seems that constructive discussions seem to be easier if the focus is more on possibilities than big challenges. For example the health panel discussions in Finland had clear challenges in this.

2.1 Theme A: Health care and well-being to prepare for an aging society

(1) Differences between Tekes' visions and NISTEP's policy visions

In Finland and Japan, the target dates for foresight as a whole differed, with Finland targeting 2030 and Japan 2020. However, there were no major differences between the visions developed in the two countries.

The Finns listed sustainable health ("health continuum") as a social goal. Initially, the Japanese side had a similar goal, but discussion in the expert panel led to a shift of social goals away from an emphasis on the elderly to the key concepts of "people of all generations in every state of health living in an aging society" and "autonomy and coexistence without force." The Japanese social goals are therefore somewhat broader than the Finnish ones. Although the concept of health continuum covers life as a whole, in Finland the emphasis was more on the pressure that aging society causes on the health care system and the health care of elderly people cause on society.

Furthermore, in order to achieve the goals, the Finns set forth visions to the effect that "social and health care is based on a synergistic approach to improve the quality of life with optimal use of resources" and "continuous development work is introducing niche business concepts internationally." In Finland, the discussions focused to a large extent on the health care system. In this discussion, economic pressure and the need for productivity growth gained a key role. Hence the focus was more on the health care system level discussion, instead of broader societal goals.

The Japanese, meanwhile, developed the following visions for the topics: "Everyone can obtain his/her accurate health information at varioius stages of life and can choose a lifestyle and medical treatment based on that information," "All generations, including the elderly, can easily access information on safety and security in their homes," and "Social business is fostered to make the same high-quality health, medical and nursing services available anywhere, anytime."

As science and technology and systems that will be necessary henceforth, the Finns listed health

food, "senior houses" (with services adapted to user needs), alarm systems that use advanced sensors and ubiquitous sensors (to prevent accidents, illness and falls), robot technology (cleaning, laundry, communication devices, security, etc.), more efficient logistics to deliver everyday products (to support the elderly), high-resolution television systems that can be enjoyed at home, and improved product design (ending resistance to high technology). These include the perspectives of both prevention and improved quality of life. The Japanese results were similar, but one item not mentioned by the Finns is labor (time) banks. Labor banks are a type of community currency. One can "deposit" time spent on care and so on into a labor (time) bank and then "withdraw" it when needed to help care for oneself or one's parents or other relatives.

An overall difference in the visions was that in Finland, a business perspective based on national strengths (IT, natural resources, and care and service models for the elderly) was clearly indicated. In Japan, on the other hand, a comprehensive perspective in which industry, government, academia, and the public fill various roles to realize social systems that raise the national quality of life was evident. Rather than arising from differences in national policies, this difference probably stems from the fact that the aging of society is more advanced in Japan than in Finland. The latter country is foresighting the future, whilst the former is already facing the reality. The emphasis on business perspective is also related to the role of Tekes in the national innovation system.

(2) Differences in scenarios

The Finnish foresight emphasized economics. They studied four scenarios, in which either the economic situation is good and funding is adequate to support health care or the economic situation is poor and only a small wealthy class can obtain services, and in which either individualism or collectivism is prevalent. Different combinations of economic success and societal values create different operational environment for health care.

In Japan, discussion in the expert panel did not include an economic perspective. The panel saw (mild) collectivism as more desirable than individualism because it perceived "autonomy without force," "coexistence among generations," and "self-help and mutual assistance rather than public sector assistance" as necessary.

(3) Differences in the Delphi results

Similar overall topics were constructed in both Japan and Finland, but they differed in their years of realization. Furthermore, comparison of the surveys as a whole finds that (i) dates of realization tend to be later for Finland than for Japan, (ii) the gaps between the dates of technical realization and the dates of social realization tend to be shorter in Japan, and (iii) dates of realization for medical treatment-related topics tend to be late in both countries.

(i) Topics where the Japanese date of realization is later than the Finnish one

Topics with early dates of realization in Finland include public transportation services for "Design guidelines and requirements for public spaces where anyone can move around safely and without barriers (social application in 2012)" and "Health services based on telemedicine services and medical data obtained at home or in the field (social application in 2012)." In Japan, similar Delphi topics have later dates of realization than in Finland: "Barrier-free modes of transportation so as to realize them in an unrestricted, safe, and low-cost manner (technological realization in 2019; social application in 2020)," and "Telemedicine systems that enable people to receive primary care at home (technological realization in 2017; social application in 2018)."

(ii) A topic where the gap between dates of technical realization and social application is shorter in Japan

In Japan, technological realization and social application for "Driving support systems for people who have difficulty driving ordinary cars (both technological realization and social application in 2018)" are expected to occur in the same year, whilst in Finland there is an almost 10-year gap

for the same topic, "A driving assistance system for people who have difficulty in driving or are unable to drive ordinary cars because of age-related problems (technological realization in 2013; social application in 2022)."

(iii) Topics related to medical care

In Finland, the topic with the last date of realization is "Stem cell therapies to replace failing organs (technological realization in 2021; social application in 2030)," whilst in Japan the last topic is "Technology for regenerating cognitive functions (technological realization in 2024; social application in 2026)."

2.2 Theme B: Consumers, media and digital convergence

(1) Differences in the overall process and themes

Both organizations divided this theme into subthemes. The subthemes of the Finnish side were "User-centered media", "Print 2.0" (combining electronic and printed media), "Mobile Internet and "Open media platforms". These represent solutions or areas where Finnish skills and competences could provide competitive innovations in the global context. In the Delphi survey, the statements were divided into various subthemes. The themes of the Japanese side were "Business perspective", "Social media perspective", "Network infrastructure perspective", and "Regulations and systems perspective". As a result, there is a slight difference in coverage. The Finns divided the Delphi topics into subthemes for convenience, but the Japanese used the subthemes as a device of their own discussions. This is a significant difference in operation, and then in methodology. The Finns utilized the Delphi survey as a tool of developing a roadmap, but the Japanese utilized the discussion of Delphi topics as a tool of setting the scenarios and visions.

Through their scenario work, the Finnish side described three types of foresight scenarios based on changes in everyday life and user behavior. Their keywords were "Better everyday media," "Web 5.0," and "Human 2.0." These scenarios were used as starting points in the process and the subthemes were identified only after the scenarios were built. In contrast, the Japanese side discussed foresight scenarios and policy proposals in accordance with the subthemes.

The Finns developed visions and goals at the third meeting of thier expert panel, and developed roadmaps toword 2020 at the final meeting. In Japan, it was revealed in the third meeting that the Delphi survey results and the opinions of the panel members did not agree on the dates of technological realization and of social application. For this reason, the development of the roadmap was unsuccessful in Japan. But this discussion was very helpful for members to clarify visions and goals, because they noticed the substantial meaning of the information and communication technology.

(2) Differences in Delphi results

Finnish Delphi survey showed that three specific topics would take at least 10 years from the technological realization to the social application. These were noted as cases of "slow social application". This was a significant difference from trends in the Japanese survey, where the social application would come quickly after the technological realization, or even before it. In addition, the Finnish Delphi survey results and the opinions of the expert panel did not agree about research and development levels. The result may depend on whether Nokia is taken as a media company or not. On the Japanese side, opinions differed on dates of technological realization, leading to deep discussion on the phenomenon that the social application comes first. An interesting commonality was that when the Delphi survey results and the opinions of the expert panels differed in this way, deep discussion took place, even if it did not reach a conclusion.

(3) Common features of the policy visions and proposals

In Finland, there was discussion of "Who and what are media for," whilst in Japan, an almost identical discussion concerned "Information and media are not aims themselves but the means".

Naturally, these essential discussions lead the policy visions to be quite similar to each other. The Finnish vision – "Finland is a proactive and daring flagship of the changing media environment for learning, well-being, and entertainment" – was closely matched by the Japanese vision: "We should use the information communication technology and media to create new culture, enhance the quality of our lives, and solve various problems such as the environment, energy-saving, health care, and so on".

The Finns use the word "entertainment", having recognized the fact that most of Europe's game development companies are located in Nordic countries, as well as the global competitiveness of Japan's game sector. The Finns' statement – "Japanese popular culture has been becoming more and more visible globally in the recent years, especially through manga, anime, films and computer games" – may be followed by the Japanese statement "The ability to generate creative contents such as manga and games should be directed towards the creation of new culture and the building of better lifestyles".

Furthermore, the existence of Nokia is relevant for the Finnish side. This was one of the main drivers behind the selection of mobile Internet as a subtheme in the Finnish panel. Nokia's strategic goal of transforming from a cellular network and phone company into a mobile Internet business company is expected to create possibilities for other companies in Finland. It is seen that public policy should support the development of smaller companies so that they can benefit from the new possibilities that Nokia's strong position in the Finnish business environment creates.

Both countries share the view of a significant role of business-driven development and private capital in technology and media business development. Government involvement involvement is primarily linked to enabling factors like standardization, IPR questions and, in particular, education and research. The Finns propose e.g. "We need multi-disciplinary education, especially in the humanistic and societal areas". This is similar to the Japanese statement "A fixed percentage of funding should go towards social science research".

2.3 Theme C: Recycling society for sustainable environment

(1) Characteristics of the process and the results

How the theme was addressed

The recycling theme had a slightly different intial focus in Finland compared to Japan. In Finland, the theme definition was reformulated as a society based on energy and material efficiency. This reflects the societal objective rather than one way of achieving a sustainable society. This difference in the intial focus has only a slight impact on the actual themes discussed – eventually very similar perspectives were covered in both countries. This also reflects the fact that the societal challenges within this theme are rather clear and the key questions concern what the actual solutions on different levels and contexts are.

Based on the theme of energy and materials efficiency, Tekes paid attention to the details of resources in narrowing down to an emphasis on economic use. Within this framework, it grappled with reducing environmental impact and using resources effectively. The Finnish subthemes were defined on the basis of the selected vision and represent themes where new strategies and actions are needed. These were primarily linked to key areas in the society that affect the use of energy and materials. The selected subthemes were: 1. Spatial planning, housing and transport, 2. Energy and material efficiency of industrial production, 3. Energy production – CO2 and small scale production, 4. Sustainable use of resources and materials, and 5. Environmental competences and environmental management skills.

NISTEP addressed the theme broadly, with subthemes of "1. Cleaning the atmosphere and reducing greenhouse gas emissions," "2. Production and efficient use of energy," "3. Reuse of resources," and "Utilization of water."

The selection of subthemes also reflect the national contexts. Although the question of water resources was raised in the Finnish discussions, the panel did raise it as a subtheme. It was identi-

fied as an important issue, but it is not essential in the Finnish context. The subthemes within this theme also reflect the difference in the overall perspective where Tekes discussions emphasized the societal challenges as demand factors for innovations and the NISTEP side approached the issues more from the perspective of the technological possibilities.

However, both countries shared many views. The expert panels discussed, from national and global perspectives, policies on energy shortages and sustainable resource consumption with climate change as the key driver. They emphasized recycling and reuse in industries such as heavy metals. Its perspective included changes in transportation and logistics services, a shift to energy-saving buildings, and the reduction of CO_2 emissions in the food industry.

Panel composition and survey methods

Like NISTEP, Tekes gathered a wide array of experts from industry, academia, and government for its panel. Previous surveys and reports were not explicitly used in the process; the survey relied solely on the experience and expertise of the panel members. Hence, knowledge from previous studies was brought to the process by the panel members. This choice partially reflects the pilot nature and limited resources of the exercise. Discussion in Japan welcomed not just experts, but also responsible parties from the hotel that provided services.

Visions and the roadmap

After the Finnish panel developed different future scenarios, they created visions for 2050. It discussed policies based on Finland's location from the perspective of efficiency in energy and product materials and related services. Unlike the concrete Japanese policy visions related to each subtheme, Tekes' vision for energy and materials efficiency is comprehensive and general. It does not include concrete policies. Concrete policy actions are part of the roadmap, which was based on the subthemes mentioned above.

(2) Common features of the results

In order to realize central solutions during the roadmap study process, Tekes examined research and education, criteria for assessing energy and materials efficiency, environmental protection mechanisms, and technology policies for energy and materials. Global environmental changes and global competition to protect energy and other resources drove its discussions.

In the expert panel in Japan, examination of the ideal of a recycling-oriented society that reuses resource took place. This "ideal society" is similar to "central solutions" reflected in the subthemes on Tekes' side.

Tekes emphasizes education related to protecting the environment. This is similar to the Japanese side's policy vision of "A platform for human resources education must be created globally through collaboration among industry, universities and the government", and "a framework to support the effective utilization of energy resources by private consumers in order to realize a low carbon society."

3 Methdological reflections and conclusions

3.1 Methodological reflections

From a methodological point of view the joint foresight process between Tekes and NISTEP can be seen as a pilot foresight combining Delphi survey with expert panel process and other foresight methods. Combining these methods was new in both countries. At Tekes, the earlier experiences of Delphi method were limited, and on the NISTEP side, the participatory panel process was the key learning objective.

The experience shows that combining panels and Delphi surveys can be beneficial. It enables combining the views on technological development that are provided by a large group of experts in a Delphi survey with a more in-depth discussions and conclusions provided by a panel process. On the other hand, the experiences suggest that these parts need to be closely integrated. In practice this means that Delphi topics and statements should be formulated on the basis of the views of the panel, and the results need to be discussed on a detailed level in the panel. This seems to be a prerequisite for integrating the Delphi results in the panel work.

The processes were independently implemented in both countries and there were some key differences in the overall process and the way individual methods were used. These differences were discussed in Chapter 1. The key difference in the process was that Finnish panels approached the themes more from the societal challenges' point of view, whilst the Japanese panels had technological possibilities as the main angle. Despite this difference, the actual discussions raised very similar aspects, and the processes show that solving societal issues can be approached from both perspectives with very similar conclusions as a result.

When we considered the key lessons from the process, we can conclude that the process produced valuable results in short time with limited resources. The nature of the pilot is reflected in the process as methodologies were partly developed during the process. The working process would also have benefitted from more systematic analysis and summaries of earlier literature and other "back office" support. The exercise was a positive experience for the panel members.

When we consider potential explanations for differences in the approaches and in the use of methods, the roles of the organizations in the national innovation systems provide some potential explanations. NISTEP is a research institute affiliated with MEXT (Ministry of Education, Culture, Sports, Science and Technology), which is planning and designing the basic policies to promote science and technology as one of the missions. NISTEP plays a role in supporting the establishment of science and technology policy in MEXT or CSTP (Council for Science and Technology Policy) of Cabinet Office. Hence, NISTEP consider science and technology, not so much business. On the other hand, Tekes is primarily a funding agency, supporting company R&D and applied research in universities and research organizations. This explains, to a large extent, the stronger emphasis on business potential in the Finnish panels.

Furthermore, the pilot had a variant role, depending on the organization. In Finland, the foresight exercise was closely linked to the parallel Tekes focus area strategy process. The discussions had a direct link to the strategy work through the Tekes representatives on each panel. This made the discussions goal-oriented and directed the way results were presented. On the other hand, in Japan this was primarily an independent pilot that

aimed at methodological development in order to produce new foresight related to R&D processes, relationship between science and technology and society as well as adapting technology to societal and economic needs. This will be used as an input in planning the 9th national foresight. For both, the role of societal challenges was strengthened in foresight.

The above issues also exerted an impact on the requirements for objectivity and reporting the results. With Tekes, the foresight did not have official status in the strategy process. Hence the panels were independent and the visions and recommendations were not expected to represent the official views of Tekes. This gave the panels the freedom to think "out of the box". Furthermore, the person level link to the strategy process made it possible to take the results and the discussions in the panels directly into account. The link to Tekes strategy process also defined the format of some of the key illustrations that were used in reporting. Hence, the link from foresight to implementation was very direct in the case of Tekes. The foresight, strategic choices and implementation all take place in the same organization, and to some extent even the same people are involved in all these activities as well as in the foresight exercise.

The overall differences in the STI (science, technology, innovation) policymaking may also explain the differences in the processes to some extent. In Finland, competitive funding plays a key role. This has created a situation where policymakers make rather general level priorizations. There is e.g. no central plan that would direct the funding decisions. Tekes is, to a large extent, responsible for priorization of its own R&D funding, and even on the Tekes level the priorities set are rather general. The actual technological choices are, to a large extent, made in individual funding decisions and projects based on the proposals from companies and researchers. This is based on the view that public policy is an enabling factor rather than something that directs the development. In Japan, CSTP serves as the headquarters for the promotion of ST policy, and it overlooks all of the nation's science and technology. The relevant ministries and agencies try to promote individual R&D-related to science and technology in the fields under their jurisdiction by CSTP's indication. This creates a much more demanding environment for the priorization decisions. CSTP have frequently requested NISTEP to provide basic data and materials related to science and technology for 5 year. Hence, NISTEP's acitivities is going to be connected with the planning process of central level science and technology policy.

The experience and tradition related to foresight also explain some of the methodological differences. NISTEP has a long tradition in Delphi methodology and detailed technology foresight and much less experience withincorporation of social aspects into foresight. Tekes has tradition in interactive participatory processes with many stakeholders, but little experience with Delphi. This explains partly the more limited role of Delphi in the Finnish panel work and the central role of Deplhi in the Japanese process. This underlines the fact that methods and practices are to some extent embedded in the processes and practices of the organization. Hence methods and practices cannot be copied directly. Adopting methods and even using results produced with the same methods requires learning.

3.2 Conclusions on international foresight collaboration

Foresight can be done on various levels, extending from the analysis of basic research to macro societal issues. Foresight projects can also have a very different distance to policymaking and other decision-making. In this project, the two national processes illustrate varied links to strategy/decision-making. A close link to decision-making is often emphasized as a success factor for foresight projects. However, this is very much linked to the questions and objectives of the foresight as well as the mandate of the project. Whilst close connection to decision-making make the use of results easier, there is a need for independence in order to be able to produce new insight.

As the foresight in this case was aimed at providing information for selecting strategic focus areas for funding or piloting a process that should pro-

duce information for making a priorization, this provides a relevant case for discussing the potential for deeper international collaboration. First of all, the parallel national processes show that even in national contexts, providing a priorization is a challenging task for panels. It seems evident that parallel panel processes covering various themes cannot be directly compared. Hence a panel process with many parallel panels cannot produce an overall priorization. It is also evident that defining the themes for the panels already include priorization. The panel themes are already strategic decisions that influence the recommendations that the panels produce. Hence questions is how much power can actually delegate to the panels. In an international foresight setting, these challenges are even more significant. This process suggest that the decision-makers would need to have a close link to the panels and, ideally, even actively participate in the work on a personal level. Still the panels should have relatively large independence. In this kind of expert panel setting with outside experts, civil servants cannot outsource the final decision-making.

Foresight on societal challenges extend from understanding the drivers behind the societal challenges to understanding the science and technology trends potentially related to the theme. There are various issues that need to be understood in order to combine the two extremes and the following list was created in the project in order to illustrate issues that are important in foresight on such societal themes:

- Global megatrends and signals
- Consumer behavior, values, etc.
- Actual societal challenges and issues to be solved
- Technological, process and social innovation, etc., solving challenges and issues
- Science and technology possibilities
- General science and technology trends

These issues are linked to national contexts to varying extent. Hence, the joint international foresight process can add value to a varying extent. In general, one can conclude that issues on both ends of the list – megatrends and signals as well as science and technology trends – are, to a large extent, global and can be addressed in joint international processes. On the other hand, the closer one moves to actual issues to be solved in the national context and the potential innovations solving these issues, the more context-specific the issues are. Hence in these areas, an international context may even prevent fruitful discussions.

In this case, both parallel processes had a strong national perspective. Collaboration took place primarily on the methdological level. On the other hand, both countries approached the issues slightly from different angles. Finnish panels act more from national societal challenges and Japanese panels from technological possibilities that could be relevant in the Japanese context. These dimensions of the project are illustrated in Figure 3.

Within the framework illustrated in Figure 3, we can consider expanding the processes towards an international focus. If the starting point of the process is finding solutions for societal challenges, the immediate question is: whose challenges and whose solutions? In the Tekes–NISTEP pilot, the themes were of common interest, but in both countries, the actual discussions had a clearly national focus. This means that in the Finnish process, the emphasis was eventually on Finnish challenges and the solutions that Finland could provide in each theme. Similarly, the Japanese part focused on Japanese society and potential solutions Japan could produce. Despite common themes and very similar issues in the discussions, the work resulted in various solutions for nation-specific challenges. In an international setting, this is a very challenging setting, as participants need to be familiar with the issues that are discussed.

Comparing results of parallel processes produced with a national focus can naturally add value. A joint process helps here, as it produces results that are comparable during the process. Even more value could be added if one were to proceed on a truly international or global level. This could mean e.g. producing joint solutions for international challenges, creating Finnish solutions for Japanese context or vice versa, etc.

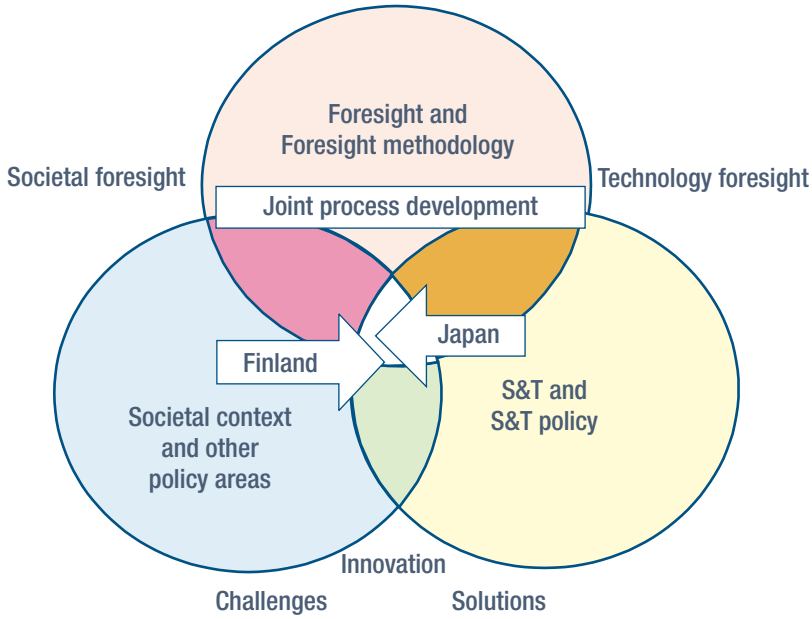


Figure 3. Illustration of the core focus of the joint and national parts of the project in Tekes-NISTEP foresight.

Moving away from the national context naturally creates process challenges. In this respect, a more exact focus thematically could be a solution. Another relevant solution could be implementing only part of the processes together on an international level and the other part nationally. To this purpose, the above list of topics could serve as a starting point.

3.3 Summary and discussion

International foresight collaboration has been limited. This joint foresight project between Finnish Tekes and Japanese NISTEP represents an attempt to learn methodologically and produce comparable results on three themes. The foresight focused on three societal themes and hence is in line with the trend that foresight expands from science and technology to a broader societal view[1].

The results show that key differences in the implemented processes were linked to the national contexts and varying interpretations of the methodologies used. This is in line with earlier results suggesting that the main challenges in foresight are related to the challenges of intergrating foresight with policymaking. In this case, the cooperation was primarily methodological and the processes were implemented independently. Independent implementation led to differences in realization. Due to its independent character, the cooperation benefits of the collaboration were, to a large extent, related to methodological development. Despite clear differences in the implementation, highly similar topics were raised in the discussions. The joint methodological framework therefore provides a good basis for comparing results.

1 See e.g. the results of ForSociety ERA-Net project in report on Methodological Aspects in National Foresight Programmes (D11) and report on New Foresight Training Schemes (D17) available at http://www.eranet-forsociety.net/ForSociety/results/index.html. See also the discussion on potential benefits and barriers in report D17.

Earlier results suggest that the closer to policy-making and implementation the processes are and the wider societal issues are discussed, the more challenges there are in setting up a process. The international dimension adds additional challenges in this respect, and there are many barriers if one tries to implement a joint process.

One of the key issues in setting up an international foresight process is defining the focus and mandate. These key question affect e.g. project funding. Currently, the national processes have differing mandates – and it would have been challenging to implement a joint project within the current settings. The conclusions from this project suggest that the best solution of this kind on societal foresight could be a hybrid process, where some parts are implemented together and some are implemented separately, nationally speaking.

Appendix
Results from panel work and Delphi surveys

The appendix introduces the foresight results of each theme. Japanese and Finnish results are presented separately.

A-1 NISTEP's panel results

The policy visions developed for each theme are shown in Sections (a), (b), and (c). Some results of the Delphi survey are shown in A-2 sections (d), (e), and (f).

Policy Vision for Theme A

1. Overview

(1) Theme name:
Health and Lifestyle in an Aged Society

(2) Social goal

All generations, both healthy persons and those in need of support in their daily lives, are able to live the social and civic lifestyle that they desire, and are able to enjoy the benefits of a safe and stable society without experiencing loneliness.

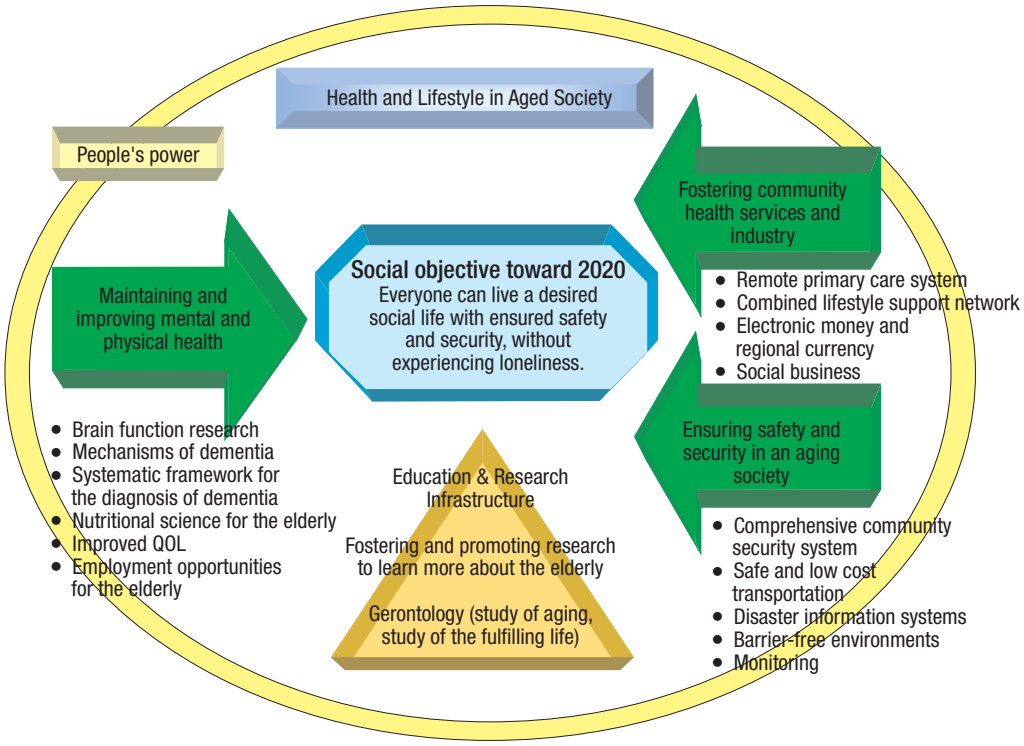
(Catch phrase for Japan 2020)

In 2020, new sciences and technologies to underpin the future Japan and a mechanism for business innovation are in place, helping to reduce anxiety about future life.

(3) Policy Recommendations (Executive Summary)

To improve "Health and Lifestyle in an Aging Society" in Japan in 2020, industry, government and universities need to provide assistance in (A) maintaining and improving mental and physical health, (B) ensuring safety and security in an aging society, and (C) fostering community health services and industry. For (A), prevention of dementia and the promotion of employment for the elderly are important. Efforts by government and universities are needed to establish a research center for the prevention of dementia and to construct a systematic framework for the diagnosis of dementia after middle age. For (B), barrier-free transportation and the construction of community security are important. Efforts by industry, government and universities are needed to construct a comprehensive community security system and to establish research centers to consider technological adaptation for both the elderly and persons with disabilities in order to identify needs and testing/evaluating prototypes. For (C), remote primary care is important. Efforts by industry, government and universities are needed towards the advancement of development in remote diagnostic apparatus and the realization of remote health care systems. Common policies that should be implemented by industry, government and universities in these three areas are to establish graduate schools for the elderly (for the improvement of work skills), the provision of preparatory courses connected with the senior years (for lifestyle advice and other such needs) and ensuring the transmission and sharing of information throughout all generations (to prevent the emergence of 'technologically deprived' persons).

(4) Conceptual illustration



2. Policy vision by subthemes

(1) *Subtheme 1:* Maintaining and improving mental and physical health

(2) Description

Everyone can obtain his/her accurate health information at various stages of life and can choose a lifestyle (including diet/exercise) and medical treatment based on that information in an attempt to maintain mental as well as physical health throughout life. A mutual support system across generations is in place to allow people with mental or physical problems to live a desired life by coping with them. Science, technology and social systems to fulfill these goals are studied.

(3) Recognition of the current situation

In 2020, Japan will face an increased need for elderly care and services, with an increased 'old-old' population (aged 75 or older) and the prospect of resultant significant increase in the number of elderly people with dementia. Since the prevention of brain function deterioration among the elderly should start in middle age, measures to prevent dementia are urgently required. Alternatively, the willingness to work is high among the 'young-old' populace (aged 65–74), as demonstrated by the fact (reported in 2004) that 50% of the males aged 65–69 are employed and that over 40% of those not employed wish to work. This trend is expected to continue, suggesting the need for elderly employment support.

(4) Policy recommendations

(i) Action to be taken by Japan <Sector in charge; industry / universities / government>

- Establishment of graduate schools for the elderly based on gerontology (for improvement of work skills) <univ. / gov.>
- Establishment of a research center for the prevention of dementia <univ. / gov.>
- Construction of a systematic framework for the diagnosis of dementia after middle age <gov.>
- The announcement of guidelines based on future-oriented labor policies <gov.>
- Provision of employment opportunities for the elderly <ind. / gov.>
- Radical review of the seniority system <ind.>

(ii) Science and Technology to be prioritized

- Brain functions research, elucidation of the mechanisms of dementia, and basic research on regeneration of cognitive functions
- Cognitive science
- Cognitive engineering to study the mechanisms of the generation of emotion, awareness and mind.
- Development of devices to measure cognitive functions
- Biomedical engineering research and product development intended to improve QOL
- Life course research, QOL research, research in subjective standards of happiness, and play research
- Gerontology, evaluation of elderly people's skills, ageism, introduction of universal design into the workplace
- Nutritional science for the elderly, development of supplements, diet management manuals, functionally designed vegetables

(iii) Social systems to be reformed

- Enhancement of work-sharing systems for the elderly (e.g. creating teams combining the elderly, people with disabilities and people without disabilities)
- Enhancement of elderly employment systems (application of an affirmative action program)
- Elimination of age discrimination and reform of both the compulsory retirement and pension systems
- Reform of clinical trials legislation
- Improvements in the framework for clinical research (development of a research system based on small combined groups of clinicians and researchers).

(1) *Subtheme 2:* Ensuring safety and security in an aging society

(2) Description

All generations, including the elderly, can easily access information on safety and security at their homes, understand such information and use it in life. A safe and secure society is created where social systems and infrastructure are fully developed to support the lives of the socially vulnerable. Science, technology and social systems to fulfill these goals are studied.

(3) Recognition of the current situation

In 2020, Japan will have an increased number of people vulnerable to disasters, due to the increase in both the proportion of the elderly and the old-old population. However, considering the financial standing of the central and local governments, future measures against disasters are unlikely to be fully financed by the public sector, and it is expected that self-help and mutual-assistance mechanisms will serve as highly effective measures against disasters. Being socially vulnerable, the elderly are more likely to become targets of crime, and measures are therefore needed to protect them. Another concern is that some elderly people may become 'technologically deprived,' as a result of failure to keep up with rapid social changes, such as the introduction of advanced systems.

(4) Policy recommendations

(i) Action to be taken by Japan <Sector in charge; industry / universities / government>

- Construction of comprehensive community security systems <ind. / univ. / gov.>
- Preparatory courses for old age (for lifestyle advice and other needs) and graduate schools for the elderly <ind. / univ. / gov.>
- Implementation of policies to support people vulnerable to disasters and improve people's preparedness for disasters <gov.>
- Disaster information distribution and sharing <ind. / univ. / gov.>
- Financial support for R&D of technologies for the elderly <gov.>
- Promotion of the use of private resources for research (for identifying needs and testing/evaluating prototypes) <ind. / univ. / gov. / people*>

(ii) Science and Technology to be prioritized

- Development of safe vehicles and safe and low cost transportation
- Multidirectional and high-grade TV and audio communication systems
- Development and promotion of disaster information systems (for evacuation guidance and information transmission in disaster situations)
- Science and technology for safe housing structure (disaster resistant housing, seismic diagnosis)
- Risk evaluation, risk management, and research in social vulnerabilities
- Technologies adapted to the needs of the elderly (sensing technologies, monitoring technologies, fall-prevention technologies)
- Technology to utilize lifestyle and health information, security technology, and privacy protection technology
- Technology to create barrier-free environments, aid and assistance technology, and community formation technology
- Technology to share and use information on the elderly

(iii) Social systems to be reformed

- Reform of traffic law
- Adult guardianship system (addition of self-awareness to the criteria to decide impaired judgment)

*<People> refers to private resources, such as citizen groups, that fall outside existing frameworks such as industry, universities and government.

(1) *Subtheme 3:* Fostering community health services and industry

(2) Description

Social business is fostered to make the same high-quality health, medical and nursing services available anywhere, anytime. Health, medical and welfare industries to meet the unique local characteristics and needs are continuously developed. Science, technology and social systems to fulfil these goals are studied.

(3) Recognition of the current situation

There is a wide variety among the elderly aged 65 or older, with some of them in need of nursing care or assistance in everyday life whilst others still contribute to local business. It is essential for future health services to incorporate inter-generational collaboration and mutual assistance among the elderly. However, in rural areas, communities are finding it more difficult to play their roles in many aspects of people's lives, with the elderly accounting for over 50% of the total population and a very small young proportion as a result of aging and depopulation. Since the disparity in health, medical and welfare services available to the elderly is expected to widen between urban and rural areas by 2020, there is an urgent need for a mechanism through which science, technology and industry support local administration.

(4) Policy recommendations

(i) Action to be taken by Japan <Sector in charge; industry / universities / government>

- Construction of a mechanism to nurture primary care doctors (establishment of education and qualification systems) <univ.>
- Advancement of development of remote diagnostic apparatus and realization of remote health care systems <ind. / univ. / gov.>
- Development center for appliances designed for use by the disabled and the elderly <ind. / univ. / gov.>
- Creation of social business (for creating the living environment in which local residents can live in comfort and safety and for comprehensively supporting the construction of health, medical and nursing systems) <ind. / univ. / gov. / people*>
- Standardization of regional currency and promotion of time (labor) banks <gov. / people*>
- Measurement and assessment of regional capabilities (promotion of employment matching) <gov.>

(ii) Science and Technology to be prioritized

- Remote primary care systems (remote operation technology, image processing technology, etc.)
- Public information provision systems
- Combined lifestyle support networks
- Nursing care streamlining systems (scheduling, effect measuring, nursing-related clerical work)
- Human interface technologies
- Electronic money research

(iii) Social systems to be reformed

- Review of medical laws
- Expansion of discretionary powers and roles of nursing staff
- Definition of service evaluation criteria (disclosure of information) and assurance of service continuity

*<People> refers to private resources, such as citizen groups, that fall outside existing frameworks, such as industry, universities and government.

Policy Vision for Theme B

1. Overview

(1) Theme name:
Media integration and its usage

(2) Social goal

People can enjoy good quality media, and keep in good contact with other persons beyond the nation or outside the existing frameworks. They are increasingly interested in culture and quality of life. The roles of individuals becomes important in creating new culture and new lifestyles, and anyone is able to live the life that he or she desires. Information and communication technology is used for the common benefit of all humanity, such as health care and sustainable environment.

(3) Policy Recommendations (Executive Summary)

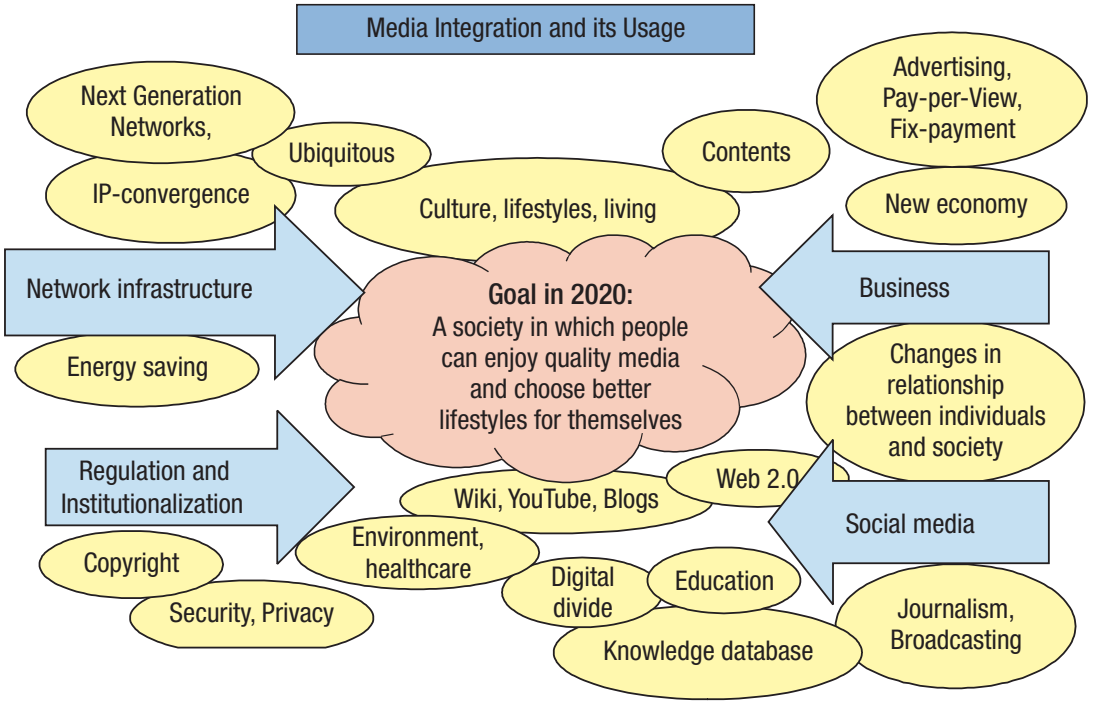
Human resources and capital investment must be properly distributed so that integrated information and communication technologies and user environments can be further developed toward 2020. The government should make a good use of private capital to the short-term development, and assign public funds to the long-term research such as infrastructures and public databases.

The technology ought to be developed based on social acceptance. A fixed percentage of funds should therefore be directed towards the research of social science. Unnecessary regulations and rules should be repealed, but rules that protect individuals are necessary. Regulations should benefit both consumers and enterprising.

Information and communication technology is not just a means of transmitting information, but it should be used for the common benefit of all humanity. It should contribute to solving environmental and health care issues, building a sustainable society, and creating new culture. Using good skills of information and communication technology, Japan has to take the initiative in the

new usage of the technology. The ability to generate creative contents such as manga and games should be directed toward the creation of new culture and the building of better lifestyles. Dissemination of Japanese culture to the world is also important. In content-based business, however, the role of individuals is greater than that of government, and policies should be aware of this.

(4) Conceptual illustration



2. Policy vision by subthemes

(1) Business perspective

The significance of business communication will be deepened by the development of the information networks as social infrastructure beyond their current state. Relationships between individuals and organizations will also change. In addition to the activities (or content) of corporations, relationships with other companies (i.e. context) will become important. Although inefficient and unnecessary movement of peoples may decrease, the importance and depth of face-to-face meetings will increase. Improvements in the technological support with knowledge processing will enhance the significance of high-level decisions made by management executives.

The government should remove the unnecessary regulations, and activate the investment of the private sectors so that the technological evolution may be accelerated.

(2) Social media perspective

The “social media”, that allows interactive communication, will become more interactive by the aid of web-related technologies, and the method of communication services and the contents of in-

formation are altered. The comprehensive management of personal information – even to the extent of assets and liabilities – will become possible, and health care and government services will become more efficient. Concern for the environment will accelerate the trends towards greater efficiency. Because our social lives will become more efficient, people's interest will turn toward the creation of new values, such as new culture.

The processes of producing and distributing media contents will change significantly, which may alter the business model. Three business models – fixed payment, pay-per-view and advertising – will coexist together for a while, but the convergence of media may cause either the choice of one model or the hybridization of three models. The creative contents will be appreciated globally, and its trade value will increase. Individuals will play a greater role in content creation, and awareness of cultural innovation and of environmental issues will grow.

The government should help people to extend their capability to create new culture and lifestyle as well as to solve various problems such as those linked with the environment, saving energy and so on. The investment of the public sector should be distributed to the development of public and knowledge databases.

(3) Network infrastructure perspective

A drastic renewal of network architecture is required because the current architecture comes to a dead end after the technological maturity. The new architecture should withstand the heavy and various usages, and it should keep reliability, security, and privacy in itself. Because a social consensus on such design concepts is vital, the management that repeatedly runs the cycle from R&D to evaluation would be necessary.

From a device perspective, density will continue to increase and cost to decrease in accordance with Moore's Law, over the next 15years. R&D that addresses new protocols, optical switching, wide-band radio waves, and ubiquitous chip will be important. The terminal devices distributing contents are the advanced versions of television, computer, and mobile phones. Device manufacturers, telecommunication companies and content providers will drive the technological evolution. The integration of broadcasting and Internet will advance, and the substantial integration of multiple media will occur.

The investment of the public sectors should be distributed in the long-term research in this field, and the secure network system should be developed under the social consensus. The management system that allows iterative cycles of R&D and social evaluation is also necessary.

(4) Regulations and institutions perspective

The urgent issues of regulations are the copyright, privacy, and security, which should be solved in a few years. Long-term issues over the next decade are not clearly identified at present. In any case, we should avoid the situation where regulations and institutions obstruct technological evolution, but individuals must be safely protected. The regulation should be beneficial to consumers and entrepreneurship alike.

The rapid progress of technology and greater changes in usage environments can cause disparities among both generations and regions. We should take care of the digital divide, because it may be a serious problem particularly in the aging society of today and the future.

The government should remove unnecessary regulations, and must solve not only the current problems concerning copyright, privacy and security but also the future problems that will come to us. For that purpose, the government must allocate a certain sum of money to explore the relationship between technology and social systems.

Policy Vision for Theme C

1. Overview

(1) Theme name:
Towards the realization of a recycling society through the recycling and re-utilization of resources

(2) Social goal

Stable securing and supply of resources, supremely effective use of cycling systems disseminated worldwide, and construction of a sustainable low-carbon society.

(Catch phrase for Japan 2020)

In 2020, to contribute to resolving global environmental problems through the development of technology for effective use of resources and the promotion of Japanese water-related technology.

(3) Policy Recommendations (Executive Summary)

In order to achieve a recycling-oriented society through reuse of resources in Japan in 2020, resource collection through product material data gathered by lifecycle assessment, research and development on energy generation through unused exhaust heat and the development of energy conservation and generation technologies are important. Promotion of the development of soft technologies to apply and promote hard technologies in society through favorable tax policies and so on is necessary. The periodic review of laws and systems together with the allocation and fostering of systems, organizations, and human resources are also important. In addition, precision monitoring and management, the development of technologies to upgrade current functions such as unrepaired or aging equipment and policies to spread Japan's outstanding environmental technologies such as waste disposal and environmental cleanup technologies around the world are vital. In order to address issues that are decreasing the soundness of the water cycle, such as frequent flood damage, water quality, impact on ecosystems and loss of water-related culture, the creation of venues to solve these problems is necessary. In order to build a sound water-cycling society, a balanced approach that considers aspects such as energy, logistics and economics as well as policy, technology and social issues is needed. It is necessary to construct a comprehensive water management system that fully considers management and education concerning culture related to agriculture, fishing and water. These environmental issues should be addressed as problems common to all Japanese people. This will require general dissemination of the perspectives of information disclosure and lifecycle assessment. Industry, academia and government should collaborate on this.

2. Policy vision by subthemes

(1) *Subtheme:* Atmospheric purification, the reduction gas emissions contributing to global warming, the creation of new energy sources and the efficient use and reuse of resources

(2) Social objectives:

Construction of a low-carbon, sustainable society through the stabilized securement of necessary resources and the establishment of a highly efficient cyclical system of reuse.

(3) Policy recommendations

(i) Action to be taken by Japan (Roles of industry / universities / government)

- Establish a tax reduction incentives system for the introduction of systems (e.g. structures, traffic systems, machinery and devices, etc.) that emit only low levels of greenhouse gases, construct a framework for the promotion of the broad social application of innovative energies and cutting-edge environmental technologies (grants and subsidies available for initial system costs), and encourage the interest and willingness to reduce greenhouse gas emissions from industry through to individuals (Government).

- Review all legislation on recycling at regular intervals; implement policies that will strengthen the collaborative partnership between industry, universities and the government and private sectors, such as the provision of support for intensive and effective research and development geared towards the development of measures on systems, organization, deployment of human resources, financial support and the reuse of resources capable of being applied throughout all local governments and municipalities. The need to construct a framework within society that can be controlled by cutting-edge science and technology (Government).
- In the future, a systematic strategy for the application of hardware technologies into general society will be required in addition to the development of such. In consideration of the important contributions to strategy formulation that can be made by software and social technologies, due attention should also be paid to the development of these. Being able to contribute to global issues in the capacity of the world leader in environmental business also represents one of the goals that Japan should be working towards (Industry / universities / government).
- The oligopolization of resource measures has advanced considerably; Japan now needs to implement policies for resources including rare metals that will facilitate change throughout its systems; such as the reuse and recycling of resources, compensatory measures using natural resources, the realization of alternative materials, resource conservation (material) and accumulation (stockpiling, social stock, etc.). A legislative system requiring the clear labeling of products with data on the raw materials used will be pushed forward, and the introduction of a grant system will be considered, with a view to promoting the introduction of designs which can be easily disassembled (Industry / government).
- Reviews of relevant laws and regulations, of systems related to resources, and of educational systems will be implemented; efforts will be made to construct a vibrant social infrastructure through the strengthening of systems to support both education and manufacturing in a manner satisfactory to Japanese citizens. There is a clear need to create a vision for the future of our society that can inspire young people (Industry / universities / government).

(ii) Science and Technology to be prioritized

Hardware side

- Although currently being considered in terms of "self-sufficiency" in Japan at present, energy will, at some point, become synonymous with problems of "supply", when there are no longer any importers. As such, low energy and energy generation technologies will be developed, with a view to achieving a self-sufficiency rate of 50% or more that will allow Japan to become a model case for the rest of the world.
- With regard to local authorities recovering rare and heavy metals from incineration ash and incinerator fly ash, the decision as to whether parts should be initially dismantled or whether the metals should be recovered from the ashes after incineration will be implemented from an LCA perspective; also, there is a need for the development of technology that will reduce the energy consumption of incinerators.

Software Side

- Strong priority placed on the development of software technologies that will advance the social application of technologies (e.g. evaluative and foresighting technologies on greenhouse gas emission levels, checking & management IT technologies for greenhouse gas emission levels, methods for ascertaining social agreement on the introduction of new technologies, etc.)
- Dissemination of easily recyclable design and the development of complete classification technologies undertaken with a view to improving recycling rates of used products as well as at the elemental level.
- There is a need to mobilize diverse technologies, such as biotechnology, crystal control, environmental simulation, marine biology, and remote sensing in order to generate environmentally reusable materials from traditional construction materials.

(iii) Social systems to be reformed

Technological support

- In terms of the reuse of resources, classifications are to be made between reverse recycling, where the properties of metals are completely restored through electrolyzation, cascade reuse, where properties continue to degenerate through reuse, as seen with manufacturing steel, aluminum virgin alloys and plastic, and cascade waste, where resources are used a number of times and then discarded. It is crucial that, classifications thus made, the reuse and recycling of resources is implemented through LCA evaluation, from the perspective of energy used and greenhouse gases emitted.
- Measures have been implemented to abolish small-scale incinerators and integrate large-scale incinerations treatment plants, resulting from the growing lack of landfill sites for incinerated waste and growing concerns about dioxins. The government should, however, push forward with efforts to produce world-leading technology and results in such areas as the recovery of the heat waste generated during incineration.

Business support

- In order to realize a low-carbon society that uses resources effectively, there is a need to facilitate social rationality (the formation of social consensus) that will bring about reforms in our social systems. This, together with action taken to form markets related to energy and environmental systems, should be proactively supported by the government, which should also create support systems to reduce the cost burdens of these social systems.
- In order to realize a 'greenhouse gas-free' society, environmental business needs to firmly establish itself. There is a need to nurture and support the establishment of environmental businesses such as labeling businesses, and third-party performance verification businesses.

Information disclosure

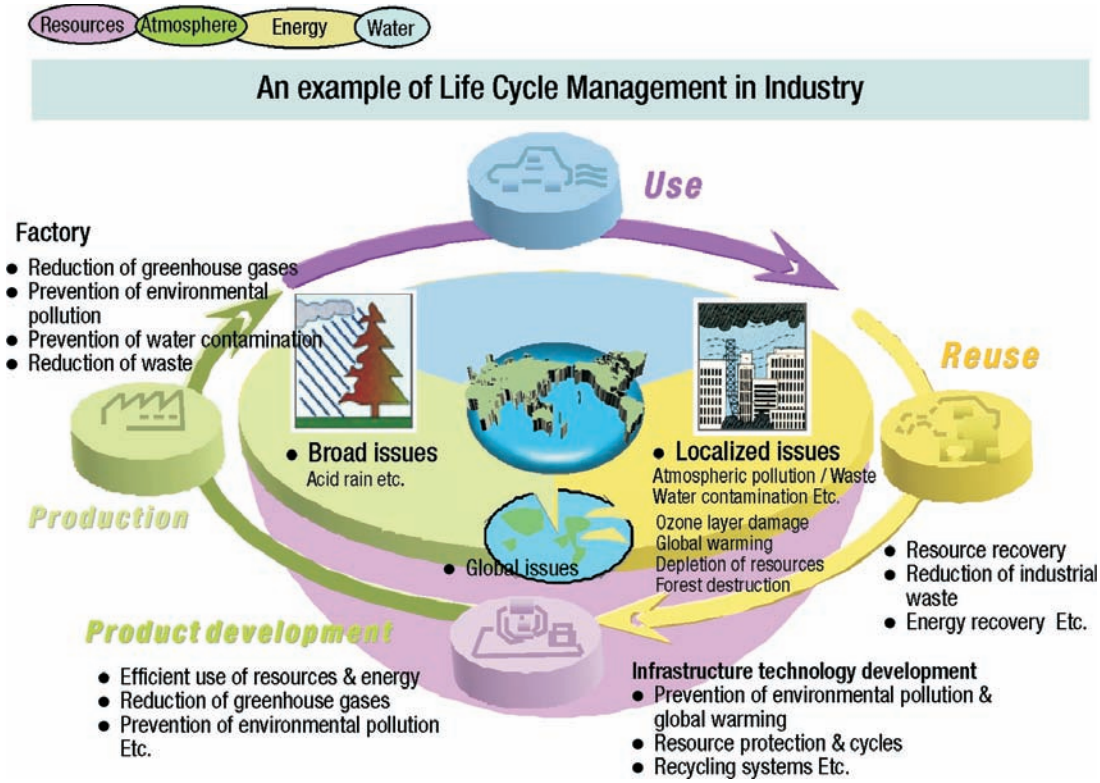
- Having established actual figures on the amount of greenhouse gases being produced annually by each person and each household, by creating systems to create awareness of this information throughout the population and providing data useful in benchmarking exercises, information closely related to environmental problems can be disclosed and shared with the population.
- When classifying waste into general or industrial, local authorities cannot have recovery systems for resources such as rare metals. From the perspective of international competitiveness, no recovery systems other than smelting currently exist. There is to be a review of the material treated by local authorities, based on the premise that material data can be organized.
- Information is to be proactively communicated in order that Japanese recycling technologies for the bottom ash generated during incineration can be applied to waste material incineration plants throughout the world.

Education

- An academic environment with regard to the reuse of recourses through recycling and environmental problems is in the process of being created. Education based on a platform for human resources must be created globally through collaboration between industry, universities and the government as well as private sectors.
- With regard to the materials used within the consumable goods used by consumers, educational campaigns are to be carried out about materials that will allow consumers to "see with their own eyes and touch with their own hands", thus improving the levels of knowledge about materials amongst consumers.
- In order to realize a low carbon society, a framework to support the effective utilization of energy resources by private consumers (users), from the perspective of drilling, devices and systems.

(Conceptual illustration)

Contribution to the resolution of global environmental problems, through the development and advancement of technologies that use resources efficiently



(1) *Subtheme:* Sustainable use of water

(2) Social objectives

Securement of water resources and stabilization of supply systems in 2020, establishment of cyclical systems for reuse, securement of safe drinking water

(3) Policy recommendations

(i) Action to be taken by Japan (Roles of industry / universities / government)

- There is a clear need to improve the circumstances surrounding the water cycle. We need to respond to diverse issues related to the damage that has been caused to the soundness of our water systems, such as multiple incidents of damage caused by water, problems with water quality, influence on ecosystems, loss of aquatic culture.
- A platform through which to resolve issues related to water resource conditions in food-exporting countries and levels of food self-sufficiency will be established.
- Bottled water to be reconsidered in terms of the energy used in transportation and the waste treatment of receptacles.
- In order to construct a sound and renewable society, grounded in harmony with ecological cycles, a balanced framework is required. Policy, technological and social issues need to be considered, together with questions of energy, transportation and economics.

(ii) Science and technology to be prioritized

Hardware side

- Promote technical development for cost reduction, including functional improvements and energy, in order to respond to the dilapidation of and inadequacies in social infrastructure facilities – e.g. water intake, storage and supply facilities – as well as with regard to the lack of precise monitoring and appropriate water management throughout the water cycle.
- Promotion of the use of sustainable natural energy, e.g. micro-hydro power generation and securement of energy.
- With a view to the promotion of application-appropriate water reuse, promote the dissemination of energy-saving, low-cost water separating and generating technologies, which apply e.g. high-flux and anti-pollution membranes.
- Promotion of forest land management together with afforestation and environmental restoration technologies.

Software Side

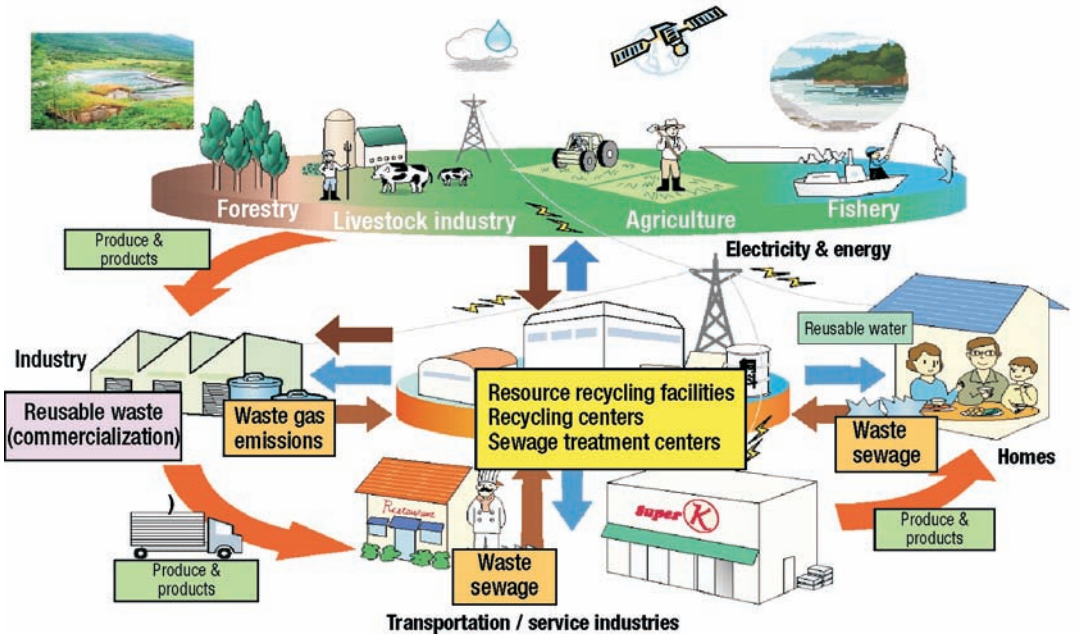
- Human resources training program to be developed and implemented through a partnership between industry, universities and the government in response to the lack of skilled human resources.
- Implement measures to disseminate Japanese technology to the rest of the world for the reuse of industrial wastewater in factories, advanced as a result of regulations on grounding water pumping, water shortages as a result of entering regional markets, standards on wastewater quality and total volume controls.
- Promotion of rainwater use to reduce the burden on normal water services as well as the communication of relevant information to encourage the dissemination of the technologies utilized at large-scale public facilities to each and every household.
- Trade between water supply & purification technologies and resources (including water used in the export of manufactured goods)
- Technologies that can ascertain the current situation both inside and outside Japan and foresee water/energy shortages.
- Systems for the application of appropriate and optimum technologies whilst facilitating functional enhancement.

(iii) Social systems to be reformed

- Containment of water demand through the dissemination of water-saving devices and water reuse (Government).
- Expansion of water supply systems possible through social infrastructure maintenance (Government).
- Sophisticated operation of current water management facilities through highly precise water cycle foresighting (Industry).
- Hydrological and meteorological foresighting through accurate global observation (Universities).
- In order to promote efficient agricultural production, the establishment of reference values for the appropriate use of fertilizers and agricultural chemicals (pesticides) (Industry / universities / government).
- Regulations on bottled water (Industry).
- Systems that can design models tailored to reflect regional particularities (e.g. soil, water supply, agricultural water, mineral composition, etc.) and environmental cycles.
- Systems to comprehensively manage agriculture, fishing industries and aquatic culture (including human resources development).

(Conceptual illustration)

Environmental cleanup advanced through water technologies, contributing to the resolution of global water problems.

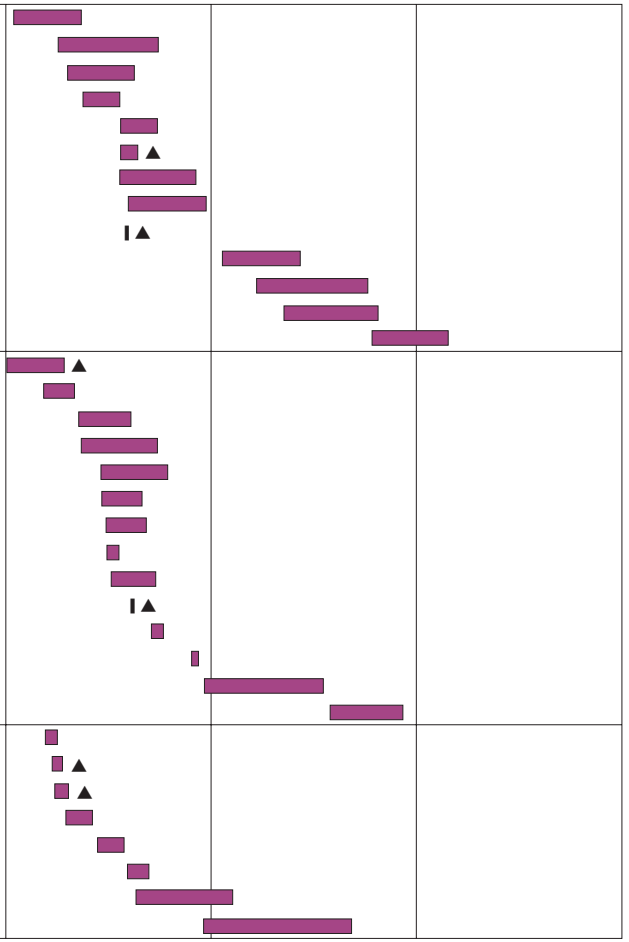


A-2 NISTEP's Delphi results

Theme A

Time of technological realization & Time of social application
(The right side of the bar shows the time of technological realization.)

3	Development of health promoting programs and methods for measuring the programs	(A) Maintinance of Health (mental & physical)
6	Labor support technology aimed at creating an environment where people with elderly	
10	Preventive technology for eradicating hospital-acquired infections	
1	Food and diets aimed at preventing the decline in antioxidant, brain functions	
2	Functional food suitable for individuals' constitutions and tastes can prevent diseases	
8	Systems for providing information on resources and programs available on life stages	
11	Noninvasive bioinstrumentation methods for understanding the behavior of elderly	
4	Simple testing systems for checking degree of suitability meal ingredients	
7	Indexes and indexing systems for conducting relative evaluations of individuals' QOL	
5	Systems for preventing cerebrovascular dementia by controlling brain functions	
12	Vita function support systems, such as health check monitors and pacemakers	
9	Technology for ascertaining the intentions of people who, due to illness	
13	Technology for regenerating cognitive functions	
16	Development of personnel can respond to various inquiries and requests from patients	(B) Security for Aged Society
15	Systems for storing on one card all medical information pertaining to an individual	
19	Indexes and indexing systems necessary for creating local communities	
25	Community security systems supported by cooperation among the parties	
21	Residential buildings designed with consideration given to the prevention of disaster	
23	Monitoring system for facilitating inter-party collaboration in regards to elderly people	
27	Technology for preventing the accidents of elderly people caused by slipping, falling	
22	Local infrastructure aimed at enabling elderly people to easily acquire risk information	
18	Advanced traveling / walking support devices and systems	
17	Driving support systems for people who have difficulty driving ordinary cars	
26	Real-time sensing network wherein elderly people and people with disabilities can act	
24	Barrier-free modes of transportation so as to realize unrestricted, safe and low-cost	
20	Residential buildings equipped with robots and devices aimed at helping elderly	
14	Memory security [backup] systems for the purpose of presenting information	
30	Systems for setting schedules and sharing information (nursing care)	(C) Regional Health Care Service (industry)
33	Systems aimed at providing information on various public services available to elderly	
28	Development of electronic medical record which can be shared among community	
35	Developer-elderly user networks where elderly users take part in development	
32	Telemedicine systems that enable people to receive primary care at home	
34	Electronic (amount-type) [time-based] complementary currency systems available	
31	Systems aimed at enabling community to independently secure	
29	Home security systems that utilize daily life support robots	



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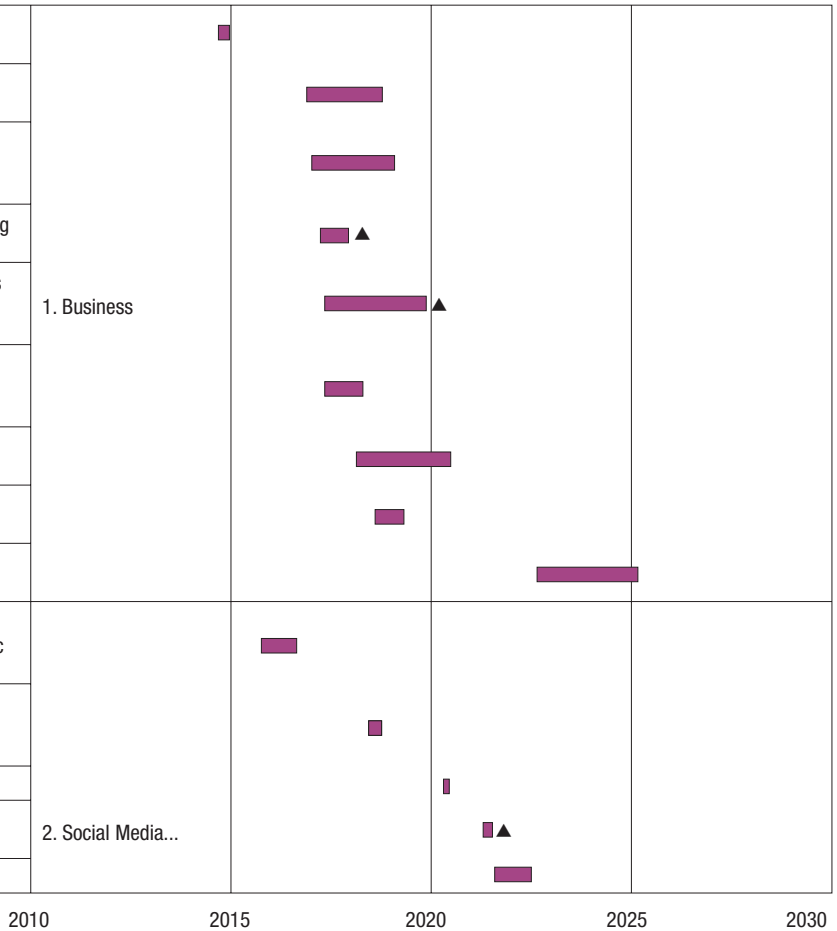
Theme B

Time of technological realization & Time of social application
(The right side of the bar shows the time of technological realization.)

03	Diffusion of electronic tags for increasing efficiency in production and distribution while ensuring traceability of goods for consumers	1. Business
06	Sharing of electronic medical records among all medical institutions in Japan, which will lead to the development of advanced telemedicine technology for health care, telediagnosis and telesurgery	
08	Promotion of flexible and quick organizational activities in a manner whereby small-sized autonomous organizations get together for each project via the Internet beyond the boundaries of companies and then break up when the project terminates	
02	Popularization of electronic secretary systems equipped with information agent functions (e.g. scheduling and database access) as well as speech recognition and fuzzy search functions	
07	Realization of a society where application services for integrated management of several bank accounts or securities accounts in one location are available to everybody regardless of age, or in short, where individuals are more active in asset management	
04	Advanced virtual manufacturing systems and operational systems thereof for supporting the activities in the production process, including designing, development, manufacturing, operation, maintenance, and destruction	
09	Expansion of a company's business process beyond its boundary, by way of collaboration and partnership with customers, suppliers, consumers and other parties concerned	
05	Circulation of electronic money that has the same reliability and anonymity as conventional money and has security functions (personal authentication), at the same volume as the issued Bank of Japan notes	
01	Computerization of about 50% of the services provided by specialists such as legal professionals (judges, lawyers), doctors, and pilots, thereby increasing service efficiency more than double	
13	Secure use of the Internet whereby people can carry out various procedures with administrative offices by way of online personal authentication without needing to prepare official documents, or the electronic voting system	2. Social Media...
14	Contribution of IT to preventing global warming in various aspects, such as reducing unnecessary costs through optimization of distribution and production processes and mitigating traffic jams with the use of ITS	
15	Provision of real-time translation functions for English conversations in all television programs	
16	Systems which store human cognitive knowledge and recognize various objects including buildings, persons, and automobiles from images at an accuracy rate of 90% or more	
17	Multimodal human interfaces whereby various sensate input means can be used cooperatively	

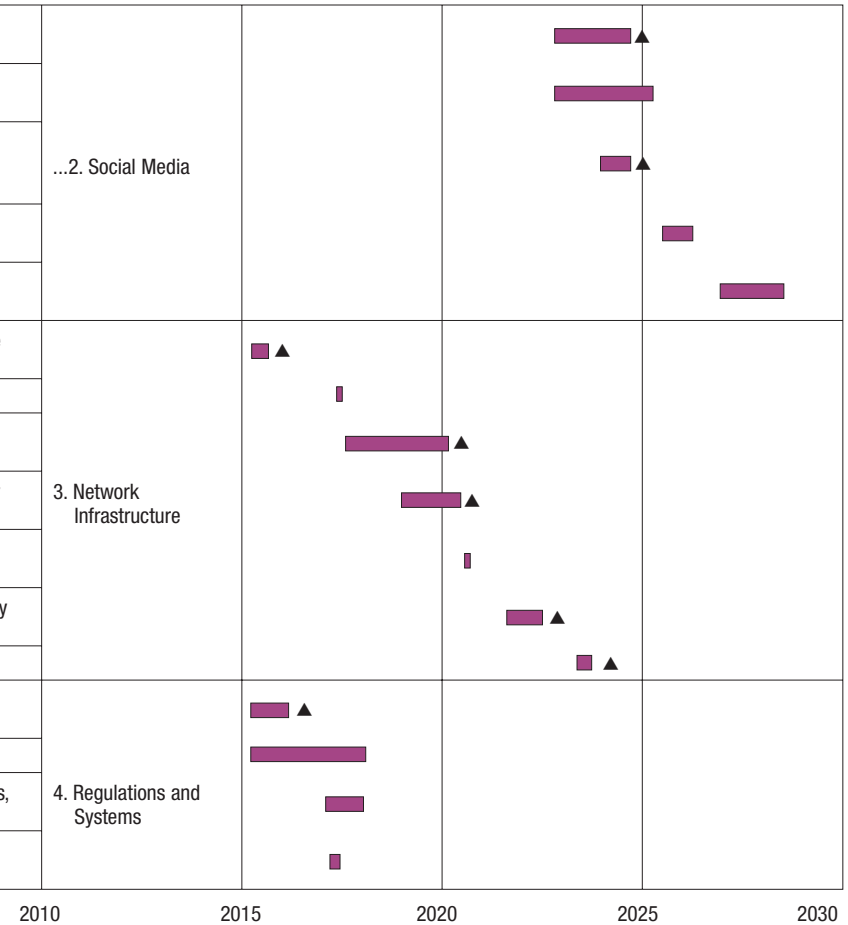


▲ In topic 2, 7, 11, 16, 20, 21, 22, 25, 26 and 29, the right side of the bar shows the time of social application.

... Theme B

Time of technological realization & Time of social application
(The right side of the bar shows the time of technological realization.)

19	Emotional expression system which can present music and pictures that fit a person's emotions based on images corresponding to keywords	...2. Social Media
18	Knowledge repository systems which can put necessary information together into a comprehensible story based on fragmentary facts and data	
11	Implementation of a lifelog project which is aimed to record every activity of one person by sound and image, and establishment of knowledge repository systems which can pull up necessary information in an instant	
12	Development of an artificial agent that can almost completely predict a person's activity and perform it on his/her behalf on the Internet	
10	Practical application of interfaces directly connected with the nervous system, not via the five senses, thereby directly exchanging information with the brain	
26	Network systems which can completely trace and identify persons who have sent spam mails and the addresses from which such mails have been sent	3. Network Infrastructure
23	Portable electronic displays that are so flexible, i.e. thin and soft, as to be an alternative to newspaper	
21	Central management of the operational procedures for various information devices so as to enable everybody at home or at their workplace to use such devices smoothly	
20	Network infrastructure which can automatically provide telecommunication functions that meet quality requirements at a fair price	
24	Three-dimensional television systems whereby people can see images from various perspectives naturally without visual aid	
22	Development of high-performance computers whose power consumption per throughput is reduced by about three digits, thereby providing PetaFLOPS-level computing power for individual computer users	
25	Display devices that can project images directly on the retina	
29	Systems for automatically checking the data of content harmful to young people that is available on the Internet	4. Regulations and Systems
28	Technology for automatically extracting meta data of visual and audio content	
30	High-resolution motion image distribution systems for searching and distribution of television programs, movies and music works that have been produced over the past several years to decades	
27	Establishment of copyright management systems that are reasonable for both users and copyrights, so as to encourage the creation and distribution of content	

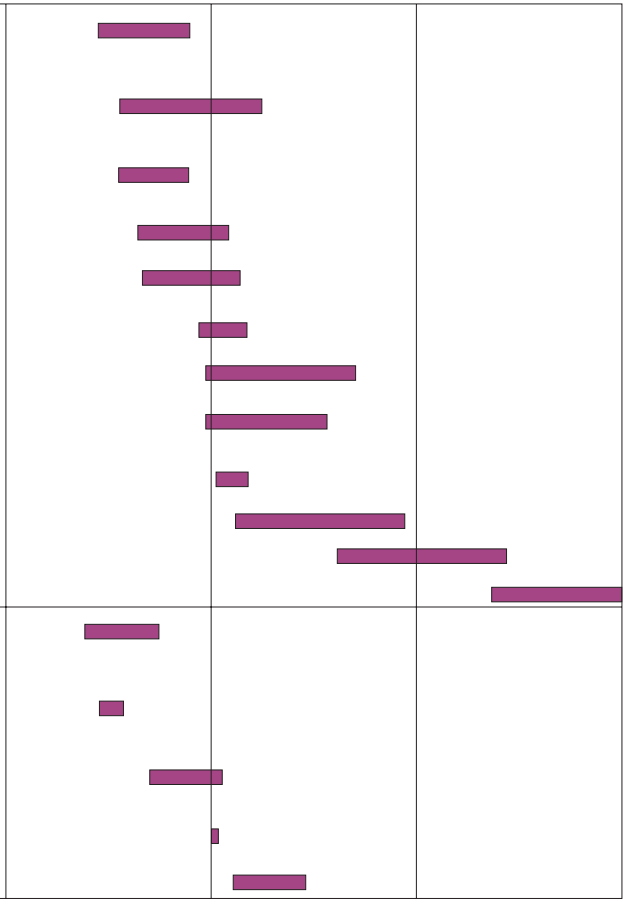


▲ In topic 2, 7, 11, 16, 20, 21, 22, 25, 26 and 29, the right side of the bar shows the time of social application.

Theme C

Time of technological realization & Time of social application
(The right side of the bar shows the time of technological realization.)

10	Power generation system using sunlight and wind power that compensates the output fluctuation at the time of system coordination	1. Energy
9	Miniaturization and performance enhancement technology using high-efficiency heat storage materials or micro compressors, and high-efficiency heat pump system using GHG-free freezing technology	
3	Technology for utilizing low-temperature waste heat to be installed to all incinerators, thermoelectric conversion technology	
12	Production of fuels and industrial materials from biomass waste materials such as woodchips at a cost similar to the use of crude oil	
2	Power generation with fossil fuels with energy efficiency generally reaching theoretical figures	
11	System wherein energy using natural sources can be accumulated so as to ensure stable supply	
1	CO_2 separation, storage and fixation technology	
8	Ultra-energy-saving technology by way of load control for entire buildings or high efficiency equipment (reduction by 50% compared to FY2000)	
6	Power generation by oceanic thermal energy conversion and tidal power generation technology, and system for distribution thereof	
5	Technology for extracting and utilizing methane hydrate	
7	FBR (fast breeder reactor) system including nuclear fuel cycle	
4	Power generation system using cosmic elements	
16	Information disclosure system for flow of materials through preparation of materials (material flow) database by different components	2. Resources
13	Technology for the effective recovery of metal from molten fly ash, technology to reduce heavy metals contained in incinerated ash, and technology to utilize slag by way of establishing a system for the recovery of products containing rare metals	
15	Design and construction technology for buildings that takes into consideration the ease of dismantling, recycling and reuse	
14	Design, production, recovery and reuse system wherein manufacturers' liability for products is stipulated and the materials used are almost 100% recycled	
17	Biotechnology enabling short-term pollutant treatment	



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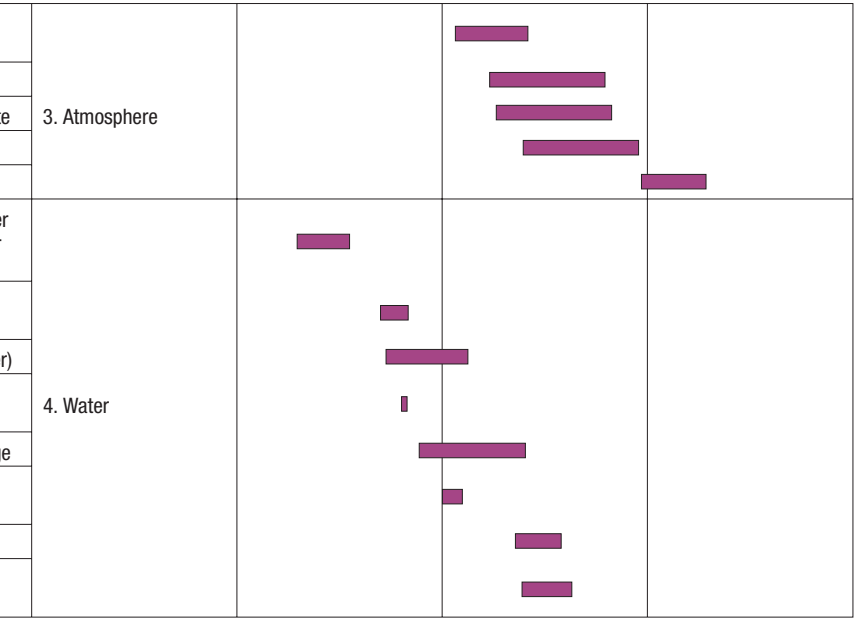
... Theme C

Time of technological realization & Time of social application
(The right side of the bar shows the time of technological realization.)

21	Social system wherein consensus on environmental and energy issues is reached by way of risk communication techniques	3. Atmosphere
22	Technology for clean production and use of coal and crude oil	
18	Technology for ultra-safe management and treatment of nuclear energy and radioactive waste	
20	Automobile that does not emit any air-polluting gas	
19	Social system using carbon-free hydrogen and electric energy	
26	System that displays real-time images of water sources and effluent streams whenever water taps are turned on in people's households, enabling the users to check the state of the water source	4. Water
23	Measurement management system for safety and microbial activity by way of methods such as bioassays and microarrays	
28	Water reuse system in widespread use nationwide (sewage, industrial drainage and rainwater)	
27	Technology for energy-efficient and low-cost water separation and purification to which high-flux and contamination-resistant membranes are applied	
25	System developed throughout the nation to reduce the amount of and effectively utilize sludge	
24	Water utilization system to control water for agricultural use and provide groundwater that is drinkable without treatment	
30	Technology for unmanned greening/nature restoration using sensing technologies and robots	
29	Water resource management system using Earth observation/weather modification and control systems	



About the questionnaire

Survey dates: November 19–26, 2007

Targets: 1,879 expert consultants of the National Institute of Science and Technology Policy's Science and Technology Foresight Center

Number of respondents: 485 (Theme A: 199, Theme B: 123, Theme C: 163; response rate: 25.8%)

Method: Online questionnaire answered by respondents over the Internet

A-3 Panel members (Japan)

Theme A

Name	Title/affiliation (as of October 2007)
(Chair) Kiyomasa Sugii	Director, IS Laboratory, Secom Co., Ltd.
Hiroko Akiyama	Professor, Program of Gerontological Research, Organization for Interdisciplinary Research Project, The University of Tokyo
Shuichi Obuchi	Leader, Department for Prevention of Dependence on Long-term Care, Tokyo Metropolitan Institute of Gerontology
Tohru Kishi	Former Vice President, National Research Institute of Police Science
Yoichi Tao	Visiting Professor, Center for Continuing Professional Development, Kogakuin University; Advisor, Secom Co., Ltd.
Shinichiro Takasugi	Assistant Professor, Department of Rehabilitation Medicine, Kyushu University Hospital
Kazumi Takano	Professor, Faculty of Social Welfare, Nagano University
Yukihisa Namiki	Vice President, Feel Fine Corp.
Yumiko Nara	Associate Professor, The Open University of Japan
Hiroyuki Fujiwara	Senior Researcher, Disaster Prevention System Research Center, National Research Institute for Earth Science and Disaster Prevention
Hiroyuki Matsuura	Director, Department of Gerontechnology, National Institute for Longevity Sciences
Shuichiro Yamamoto	Senior Executive Manager, Research Institute for System Science, NTT Data Corp.

Theme B

Name	Title/affiliation (as of October 2007)
(Chair) Yasunori Baba	Professor, Research Center for Advanced Science and Technology, University of Tokyo
Ryo Imura	Executive Managing Director, Security and Traceability Division, Hitachi, Ltd.
Kazunori Ozaki	President, Nikko antfactory K.K.
Mariko Kishi	Professor, Faculty of Business Administration, Hosei University
Naohiro Shichijo	Associate Professor, Interfaculty Initiative in Information Studies, Graduate School of Interdisciplinary Information Studies, University of Tokyo
Koichi Suzuki	President, Internet Initiative Japan Inc.
Hideyuki Nakashima	President, Future University-Hakodate
Yuichi Nakamura	Professor, Academic Center for Computing and Media Studies, Kyoto University
Koichiro Hayashi	Vice President, Institute of Information Security
Masaki Hirabaru	New Generation Network Research Center, National Institute of Information and Communications Technology
Takakazu Fujimoto	Director, Spinal Code Inc.
Masayasu Morita	President, hitomedia, inc.
Hiroo Yamagata	Senior Consultant, Consulting Division, Nomura Research Institute

Theme C

Name	Title/affiliation (as of October 2007)
(Chair) Yasunari Matsuno	Associate Professor, Department of Materials Engineering, University of Tokyo
Taikan Oki	Professor, Institute of Industrial Science, The University of Tokyo
Naomichi Mori	System Development Department, Systems Development Control Department, Environmental Systems Division, Hitachi Plant Technologies, Ltd.
Tomoaki Omura	Senior Staff Member, Technology Planning Office, Technology Headquarters, Mitsubishi Heavy Industries, Ltd.
Kenichiro Saito	Deputy General Manager, Research and Development Planning Department, Research and Development Division, Nippon Oil Corp.
Hiroki Hondo	Associate Professor, Graduate School of Environment and Information Sciences, Yokohama National University
Takashi Matsunawa	President, Nikken Sekkei Research Institute
Tadatoshi Kato	General Manager, Recycling Planning Office, CSR and Environment Department, Toyota Motor Corp.
Yuji Sugimoto	Managing Director and General Manager, Solutions Headquarters, NRE-Happiness
Yuko Sakita	Environmental Counselor
Hidekazu Kato	General Manager, Environmental Solutions Office, Dowa Eco-System Co., Ltd.

A-4 Tekes panel results[1]

A) Health in an aging society

Overview

Target

Finnish social and health care is based on a synergistic approach to improving the quality of life with optimal use of resources. The continuous development work is introducing niche business concepts internationally.

Vision for 2030

The vision for 2030 is described in the following statements:

- There are internationally successful niche based businesses which effectively exploit the concept of a health continuum
- The health continuum concept is optimally exploited, providing high added value to society
- The Finnish models for providing care to the aging population have been successfully converted to products and services which are used worldwide
- The selected ways to operate are true win-win solutions to benefit all parties of social and health care

Technological advances are fully exploited in order to reduce the amount of routine work in health and social care. The level of safety and the human touch make Finland an attractive country for people to settle in. People from different countries are coming to spend shorter or longer periods in Finland and enjoy the high quality of services. The production of health is the focus of both private and public organizations. Its unspoilt nature enables Finland to produce health food products, which are exported worldwide.

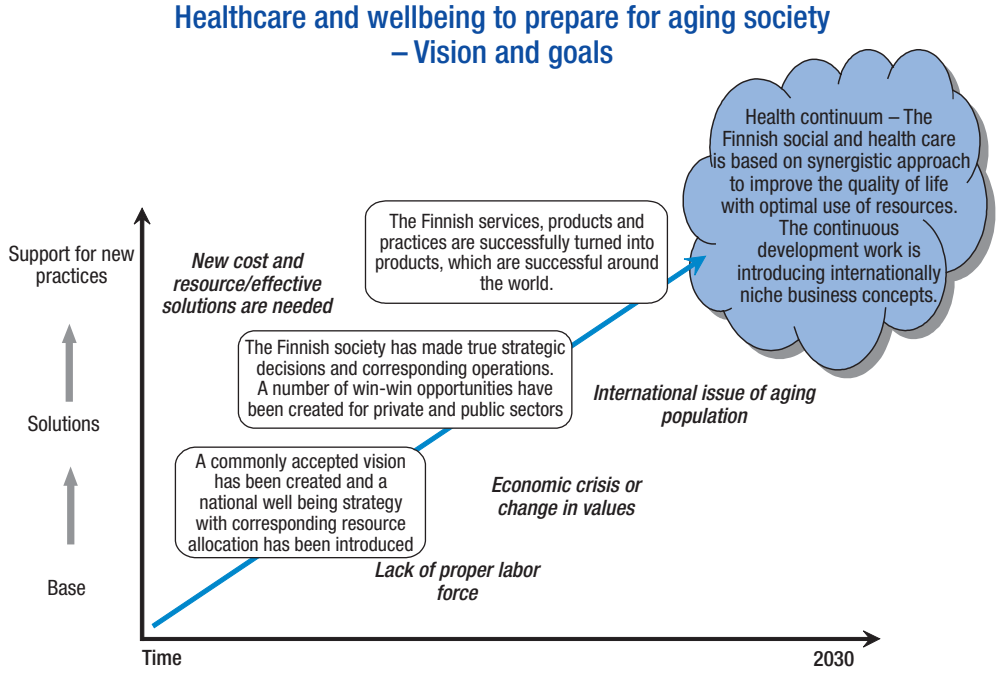


Figure 1. Vision for Finland in 2050

1 The wider report of the Finnish results has been published in the Tekes Review No 227/2008.

The development of new technology takes place in pilot environments to ensure that the customer requirements are already taken into account at the beginning of a development project. The goals and vision are shown in Figure 1.

Policy recommendations (executive summary)

The responsibility of each individual of his/her health must be emphasized more than has been done so in the past. It has been suggested that the poor cost/benefit performance of health care in the USA is partially due to people's poor lifestyle choices. Low levels of physical activity, combined with a high caloric and fatty diet, are proving to be behind this chronic condition.

The lifestyle of the Finnish population is following that of the USA. The importance of diet, weight control and proper physical exercise has been demonstrated in a number of well-controlled studies. The difficult question is how to change the lifestyle of the majority of the population.

The major recommendations from the panel emphasized that instead of focusing on single areas and actions, the challenge should be faced by addressing the whole health continuum, which is depicted in Figure 2. Increased need for acute care is avoided if proactive self-care is emphasized and the policy actions pay attention to the whole health continuum.

As the conclusion from the panel was that the future requires integrated approaches and an analysis of the health continuum as a whole, there were no clear policy subthemes for which specific targets would have been developed. There were some general policy recommendations that help Finland to create a well-functioning health continuum, which are summarized in Figure 3 and shortly described in the following.

The use of technology in health and social care in Finland is not as effective as it should be. ICT has increased the productivity in industry and in some services like banking considerably. Regrettably, this has not been happening in public services. There are many projects going on and a considerable amount of money and effort have been invested in poorly managed operations.

The poor organization and tight budget of the public social and health care sectors do not permit

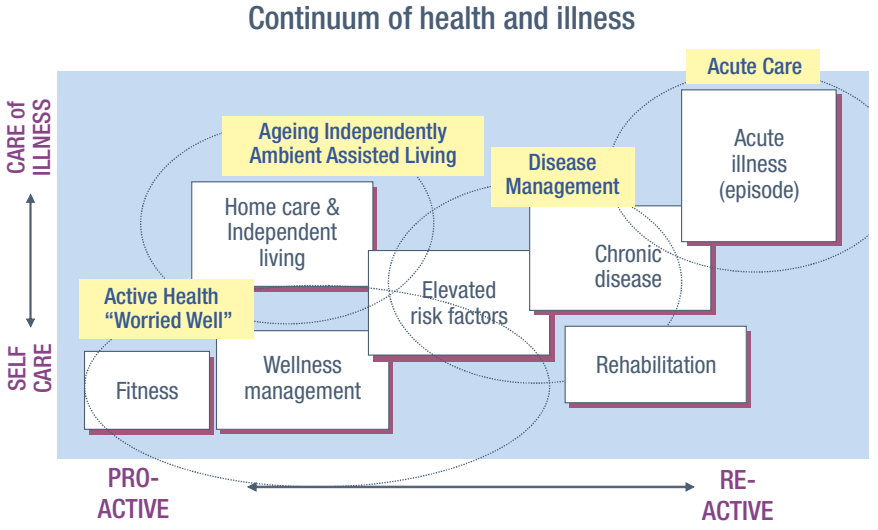


Figure 2. The Health Continuum

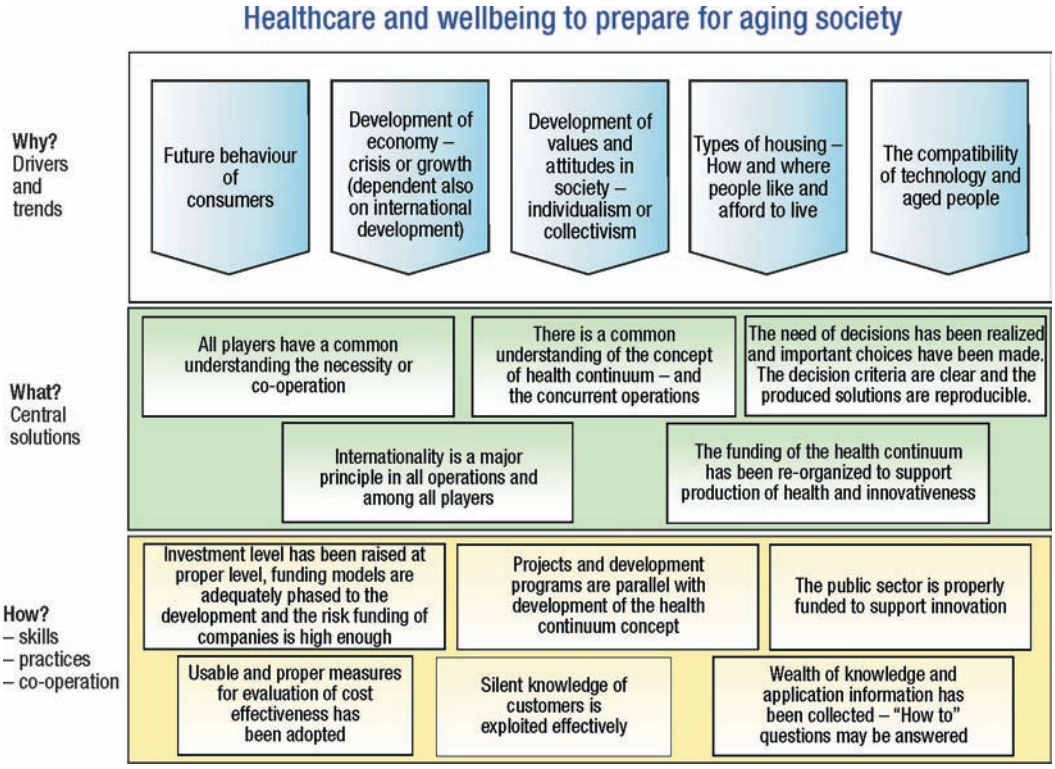


Figure 3. Summary of drivers, solutions and general actions to reach the goals

well-managed pilot studies. Even project-based extra funding does not help, because people are unavailable who are capable of investing sufficient time and effort in piloting. In addition to this, practical tests of a new radical idea also assume changes in the practises of the organization. This requires some extra resources available within the organization. It is well-known that these resources do not exist. The tacit information of the organization cannot be extracted and applied to improvements in ideas and new products.

Before any significant progress can be expected, the present situation must be analysed. The obvious weaknesses must be openly recognized and the necessary strategic choices made. An understanding of the operation of the health care system is still at a very low level. Currently, the change due to aging will take place within the next 10 years. This is fast compared to the time constants involved in the system. Institutional public health care will react slowly, so the fastest and probably most cost-effective operations can be made outside the institutions.

The health continuum concept includes the tight relationship between the operations to support a healthy life style and the costs of institutional health care. Institutional care will be replaced by home care and special senior housing with tailored services. Preventive operations will be more and more important. This situation generates some good business opportunities: Health food manufacturers, fitness clubs, home care monitors, ubiquitous systems, peer group organizers and various cooperatives may find new concepts which may be marketed internationally.

The funding of the research and development projects should depend on how well they can expect to support the health continuum concept. The scientific basis of projects should be sound and the research is more related to implementation and the demonstration of cost effectiveness.

The problem has been recognized and some operations have already been initiated.

The funding of R&D must be increased considerably, and it should be addressing new ideas which change the established ways of operating. The present way to support the projects – only if they are accepted by the established companies – will not lead to the positive goal desired.

B) Consumers, media and digital convergence

Overview

Target

Media takes an ever-growing share of everyday life. The media landscape is also rapidly changing, mainly due to technical innovations and the accelerating adoption of new technology by the consumer market. The task of the foresight work for this theme was to first formulate future scenarios of media use, primarily in Finland from the viewpoint of media behaviour of people and their values and attitudes.

Vision for 2020

The vision for 2020 for Finland was:

> *"Finland is a proactive and daring flagship of the changing media environment for learning, well-being and entertainment."*

Figure 4 shows how the vision was formed. It was based on three larger drivers, which were 1) rapid development of technology, 2) media as an enabler in societal and business practices and 3) the changing role of users and increased consumer power.

The basis of this vision is the current status of technically capable Finland, with a high level of competence in key media technology areas: open media platforms, mobile Internet and combinations of print and electronic media. These technical possibilities can be considered to be a solid basis for building new user-centered media services.

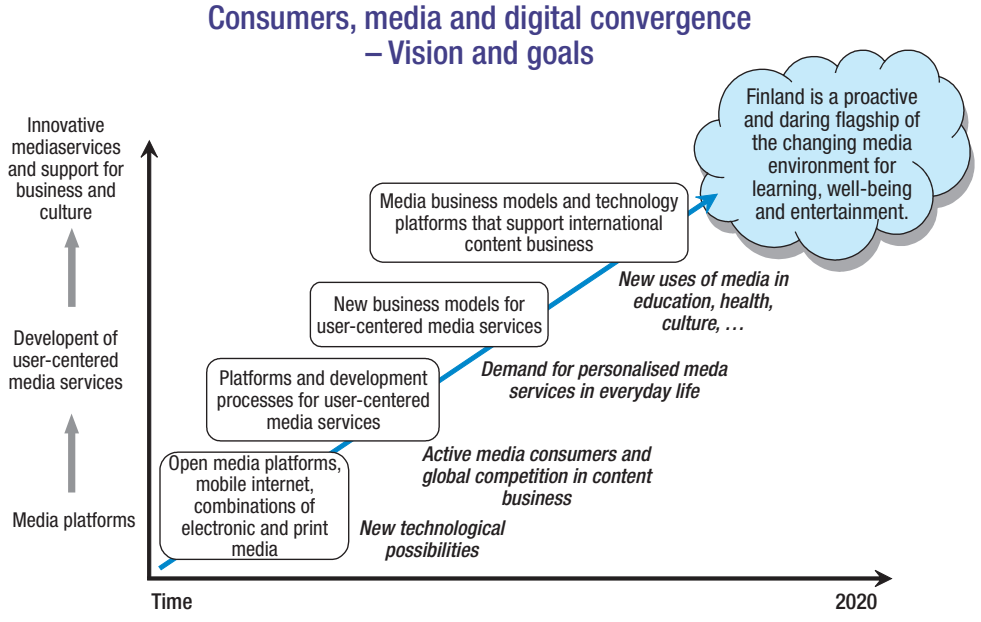


Figure 4. Vision and goals for the Finnish converging media and communications sector in the year 2020

Policy recommendations (executive summary)

Media cluster development

It is important to recognize that the Finnish media cluster should be tightened, and it should have a stronger supporting R&D network and international contacts behind it. Media cluster should be closely connected to nearby clusters. New ways of functioning and collaboration are needed, and this necessitates global networks and internationally visible flagship actors. New investments need to be made in strategically chosen content and service domains. Learning, well-being and entertainment hold the biggest promise as areas for content and media services. With adequate support for development and access to capital, the game sector could develop into the cultural powerhouse of the Finnish content industry. Being one of the top five game media countries globally and a leader in some of the fastest growing sectors of games and synthetic worlds should be chosen as a national goal.

Understanding of user-driven media development and business models

Experimental settings for constant experimentation are needed, and citizens and prospective users should embrace these national and local initiatives and participate actively. There are many living labs initiatives currently being run and prepared, but it is important that these truly reach the everyday lives of people, or rather that they would be welcomed as an integral part of it. One solution is to think of this concept of living labs from a non-media and IT-centric viewpoint. Finnish media business actors should be leading the world in promoting open user innovation, and also understanding its commercial potential and connected business models. Finland should take a leading role in creating do-it-yourself media tools and platforms.

Investment in R&D and education

There is a need to increase R&D funding in the media cluster. Change will result from a combination of attitude shift in established companies towards R&D, new clusters of start-ups, targeted research programs and expertise networks, and better quality universities. There is a need to significantly improve the quality and scope of interactive digital media research and education in Finland, and quality has to be at the top international level. Multi-disciplinary education from various domains related to the media field is needed, especially concerning humanistic and societal areas. Journalism education should be developed, but there should also be more emphasis on media service innovation and media management.

Good innovation environment

New positive business thinking is required: concrete initiatives to help form new businesses and encourage risk-taking that is targeted for international success. This necessitates new initiatives for higher education and venturing. A culture that tolerates failure in business ventures needs to be built and more business expertise is required. There is too long a way from interesting and potential areas of content to products, markets and business. This could be a positive challenge for The Finnish Innovation Fund (Sitra), and they should be involved more in planning. New types of business need to be connected to campuses and their vicinity, where new generations of media use will be incubated and new forms of knowledge creation shall flourish. The sector would benefit from professorships which are partly within the university and partly in companies.

IPR rules enabling new business

IPR is central to media business, but it can act locally either as a hindrance or as an enabler. IPR legislation needs to be internationally reconsidered, for example, in order to better support open innovation practices in media.

Cooperation between different authorities and funding agencies

Conscious choices on where to put the emphasis need to be made, and government officials should share the common vision. New tools and funding structures may be necessary, and the ICT SHOK could be important for the future of media. However, current plans include only a small fragment concentrating on media, and this will not be large enough. We should also promote the capabilities

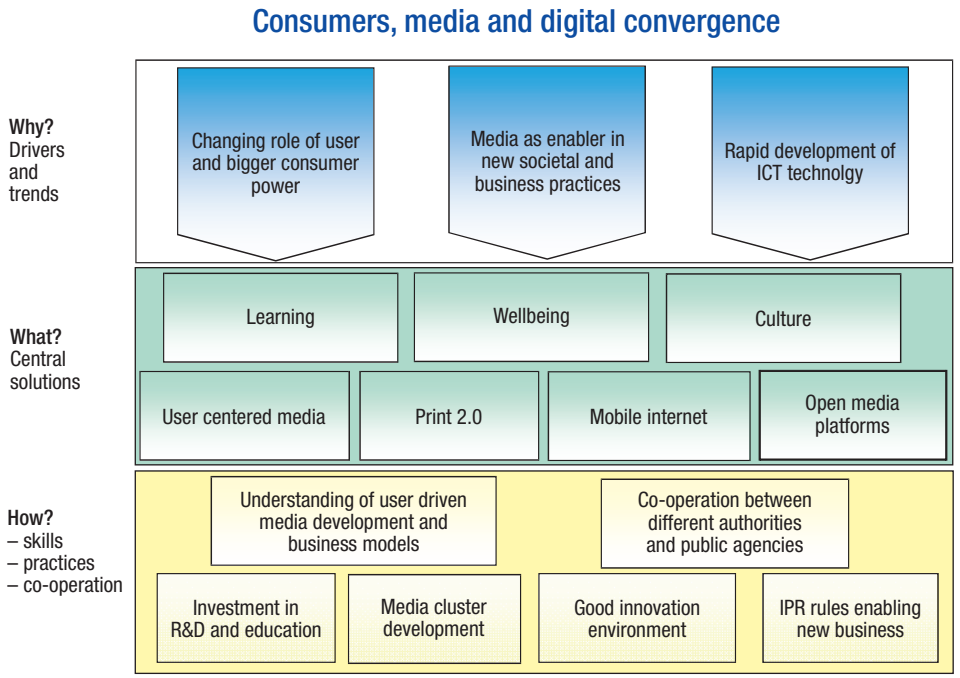


Figure 5. Summary of drivers, solutions and general actions to reach the goals

and new media literacy of Finnish citizens at large (Ministries of Transport, Communications and Education).

Policy vision by subthemes

1 User-centered media

Objective for 2020

The role of the media is based on the observed everyday life of people. New media breakthroughs come through projects that involve users from an early stage. This requires constant measuring, modeling and development in product design, resulting in the continuing perfection of services, media and design.

Policy recommendations

Integrating "consumer-driven" and "interactive" to modes of thinking and measurement tools of the media industry is important. There is a new set of skills that the traditional media industry needs to learn on how to understand what the customers need, and it looks like it is other new players that are taking this role and doing it instead.

A key characteristic of the Internet era is that media is becoming more a service than a packaged product. This has to be reflected in how business is conducted. Mobile is becoming as powerful as PC technology and the two may largely merge by the year 2020.

Better understanding of the media user experience is important, and human-centric and multi-disciplinary media research is needed for this purpose.

Collecting information dynamically and in real time about the use of products and services represents a key skill for human-centric development. This results in making constant changes and revisions in the services, thereby shortening development cycles drastically. Swarm behaviour is different than uses of current social media, and we can provide new forms of following how the flocks behave and move *vis-a-vis* each other. Here new mobile Internet tools are a key enabler.

There needs to be ways to measure success and excellence of user interfaces better. Conceptualizing

the Social UI may become a critical new business enabler. People need better tools to control their presence in different social circles. Prosumer UIs are also different from consumer UIs, and understanding this difference is critical.

2 Open media platforms

Objective for 2020

Open platforms should be supported so that we have an advantage in building new services more flexibly: open models support professional content creation and can benefit from various forms of "collective human intelligence".

Policy recommendations

Core actors need to be located in Finland, but Finland also needs to be open to all local and international actors. In the ICT sector at large, a multitude of companies already exist that are building their business on the open source model, but doing integration and services. The same applies to digital media content.

Open innovation models works particularly well for new media content and services for the benefit of the public sector. There are many large-scale efforts that have the goal of creating major assets from the media available. Some of these collaborative peer-produced media products are generated by active user communities, such as Wikipedia. The underlying content production platform, Wiki, is an open user interface innovation as such.

Open business models can become an integral part of media company strategy and actions. However, it must be acknowledged that the business models and benefits of the fully open IPR model are still quite foggy. New models may be required, and the example of dual-licensing from open source software may also be relevant here.

3 Print 2.0

Objective for 2020

Publishing, print communication and ICT combined with new products and services is a unique combination globally, and fundamental for the Finnish industrial structure. There is a need to redefine the role of print products in the future landscape of media use, as media, ICT and paper industry have a joint future.

Policy recommendations

Print media is not disappearing, though the forest sector is facing important long-term challenges in keeping the position it has today on the media market. There is a need to rethink what paper-based products are good for in the future, and most likely they will develop and obtain new features in the future.

ICT & Forest industry: cross-sector collaboration:

Finland has leading expertise globally in the ICT and forest sectors, and the media and communications sector overlaps to a large degree with both. It is of great national importance for Finland how these three sectors could succeed in working closer together in order to develop new solutions and new products.

Combining social digital media with print:

When new innovations are considered on the web and Internet, paper is almost always neglected as a possible media. The problem is that paper is seen as old and uninteresting technology. There are also only a few web-based tools and services for people to reinvent paper products themselves.

A lesson learned from the ICT sector is to be open and facilitate innovation among end users. To achieve this, the pulp and paper industry must take an active role in enabling regular people to be creative with paper, especially using digital tools and online collaboration. New business models for small-scale publishing allow various forms of publishing. New innovative uses for paper could start from better use digital tools and online collaboration, which has been witnessed to work in all-digital media use, and closer interaction with users as well as obtaining inspiration from the everyday changes in people's lives.

User-centric print products:

The paper industry has traditionally done relatively little user-centric R&D, and could learn from the methods now commonplace in ICT, such as human-centric design and user-generated content. This could help in defining how media

use in everyday life is changing and exploring innovatively new uses for paper.

The pulp and paper business may be interested in coming up with new innovative consumer products and services. The paper industry should also accept new design and business perspectives. It may be useful to compare the situation of some hardware and software giants (Intel, Microsoft, Nokia) and the paper industry. The ICT industry is adapted to understanding the everyday life context of their new products and is willing to invest major amounts of funding to use their own R&D for the creation of new markets for IT core products such as microprocessors, operating systems and telecommunications hardware.

It should be the role of the paper industry to show both consumers and businesses that paper is often far superior to digital alternatives. However, the situation is changing and the pressures to cut costs to keep in line with sinking markets and diminishing profits often mean that little is reserved for truly novel thinking.

C) Society based on energy and material efficiency

Overview

Target

The focus of the work in society based on energy and material efficiency panel was on the meticulous and economical use of resources. Important aspects to be included were also societal aspects in the use and reuse of materials and energy. The target was set to envisage Finland as a society and the country's competitiveness on the global market.

Vision for 2050

It was agreed that the foresight goal needs to be far enough in terms of time, as in the energy field the infrastructure is very slow to change and investments are commonly made for about 50 years. Therefore, the time-span for trends and drivers as well as the overall vision was set to the year 2050, and for specific measures the goal was set to 2020.

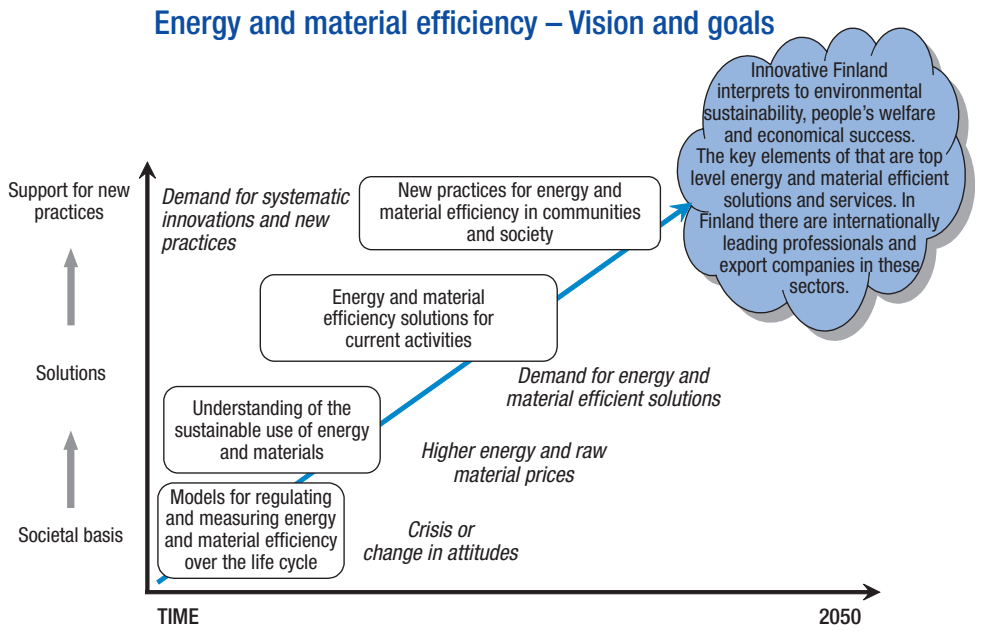


Figure 6. Vision for Finland in 2050

The vision for 2050 for Finland was:

> *"Innovative Finland translates to environmental sustainability, people's welfare and economic success. The key elements of this are top level energy and material efficient solutions and services. In Finland, there are internationally leading professionals and export companies in these sectors."*

Policy recommendations (executive summary)

To achieve the vision, several pre-requisitions must be taken into consideration. Attitude changes towards energy and environmental sustainability are needed (Figure X). Additionally, the challenges faced by climate change must be taken seriously on all levels. Higher energy and raw material prices will create a better understanding of the sustainable use of energy and materials, but energy and material efficiency solutions will demand better environmental competence throughout all sectors. What is essential is the role of directives and regulations to support development.

In order to achieve this vision, education and training on energy and material efficiency on all levels – from primary education to the continuing training of professionals – should be developed and improved. Entrepreneurship should be supported by providing education and further training for companies. Investment in stronger and more competent bases of basic and applied research in material and energy efficiency as well as in capacity building enables industry to adapt research results, demonstrate findings and develop new business opportunities. On the consumer level, a major change in consumption behaviour and attitudes is necessary. It can be achieved with education, but also with active information dissemination and advice, demonstrating good examples, and economic benefits. The development of indicators suitable to measure and monitor energy and material efficiency is important to present results, but also to further develop current systems. Legislation, regulations and various incentives and taxation should be in line with sustainability goals, and research is also required in this area.

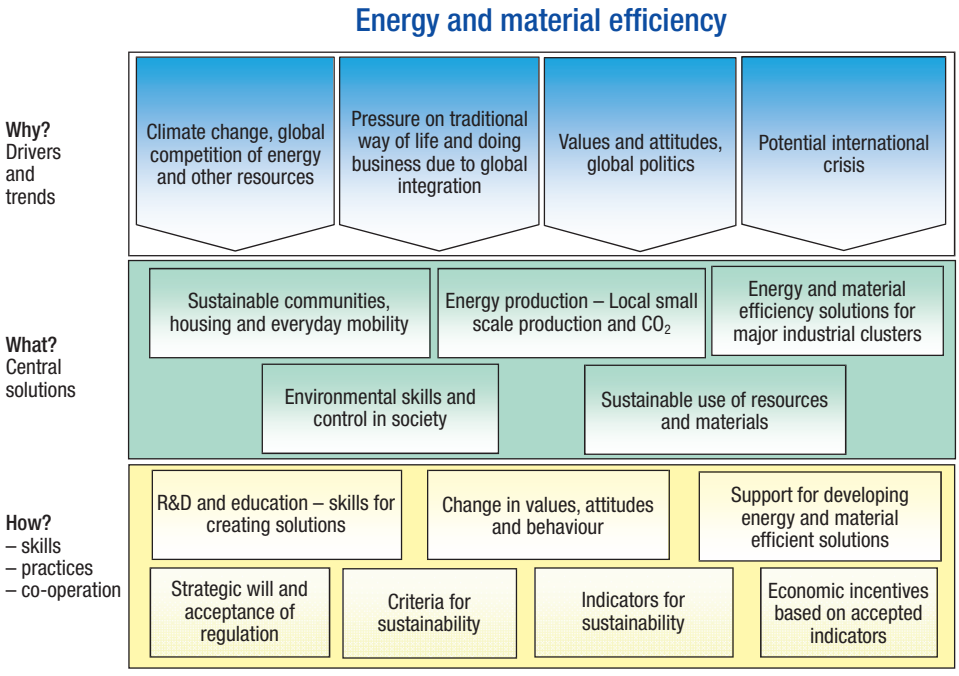


Figure 7. Summary of drivers, solutions and general actions to reach the goals

New energy and material efficient technology and applications should have a priority for R&D support and market incentives, e.g. risk financing. The production and marketing of energy- and material-efficient products should have extra support in order to lower the risk of companies. Entrepreneurship should also be supported by new and flexible funding options and start funding. Public support – e.g. public procurement – for public transport and other sustainable mobility options would increase their attractiveness. Energy storage and distribution technology and systems need to be developed to avoid losses through the process. Technology needs public support through, e.g. investment and R&D support. New inexpensive technological solutions for small-scale production of solar, wind and bioenergy applications could ensure faster market uptake. These are important, especially in rural areas. Public transport services need to be developed to better meet the needs of consumers and society.

The strategy towards energy and material efficient society must be a long-term, continuously updated/developed and continuing process. Strategic will is important on the political level as well as in companies.

Policy Vision by Subthemes

1 Spatial planning, housing and transport

Objective for 2020

Developing a dense and mixed urban structure with well-functioning rail transport. In the urban communities, distances to work, services and recreational areas are close to home. Finland will be globally competent in producing public transport solutions and products in addition to low-energy, material- and energy-efficient products and services.

Policy recommendations

Finland needs to invest in research, development and innovation (R&D&I) activities, education and capacity building in the sectors and provide appropriate and sufficient regulation and support mechanisms.

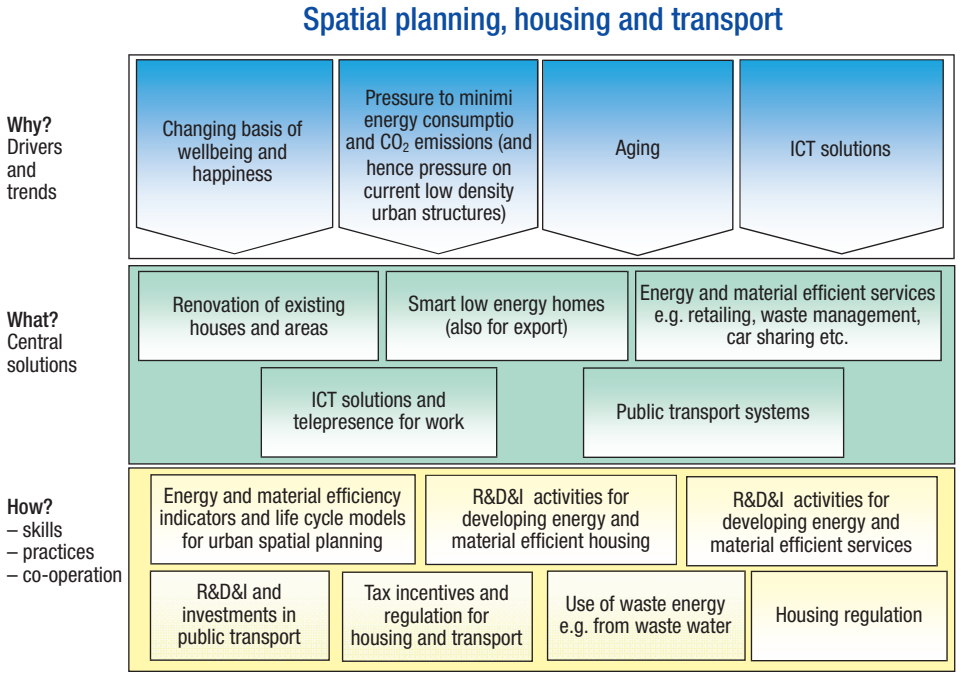


Figure 8. Drivers, solutions and actions to reach the goals of spatial planning, housing and transport.

Central solutions to reach the goals are the renovation of existing houses and areas, smart low energy homes, energy and material efficient services (e.g. retailing, waste management, car sharing), ICT solutions and telepresence for work and public transport systems (Figure 8). The central solutions can be supported by developing energy and material efficiency indicators and monitoring as well as life-cycle systems for spatial planning and land use. Legislation and specific regulations towards energy- and material-efficient buildings and components must be improved. Public transport services must be improved, and one option for that direction is to develop sustainable pricing systems in mobility and transport sector.

2 Energy and material efficiency of industrial production

Objective for 2020

Finland will be a top exporter of energy and material efficient products and services. There will be internationally leading Finnish manufacturers and exporters on the global market in certain sectors: forest and metal industry, alternative transport fuels, water purification technology and ICT. Some areas of chemical industry could also be Finland's strengths. These strengths are based on long experience and know-how in energy-intensive processes and the metal industry, which facilitates new business areas in smart processes and the management of material and energy flows.

Policy recommendations

Central solutions in reaching the goals are globally competitive energy- and material- efficient products, regulation that supports energy and material efficiency, energy and material efficient services, and understanding as well as managing energy and material flows together with smart processes (Figure 9).

To achieve the goal and support solutions, competence must be ensured by investing in basic research and improving the vocational education of experts as well as supporting entrepreneurship. Investments in R&D&I for activities in material- and energy-efficient industry as well as support

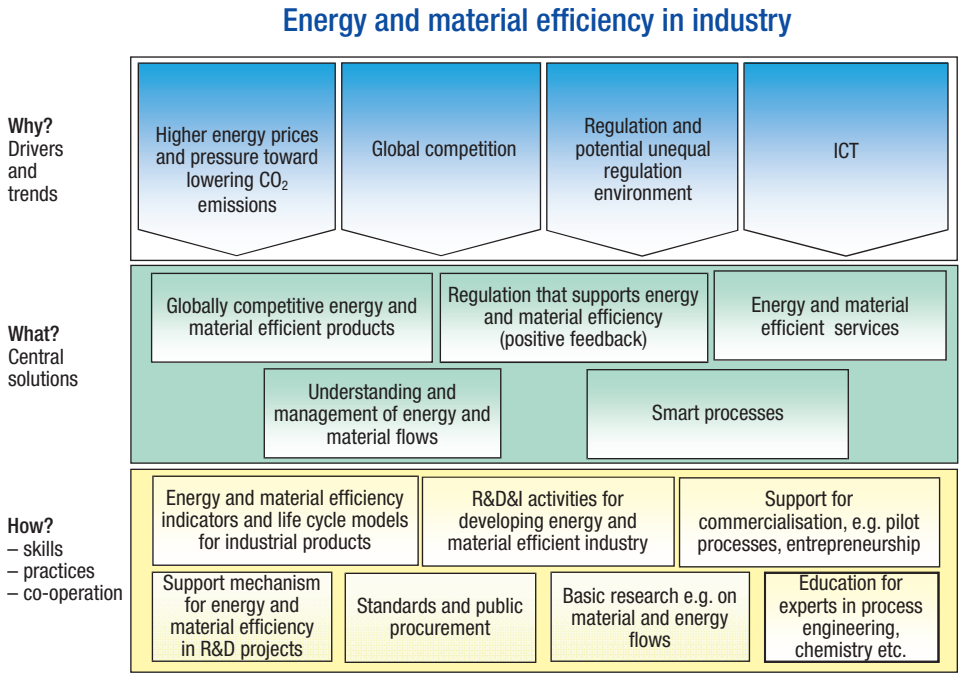


Figure 9. Drivers, solutions and actions to reach the goals of energy and material efficiency in industry

mechanisms for the commercialization of new innovations. Material- and energy-efficient solutions should be supported with lower taxation than the conventional ones. Indicator and life-cycle systems for material and energy efficiency industrial products must be developed.

3 Energy production – CO2 and small scale

Objective for 2020

The objective is to maintain sufficient energy production to ensure people's equal welfare. In the year 2020, there is a 30% reduction of CO2 emissions and use of natural resources in energy production, and everyone has an equal opportunity to use energy. Local energy production is important to ensure the security of supply and local independence.

Policy recommendations

Local energy production is possible by utilizing passive solar energy and passive cooling. Waste as an energy source will present opportunities for local production. New alternative technologies, e.g. small-scale bioenergy and solar heating as well as electricity solutions for energy generation are developed. Infrastructure and electricity distribution systems support local small-scale production (Figure 10).

Local production requires specific support mechanisms, e.g. feed-in tariffs, and renewed taxation systems from the government. Also, housing regulation needs to be developed. The small-scale energy production infrastructure must be understood to facilitate proper distribution and logistics systems. Investments in R&D&I activities ensure development of new systems and services. The central drivers are based on a need to improve energy production more efficiently and reduce CO2 emissions. Climate change requires actions to reduce CO2 emissions and CO2 tax on energy production is evident. The efficient use of resources, e.g. waste energy, is an effective driver. Security of supply must be ensured with local production. Small-scale solutions are essential in rural areas.

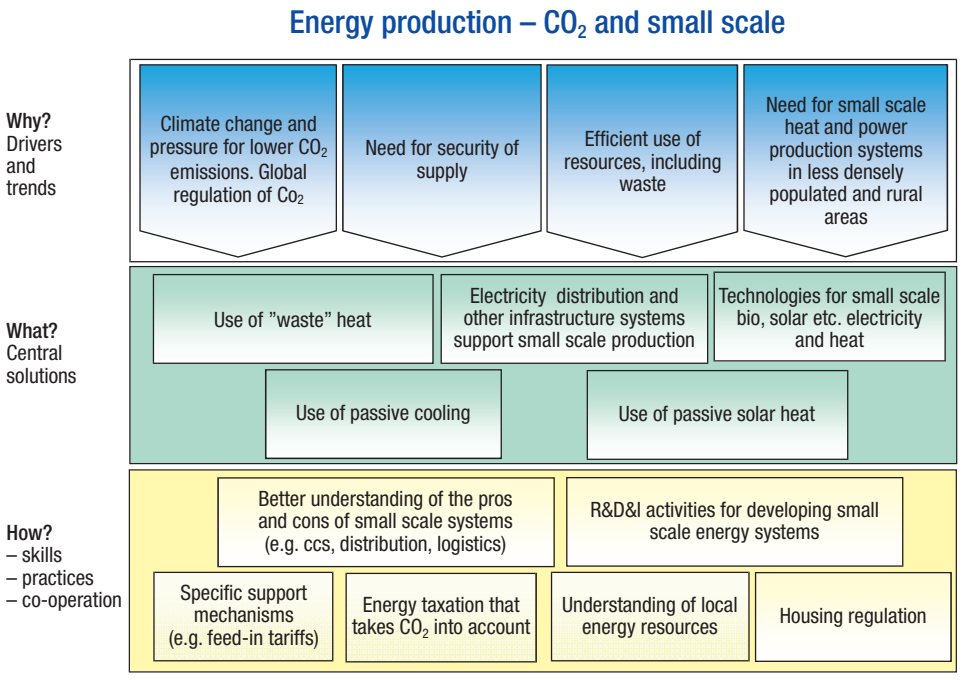


Figure 10. Drivers, solutions and actions to reach the goals of energy production

4 Sustainable use of resources and materials

Objective for 2010

The target for sustainable use of resources and materials was set for the year 2010. Sustainable use is in line with the current trend of limited supply of resources and materials. Sustainable use of materials and resources covers the essential resources for Finnish industry. Forest-based raw materials from the pulp and paper industry and wood energy production; biomass and peat for energy production, minerals and water resources. Sustainability in material and resources use is still underdeveloped and provides several possibilities for new solutions and businesses.

Policy recommendations

The most important solutions towards sustainability are increased recycling and reuse of materials and products, utilization of waste and side flows in processes (Figure 11). Industrial ecology principles provide new production solutions and innovations. Holistic planning of natural resources through the whole life cycle produces new services and systems in industry.

Basic research on material and energy flows and understanding of material life-cycle models must be in place. National and international regulation must be supportive to the recycling and reuse of products. New criteria, methods and technologies for sustainable use of materials need to be developed, and local social and economical sustainability require models. A realistic understanding of the exploitation potential of natural resources can be achieved through education and research. It is also important to use the utilized resources to the fullest through, e.g. collaboration with other industries.

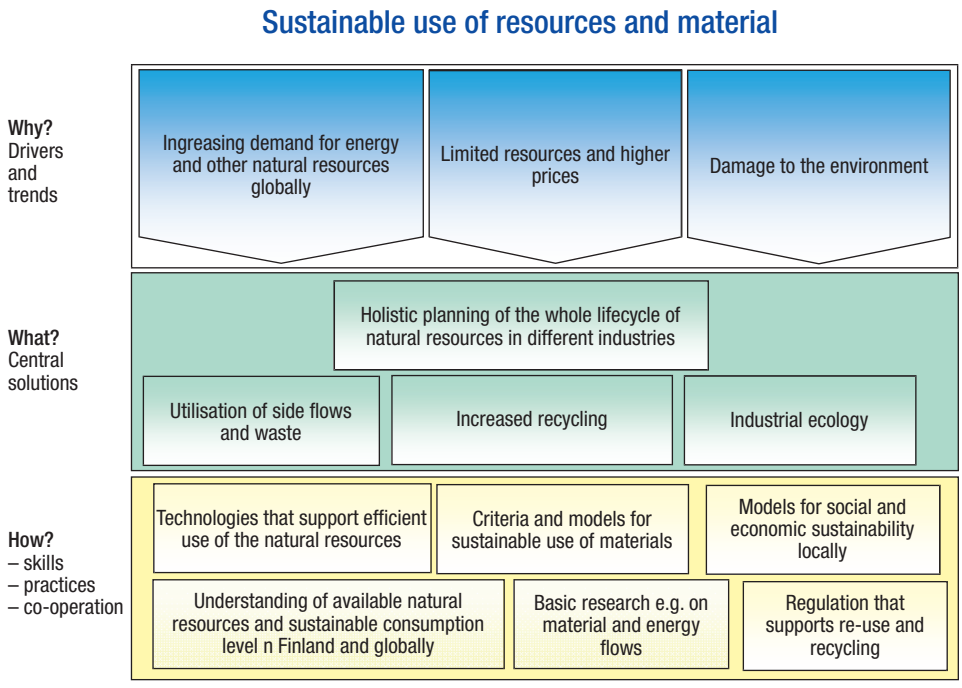


Figure 11. Drivers, solutions and actions to reach the goals of sustainable use of resources and material

5 Environmental competence and societal management

Objective for 2010

A sustainable society ensures that basic education and competence levels are good and regulative measures ensure active development.

Policy recommendations

The goal is to increase Finnish exports, which calls for competent expertise also in political decision-making and in the public and private sectors to facilitate the implementation of actions. Central solutions to achieve the target are competent skills for energy and material efficiency activities, which ensure the competence and competitiveness of the industries (Figure 12). Regulation and procurement methods must be efficient and effective. For implementation, the community needs to support peoples' well-being and happiness.

Competence can be ensured by investing substantially in education and training energy and material efficiency for all, from primary schools to advanced and continuing education at work. Primary education is insufficient and too slow to bring change and improvement in competence, and therefore capacity building must cover society as a whole at the same time. Basic research on material and energy efficiency must be invested in, and new regulations and support mechanisms must be developed accordingly. Regulation and support for procurement test beds and commercialization are needed. There is need for new life-cycle models and indicators to monitor energy and material efficiency as well. To change attitudes and behavior, sufficient information, e.g. through education is needed as well as best practices and evidence of benefits both in terms of sustainability and economy.

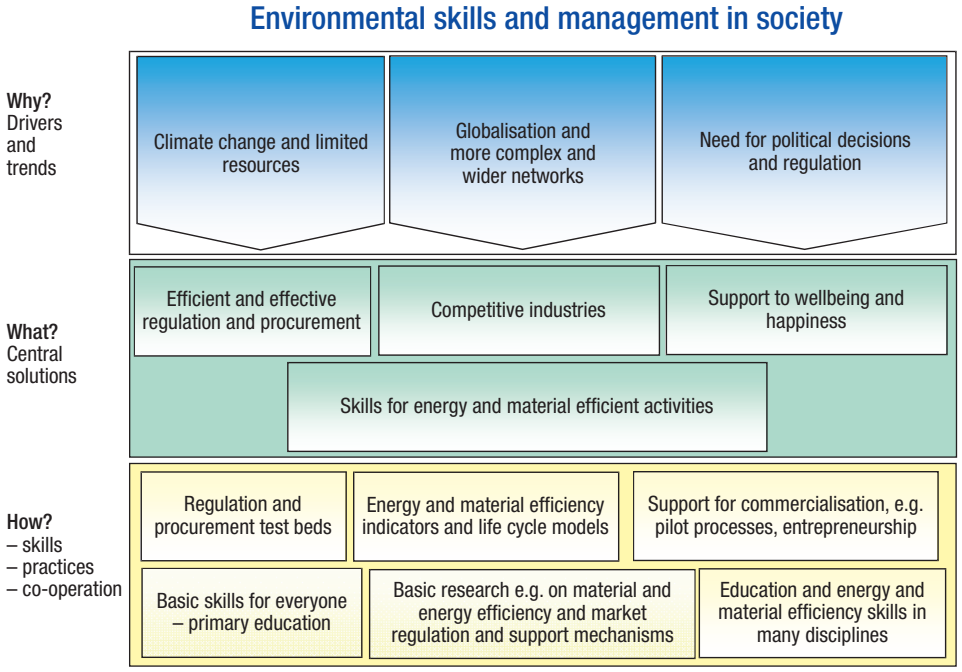
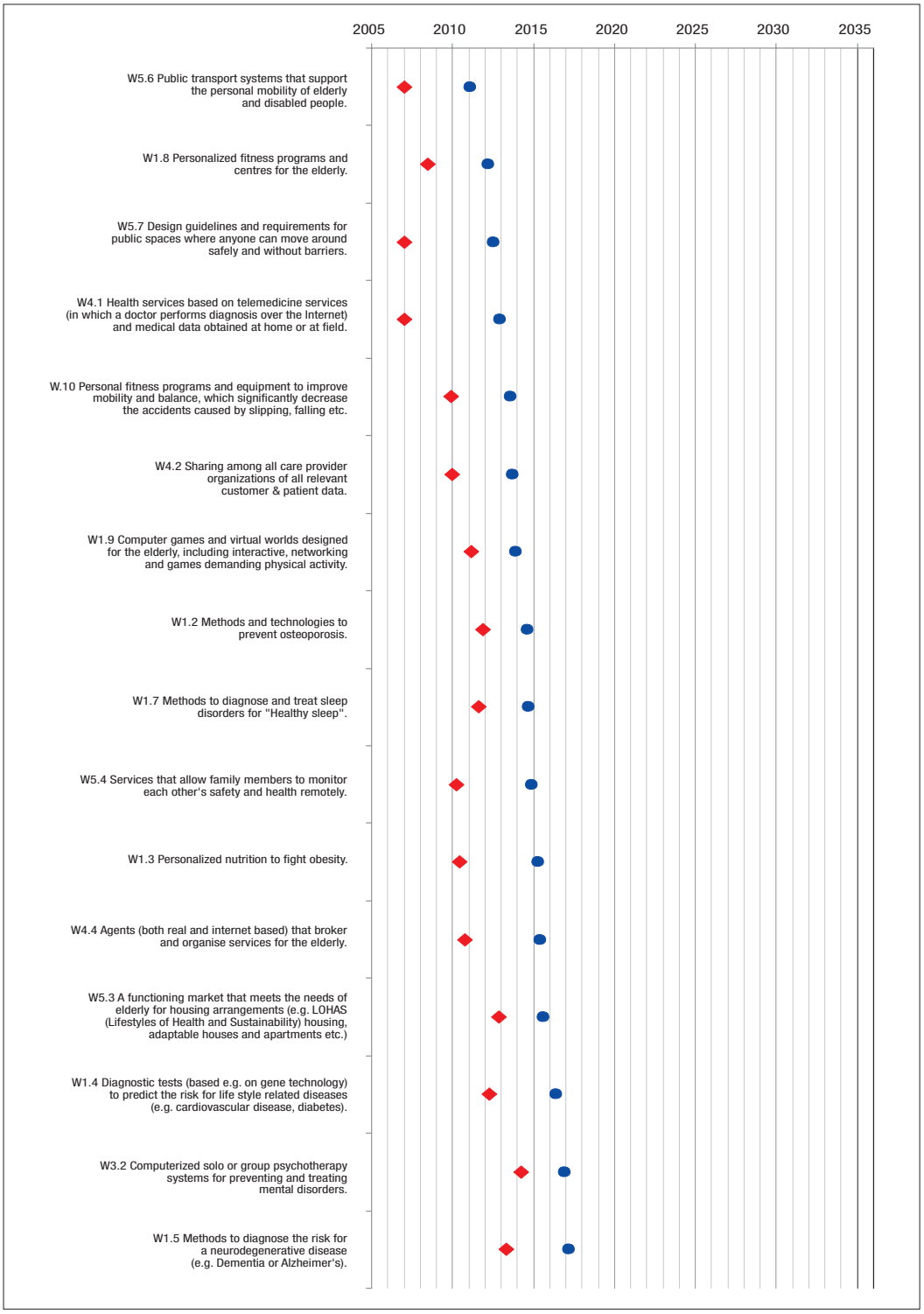
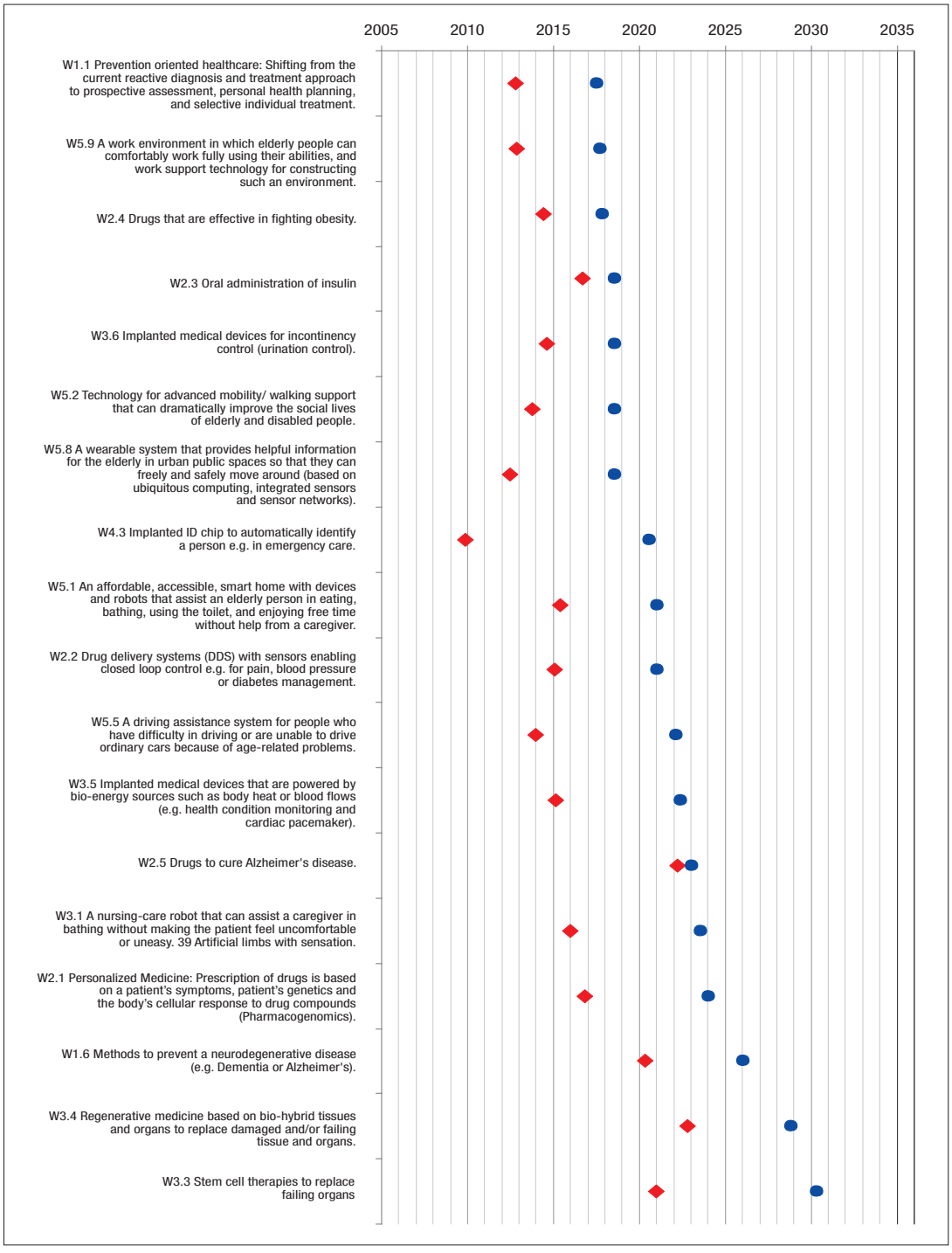


Figure 12. Drivers, solutions and actions to reach the goals of environmental skills and control in society

Economical and administrative control in the right direction is essential, and that calls for improved competence and skills from decision-makers in order to make educated decisions. Encouraging regulative measures speeds up development. Climate change and limited resources are effective drivers for improving competence in the society. Globalization requires new skills and expertise to manage in economic competition. Wider and more complex professional and economical networks need new skilled people.

A-5 Tekes Delphi results

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W1.1 Prevention oriented healthcare: Shifting from the current reactive diagnosis and treatment approach to prospective assessment, personal health planning, and selective individual treatment.
W5.9 A work environment in which elderly people can comfortably work fully using their abilities, and work support technology for constructing such an environment.
W2.4 Drugs that are effective in fighting obesity.
W2.3 Oral administration of insulin
W3.6 Implanted medical devices for incontinency control (urination control).
W5.2 Technology for advanced mobility/ walking support that can dramatically improve the social lives of elderly and disabled people.
W5.8 A wearable system that provides helpful information for the elderly in urban public spaces so that they can freely and safely move around (based on ubiquitous computing, integrated sensors and sensor networks).
W4.3 Implanted ID chip to automatically identify a person e.g. in emergency care.
W5.1 An affordable, accessible, smart home with devices and robots that assist an elderly person in eating, bathing, using the toilet, and enjoying free time without help from a caregiver.
W2.2 Drug delivery systems (DDS) with sensors enabling closed loop control e.g. for pain, blood pressure or diabetes management.
W5.5 A driving assistance system for people who have difficulty in driving or are unable to drive ordinary cars because of age-related problems.
W3.5 Implanted medical devices that are powered by bio-energy sources such as body heat or blood flows (e.g. health condition monitoring and cardiac pacemaker).
W2.5 Drugs to cure Alzheimer's disease.
W3.1 A nursing-care robot that can assist a caregiver in bathing without making the patient feel uncomfortable or uneasy. 39 Artificial limbs with sensation.
W2.1 Personalized Medicine: Prescription of drugs is based on a patient's symptoms, patient's genetics and the body's cellular response to drug compounds (Pharmacogenomics).
W1.6 Methods to prevent a neurodegenerative disease (e.g. Dementia or Alzheimer's).
W3.4 Regenerative medicine based on bio-hybrid tissues and organs to replace damaged and/or failing tissue and organs.
W3.3 Stem cell therapies to replace failing organs


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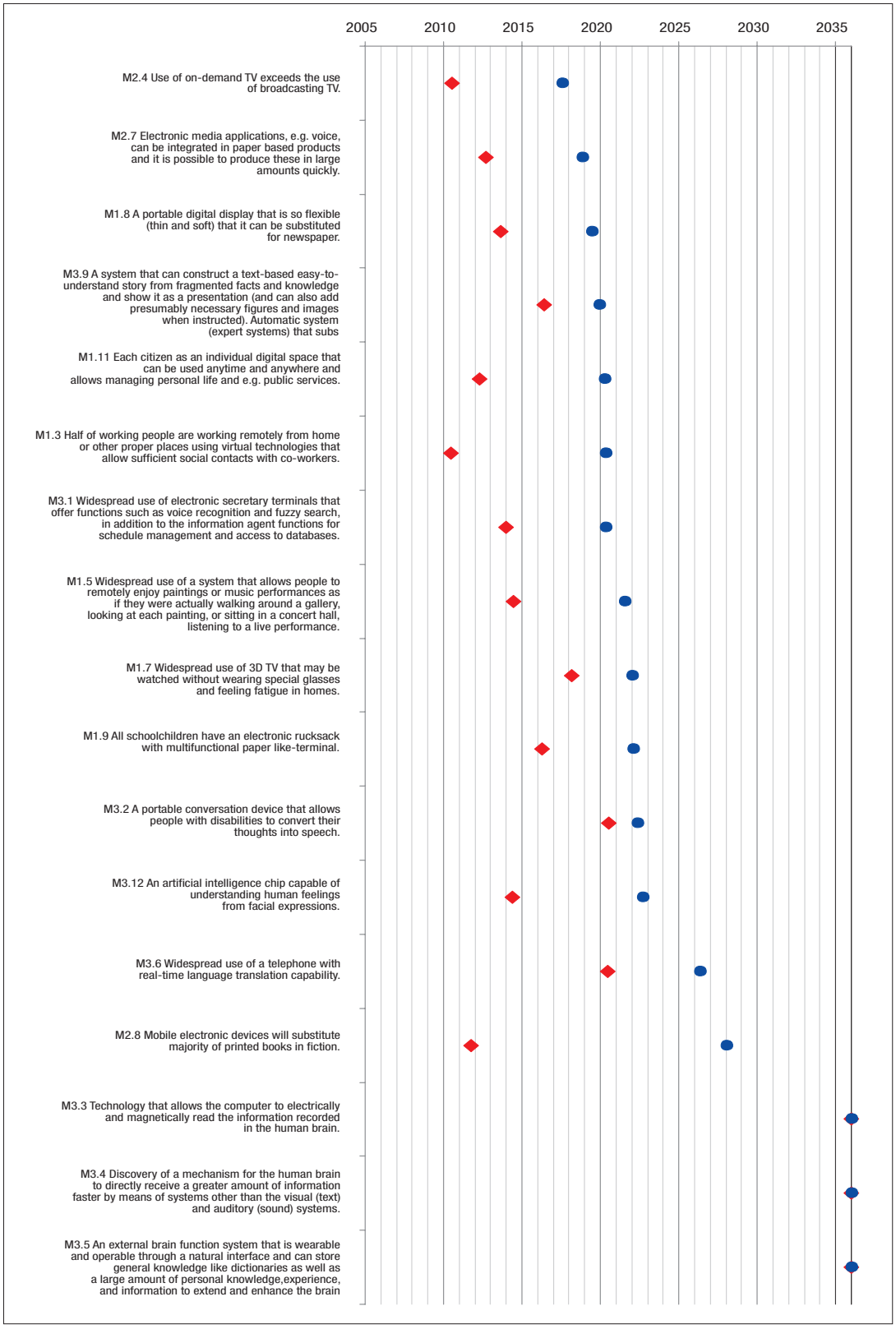
M3.13 A system capable of identifying the online content harmful to young people and automatically checking it.
M1.6 All media devices at home can be controlled through single user interface.
M2.9 2 D barcodes or RFID or suchlike, which can be read by a mobile phone or other mobile terminal, are widely used in different applications.
M2.2 In such fields as art, theater, cinema, music, and literature, there are artistic activities whose viability is threatened due to a very small consumer population. Such small-scale artistic activities can be made economically viable not by increasing
M3.10 Search technology that allows searchers to find the desired information through fuzzy instructions.
M1.10 Educational games are commonly used for supporting learning in primary and secondary education.
M3.8 Technology that allows to utilize networked, but heterogeneous, global information sources (the Web, etc.) like an encyclopedia (including a summarization function of important items and a question-and-answer mechanism).
M3.7 A system capable of automatically retrieving from the network new information and valuable knowledge with high relevance to the specified topic and presenting them.
M1.1 A virtual company, with € 100 million revenue (among 400 largest companies in Finland), that has no office building and conducts all business operations over the Internet (using e.g. virtual technology).
M3.11 Search technology that allows searchers to find the desired information using instructions given with sensible, natural language sentences in everyday use.
M2.6 A high-resolution video distribution system that allows searching through and distribution of TV, film, and music archives of the past few years.
M2.5 Significant share of TV content is watched on mobile terminals.
M1.2 A remote distributed conferencing system with high realism that enables, with the aid of a virtual agent, participants to shareinformation material and hold natural-language conversations.
M2.1 In TV and other broadcasting media, advertising material can be adapted to individual viewers.
M1.4 A display device that allows people to enjoy movies anywhere, anytime by directly projecting images on their retinas.
M2.3 Traditional and participatory media have largely integrated and half of the content in a national newspaper is produced by the readers.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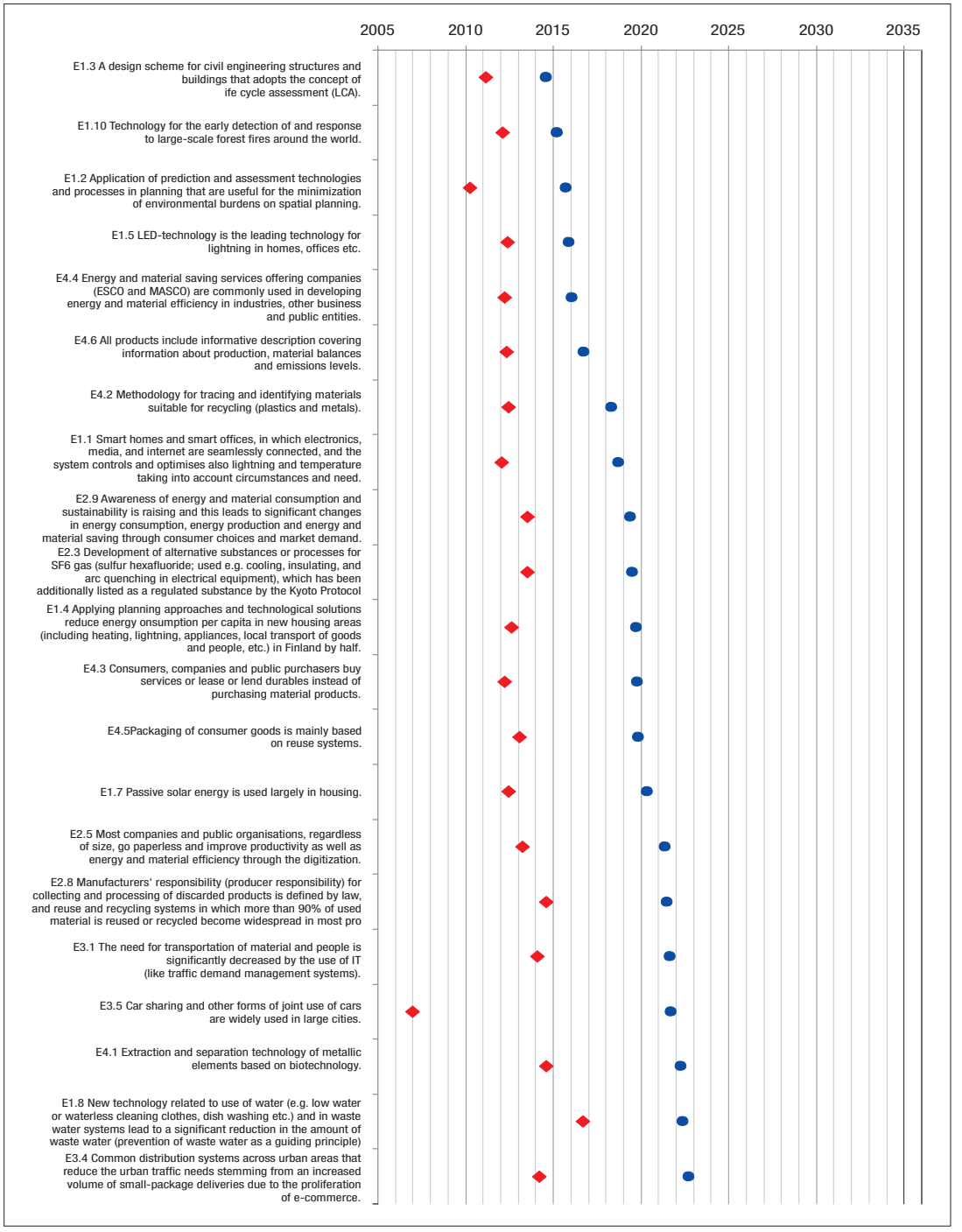
M2.4 Use of on-demand TV exceeds the use of broadcasting TV.
M2.7 Electronic media applications, e.g. voice, can be integrated in paper based products and it is possible to produce these in large amounts quickly.
M1.8 A portable digital display that is so flexible (thin and soft) that it can be substituted for newspaper.
M3.9 A system that can construct a text-based easy-to-understand story from fragmented facts and knowledge and show it as a presentation (and can also add presumably necessary figures and images when instructed). Automatic system (expert systems) that subs
M1.11 Each citizen as an individual digital space that can be used anytime and anywhere and allows managing personal life and e.g. public services.
M1.3 Half of working people are working remotely from home or other proper places using virtual technologies that allow sufficient social contacts with co-workers.
M3.1 Widespread use of electronic secretary terminals that offer functions such as voice recognition and fuzzy search, in addition to the information agent functions for schedule management and access to databases.
M1.5 Widespread use of a system that allows people to remotely enjoy paintings or music performances as if they were actually walking around a gallery, looking at each painting, or sitting in a concert hall, listening to a live performance.
M1.7 Widespread use of 3D TV that may be watched without wearing special glasses and feeling fatigue in homes.
M1.9 All schoolchildren have an electronic rucksack with multifunctional paper like-terminal.
M3.2 A portable conversation device that allows people with disabilities to convert their thoughts into speech.
M3.12 An artificial intelligence chip capable of understanding human feelings from facial expressions.
M3.6 Widespread use of a telephone with real-time language translation capability.
M2.8 Mobile electronic devices will substitute majority of printed books in fiction.
M3.3 Technology that allows the computer to electrically and magnetically read the information recorded in the human brain.
M3.4 Discovery of a mechanism for the human brain to directly receive a greater amount of information faster by means of systems other than the visual (text) and auditory (sound) systems.
M3.5 An external brain function system that is wearable and operable through a natural interface and can store general knowledge like dictionaries as well as a large amount of personal knowledge,experience, and information to extend and enhance the brain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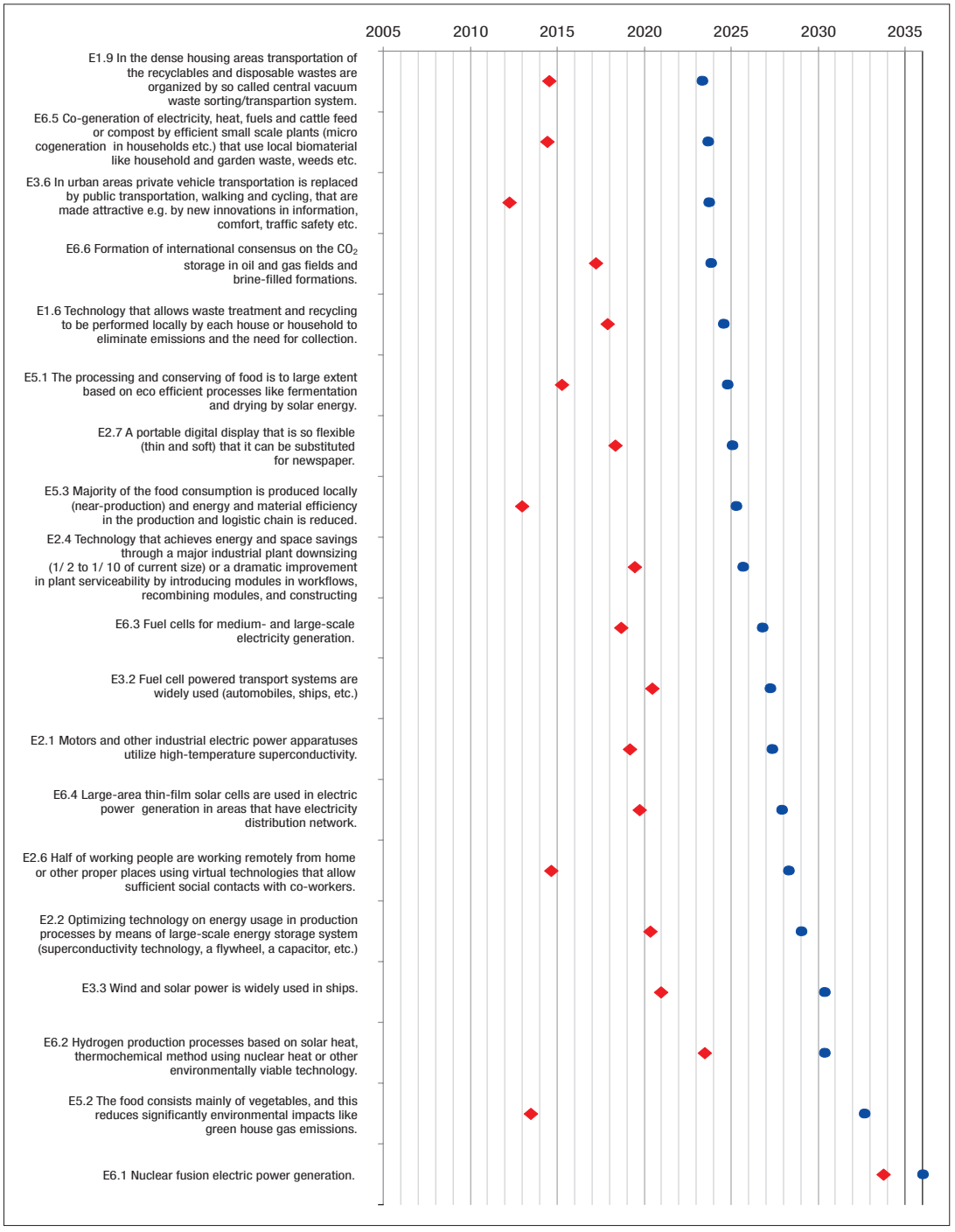
E1.3 A design scheme for civil engineering structures and buildings that adopts the concept of ife cycle assessment (LCA).
E1.10 Technology for the early detection of and response to large-scale forest fires around the world.
E1.2 Application of prediction and assessment technologies and processes in planning that are useful for the minimization of environmental burdens on spatial planning.
E1.5 LED-technology is the leading technology for lightning in homes, offices etc.
E4.4 Energy and material saving services offering companies (ESCO and MASCO) are commonly used in developing energy and material efficiency in industries, other business and public entities.
E4.6 All products include informative description covering information about production, material balances and emissions levels.
E4.2 Methodology for tracing and identifying materials suitable for recycling (plastics and metals).
E1.1 Smart homes and smart offices, in which electronics, media, and internet are seamlessly connected, and the system controls and optimises also lightning and temperature taking into account circumstances and need.
E2.9 Awareness of energy and material consumption and sustainability is raising and this leads to significant changes in energy consumption, energy production and energy and material saving through consumer choices and market demand.
E2.3 Development of alternative substances or processes for SF6 gas (sulfur hexafluoride; used e.g. cooling, insulating, and arc quenching in electrical equipment), which has been additionally listed as a regulated substance by the Kyoto Protocol
E1.4 Applying planning approaches and technological solutions reduce energy onsumption per capita in new housing areas (including heating, lightning, appliances, local transport of goods and people, etc.) in Finland by half.
E4.3 Consumers, companies and public purchasers buy services or lease or lend durables instead of purchasing material products.
E4.5Packaging of consumer goods is mainly based on reuse systems.
E1.7 Passive solar energy is used largely in housing.
E2.5 Most companies and public organisations, regardless of size, go paperless and improve productivity as well as energy and material efficiency through the digitization.
E2.8 Manufacturers' responsibility (producer responsibility) for collecting and processing of discarded products is defined by law, and reuse and recycling systems in which more than 90% of used material is reused or recycled become widespread in most pro
E3.1 The need for transportation of material and people is significantly decreased by the use of IT (like traffic demand management systems).
E3.5 Car sharing and other forms of joint use of cars are widely used in large cities.
E4.1 Extraction and separation technology of metallic elements based on biotechnology.
E1.8 New technology related to use of water (e.g. low water or waterless cleaning clothes, dish washing etc.) and in waste water systems lead to a significant reduction in the amount of waste water (prevention of waste water as a guiding principle)
E3.4 Common distribution systems across urban areas that reduce the urban traffic needs stemming from an increased volume of small-package deliveries due to the proliferation of e-commerce.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E1.9 In the dense housing areas transportation of the recyclables and disposable wastes are organized by so called central vacuum waste sorting/transpartion system.
E6.5 Co-generation of electricity, heat, fuels and cattle feed or compost by efficient small scale plants (micro cogeneration in households etc.) that use local biomaterial like household and garden waste, weeds etc.
E3.6 In urban areas private vehicle transportation is replaced by public transportation, walking and cycling, that are made attractive e.g. by new innovations in information, comfort, traffic safety etc.
E6.6 Formation of international consensus on the CO_2 storage in oil and gas fields and brine-filled formations.
E1.6 Technology that allows waste treatment and recycling to be performed locally by each house or household to eliminate emissions and the need for collection.
E5.1 The processing and conserving of food is to large extent based on eco efficient processes like fermentation and drying by solar energy.
E2.7 A portable digital display that is so flexible (thin and soft) that it can be substituted for newspaper.
E5.3 Majority of the food consumption is produced locally (near-production) and energy and material efficiency in the production and logistic chain is reduced.
E2.4 Technology that achieves energy and space savings through a major industrial plant downsizing (1/ 2 to 1/ 10 of current size) or a dramatic improvement in plant serviceability by introducing modules in workflows, recombining modules, and constructing
E6.3 Fuel cells for medium- and large-scale electricity generation.
E3.2 Fuel cell powered transport systems are widely used (automobiles, ships, etc.)
E2.1 Motors and other industrial electric power apparatuses utilize high-temperature superconductivity.
E6.4 Large-area thin-film solar cells are used in electric power generation in areas that have electricity distribution network.
E2.6 Half of working people are working remotely from home or other proper places using virtual technologies that allow sufficient social contacts with co-workers.
E2.2 Optimizing technology on energy usage in production processes by means of large-scale energy storage system (superconductivity technology, a flywheel, a capacitor, etc.)
E3.3 Wind and solar power is widely used in ships.
E6.2 Hydrogen production processes based on solar heat, thermochemical method using nuclear heat or other environmentally viable technology.
E5.2 The food consists mainly of vegetables, and this reduces significantly environmental impacts like green house gas emissions.
E6.1 Nuclear fusion electric power generation.

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Theme A)
Health care and Well-being to Prepare for an Aging Society

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Theme B)
Counsumers, media and digital convergence

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Theme C)
Energy and material efficiency

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