NEDO

focus NEDO

2020
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Reporting on Today and Tomorrow's Energy, Environmental, and Industrial Technologies

1st Featured Article

Catch Moves and Design Our Future

Technology Strategy Center

2nd Featured Article

Accelerating toward Commercialization!

Eco-friendly Smart Cell Technologies

New Energy and Industrial Technology Development Organization

Topic for this issue **Simplifying preliminary studies needed for industrial heat pump installations**

Development of Industrial Heat Pump Simulator to Quantitatively Assess Effectiveness of Installing Heat Pumps

Simplified data entry and operational features significantly reduce time and cost for preliminary studies of heat pump installations

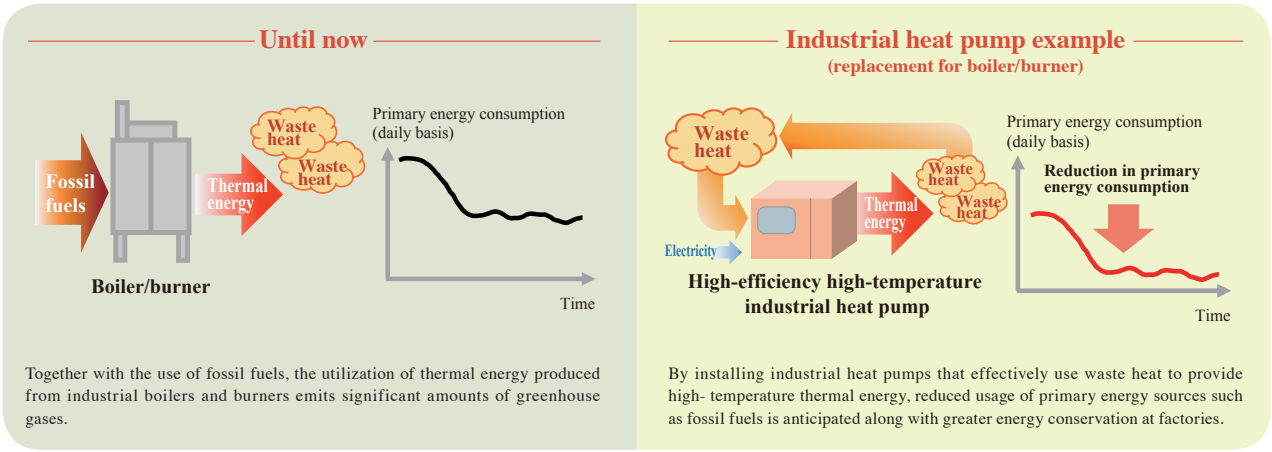
NEDO, the Thermal Management Materials and Technology Research Association (TherMAT), Waseda University, the Japan Research and Development Center for Metals, and Mayekawa Mfg. Co., Ltd., have developed an industrial heat pump simulator that can quantitatively assess the effectiveness of installing industrial heat pumps.

With its simplified data entry and operational features, this simulator can quickly and accurately estimate primary energy consumption and CO_2 emissions for heat pumps installed in factories, making it possible to significantly reduce the time and cost for preliminary studies of industrial heat pump installations. In the future, this simulator will be used to demonstrate in a concrete manner the effectiveness of installing industrial heat pumps, thereby supporting efforts to effectively utilize thermal energy, comprehensively conserve energy, and prevent global warming.

Scan below for September 9, 2020, Japanese press release with more details

https://www.nedo.go.jp/news/press/AA5_101353.html
(only available in Japanese)

Background regarding development of industrial heat pump simulators and this simulator



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Contents

Learn more about the industrial heat pump simulator!

Why is the industrial heat pump simulator needed?

Amidst growing demands for energy conservation, market introduction and expansion of industrial high-efficiency high-temperature heat pumps is being pursued. Such heat pumps can supply heat of up to 200°C by effectively utilizing waste heat that is not used in factory production processes and would otherwise be discarded into the environment. However, assessments for using industrial heat pumps are time-consuming and costly, and this has been a major barrier to their installation. For this reason, an industrial heat pump simulator has been developed that can quantitatively assess the impact of installing a heat pump and facilitate preliminary studies of its use.

What can the industrial heat pump simulator do?

Primary energy consumption and CO_2 emissions can now be quickly and accurately calculated with simple data entry and operational features, without having to acquire actual test data from industrial heat pumps in factories and other facilities.

How will the simulator be used in the future?

The simulator will be used to concretely demonstrate the impact of installing industrial heat pumps. The simulator will also be enhanced as a tool to facilitate the design and engineering of the entire production process and is planned to be released to the public.

Visualization showing impact of installing heat pumps

Rated heating capacity
High-temperature side feed water temperature
High-temperature side supply temperature
High-temperature side flow rate
Low-temperature side feed water temperature
Type of refrigerants

Inputs

Consideration of fluctuating loads

Industrial heat pump simulator

Outputs

- **Amount of primary energy consumption**
- **Comparison of CO_2 emissions**

This simulator enables energy managers to calculate primary energy consumption and CO_2 emissions by a simple operation without obtaining test data for industrial heat pumps in the factory and enables quantitative assessment of effectiveness prior to installation. In addition to comparing boiler/burners and heat pumps, it is also possible to compare performance between heat pumps.

Note: To prevent the spread of COVID-19, persons appearing in photos wore facial coverings except during the time photos were taken.

Reporting on Today and Tomorrow's Energy, Environmental, and Industrial Technologies

"Focus NEDO" is the public relations magazine of the New Energy and Industry Technology Development Organization (NEDO), introducing the public to NEDO's various projects and technology development activities related to energy, environmental, and industrial technologies.

Please let us hear your views!
Reader Questionnaire

We welcome your feedback and opinions on the content and technologies introduced in this magazine. Your feedback will be used for reference purposes in our future public relations activities and magazine publications. We look forward to hearing from you!

(only available in Japanese)

A Few Words from the Editor

As the impact of the COVID-19 pandemic continues to be felt, an important consideration is how to identify and respond to changes in society. In the 1st Featured Article, we present an interview with Dr. KISHIMOTO Kikuo, who was appointed Executive Director of the NEDO Technology Strategy Center (TSC) in April 2020 when the impact of the pandemic began to take hold and highlight the TSC report on COVID-19. In the 2nd Featured Article, we introduce the results of NEDO's Smart Cell Project. The commercialization of this project's results is accelerating and the number of project-related tools which many people can use is also increasing. In the opening section, we describe the development of a simulator that is helpful in considering whether to install a heat pump to address environmental issues. Also be sure to check out our selection from NEDO Success Stories, profiles of up and coming startups, the video on the back cover, and more!

Catch Moves and Design Our Future

Technology Strategy Center

Japan is facing major social change due to the impact brought about by the COVID-19 pandemic.
In this context, we asked the NEDO Technology Strategy Center (TSC) about its perspectives on how to further promote future innovation and what role it should play.

Interview with TSC Executive Director

Outlook for the TSC in a New Era

Dr. KISHIMOTO Kikuo
Executive Director, NEDO Technology Strategy Center

Born in 1952 in Tokyo, Japan, Dr. Kishimoto received the following degrees from the Tokyo Institute of Technology: a bachelor's degree from the School of Engineering in 1975, an M.S. in mechanical engineering in 1977, and a Ph.D. in engineering in 1982. After serving as a visiting scholar at the University of Cambridge, he became a professor at the Tokyo Institute of Technology in 1995, continuing his career as Vice-President in charge of academic operations, Dean of the Graduate School of Science and Engineering, and Dean of the School of Environment and Society. He has been a Professor Emeritus since 2018. Dr. Kishimoto has served as President of the Japan Society of Mechanical Engineers as well as President of the Japan Federation of Engineering Societies, and in 2020, he was appointed to the position of Executive Director of the NEDO Technology Strategy Center.

TSC, an organization with a diverse mix of human resources

You were appointed as Executive Director of the TSC in April 2020. What were your initial impressions and goals for TSC?

NEDO is celebrating its 40th anniversary in 2020. Under its missions of "solving energy and global environmental problems" and "strengthening industrial technology capabilities," NEDO has promoted innovation through management of the government, industry, and universities for many years. Even before taking office, I was aware that TSC has a very important role to play in the realization of NEDO's missions.

In fact, immediately after assuming office, I realized that TSC is expected to formulate technology strategies in a range of medium- to long-term perspectives and formulate plans for implementation of those strategies, while identifying important fields of technology development that the government should handle. I also realized that TSC is expected to contribute to the formulation of important national policies. Furthermore, as society becomes more complex, I realized there are some needs to be more sensitive to social moves and to stimulate discussion by disseminating information. For these reasons, starting this fiscal year, we have redefined the mission of TSC as "Catch Moves, Design Our Future and Show Strategies Forward." We will continue to strengthen cooperation with the policies of the Ministry of Economy, Trade and Industry (METI) and other ministries and agencies, and emphasize actionability while firmly fulfilling our expected role.

What are your impressions of your new position so far?

Everything was new to me. The TSC office is open with no fixed seating arrangement, and we have a diverse group of employees with a wide range of backgrounds and expertise, including employees from companies, other public institutions, and those temporarily transferred from government agencies. It's a very lively workplace, where people constantly conduct research and are very interested in new things. I am also inspired every day by the way in which they strive to resolve social issues through lively and energetic discussions while successfully integrating the views of many stakeholders.

Was there anything particularly impressive to you?

When I became Executive Director in April 2020, it was just when social changes caused by the COVID-19 pandemic were starting to become apparent. So, soon after I assumed my position, I organized a special team within TSC to collect and analyze information from Japan and overseas, such as on the impact of the pandemic on society and industry. The team was charged with determining the impact of the pandemic, describing the post-pandemic society, and specifying promising areas for innovation. In June 2020, after subsequent discussions among industry, academia, and government, TSC released a report entitled "Social Changes and Promising Innovations in the Post-COVID World" (hereinafter the Brief Report of Post-COVID World).

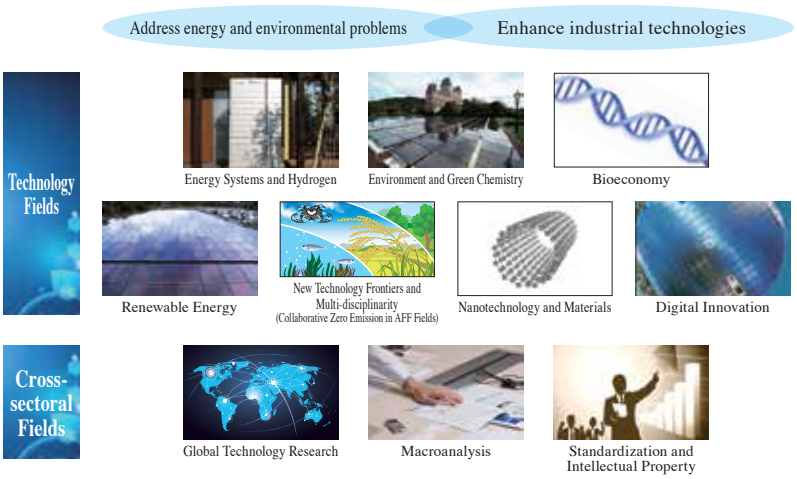
The outbreak of COVID-19 is indeed an opportunity to raise

TSC website
https://www.nedo.go.jp/activities/tsc_index.html
(only available in Japanese)

TSC Mission

Catch Moves, Design Our Future and Show Strategies Forward

TSC areas of focus



public awareness of the uncertainties associated with an accelerating society. I believe that for such a society, it is important to establish a framework to learn from the multiple challenges of various hypotheses and apply them to upcoming challenges. Because TSC is an organization which brings together diverse human resources, I believe that it can demonstrate its capabilities and strength even in this increasingly uncertain world.

Information dissemination generates discussion

Because of the uncertain social situation, the June release of "Brief Report of Post- COVID World" was certainly meaningful. Is this understanding correct?

The report presents an image of promising innovations for realizing digital transformation which are receiving attention due to the pandemic, as well as an image of promising innovations that is expected to transform into a sustainable society. The Digital Innovation Unit at TSC took the lead, with the support of the Global Technology Research Unit, Macroanalysis Unit, as well as other relevant units. I believe that the TSC's organizational flexibility has allowed us to rapidly embody our new mission of grasping social change more proactively and quickly than ever before.

With the release of this report, we have received considerable feedback not only from METI, but also from private companies, the Engineering Academy of Japan, the Japan Society of Mechanical Engineers, and various other organizations in industry, academia, and government. We believe the significance of information dissemination lies in our efforts to engage in collaborative discussions which are the source of the next challenge. In the future, I think it's important for TSC to continue to actively disseminate ideas for consideration both inside and outside our organization, encourage further discussion and foster an environment where everyone can work together to address new issues.

Looking ahead, what are your thoughts regarding coordination on policies related to formulating future technology strategies and implementing the proposals?

For the social implementation of technology development results, it is important to coordinate on policy. In February 2020, the TSC formulated the "Comprehensive R&D Principle for Sustainable Society 2020". This principle was formulated in response to the "Beyond Zero" initiative for reducing CO_2 emissions to practically zero by 2050, which was proposed in the Japanese government's "Environment Innovation Strategy" released in January 2020, and provides an indication of technology development and future directions NEDO should pursue.

The principle proposes the integrated and organic promotion of three social systems, "Sustainable Energy," "Circular Economy," and "Bioeconomy," and, when considering how best to realize reduced CO_2 emissions by 2050, advocates comprehensive and objective evaluations of CO_2 emissions reduction technologies. In order to realize the three social systems described in the principle, it is important to not only develop technology, but also develop research systems and environments, and provide various support measures for social implementation. The TSC will continue to coordinate with policies to realize these systems.

Please tell us about future prospects for TSC activities.

In publishing the Brief Report of Post-COVID World, we held numerous dialogues with various people inside and outside of NEDO and received many suggestions. In the future, the TSC will, while being sensitive to social changes, continue to develop new visions for innovation and the realization of social systems, through discussions with a wide range of stakeholders. In addition, during the social implementation phase, it is essential to communicate with the general public and gain trust in the technologies being introduced, through providing information based on solid evidence. With this in mind, we will do our utmost to ensure that our activities are firmly linked to NEDO's technology development projects and other practical proposals which will lead to the creation of future innovations.

TSC Foresight Brief Report

Social Changes and Promising Innovations in the Post-COVID World

A special TSC team was established in April 2020, to prepare the report “Social Changes and Promising Innovations in the Post-COVID World” which was released in June 2020.
In this section, we summarize the report which describes the importance of social changes and the promotion of digitalization for the revival of Japanese industry in the aftermath of the COVID-19 pandemic.

Scan here for TSC Foresight Brief Report (only available in Japanese)

https://www.nedo.go.jp/library/ZZNA_100039.html

Social changes brought about by COVID-19 pandemic

A report which captures social changes and connects them to the future

As the impact of COVID-19 continues, a "new way of life" is needed to continue economic activity while preventing spread of the disease. In June 2020, NEDO released its report “Social Changes and Promising Innovations in the Post-COVID World,” which looks back at the foundation of social activities prior to the pandemic and identifies what should be done to develop technologies needed by society in the future.

ITOH Satoshi, Director General of the TSC Digital Innovation Unit who prepared the report, says, "It is difficult to predict when the pandemic will end, but we believe that digitalization is important regardless of the scenario. We summarized the social changes which many people are vaguely aware of, and have made the information available to the public, so that they can understand these changes and become motivated to tackle new initiatives to generate innovation.”

New visions of society and social values have gradually become clearer to us, through the compilation of predictions regarding social changes made by 120 experts from Japan and overseas who provided their views regarding the current situation, post-pandemic society, and promising innovations for the post-pandemic society.

Specific examples are presented under the following six themes: digital shift, political frameworks and international conditions, industrial structures and corporate actions, moving from centralization to decentralization, individual behavior, and awareness of environmental issues.

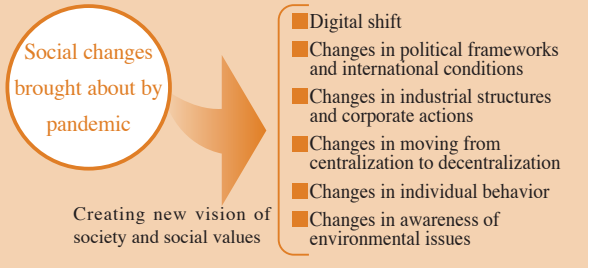
Opening doors to new innovations

MONKAWA Akira, a Director in the TSC Digital Innovation Unit who led the preparation of the report, says, “It is easy to talk about digitalization, but that does not mean you can use the system as soon as it is introduced. The challenge is to find out which parts of data can be extracted as digital data, and how to analyze extracted data to improve productivity and create new value. On the other hand, once you enjoy the convenience, there is no turning back. We anticipate that social change will accompany digital transformation.” As contact-free situations are increasingly pursued, Monkawa adds, “It's also important to be thoroughly digitalized and, conversely, to know what can't be digitalized. In Japan, where digitalization lags behind the rest of the world, I think this is a great opportunity to take on new challenges without being constrained by the existing framework. I hope that not only large companies, but also other companies, such as small and medium-sized startups, will participate and create new innovations.”

ITOH Satoshi
Director General, Digital Innovation Unit
NEDO Technology Strategy Center

MONKAWA Akira
Director, Digital Innovation Unit
NEDO Technology Strategy Center

Six social changes expected in the future



Concrete examples of changes leading to digitally enabled cities

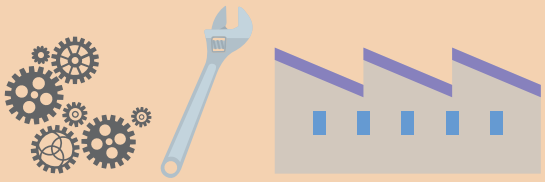
Remote/online systems

Medical care/disease prevention

- ☑ At present, limited medical resources need to be focused on COVID-19
- ☑ Urgent need for disease prevention measures using IT, AI, and sensing technologies
- ☑ Advances in telemedicine

Workplaces/industry

- ☑ Increasing operational efficiency through advanced technologies
- ☑ Competitive recruiting and supply chain changes
- ☑ Accumulation of small and medium-sized enterprises and smartification

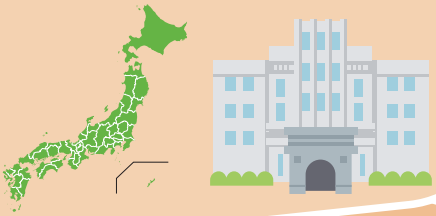


Educational/household

- ☑ Educational disparities diminish with introduction of online classes
- ☑ Childcare is challenge for households where telework is not possible

Government

- ☑ Expanded/strengthened powers needed by municipalities and prefectural governors
- ☑ Government operations need to accommodate shifts to telework



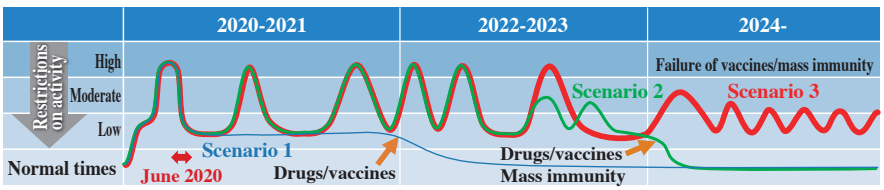
Urban changes

- ☑ Shift from centralized to decentralized/networked offices, factories and cities
- ☑ Optimizing energy through use of renewables and power visualization to improve stable supply of power and resilience


Image of digitally enabled cities

Changes related to digital transformation expected in post-COVID society

From the perspectives of drug and vaccine development and the acquisition of mass immunity, the report puts forward three scenarios regarding when the COVID-19 pandemic will come to an epidemiological conclusion, indicating under each scenario responses to the disease and impacts on society. In all three scenarios, the TSC predicts that the progression of digital transformation, which offers effective contact-free technologies for disease control, will be central to the social changes anticipated in the future.



	Responses to COVID-19	Impacts on society
Scenario 1	· Fewer cases of new outbreaks · Vaccine development in 1-2 years (predicted for winter 2021) · Recovery with medication possible (improvement with initial administration) ⇒Economic activity like pre-COVID period, lifting of international travel restrictions	Limited impacts on work/school Progression of digital transformation faster than before V-shaped economic recovery expected Social changes inevitable
Scenario 2	· Outbreaks continue for about 2-3 years · Development of drugs and vaccines or attainment of mass immunity after 2-3 years · Continued intermittent restrictions on economic activity ⇒Economic activity returns to pre-COVID levels in 5 years and globalization retreats	High impacts on work/school Progression of digital transformation accelerates Economic downturn leading to global depression Social changes occur rapidly
Scenario 3	· Outbreaks continue · Virus strengthens and persists in body like HIV and herpes viruses =Failure to develop drugs and vaccines and attain mass immunity ⇒"New normal" established with new policies for economic activity	Work/school-related activities conducted online Introduction of digital transformation: progression in many fields Economic downturn, political regime changes Social changes occur rapidly and continue

TSC Foresight Brief Report Social Changes and Promising Innovations in the Post-COVID World

Promising Innovations in the Post-COVID World

Digital shift

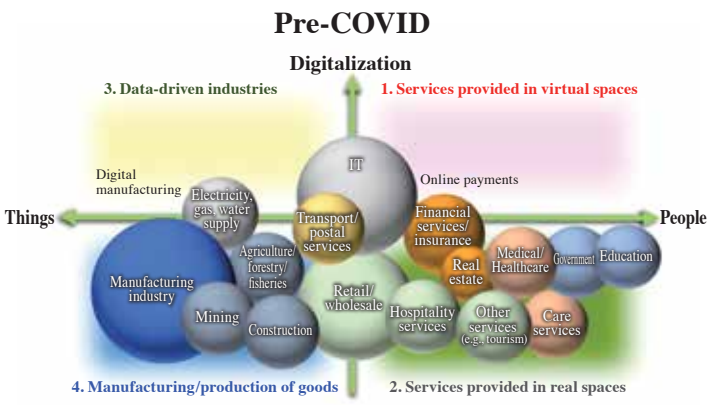
The TSC has identified the "digital shift" as a key trend related to promising innovations in the post-COVID world.

As a result of work summarizing future needs and technologies related to changes anticipated in various fields over the next 10 years, a digital shift, including remote/online operations, decentralization, automation, and labor reduction, has emerged as common elements across the fields of medical care/disease prevention, work/industry, education, and government/cities.

The TSC has identified common technologies essential for realization of a digital shift as technologies necessary for creating innovation. These are, respectively, online communications: required for telework, remote learning, and telemedicine; virtual reality: required for virtual meetings and online events; and reliability/security: required for technologies related to contact-free interactions. The TSC expects that these technologies will become commonplace for children, the so-called digital natives, who have experienced going online during the pandemic.

These technologies are expected to be used to create innovation.

Digitalization progressing in industrial field



Industry sectors categorized according to degree of relationship between people and things and progress of digitalization.

In the industrial field as well, a major post-COVID development will be digitalization in various sectors. The diagrams on the left and below divide industry into four categories: 1. services provided in virtual spaces; 2. services provided in real spaces; 3. data-driven industries; and 4. manufacturing/production of goods. The diagrams show the overall shift to digitalization and the differences in the image of innovation for each category.

The diagrams' vertical axes show the level of digitalization, with things and humans depicted on the horizontal axes, which are broadly divided according to whether the sectors depicted are involved in producing goods or providing services to people. The size of the spheres is based on the approximate total market size for that sector. In goods-based industries, such as those in category 4, the fusion of digital and analog is the key to innovation.

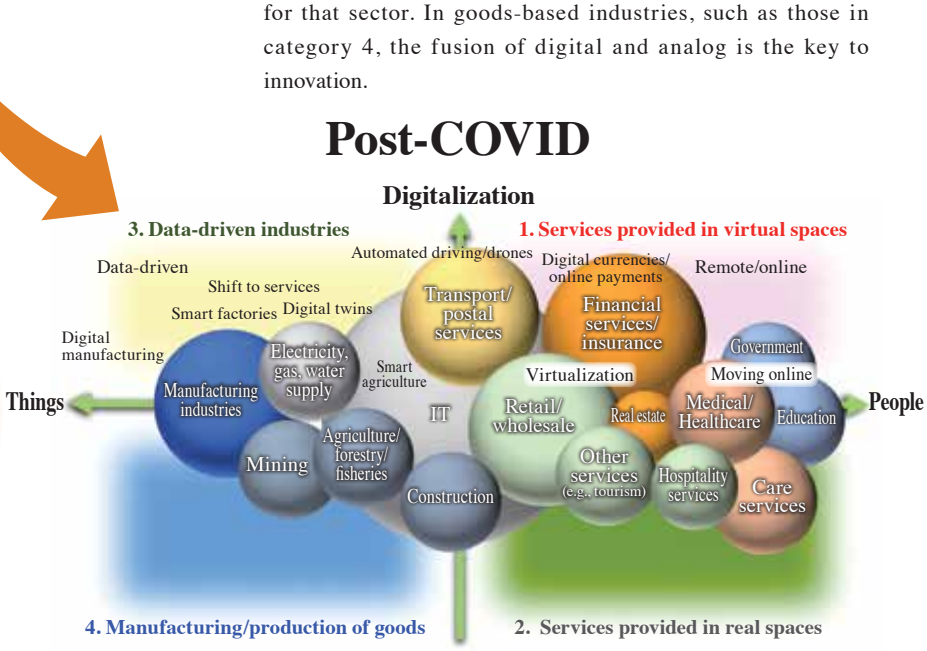
Changes in industrial field pre-/post-COVID

Pre-COVID

In all four categories, the degree of digitalization progress was lagging. The use of digital technologies in manufacturing and online payments attracted considerable attention.

Post-COVID

All sectors are becoming more or less digitalized. As a result, differences in the level of innovation needed under each category have become clearer.



Note: The above are Japan Standard Industrial Classification expressions. Keywords related to digitalization are listed in each quadrant (e.g., digital manufacturing).

Examples of digitalization

■Reduced labor needs for more efficient manufacturing

In manufacturing, digitalization will help reduce needs for labor. The core technologies are both autonomous controls using artificial intelligence and telexistence,* which involves using remote control technology and avatar robots. The use of these technologies is expected to improve production efficiency and enable competition with industries that employ low-cost overseas labor. These technologies make significant contributions to hygiene management in food processing plants and enable individuals to work at multiple manufacturing sites at the same time, making it possible to balance work with child and nursing care and to utilize the work experiences of senior citizens.

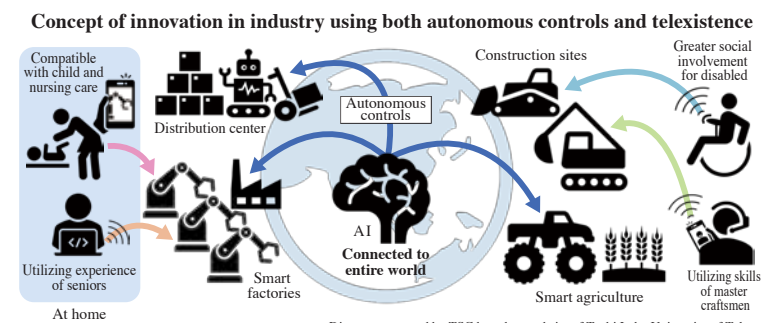


Diagram prepared by TSC based on website of Tachi Lab., University of Tokyo.

Reduced needs for labor in manufacturing and production sectors, due to autonomous controls and digitalization, such as telexistence. Involvement in manufacturing operations regardless of physical limitations increases production efficiency.

*Telexistence refers to freeing people from conventional space-time constraints and allowing them to perform effectively in remote environments.

■Restructuring food logistics operations to address environmental problems

The food supply chain needs to restructure its resilience against epidemics and natural disasters. This requires cold technologies such as Cells Alive System (CAS) and other non-conventional freezing technologies, as well as technologies that enable food stockpiling, such as aging technologies to extend the shelf life of food products. With the growing trend toward reducing food waste around the world, expectations are growing for creating systems that move away from mass production and consumption. Powerful lockdown experiences during the pandemic have accelerated such reconsideration of conventional ways of life.

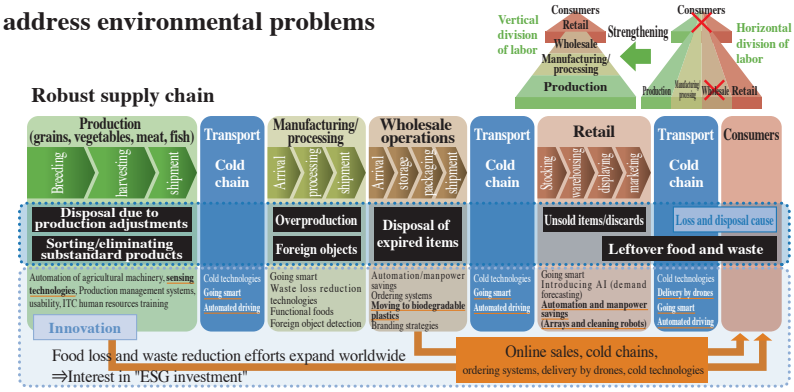


Diagram created by TSC using materials prepared by NEC

The structure of production, manufacturing/processing, wholesaling, and retailing has changed from a traditional horizontal division of labor to a vertical division of labor. Expectations are high for restructuring a robust supply chain and returning domestic operations to Japan, where efficiency and optimization are balanced with safety and reliability.

KEY POINT
Key point

Keys are "digital" and "resilient transformation"

To realize promising innovations in post-COVID society,
the comprehensive power of integrated Japanese technologies is a strength.

Innovations to realize positive changes in society

The COVID-19 pandemic has been the inevitable catalyst for the transition to a new society and has provided the opportunity to rethink all things previously assumed to be normal. Significant changes in our thinking about close communications and supply chains are required, and the spread of digital technologies to various sectors is also helping facilitate the transition to a new society. TSC believes that promising new innovations are essential for the realization of positive changes in society and will lead to the revival of Japanese industry.

The pandemic has necessitated that many areas of activity go online. In the business world, meetings, which normally took place face-to-face, and long-used physical objects once considered essential, such as business cards and document stamps, are now being replaced with digital counterparts. In the future, we hope that exhibitions and lecture meetings can also be conducted virtually.

Integrating digital with existing strengths

Japan's digital technologies, which on their own have lagged behind the rest of the world, can be leveraged in combination with Japan's strengths, such as water treatment and other technologies to reduce environmental impacts, as well as the high-precision manufacturing industry. Building a "resilient" energy society that grows by turning crises into increased resilience and by creating robust supply chains are also goals. Furthermore, TSC believes it is possible to realize" digitally enabled cities" equipped with infrastructure that supports technologies such as 5G and makes maximum use of digital technology through the integration of Japanese technologies. By collaborating with the public and private sectors to propose social infrastructure systems that match the realities of each country, we believe that societies stricken by the pandemic can receive courage and vitality.

TSC Foresight Brief Report **Social Changes and Promising Innovations in the Post-COVID World**

TSC Foresight Online Seminar Report

Towards "New Normal" After Pandemic

The 2020 NEDO TSC Foresight Online Seminar was held in July 2020. In the next section, we report on the panel discussion at the seminar with panelists offering various viewpoints on the questions, "What will be the 'new normal' after the COVID-19 pandemic?", and "What kinds of innovation should be pursued?"

Scan below for videos from the seminar

Brief Report of Post-COVID World

Panel discussion

(only available in Japanese)

Discussion on new normal after the pandemic, focusing on three topics

The first half of the discussion focused on two topics, "What kinds of innovation should be pursued?" and "What is the best way to accelerate this process?" The second half focused on the topic "What should Japan do in this context?" TSC Executive Director KISHIMOTO Kikuo moderated the discussion, with participation by TSC Unit Director Generals ITOH Satoshi and MORITA Kentaro. Three outside experts participated: KOBAYASHI Tetsuhiko, a Fellow at the National Institute of Advanced Industrial Science and Technology (AIST), YANO Kazuo, a Fellow at Hitachi, Ltd. (participating online), and Professor HATANO Mutsuko of the Tokyo Institute of Technology's School of Engineering.

Kishimoto: First, let me ask for your views regarding what kinds of innovation should be pursued, from the viewpoints of digitalization and environmental challenges.

Hatano: I believe that spiritual and social enrichment and a sense of humanity will become more important in the future. From an educational point of view, we want to develop students who are inclusive. But nowadays, online classes do not allow us to grasp the level of understanding or feelings of the students. With the increasing importance of real-world contexts, I feel that highly sensitive technology will be necessary in the future.

Yano: Compared to the time prior to the COVID-19 pandemic, the importance of communication and the need for people to work vigorously and happily has increased dramatically. More than 90 percent of instinctive human behavior and communication is non-verbal, but nowadays non-verbal communication cannot be easily grasped online. In the future, I think it will be important to incorporate non-verbal information into IT systems.

Itoh: In order to achieve close connections in cyberspace

while maintaining physical distance, it is necessary for IT to capture and correctly communicate what cannot be felt directly. It's important for such systems to recognize people's sensitivities and feelings digitally, and I believe that the importance of sensors and systems that analyze and communicate these sensitivities and feelings will also increase.

Kobayashi: As for environmental challenges, with growing concerns about climate change, the economic burdens of the pandemic are enormous, so we need to appeal for strengthened social governance and the inclusion of environmental issues as well. I also believe that the role of connecting the global research community with industry will be important for addressing environmental issues.

Panel discussion conducted using transparent acrylic partitions placed between speakers to prevent spread of virus

Moderator **KISHIMOTO Kikuo**
Executive Director
NEDO Technology Strategy Center

Appointed TSC Executive Director in April 2020 and soon after led effort to prepare and release TSC's Brief Report of Post-COVID World.

Panelist **ITOH Satoshi**
Director General
Digital Innovation Unit
NEDO Technology Strategy Center

Itoh took the lead in preparing the Brief Report of Post-COVID World, capturing the social changes that have taken place since the start of the pandemic and describing innovations expected in the future.

Kishimoto: What are your views on innovative ideas that will accelerate the establishment of a new society and efforts to increase the level of competition for knowledge?

Hatano: I think Japanese students can be more active globally. I hope the pandemic will lead to the development of more people who have high-level perspectives, who are not constrained by common sense, and who can play an active role regardless of the field. I think we need those kinds of abilities, and a society that embraces them, to lead the world in the future.

Yano: The reason why innovation is difficult to produce among already existing Japanese companies is that, even though they have many talented employees, there is a problem with their system. As noted in Drucker's book, new businesses need to take an approach diametrically opposed to that for existing businesses. It's logical for them to have a system that is highly independent, agile, and can be used to some extent in conjunction with the resources of large companies.

Kobayashi: In the environmental energy field as well, I think the pandemic will further advance digitalization. However, digital technologies are not understood in detail by many people working in the energy sector. For digitalization, which will probably continue accelerating more and more, I believe a mechanism is necessary to fill the gaps for those who want to use these technologies but don't understand them very well.

Itoh: In order to realize innovative ideas likely to emerge in the future, I believe it's important to not only develop technology, but also learn from testing conducted in real-world settings, provide feedback on the testing results, and then connect these results to next steps.

Kishimoto: Finally, looking toward the establishment of a "new normal" society, what are your views regarding how best to create mechanisms that leverage and exploit Japan's strength?

Hatano: Japan is still very strong in manufacturing technologies, especially in fields that require reliability. I think it is a matter of creating new value by making the most of these strengths and proactively integrating them, regardless of the field.

Yano: Japan's greatest strengths are its still-dormant assets and human capital. To capitalize on these strengths, it is important to maintain the cycle of innovation, marketing, and operations, as well as pursuing experimentation and learning. We also need to change organizations and human resource development methods to make this happen. I hope that we will see a trend of investment in these areas.

Kobayashi: I think Japan has been a leader in my fields of interest, namely hydrogen, batteries, and fuel cells. From a global viewpoint, however, it is sometimes said that momentum toward social implementation in these fields has been lacking. By connecting Japanese industry with global technology developments, I believe AIST can help industry take better advantage of its strengths.

Morita: In collecting information from overseas, I myself do not feel pessimistic about the current situation in Japan. For example, economist Jacques Attali has said that Japan possesses a more or less complete supply chain with no noteworthy vulnerabilities, so, the COVID-19 pandemic will provide Japan with an opportunity to enhance its power relative to the rest of the world. I therefore don't see the future as being bleak at all.

Itoh: I believe promoting areas where digitalization is not progressing is also effective and integrating more advanced areas will realize digitalization at the city level which tourism, value has been discovered in real-world sites and I think value is created by skillfully utilizing and marketing this in cyberspace.

Kishimoto: Thank you all very much. Japan has the human resources, technologies, and potential in various forms to move forward into the "new normal" era. I believe that if we take advantage of these things, we should be able to create a new society that will become a strength for Japan. To achieve this, experimentation and learning are necessary, and I believe the TSC's role is to formulate projects that will create opportunities for such experimentation.

Panelist **MORITA Kentaro**
Director General
Global Technology Research Unit
NEDO Technology Strategy Center

Morita is examining activities related to technology, innovation, environment, and energy in countries around the world since the declaration of the pandemic by the WHO.

Panelist **KOBAYASHI Tetsuhiko**
Fellow
National Institute of Advanced Industrial Science and Technology (AIST)

One of three members serving on the Post-COVID Review Council, established in June 2020 by AIST Kansai.

Panelist **YANO Kazuo**
Fellow
Hitachi Ltd.

CEO of Happiness Planet, a company established by Hitachi Ltd. in July 2020 to bring people happiness through technology solutions.

Panelist **HATANO Mutsuko**
Professor
Department of Electrical and Electronic Engineering, School of Engineering Tokyo Institute of Technology

Worked at Hitachi Ltd. for 27 years and is currently a university professor. Research interests include quantum sensors and quantum light sources for quantum networks.

Accelerating toward Commercialization!

Eco-friendly Smart Cell Technologies

NEDO's Smart Cell Project aims to realize a smart cell industry, an eco-friendly industry utilizing smart cells that maximizes the material production capacity of plants and microorganisms. The project has developed numerous technologies and applications over the past five years. This section introduces the results of this remarkable project, which can help contribute to the development of pharmaceuticals and the creation of a sustainable society.

NEDO Smart Cell Project

https://www.nedo.go.jp/activities/ZZJP_100118.html
(only available in Japanese)

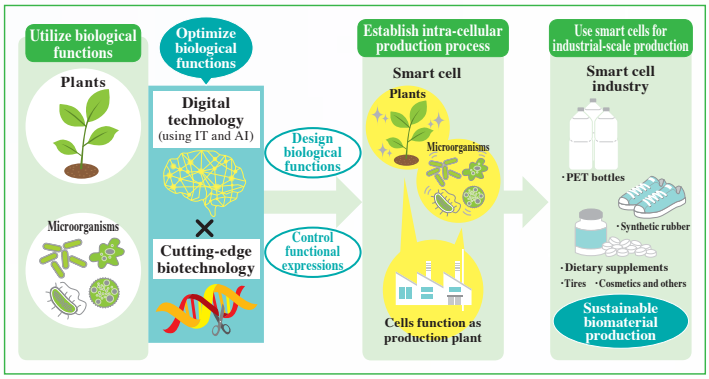
Utilizing digital technologies to create highly functional biomaterials

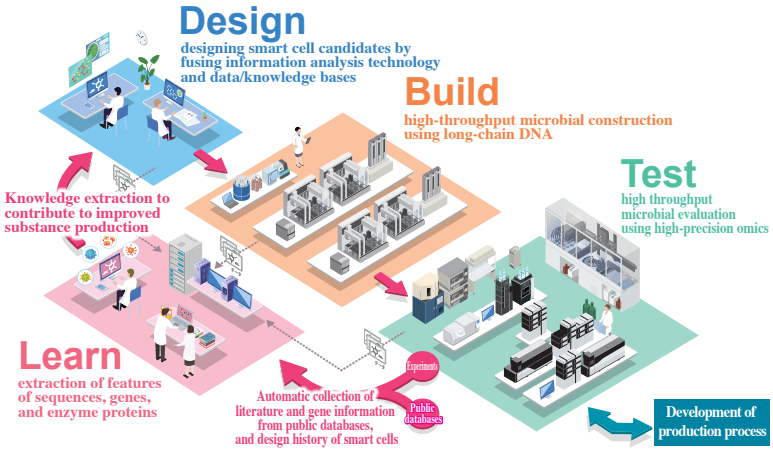
As part of its efforts to address global issues such as climate change and resource depletion and at the same time foster economic development, NEDO has been pursuing the Project for Development of Production Techniques for Highly Functional Biomaterials Using Smart Cells of Plants and Other Organisms (known as the Smart Cell Project) for five years from 2016 to 2020, with the aim of creating a bioeconomy and realizing a carbon-recycling society.

This project develops technologies that allow cells to function like factories for the production of biomaterials by designing biological functions in plant and microbial cells and controlling the expression of functions based on that new design. Specifically, technology development is taking place in the following areas: information analysis to enable rational designs, genome editing techniques developed in Japan that are easy for industry to utilize, and expression controls to maximize production capacity for biomaterials.

In the field of plants, advances in the development of genome editing technologies and cultivation/growth environment control technologies are expected to enable the efficient production of plant-derived substances that have been chemically synthesized in the past or that could only be collected in minute quantities. In the field of microorganisms, a design, build, test, learn (DBTL) cycle has been developed that utilizes information analysis technology. Experimental data can be used to solve problems in areas such as the production of new compounds and the improvement of productivity/functionality for useful compounds.

Conceptual diagram of NEDO project





NEDO Materials Technology and Nanotechnology Department, Bioeconomy Promotion Division (from rear left)
Technical Researcher TAKATSUKI Kenichi, Project Coordinator TSUCHIYA Hirofumi, Technical Researcher ITO Masato, Project Coordinator KANEDA Koichi, Project Manager HAYASHI Chikako, Technical Researcher AKIBA Yukinori

Acting as Bridge to Bring Project Knowledge and Technologies to Industry

NEDO conducts research and development on the premise that it will eventually be applied in industrial settings, so the knowledge and technologies developed under the Smart Cell Project over the past five years are being made available to the public in a variety of ways. NEDO has produced a video that explains the concepts underlying the project and the technologies being developed in an easy-to-understand manner. We also introduce two websites established for public outreach regarding the use of technologies developed under the project.

Video demonstration of Smart Cell Project

Smart cell industry shaping future with bio and digital technologies

On the NEDO Channel, companies and researchers who would like to contribute to the realization of a sustainable society by getting involved in the smart cell industry can view a video explaining how to use the "Smart Cell Creation Platform" created as a result of research carried out under this project. Through this video, the public can learn how to consider the use of smart cells in specific business applications and how microorganisms that produce eicosapentaenoic acid (EPA), a substance beneficial to human health, are produced, thus providing an example of the "smart cell industry" increasingly expected to become a next-generation industry.

Smart cell industry shaping future with bio and digital technologies

(only available in Japanese)

Discover new possibilities of using information analysis technology in production of useful biomaterials.

Public outreach on technologies to support development of smart cell industry

A variety of public outreach outlets have been established to provide basic information about smart cells, information for networking and for researchers who possess smart cell- related technologies, information for those considering the use of smart cells in business, and information for consultations regarding smart cell research.

Smart cell creation platform technology aggregation website

The website of the Japan Bioindustry Association (JBA), which participated in this project, provides a wide range of information, including introductions of individual technologies and many kinds of seminars, so that project results can be applied in a wide range of industries. JBA has also established an information desk so people unfamiliar with the biotechnology industry can reach out freely for consultations. The information desk was created to support both people with specific issues to resolve as well as those who are unsure what information they need.

Homepage introducing basic technologies for producing smart cells and case studies of applications

Official webpage for NEDO Smart Cell Project

https://www.jba.or.jp/nedo_smartcell/

(only available in Japanese)

Genome editing technology aggregation website

The website for the Genome Editing Industrial Network shows the genome editing technologies developed under the NEDO Smart Cell Project. The site includes overviews and information on project results, as well as information on challenges for commercialization and technologies that are available. In addition, the site can be used to facilitate the creation of networks for researchers and research institutions, and features videos that explain the basics of genome editing in an easy-to-understand manner, a map of genome editing technologies, and links to Japanese genome editing projects and startups.

Website established to convey results of Japanese genome editing technologies in easy-to-understand manner

Official website of Genome Editing Industrial Network

https://www.mls.sci.hiroshima-u.ac.jp/smg/GEIN/en/catalog/index.html

Harnessing Power of Living Cells Smart Cell Case Studies

The NEDO Smart Cell Project has developed a variety of technologies by merging digital technologies with cutting-edge biotechnologies. In this section, we highlight four case studies, two concerning microorganisms and two concerning plants, that are close to commercialization. The Smart Cell Project Achievements pamphlet describes other research and development work conducted under this project.

Pamphlet describing results of work conducted with companies and universities across Japan

Over a period of five years, four types of research and development have been carried out under this project: development of basic technologies for bio-production using plants, development of high-performance product production using plants, development of information analysis systems for the creation of highly productive microorganisms, and development of production technology for high-performance products using microorganisms. In this pamphlet, these R&D themes are divided into "common platform technology" and "verification of platform technology in material production," and an overview of the technologies and related information is presented.

Smart Cell Project Achievements pamphlet available on NEDO website

https://www.nedo.go.jp/library/pamphlets/ZZ_pamphlets_00054.html

(only available in Japanese)

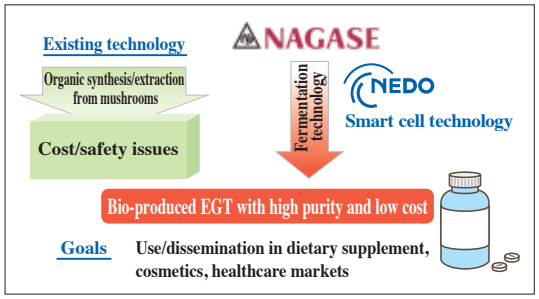
Utilizing functions of microorganisms

CASE 1 Nagase and Co., Ltd.

Eco-friendly low-cost mass production of rare amino acid called "vitamin of longevity"

Low-cost mass production of ergothioneine (EGT) through production method that incorporates fermentation technology

Although the rare amino acid EGT is a strong antioxidant with high expectations for its use in healthcare and other settings, its production from natural sources is low, and its high production costs and chemical synthesis process have been challenges up to now. By utilizing smart cell technology, however, a microorganism has been created that can be stably produced at low costs with minimal environmental impacts. The development of a fermentation process for mass production is now underway.



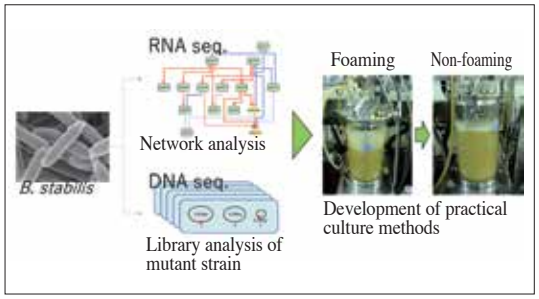
Developed high-throughput microbial creation and evaluation technology that allows for culture evaluation of thousands of strains per week, and succeeded in obtaining highly reactive, highly functional enzymes.

CASE 2 Asahi Kasei Pharma Corporation

Innovation in cholesterol esterase production to meet increasing demand

Extending seemingly limited capabilities of industrial microorganism used for 30 years

The enzyme cholesterol esterase is most often used in measurement kits for blood cholesterol. Produced by industry for 30 years using microorganisms, it has been considered difficult to make its production more efficient. A new production method derived from the DBTL cycle combined with smart cell technology was tried, however, and the productivity of the enzyme was improved. Information technology has yielded results that go beyond human understanding.



By using information technology to analyze how enzymes are produced in cells of microorganisms, a different way to culture them has been discovered.

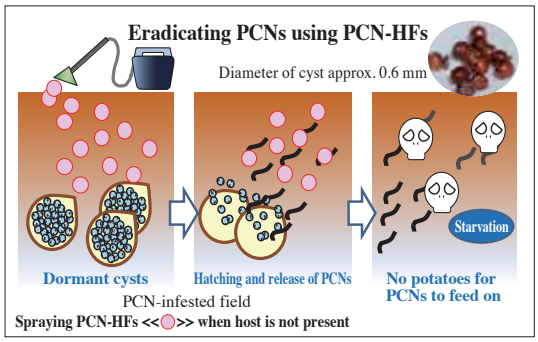
Utilizing functions of plants

CASE 1 Hokusan Co. Ltd.

Eradicating parasite causing enormous damage worldwide to potato crops

Difficult-to-control pest with hard shell covering Key to solution was hatching factors

Potato cyst nematodes (PCNs) are parasitic pests that damage potatoes when PCN eggs hatch after potatoes are planted. Eradicating PCNs before they hatch is ideal, but nearly all current pesticides are ineffective because PCN eggs are encased in hard pesticide-resistant shells known as cysts. Because of this, attention has focused on PCN hatching factors (PCN-HFs) which are substances secreted by potatoes that promote the hatching of PCN eggs. If PCN-HFs can be created through the use of smart cell technologies, the global problem of decreasing potato yields caused by PCN infestations can be resolved.



Spraying PCN-HFs prior to planting can protect potato crops from pest damage, as PCN larvae cannot survive without food.

CASE 2 Amino Up Co., Ltd.

Controlling cultivation environment for plants to increase production of useful substances

Controlled cultivation environment promotes growth and increases yield of perilla leaves

The content and yield of functional ingredients that demonstrate the antioxidant and anti-allergic effects of perilla leaves are unstable in open-field cultivation environments. Amino Up is conducting research using white sesame seeds (a variant of perilla), aiming at higher content and stable production of functional ingredients in perilla leaves using genetic transformation/genome editing technologies and technologies for controlling the environment in plant factories. To date, the company has succeeded in increasing the annual yield per unit area by about 50 times and the content of certain functional ingredients by about 20 times.

The difference in size is clear when compared to commercially sold perilla leaves. Increased yield is the result of optimizing cultivation environment controls, including light and temperature.

column Combining bio and information analysis technologies to contribute to sustainable society

At the end of FY2020, NEDO's Smart Cell Project will reach a milestone at the conclusion of its five-year plan. The Project Leader, Dr. KUHARA Satoru, Professor Emeritus of Kyushu University, describes the results and future prospects of the project by saying "Through the fusion of bio and digital technologies, this project has developed new approaches and various tools to efficiently extract 'potential biological functions' that were previously unavailable. By applying these tools to collect and analyze biological information, and modify and express biological functions, high expectations exist regarding the development of a bioeconomy that sets forth significant changes in the economy and society. There are hopes that various industries and academia will utilize these tools to realize a society filled with circulatory bio-derived products."

Deputy Project Leader Dr. MATSUMURA Takeshi, Plant Molecular Technology Research Group Leader at the AIST Bioproduction Research Institute, expresses hope for further development and use of these technologies by saying "Going forward, the selective use of results from this project, according to the development stages of the companies/research institutions, knowledge in many business fields will be further accumulated, refined as practical technology, and realized in Japan's bioeconomic society."

Dr. KUHARA Satoru
Project Leader,
NEDO Smart Cell Project
Professor Emeritus, Kyushu University

Dr. MATSUMURA Takeshi
Deputy Project Leader,
NEDO Smart Cell Project
Group Leader,
Plant Molecular Technology Research Group
AIST Bioproduction Research Institute

R&D case study

NEDO PROJECT SUCCESS STORIES

Highlights of Project Results

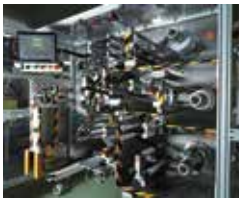
Volume 2

The results of many NEDO projects can be seen in the manufacturing processes of various companies and in end-products we actually use. This series of articles, taken from the NEDO Project Success Stories website, includes digests of interviews that highlight the development stories of how companies overcame daunting technical challenges to realize commercialization.

Toshiba Corporation

Next-Generation Lithium-Ion Batteries That Support New Energy Applications

Two types of commercialized SCiB™ cells and their anode material (lithium titanium oxide) (on the right)



Equipment for winding electrode and separator sheets at high speed

Electrode coating equipment for high-speed smooth coating of electrode slurry

Charge-discharge test equipment occupying most of the room

NEDO's role

Technology Development Project for the Application and Commercialization of Lithium-Ion Batteries and other projects

To overcome dependence on oil and reduce CO_2 emissions in the transportation sector, the recent proliferation of next-generation vehicles, such as electric (EVs) and plug-in hybrid electric vehicles (PHEVs) is expected to continue, and international competition is intensifying in the development and commercialization of such vehicles.

Under this project, with the goal of extending the driving range per battery charge for lithium-ion batteries used in EV and PHEV vehicles, technologies have been developed that contribute to higher energy density, improved safety, and lower cost.

NEDO leveraged its accumulated knowledge of the market, industry, and technological development trends for storage batteries, EVs and PHEVs, as well as its management experience and know-how, in monitoring the progress of this project, and convened regular meetings of the NEDO Technology Committee for Energy Storage Technology Development, which consisted of academic experts and specialists. The project was managed on the basis of input and recommendations provided by this committee and, as necessary, accelerated budgets were allocated. As a result, the innovative lithium-ion batteries developed by Toshiba were commercialized ahead of schedule.

The NEDO Project Success Stories website features interviews with companies involved in these projects. To date, more than 100 articles have been published.

The original version of this article with more detailed development episodes is available on our website!

NEDO Project Success Stories Lithium-ion batteries Search

https://www.nedo.go.jp/hyoukabu/articles/201901toshiba/

(only available in Japanese)

Aims

Promoting an early shift to next-generation vehicles to address the problem of global warming

Challenges

Increasing the energy density of lithium-ion batteries, enhancing their safety, and reducing their cost

Achievements

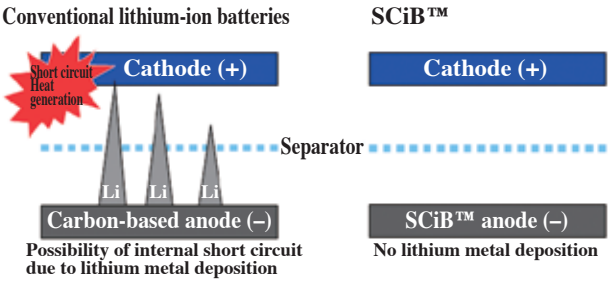
Development and commercialization of innovative lithium-ion batteries with increased energy density and higher output power

Through its participation in NEDO's projects, Toshiba Corporation developed innovative lithium-ion batteries based on out-of-the-box thinking. This resulted in the successful development and commercialization of a high-energy type battery in 2015 and a high-power type battery in 2016. The high-energy type battery with increased energy density has been used in rapid-charging electric vehicles overseas and large power storage facilities at substations. The high-power type battery has been used in mild hybrid vehicles and has enabled a significant increase in fuel efficiency.

Safe, groundbreaking lithium-ion batteries

Improvement of lithium-ion battery performance is essential for the spread of next-generation vehicles such as electric vehicles and plug-in hybrid vehicles. Toshiba Corporation was one of the first to initiate research and development of innovative new lithium-ion batteries.

Based on a careful examination of its strategy, Toshiba decided to use lithium titanium oxide (LTO) for the anode rather than carbon materials traditionally used in negative electrodes. LTO is an incombustible ceramic material that is not prone to lithium metal deposition, which often causes fire in lithium-ion batteries using carbon-based negative electrodes. Using LTO for the anode, Toshiba worked to improve battery performance and succeeded in commercializing the SCiB™ rechargeable battery in 2007. It can be safely charged and discharged at a high current rate.



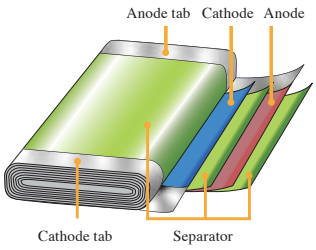
Lithium titanium oxide is not susceptible to an internal short circuit caused by lithium metal deposition

Achieving higher performance through improvement of underlying technologies

Aiming to further increase the energy density of SCiB™, Toshiba was selected to participate in a NEDO project in 2012. It then embarked on the development of a thinner separator which insulates the cathode and anode.

As a result, the company commercialized a high-energy type 23Ah SCiB™ cell in 2015. The new cell has a separator with a thickness 30 percent less than the conventional model but is just as strong. It is used in electric power storage facilities as part of power supply-demand balance adjustment systems.

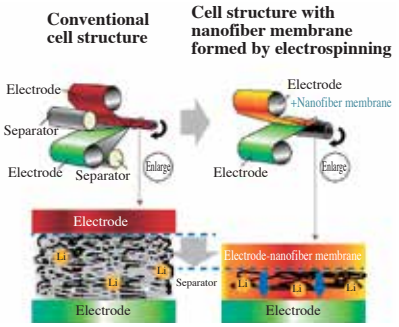
Toshiba's next goal was to increase battery output power. To increase the capacity of high-power type cells, the company took up the challenge of increasing the surface area by increasing the number of electrode turns. The development of this new approach led to the commercialization of a high-power 10Ah cell in 2016. It is used in mild hybrid systems for new light vehicles and has significantly improved fuel efficiency through increased frequency of motor assist. To further improve cell input-output performance (namely, the amount of electricity that can be input and output per unit time) and capacity, Toshiba looked for ways to push the limits of thin separators. The company adopted technology for fabricating nanofiber membranes on electrodes based on the original idea of integrating electrodes and separator. With support from NEDO, the company introduced equipment similar to that used to manufacture actual products in the trial phase onward, which led to success in enhancing input-output performance and capacity to 1.2 times that of the conventional model. Research and development are ongoing toward commercialization.



Schematic diagram of SCiB™. Long sheets of electrode and separator are wound together.

In recognition of its safety performance, Toshiba's SCiB™ battery system was the first lithium-ion battery to be certified as compliant with the highest safety standards mandated for rolling stock in Europe. SCiB™ batteries are expected to find more and more applications in fields that require a high level of safety, input-output performance, and long life.

(Interview: September 2018)



Technology for fabricating nanofiber membranes directly on electrode (electrospinning)

Startup Support and Beyond
The Future for NEDO Startups

NEDO Startups Future

Innovator File.11

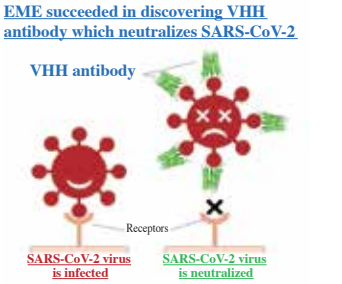
Epsilon Molecular Engineering, Inc.

Representative Director and CEO Dr. NEMOTO Naoto

Joint research and development and licensing for VHH antibodies and cyclic peptides for next-generation biopharmaceuticals

2017: Selected for NEDO Seed-stage Technology-based Startups (STS) program.
2018: Selected for Mitsubishi UFJ Technology Development Foundation's FY 2018 1st Research and Development Grant program.
2019: "Real Tech Venture of the Year, Startups Division" awarded from Leave a Nest Co., Inc.
2020: Selected for Small and Medium Enterprise Agency's "Support Project for Strategic Basic Technologies."

https://www.epsilon-mol.co.jp
(only available in Japanese)



Utilizing a VHH high-throughput screening system developed under a NEDO support program, the company was successful in discovering a VHH antibody which neutralizes the SARS-CoV-2 virus.

Q1 How do you take advantage of NEDO's support programs?

Our company designs functional peptides and proteins for various kinds of purposes by evolutionary molecular engineering. This is consistent with our company's mission to "create biomolecules for the future." In line with our mission, we are currently focused on developing biopharmaceuticals with new modalities from conventional drugs.

Specifically, our goal was to create a high-throughput evolutionary system for next-generation camelid single-domain heavy-chain (VHH) antibodies (also called nanobodies) in order to design VHH antibodies capable of targeting membrane proteins such as G-protein-coupled receptors (GPCRs), which conventional antibodies have difficulty with. However, we found out that building such a system would require a little under 100 million yen. We could build the system because we learned about and were selected for the NEDO STS program.

Making presentation at NEDO's pitch booth in Innovation Japan 2018 Conference

Q2 What is Epsilon Molecular Engineering's vision for the future?

Development of this system makes it possible to conduct screening with about 10,000 times the efficiency of conventional technologies, and allows for collaborative research and in-house development pipelines to proceed in parallel. In addition, the ability to embed transmembrane proteins into nanodiscs for screening has made it possible to produce VHH antibodies for more important drug development targets. In collaboration with Kao Corporation and Kitasato University, in May 2020 we discovered a VHH antibody that neutralizes the SARS-CoV-2 virus. In the future, we plan to develop a number of innovative biopharmaceuticals, and at the same time, aim to become a leading company in the development of markets where new bio-functional molecules are required.

Snapshot in the laboratory

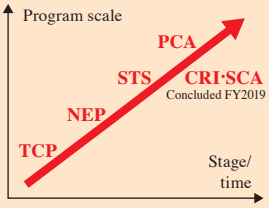
Comment from NEDO

The company, a Saitama University startup, is expected to make full use of its innovative screening technology completed under a NEDO project to develop new antibody pharmaceuticals for unmet medical needs, and has great potential for future success.

NEDO startup support programs for R&D related to industrial technologies

More information on NEDO startup support programs
https://www.nedo.go.jp/activities/ZZJP2_100063.html
(only available in Japanese)

Programs used by startups featured in this section



TCP Technology Commercialization Program

Support for entrepreneurial development at universities, research institutions, and startups

To revitalize the economy, it is important to foster entrepreneurs that have competitive new technologies. NEDO provides startup support from a variety of perspectives to develop research and development-oriented startups and entrepreneurs. Here, we examine notable startups that are continuing to grow toward the future.

Innovator File.12

AMI Inc.

Representative Director and CEO OGAWA Shimpei

R&D on "Super stethoscope" that assists with heart disease diagnosis corresponding to telemedicine

2015: AMI Inc. founded.
2017: Selected for NEDO Seed-stage Technology-based Startups (STS) program.
2018: Selected for NEDO Seed-stage Technology-based Startups (STS) program.
2020: Raised approximately 540 million yen in R&D funding through third-party allotments (Series A).
Selected for NEDO Project for Accelerating Innovative AI Chip Development.

https://ami.inc/
(only available in Japanese)

Prototype of "Super stethoscope"

Q1 How do you use NEDO's support programs?

We are developing a new stethoscope named "Super stethoscope," which will assist with heart disease diagnosis by quantitatively evaluating heart sounds.

We started research and development of the "Super stethoscope" with a desire to reduce sudden death due to heart disease and received a grant from the NEDO STS program to accelerate hardware development. By arranging for equipment and the environment needed for development as well as organizing a group of medical professionals, engineers and other experts, the STS program has helped us make progress on our research and development activities.

As a result, we received the JHVS2019 Venture Award from the Ministry of Health, Labor and Welfare. We believe that the results of our research and development have now been recognized and have allowed us to attract approximately 590 million yen in funding.

Receiving JHVS2019 Venture Award

Q2 What is AMI's vision for the future?

By participating in the STS program, we were able to develop a device that can acquire high-quality heartbeat data, but the development of the diagnosis-assist function using artificial intelligence (AI) has not yet taken place.

For development of this AI-related technology, we will participate in the NEDO Project for Accelerating Innovative AI Chip Development. In this project, we will develop AI algorithms to provide highly accurate automated diagnoses of heart disease.

In the future, we will continue our research and development for the launch of the "Super stethoscope". We also plan to expand the scope of "biomedical sounds" to include not only heart sounds, but also lung and bowel sounds. Our vision is to make biomedical sounds a kind of universal language, and we also aim to work on telemedicine-related applications.

Development work at Kagoshima head office

Comment from NEDO

Due to the declining/aging population, telemedicine conducted through the use of IT has become essential for maintaining the healthcare system. AMI is developing technologies for the social implementation of telemedicine and is doing great work with its small group of experts.

NEP NEDO Entrepreneurs Program
Support for entrepreneurs through provision of specialists who assist with commercialization efforts

STS Seed-stage Technology-based Startups
Support for commercialization of seed-stage technology-based start-ups by promoting collaborations with venture capitalists and other relevant entities

CRI Collaboration with Research Institute
Support for R&D-based startups to develop commercial applications
Concluded FY2019

SCA Startups in Corporate Alliance
Support for R&D-based startups to conduct joint research with project companies
Concluded FY2019

PCA Product Commercialization Alliance
Support for R&D-based startups to develop concrete business plans for sales activity approximately three years after submission of proposal

Domestic Offices

Head Office
MUZA Kawasaki Central Tower, 16F-20F
1310 Omiya-cho, Saiwai-ku
Kawasaki City, Kanagawa 212-8554 Japan
Tel: +81-44-520-5100
Fax: +81-44-520-5103

Kansai Branch Office
9th Floor, Knowledge Capital Tower C Grand Front Osaka,
3-1 Ofuka-cho, Kita-ku, Osaka 530-0011 Japan
Tel: +81-6-4965-2130
Fax: +81-6-4965-2131

Overseas Offices

Washington, D.C
1717 H Street, NW, Suite 815
Washington, D.C. 20006, U.S.A.
Tel: +1-202-822-9298
Fax: +1-202-733-3533

Silicon Valley
3945 Freedom Circle, Suite 790
Santa Clara, CA 95054 U.S.A.
Tel: +1-408-567-8033
Fax: +1-408-567-9831

Europe
10, rue de la Paix 75002
Paris, France
Tel: +33-1-4450-1828
Fax: +33-1-4450-1829

New Delhi
15th Floor, Hindustan Times House,
18-20 Kasturba Gandhi Marg,
Connaught Place,
New Delhi 110 001, India
Tel: +91-11-4351-0101
Fax: +91-11-4351-0102

Beijing
2001 Chang Fu Gong Office Building
Jia-26, Jian Guo Men Wai Street
Beijing 100022, P.R. China
Tel: +86-10-6526-3510
Fax: +86-10-6526-3513

Bangkok
8th Floor, Sindhorn Building Tower 2
130-132 Wittayu Road, Lumphini
Pathumwan
Bangkok 10330, Thailand
Tel: +66-2-256-6725
Fax: +66-2-256-6727

New Energy and Industrial Technology Development Organization
MUZA Kawasaki Central Tower, 1310 Omiya-cho, Saiwai-ku
Kawasaki City, Kanagawa 212-8554 Japan
Tel: +81-44-520-5100 Fax: +81-44-520-5103
URL: https://www.nedo.go.jp/english/index.html

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