



NEDO Activity Report Annual Report

FY2022

2022.4 - 2023.3



Chairman's Message

Accelerating Innovation to Achieve Carbon Neutrality by 2050 and Realize a Sustainable Future

Since it was established in 1980, NEDO has been one of the largest public research and development management organizations in Japan and has worked with the government to promote economic and industrial policies. In this role, NEDO undertakes technology development and demonstration activities to carry out two missions of addressing energy and global environmental problems and enhancing industrial technology by integrating the combined efforts of industry, academia, and government. In FY2022, the final year of its Fourth Five-Year Plan, NEDO worked toward maximizing the results of its research and development activities in six areas: Energy Systems; Energy Conservation and Environment; Industrial Technology; New Industry Creation and Discovery of Technology Seeds; Cross-Sectoral Proposal-Based Research and Development Activities, and Programs for Specified Semiconductor Production-Related Development. In addition, NEDO has focused on the following three pillars: achieving results for practical use through research and development management; fostering technology-based startups; and providing a new direction for mid- to long-term technology development. To this end, NEDO has sought to further strengthen its research and development management capacity from strategy formulation to practical application in order to promote challenging research and development activities, encourage open innovation, and foster technology-based startups.

One major development in FY2022 was the launch of the Key and Advanced Technology R&D through Cross Community Collaboration Program (K Program), which was created through a fund newly developed at NEDO. Aimed at the strengthening and promotion of economic security in Japan, the objective of the K Program is the medium- to long-term fostering of seeds considering needs related to important advanced key technologies and based on the vision and concept set forth by the government. Furthermore, against the backdrop of the need to create a steady supply system for semiconductors, a program has been launched to support development and manufacture at special semiconductor facilities. From September to October NEDO held several international conferences and events, including the Hydrogen Energy Ministerial Meeting and the International Conference on Carbon Recycling. The annual Innovation for Cool Earth Forum (ICEF) was held on an in-person basis for

the first time in three years, and attracted over 1,600 participants from 87 nations. The resultant Roadmap for Low-carbon Ammonia and Roadmap for Blue Carbon were presented at the COP27 conference

Further afield, following the Russian invasion of Ukraine NEDO published the Ukraine & Russia Report, which summarized the state of responses mainly in the energy and resources field, and also put forward for examination some global matters that are likely to become important in the future. Amid the increase in large-scale initiatives towards the realization of green transformation and obtaining economic security, NEDO has become keenly aware of its increasingly demanding role and the expectations of the organization. In FY2023, the first year of the new Five-Year Plan, NEDO will continue to pursue initiatives to maximize the results of research and development through research and development management, and strive to respond to the expectations of one and all. NEDO intends to enhance its role as an innovation accelerator that promotes the practical application of project results and to contribute even further to the resolution of social issues.

New Energy and Industrial Technology
Development Organization (NEDO)

Chairman **SAITO Tamotsu**



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FY2022 Budget

1.18 billion US dollars
(Initial budget for FY2022)

NEDO aims to address energy and global environmental problems and raise the level of industrial technology through the integrated management of research and development. This ranges from the discovery of technology seeds to the promotion of mid- to long-term projects and support for practical application.

*As only an outline of NEDO's activities is given below, individual budget amounts do not add up to the total.
*Converted at the exchange rate of 1 US dollar = 133.04 yen

<p>433 million US dollars</p>	<p>Energy Systems</p> <ul style="list-style-type: none"> • System provision technology • Energy storage technology, such as batteries • Technology related to hydrogen production, storage, transport, and use • Technology related to renewable energies
<p>313 million US dollars</p>	<p>Energy Conservation and Environment</p> <ul style="list-style-type: none"> • Technology to harness unutilized thermal energy • Development of high-efficiency coal-fired power generation technology • Fluorocarbon recovery technology • International demonstrations, Joint Crediting Mechanism activities, and other activities • Environmentally friendly steel manufacturing technology • CO₂ capture, utilization, and storage • 3R technology, including resource screening and metal refining technology
<p>320 million US dollars</p>	<p>Industrial Technology</p> <ul style="list-style-type: none"> • Robot and AI technology • Materials and nanotechnology • IoT, electronics, and information technology • Biotechnology • Manufacturing technology
<p>52.6 million US dollars</p>	<p>New Industry Creation and Discovery of Technology Seeds</p> <ul style="list-style-type: none"> • Fostering technology-based startups • Promotion of open innovation

***Additional projects other than those to the left are implemented through funds.**

• Moonshot research and development!	189 million US dollars
• Research and Development Project of the Enhanced Infrastructures for Post-5G Information and Communication System	2.33 billion US dollars
• Green Innovation Fund Projects	15.0 billion US dollars
• Program for Developing Important Economic Security Technologies	940 million US dollars
• Programs for Specified Semiconductor Production-Related Development	4.64 billion US dollars

Managing Technological Development to Utilize Results in Society Project Management

To ensure that its activities have meaningful benefits to society, NEDO engages in activities that range from collecting research and development information from around the world to devising strategies and implementing and assessing projects in various fields using a consistent management system.

<p>Start</p> <p>Collecting information and formulating strategies for each field</p>		<p>As research and development activities become increasingly competitive worldwide, NEDO eagerly collects information on a variety of different fields both inside and outside of Japan. Such information is then used to formulate technology strategies, set milestones, and develop project plans.</p>
<p>1 to 2 years</p> <p>Research and development to support progress in fields with a promising future Project planning</p>	<p>NEDO projects make it possible!</p> <ul style="list-style-type: none"> • Medium- to long-term initiatives • Research and development coordinated with standardization • Cross- industrial cooperation • Full-scale demonstration • International cooperation 	<p>NEDO sets goals for research and development by studying domestic and international research and development trends and consulting with experts. It aims to use innovation to drive economic growth and solve societal problems. Projects are planned by looking five, ten, and twenty years into the future.</p>
<p>2 to 6 years</p> <p>Research and development and demonstration testing</p>		<p>NEDO promotes research and development projects and large-scale demonstration projects that are difficult for private sector companies to carry out on their own. It aims to make the most of its results. To do so, it focuses on authentication and systems for society to use, while anticipating future developments from a global perspective.</p>
<p>10 years</p> <p>Project review and follow-up monitoring</p>		<p>After a project is completed, an evaluation is conducted by a third party, and project results are thoroughly assessed. In addition, NEDO conducts follow-up monitoring of results to examine the economic and social effects of the project. Information collected during monitoring is also used to improve future project management.</p>

FY 2022 Project List

Project name	Period (FY)	Department
Energy Systems		
Research and Development of Wind Power Generation Technologies	2008 - 2024	New Energy Technology Department
Project for Supporting the Introduction of Wind Power Generation	2013 - 2023	New Energy Technology Department
Development of Production Technologies for Biojet Fuels	2017 - 2024	New Energy Technology Department
Research and Development for Total Cost Reduction of Heat Utilization as Renewable Energy	2019 - 2023	New Energy Technology Department
Development of Technologies to Promote Photovoltaic Power Generation as a Primary Power Source	2020 - 2024	New Energy Technology Department
RD&D for Innovative Technologies Applied to Geothermal Exploration and Exploitation	2021 - 2025	New Energy Technology Department
Support Project for Creating Sustainable and Effective Supply Systems of Woody Biomass Fuels	2021 - 2028	New Energy Technology Department
Advancement of Hydrogen Technologies and Utilization Project	2014 - 2022	Smart Community and Energy Systems Department
Development of Technologies for Realizing a Hydrogen Society	2014 - 2025	Smart Community and Energy Systems Department
Development of Material Evaluation Techniques for Advanced and Innovative Batteries (Phase 2)	2018 - 2022	Smart Community and Energy Systems Department
Development of Technologies for Hydrogen Refueling Stations	2018 - 2022	Smart Community and Energy Systems Department
Next-Generation Power Network Stabilization Technology Development for Large-Scale Integration of Renewable Energies	2019 - 2023	Smart Community and Energy Systems Department
Development of a Multi-Purpose and Multi-Terminal High Voltage Direct Current Transmission System	2020 - 2023	Smart Community and Energy Systems Department
Collaborative Industry-Academia-Government R&D Project for Solving Common Challenges Toward Dramatically Expanded Use of Fuel Cells and Related Equipment	2020 - 2024	Smart Community and Energy Systems Department
Technology Development for the Utilization and Production of Ammonia as Fuel	2021 - 2025	Smart Community and Energy Systems Department
Research and Development Initiative for Scientific Innovation of New Generation Batteries 3	2021 - 2025	Smart Community and Energy Systems Department
Next-Generation Power Network Stabilization Technology Development for Large-Scale Integration of Renewable Energies	2022 - 2026	Smart Community and Energy Systems Department
Development of Flexible and Distributed Energy Resources Control Technology to Mitigate Congestion in Power Systems (FLEX DER Project)	2022 - 2026	Smart Community and Energy Systems Department
Research and Development on New Energy Technology for Discovering Technology Seeds and Commercializing Developed Technologies	2007 -	New Energy Technology Department and Innovation Promotion Department
NEDO Feasibility Study Program	2014 - 2027	Frontier and Moonshot Technology Department
International Demonstration Project on Japan's Energy Efficiency Technologies	1993 - 2025	International Affairs Department
Program to Facilitate Private-Sector-Led Promotion of Low Carbon Technology Overseas	2011 - 2022	International Affairs Department
Research and Development Program for Promoting Innovative Clean Energy Technologies Through International Collaboration	2020 - 2025	International Affairs Department
Research for Strategy Formulation	2000 -	Technology Strategy Center
Energy Conservation/Environment		
Research and Development Project on Innovative Thermal Management Materials and Technologies	2015 - 2022	Energy Conservation Technology Department
Development of Technologies for Carbon Recycling and Next-Generation Thermal Power Generation	2016 - 2026	Environment Department
Research and Development of Recycling Technologies for Establishing a High Efficiency Resource Circulation System	2017 - 2022	Environment Department
Development of Technology and Assessment Techniques for Next-Generation Refrigerants with a Low GWP Value	2018 - 2022	Environment Department
Innovative Plastic Resource Circulation Process Technology Development	2020 - 2024	Environment Department
Research, Development and Demonstration of CCUS Technology	2018 - 2026	Environment Department
Development of advanced circulation technology for aluminum materials	2021 - 2025	Environment Department
Development of Environmental Technology for Steelmaking Process	2013 - 2022	Environment Department and Energy Conservation Technology Department
Strategic Innovation Program for Energy Conservation Technologies	2012 - 2024	Energy Conservation Technology Department
Program to Develop and Promote the Commercialization of Energy Conservation Technologies to Realize a Decarbonized Society	2021 - 2035	Energy Conservation Technology Department
NEDO Feasibility Study Program	2014 - 2027	Frontier and Moonshot Technology Department
Demonstration Project for Introducing an Energy-Saving Resource Circulation System in Asia	2016 - 2022	Environment Department
Project for International Promotion and Dissemination of Carbon Recycling and Advanced Thermal Power Generation Technologies	2022 - 2026	Environment Department
International Demonstration Project on Japan's Energy Efficiency Technologies	1993 - 2025	International Affairs Department
Program to Facilitate Private-Sector-Led Promotion of Low Carbon Technology Overseas	2011 - 2022	International Affairs Department
International Research and Development Co-Funding Project	2014 - 2022	International Affairs Department
Research and Development Program for Promoting Innovative Clean Energy Technologies Through International Collaboration	2020 - 2025	International Affairs Department
Research for Strategy Formulation	2000 -	Technology Strategy Center

- National Projects
- Proposal-Based Activities
- International Demonstration and Joint Projects
- Survey Activities
- Specified Proposal-Based Research and Development
- Demonstration Projects
- Programs for Specified Semiconductor Production-Related Development
- Other Projects

Project name	Period (FY)	Department
Industrial Technology		
Development of Integrated Core Technologies for Next-Generation AI and Robots	2018 - 2023	Robot and Artificial Intelligence Technology Department
Realization of a Smart Society by Applying Artificial Intelligence Technologies	2018 - 2022	Robot and Artificial Intelligence Technology Department
Drones and Robots for Ecologically Sustainable Societies Project	2017 - 2022	Robot and Artificial Intelligence Technology Department
Research and Development of Advanced Aircraft Systems for Practical Application	2015 - 2023	Robot and Artificial Intelligence Technology Department
Cross-Ministerial Strategic Innovation Promotion Program (SIP): Automated Driving for Universal Services	2018 - 2022	Robot and Artificial Intelligence Technology Department
Cross-Ministerial Strategic Innovation Promotion Program (SIP):Big Data and AI-Enabled Cyberspace Technologies	2018 - 2022	Robot and Artificial Intelligence Technology Department
Technology Development Project on Next-Generation Artificial Intelligence Evolving Together with Humans	2020 - 2024	Robot and Artificial Intelligence Technology Department
Project to Construct a Basis for Research and Development of Innovative Robots	2020 - 2024	Robot and Artificial Intelligence Technology Department
Development of AI-Based Innovative Remote Technologies	2021 - 2024	Robot and Artificial Intelligence Technology Department
Realization of Advanced Air Mobility (ReAMo) project	2022 - 2026	Robot and Artificial Intelligence Technology Department
Project for Innovative AI Chip and Next-Generation Computing Technology Development	2016 - 2027	Internet of Things Promotion Department
Project for Accelerating Innovative AI Chip Development	2018 - 2022	Internet of Things Promotion Department and Innovation Promotion Department
Basic Technology Development Project for Metal Additive Manufacturing Parts	2019 - 2023	Internet of Things Promotion Department
Cross-Ministerial Strategic Innovation Promotion Program (SIP):Intelligent Knowledge Processing Infrastructure Integrating Physical and Virtual Domains	2018 - 2022	Internet of Things Promotion Department
Cross-Ministerial Strategic Innovation Promotion Program (SIP):Cyber Physical Security for IoT Society	2018 - 2022	Internet of Things Promotion Department
Technology Development Project to Strengthen the Semiconductor Manufacturing Base of Energy-Saving Electronics	2021 - 2025	Internet of Things Promotion Department
Research and Development Utilizing Wireless Communication Technologies to Reinforce the Dynamic Capabilities of the Manufacturing Industry	2021 - 2025	Internet of Things Promotion Department
Digital Infrastructure Development Project for Digital Transformation of Industries	2022 - 2024	Internet of Things Promotion Department
Research and Development of Innovative Structural Materials	2014 - 2022	Materials Technology and Nanotechnology Department
Ultra High-Throughput Design and Prototyping Technology for Ultra Advanced Materials Development	2016 - 2022	Materials Technology and Nanotechnology Department
Development of Innovative Sensing Technology to Realize an IoT Society	2019 - 2024	Materials Technology and Nanotechnology Department
Development of Continuous Production and Process Technologies of Fine Chemicals	2019 - 2025	Materials Technology and Nanotechnology Department
Technology Development Project for Social Implementation of Marine Biodegradable Plastics	2020 - 2024	Materials Technology and Nanotechnology Department
Cellulose Nanofiber Related Technology Development to Contribute to a Carbon Cycle Society	2020 - 2024	Materials Technology and Nanotechnology Department
Development of New Innovative Composite Materials and Forming Technologies	2020 - 2024	Materials Technology and Nanotechnology Department
Development of Bio-Based Production Technology to Accelerate Carbon Recycling	2020 - 2026	Materials Technology and Nanotechnology Department
Development of Materials for Aircraft Engines and Bases for Material Evaluation Systems	2021 - 2025	Materials Technology and Nanotechnology Department
Development of a Technology Base and Applied Technologies for the Manufacturing Processes of Next-Generation Advanced Ceramics	2022 - 2026	Materials Technology and Nanotechnology Department
NEDO Feasibility Study Program	2014 - 2027	Frontier and Moonshot Technology Department
International Demonstration Project on Japan's Energy Efficiency Technologies	1993 - 2025	International Affairs Department
Research and Development Program for Promoting Innovative Clean Energy Technologies Through International Collaboration	2020 - 2025	International Affairs Department
International Research and Development Co-Funding Project	2014 - 2022	International Affairs Department
Research for Strategy Formulation	2000 -	Technology Strategy Center
New Industry Creation and Seed Discovery		
Development Promotion Project for Practical Use of Welfare Equipment	1993 - 2022	Innovation Promotion Department
Research and Development on New Energy Technology for Discovering Technology Seeds and Commercializing Developed Technologies	2007 -	New Energy Technology Department and Innovation Promotion Department
Technology-Based Startup Support Program	2014 - 2023	Innovation Promotion Department
Intensive Support for Young Promising Researchers	2020 -	Frontier and Moonshot Technology Department
Development and Demonstration of a Situation Awareness System Using Satellites to Contribute to Efficient Supply Chain Modification	2021 - 2022	Innovation Promotion Department
SBIR Promotion Program	2021 -	Innovation Promotion Department
NEDO Feasibility Study Program	2014 - 2027	Frontier and Moonshot Technology Department
Fundamental Technology Research Facilitation Program	2001 -	Innovation Promotion Department
Specified Proposal-Based Research and Development		
Moonshot Research and Development	2020 -	Frontier and Moonshot Technology Department
Research and Development Project for Enhancement of the Bases for Post-5G Information and Communication Systems	2020 -	Internet of Things Promotion Department
Green Innovation Fund Projects	2021 -	Green Innovation Fund Projects Coordination Office
Program for Developing Important Economic Security Technologies	2022 -	Economic Security Program Coordination Office
Programs for Specified Semiconductor Production-Related Development		
Specified Semiconductor Funding Program	2022 -	Internet of Things Promotion Department
Program for Specified Semiconductor Interest Subsidies	2022 -	Internet of Things Promotion Department

4 April

- Establishment of standard battery model creation technology for all-solid-state lithium-ion batteries [P.12](#)



Prototype sulfide all-solid-state lithium-ion batteries

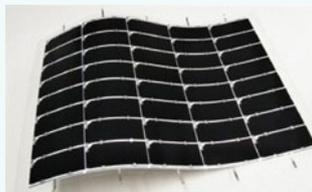
- Promotion of technological development towards reduction of CO₂ in iron and steelmaking processes [P.17](#)
- Succeeded in AI-based traffic congestion prediction and demonstrations aimed at appropriate signal control [P.20](#)
- Applied and tested performance of flame-retardant magnesium alloy floor panels on next-generation Shinkansen test train ALFA-X [P.10](#) [P.24](#)



The next-generation Shinkansen in which the performance test was conducted

6 June

- Achievement of the world's highest conversion efficiency rate for mobile photovoltaic modules [P.13](#)



Triple-junction compound solar cell module

- Started demonstration tests aiming at practical application of automated delivery robots in last mile logistics [P.19](#)

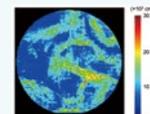


Automated delivery robot (DeliRo)

- Development of AI not requiring the collection of vast actual image data by generating formula-driven mass image sets [P.20](#)
- Establishment of data-driven materials design methods towards the accelerated speed of functional material development [P.24](#)
- Support for the independent walking and movement of people with disabilities using the Ashirase walking navigation system [P.26](#)
- Succeeded in the visualization of dislocation and strain distribution inside semiconductor wafers [P.27](#)



The XS-1Sirius crystal dislocation visualization equipment with a dislocation counting system and heat map display function



Heat map display of number of threading dislocation included in 4-inch SiC wafers

2022

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5 May

- Demonstration of package delivery by a drone equipped with autonomous flight AI [P.10](#)



AI drone

- Development of a research base for sustainable aviation fuel (SAF) [P.14](#)



Exterior of the Institute of Microalgal Technology, Japan (IMAT) Technical Base Research Center

8 August

- Successful practical application of a predictive diagnostic system to reduce incidences of trouble at geothermal power plants [P.14](#)



Patuha Geothermal Power Plants (Indonesia)

- Started working on the development of methods for evaluating the performance of AAM, and the development of AAM traffic management technologies for low-altitude airspace harmonization [P.19](#)



Image of the AAM aimed for after the completion of the project

9 September

- Grand open of Japan's first RD and Demonstration Base for Carbon Recycling [P.8](#)

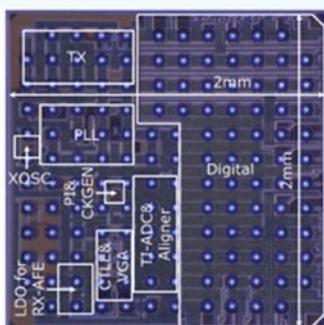


RD and Demonstration Base for Carbon Recycling

In order to realize a sustainable society, NEDO is engaged in the research and development of a wide range of fields. The following highlights NEDO's developments and demonstrations to solve an array of issues in each month of FY2022.

10 October

- Achievement of the world's top level oil production (98g/L) using oleaginous yeast as a palm oil alternative [P.25](#)
- Succeeded in advanced 5G slice orchestration using artificial intelligence (AI) [P.33](#)
- Developed a false-lock-aware locking technique for 56 Gbps PAM4 transceivers [P.33](#)



Chip micrograph of transceiver using 16nm-FinFET technology

12 December

- Completed the Fukushima Hydrogen Refueling Technology Research Center and commenced operations [P.8](#) [P.12](#)



Fukushima Hydrogen Refueling Technology Research Center (Nami Town, Fukushima Prefecture)

- Successful fabrication of RGB pixel arrays with cadmium-free quantum dots for next-generation high-efficiency displays [P.9](#) [P.15](#)
- Evaluation of the effects and economic viability of CO₂ emissions reductions through cross-industry cooperation in the use of carbon recycling technologies at industrial complexes [P.17](#)
- Development of an AI chip achieving a maximum efficiency ten times greater than conventional technologies [P.21](#)

2 February

- Promotion of the development of an innovative energy- and labor-saving production system for fine chemicals [P.16](#)



The iFactory[®] module (left) and automatic analysis device (right)

- Started on the development of an infrastructure for linkage of various spatial information [P.22](#)
- Creation of a dynamic production line using a multi-skilled self-propelled robot that can work with existing production equipment [P.23](#)

10

11

12

2023

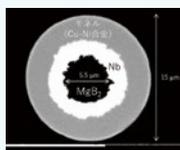
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11 November

- Successfully promoted domestic production and cost reduction for 5G core technology [P.9](#)
- Completion of Japan's first demonstration facility for chemical recycling of plastics using microwave process [P.15](#)
- Mathematical models (equations of state) for hydrofluoroolefin (HFO) refrigerants have become the international standard (ISO17584 - Refrigerant properties) [P.18](#)
- Organization of NEDO Pitch, an event to support startups [P.26](#)
- Developed the ultra-fine MgB₂ 15 micrometer superconducting wire, the world's smallest [P.27](#)



Cross section of the ultra-fine MgB₂ 15 micrometer superconducting wire

3 March

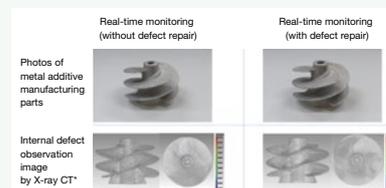
- Issued Japan's first guidebook for offshore wind condition observations [P.13](#)
- Development of a stand-alone ORC power generation system that achieves both excellent power output and Japan's highest level of energy conservation [P.16](#)
- Development of fundamental design technology for AI chip development and establishment of AI Chip Design Center (AIDC) [P.21](#)



AI Chip design booth

- Development of the world's first IC chip that automatically provides optimal control of power semiconductors and reduces loss [P.22](#)

- Confirmation of the efficacy of metal additive manufacturing, monitoring, and defect repair technologies during the metal additive manufacturing process by user verification [P.23](#)



Modeling results based on user verification

- Created samples of and implemented composite flooring materials by integrating the results of different development themes and the use of cellulose nanofibers [P.25](#)



Composite flooring using CNFs

Utilizing CO₂ as a resource

Grand open of Japan's first RD and Demonstration Base for Carbon Recycling



Using CO₂ from an adjacent thermal power plant for the early practical application of carbon recycling technologies

To promote the development of Carbon Recycling technologies that convert CO₂ to various useful products, NEDO has established a facility where CO₂ separated and recovered from a thermal power plant can be used for RD.



RD and Demonstration Base for Carbon Recycling

Towards the expanded use of ultra-clean energy

The Fukushima Hydrogen Refueling Technology Research Center, a facility for hydrogen refueling research, has come into operation



Aiming for the early practical application of hydrogen refueling and measuring technologies for heavy-duty vehicles (HDV)

The research facility where it is possible to develop and test technologies for the large-volume refueling and large-volume measurement of heavy-duty vehicles (HDV) equipped with fuel cells using mainly the hydrogen produced at the Fukushima Hydrogen Energy Research Field (FH2R) has begun to fully operate.



The completed Fukushima Hydrogen Refueling Technology Research Center

This section presents a selection of high-profile projects conducted by NEDO in FY2022.

Towards expanding the use of geothermal resources Developed a geothermal power plant risk assessment system



Promoting the use of acidic hot water resources and contributing to their use as geothermal resources

Damage caused to metal materials by acidic fluids is one of the factors behind the low usage rates of geothermal power stations and the abandonment of their development. However, using the results of the Research and Development of Geothermal Energy Generation Technologies project a system has been developed that will be useful in the consideration of the optimal generation equipment materials. It is hope that this will lead to improved geothermal power plant usage rates and increased facility capacity.



Geothermal power plant risk assessment system (acidic hot water response version)

Towards the further penetration of local 5G Successfully promoted domestic production and cost reduction for 5G core technology



Moving forward to a communications network that maximizes the use of the cloud for communications infrastructure in the post-5G era

Based on Open Source Software, we succeeded in developing a "practical version" of the 5G core network (5GC) with commercial-level functionality, performance, and stability.

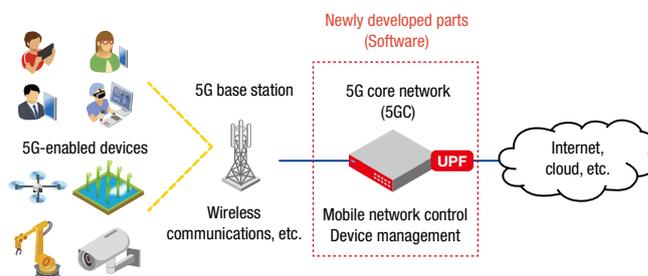


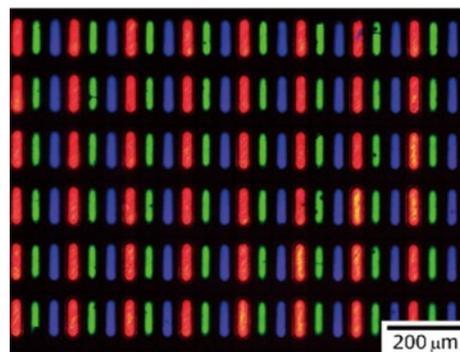
Image of the newly developed 5GC

Towards energy-saving displays Succeeded in fabricating RGB pixel arrays with cadmium-free quantum dots



Towards the realization of displays with a low environmental burden, high luminance, high contrast, and wide color gamut

NEDO succeeded in developing quantum dots (QDs) emitted by electric current injection and fabricating red/green/blue (RGB) pixel arrays using QDs that have steep emission peak with narrow half-value width and do not contain cadmium. This will enable new self-luminous displays with a low environmental burden, high luminance, high contrast, and wide color gamut.



RGB pixel arrays of developed QD-LED devices

Towards an aviation industry revolution
Demonstration of package delivery
by a drone equipped with autonomous flight AI



Aiming for a society where drones are used at
logistics sites in Level 4 environments

NEDO succeeded in verifying and validating the effectiveness of an out-of-sight safe package delivery in the actual field of a logistics provider by combining a function that automatically continues the flight while avoiding the airspace over people detected by the AI on the drone and a function that automatically generates a flight route with low risk of collision with people or buildings on the ground in advance.



AI drone

Towards weight-saving in railway carriages
Applied and tested performance of flame-retardant magnesium
alloy floor panels on the next-generation Shinkansen test train
ALFA-X



A weight reduction of about 23% per-passenger
cabin floor panel was attained, contributing to
energy savings

Newly developed flame-retardant magnesium alloys were applied on the passenger cabin floor of one of the intermediate carriages of the next-generation Shinkansen test train ALFA-X, and as a result of the performance test implemented a weight reduction of around 23% (around 50kg/car) was attained while maintaining sound insulation properties.



A passenger cabin floor panel of Shinkansen using flame-retardant magnesium alloys



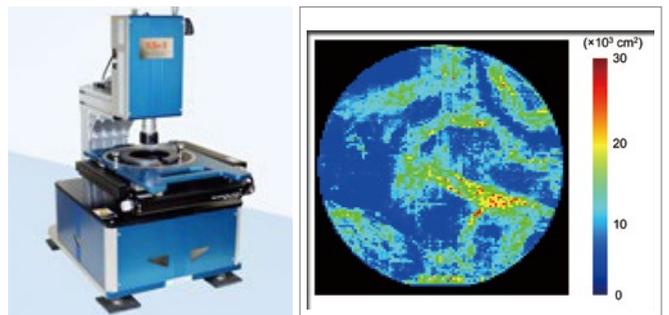
Next-generation Shinkansen test train ALFA-X

Towards the development of semiconductor production technologies
Succeeded in visualization of dislocation and strain
distribution inside semiconductor wafers



Contributing to improved convenience and
greater efficiency in the inspection process of
semiconductor production

In order to develop a system that would visualize the crystal defects (dislocation) in semiconductor crystal wafers and automatically inspect for killer faults that degrade the breakdown voltage characteristics of products, NEDO succeeded in building a system for counting dislocations, and developing a heat map display function that shows the dislocation distribution and strain distribution over the entire wafer in an intuitive and easily understood way.



XS-1 Sirius crystal dislocation visualization equipment and heat map displaying the results of dislocation counting system

Project Summaries

Energy Systems

Energy Conservation and Environment

Industrial Technology

**New Industry Creation and
Discovery of Technology Seeds**

**Cross-Sectoral Proposal-Based Research and
Development Activities**

**Programs for Specified Semiconductor
Production-Related Development**

Energy Systems

NEDO adopts a cross-sectoral approach in the development of technologies for the wider application of batteries, fuel cells, and hydrogen as well as for the reliable operation of more robust power grids. It also conducts demonstrations of solutions developed to address both the technical and business issues associated with commercial operations with the aim of delivering more resilient and sustainable energy systems.

All-solid-state lithium-ion batteries

Establishment of standard battery model creation technology for all-solid-state lithium-ion batteries

All-solid-state lithium-ion batteries are a type of storage battery that is being developed in order to achieve further improvements in the performance and safety of current mainstream lithium-ion batteries. Aiming to expand the storage battery market centering on use in vehicles, the development of basic technologies for materials evaluation, including a standard battery model that will serve as a yardstick for materials development, is underway.

Achievements

The capacity of first-generation batteries*1 was 450 Wh/L for medium-sized batteries, while for next-generation batteries*2 it was 860 Wh/L, demonstrating a much higher energy concentration. Applying these achievements, production techniques for a stable standard battery model have been established.

*1 Batteries replacing the electrolyte part of the liquid electrolyte in usual lithium batteries with a solid

*2 Batteries using a high-capacity active material and a high-performance solid electrolyte

Going forward

NEDO will contribute to the early commercialization of all-solid batteries including the creation of new materials through the development of a standard battery model and elemental technologies. It will link these efforts to the strengthening of the international competitiveness of battery-related industries and the realization of carbon neutrality by 2050.



Prototype sulfide all-solid-state lithium-ion batteries
Courtesy of LIBTEC

Project name: Development of Material Evaluation Techniques for Advanced and Innovative Batteries (Phase 2)

Implementation: FY2018–FY2022

Budget: 2.149 billion yen (FY2022)

Hydrogen

Completed the Fukushima Hydrogen Refueling Technology Research Center and commenced operations

It is hoped that in the future hydrogen will play a central role as the ultimate clean energy source. Amid expectations for the development of hydrogen stations towards the utilization of hydrogen in the transport sector, with regard to the development of hydrogen stations aimed at large and commercial heavy duty vehicles (HDVs), the high-volume hydrogen refueling methods and measurement technologies are still undeveloped, so there is a need to resolve these technical issues.

Achievements

Using mainly the hydrogen produced at the adjacent Fukushima Hydrogen Energy Research Field (FH2R), a hydrogen production facility, NEDO is promoting the development of research facilities where it is possible to conduct technology development and verification regarding high-volume hydrogen refueling of HDVs mounted with fuel cells and also high-volume measurement technologies. The facility went into full operation in December 2022.

Going forward

The objective for the development of refueling technologies is to enable hydrogen refueling times to be reduced to a practical length of around 10 minutes and enable accurate measurements with regard to measurement technology. NEDO will aim for the early commercialization of these technologies.



Fukushima Hydrogen Refueling Technology Research Center
(Namie Town, Fukushima Prefecture)

Project name: Development of Technologies for Hydrogen Refueling Stations

Implementation: FY2018–FY2023

Budget: 3.08 billion yen (FY2022)

Renewable Energy

NEDO is striving to facilitate the large-scale deployment of renewable energy sources with the aim of making them main power sources. In order to achieve this, NEDO issues guidebooks, sets out technical and other guidelines and works to develop and demonstrate relevant technologies in order to tap into renewable energy at lower costs. Examples of energy sources targeted by NEDO include solar, wind, biomass, geothermal, and renewable thermal energy.

Solar power generation

Achievement of the world's highest conversion efficiency rate for mobile photovoltaic modules

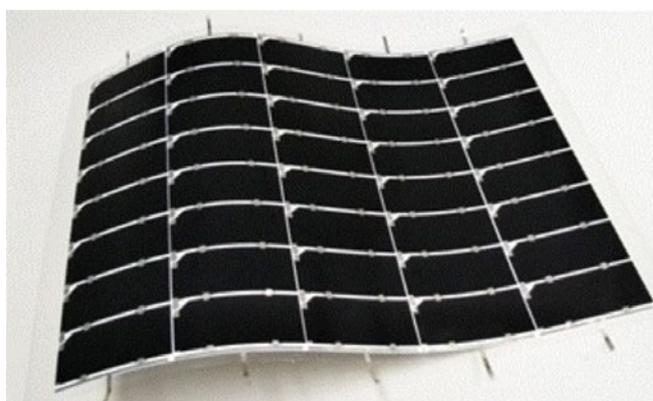
With the aim of introducing solar panel to places where it has previously been difficult to install them, NEDO is conducting technical development to improve efficiency, reduce weight, make them adaptable to curved surfaces, and reduce costs. NEDO will continue to increase the introduction of solar power generation into the market through new solar cells, modules, and system technologies, aiming to strengthen industrial competitiveness.

▶ Achievements

NEDO developed a triple-junction compound solar cell module made from light, flexible metal alloys in a size practical for application in modes of transport such as vehicles and trucks, which have surface restrictions and curved surfaces, achieving the world's highest conversion efficiency of 32.65%.

▶ Going forward

Through the development of elemental technologies for places with weight restrictions that have made the introduction of solar module difficult using the hitherto technologies, such as roofs, building wall and vehicles, NEDO promotes technology development that will lead to the creation of new solar power markets.



Triple-junction compound solar cell module Courtesy of Sharp Corporation

Project name: Development of Technologies to Promote Photovoltaic Power Generation as a Primary Power Source
Implementation: FY2020–FY2024
Budget: 3.05 billion yen (FY2022)

Wind power generation

Issued Japan's first guidebook for offshore wind condition observations

The introduction of offshore wind power is essential for expanding the introduction of renewable energy, and there is a need for the early practical application of a power generation system that reflects the topography and particular sea conditions of Japan. NEDO is establishing methods to acquire the high-precision wind condition data that is vital to the consideration of project plans for offshore wind power plants. NEDO is also conducting the collection of the required information and technical development to accelerate the commercialization of offshore wind power.

▶ Achievements

Actual observations were conducted at Mutsu Ogawara Port in Aomori Prefecture and other locations, and low-cost and precise offshore wind condition measurement combining remote sensing was established. This achievement has been compiled in the *Offshore Wind Condition Observations Guidebook* aimed at those involved in the implementation of wind condition observations.

▶ Going forward

It is expected that the use of the guidebook will contribute to the expanded introduction of offshore wind power, one of the keys to making renewable energy the main power source. In the future, NEDO will continue to promote the collection of information and technology development related to offshore wind power.



Offshore Wind Condition Observations Guidebook



Project name: Project for Supporting the Introduction of Wind Power Generation/ Project to Support Fixed-Bottom Offshore Wind Farm Development / Project to Support Fixed-Bottom Offshore Wind Farm Development (Establishment of offshore wind resource assessment method)
Implementation: FY2019–FY2022
Budget: 50 million yen (FY2022)

Biomass

Development of a research base for sustainable aviation fuel (SAF)

In order to solve the issue of feedstock procurement for future sustainable aviation fuel (SAF) demand, NEDO is working on the development of microalgae-derived SAF production technology. With a view to SAF production and CO₂ emissions reductions and utilization, NEDO will develop a research base and basic technology that are necessary for the research and development of related technologies, establish standardization methods for microalgae culture and analysis, and design model cases for SAF production processes through techno-economic and environmental impact analyses.

▶ Achievements

In FY2021, NEDO built a research base and established a culture and analysis facility there. From FY2022, NEDO has been working on developing standards for standard culture conditions and standard analysis conditions. It also promoted the roles and activities of the organization at exhibitions and site tours and conducted technical exchanges with organizations in different fields to discover innovative technologies.

▶ Going forward

While continuing activities to establish standards for standard culture conditions and standard analysis conditions, NEDO will use exhaust gas for microalgae culture to conduct techno-economic and environmental impact analyses and solve industrialization issues. It will also provide a forum for the exchange of technical information and the accumulation of opinions and technologies among industry, government, and academia, thereby promoting the industrial utilization of microalgae and the development of related technologies.



Exterior of the Institute of Microalgal Technology, Japan (IMAT) Technical Base Research Center Courtesy of Institute of Microalgal Technology, Japan

Project name: Development of Production Technologies for Biojet Fuels/Development of Basic Technologies for Microalgae Utilization/Development of a Research Base and Basic Technologies that Contribute to the Industrialization of Microalgae-Derived Biojet Fuel Production and Improvement of CO₂ Use Efficiency

Implementation: FY2020–FY2024

Budget: 383 million yen (FY2022)

Geothermal power generation

Successful practical application of a predictive diagnostic system to reduce incidences of trouble at geothermal power plants

Although geothermal power is a power source that can stably produce electricity regardless of the weather or time of day, drops in capacity factor due to trouble caused by the ageing of facilities and scaling have become issues. One of the themes of NEDO's Research and Development of Geothermal Energy Generation Technologies project, which has been underway since FY2013, is Research on Improvement of the Capacity Factor of Geothermal Power Plants, and test experiments of sign diagnostic systems for trouble at geothermal power plants utilizing the IoT and AI have been implemented.

▶ Achievements

As part of the Research and Development of Geothermal Energy Generation Technologies, using the achievements of the test experiments of sign diagnostic systems for trouble at geothermal power plants utilizing the IoT and AI a sign diagnostic system was completed. It was confirmed that the system can reduce occurrences of trouble by over 20%, and the practical application of the system was successfully achieved.

▶ Going forward

NEDO will aim for a more efficient operation of geothermal power plants and improved plan load factors through the use of the IoT and AI and pursue the further introduction of geothermal power.

Project name: Research and Development of Geothermal Energy Generation Technologies/Technology Development for Advanced Utilization of Geothermal Energy/Research on Improvement of the Capacity Factor of Geothermal Power Plants

Implementation: FY2018–FY2020

Budget: – (FY2022)



Patuha Geothermal Power Plants (Indonesia)
Courtesy of Toshiba Energy Systems & Solutions Corporation

Energy Conservation

In the outlook for energy supply and demand in FY2030 prepared by the Ministry of Economy, Trade and Industry, energy conservation measures were significantly revised with a new goal established to conserve approximately 62 million kL of energy by FY2030 through more diligent energy conservation efforts. In support of this goal, NEDO promotes research and development into innovative energy conservation technologies.

Strategic energy conservation

Successful fabrication of RGB pixel arrays with cadmium-free quantum dots for next-generation high-efficiency displays

In the display field, new technologies such as quantum dots (QDs) are being used as next-generation display technologies to replace LCD and OLED. NEDO has been working on the development of materials and processes for next-generation high-efficiency displays since FY2019 with the aim of commercializing next-generation high-efficiency displays that do not require color filters and thus lead to energy conservation.

▶ Achievements

The fabricated pixel arrays successfully emitted light with all RGB-colored and Cd-free QDs excited by electric current injection. In addition, the use of QDs with a blue spectral width approximately 60% narrower than that of conventional ones has enabled a wider color gamut.

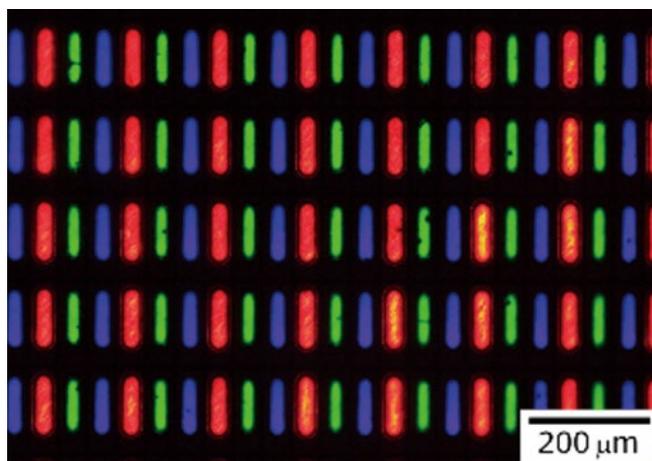
▶ Going forward

NEDO will work on the early practical application of energy-saving displays that feature low power consumption with high brightness, high contrast, and a high color gamut, and that can be applied to small- and medium-sized high-definition displays such as head-mounted displays as well as large-sized 4K/8K displays.

Project name: Strategic Innovation Program for Energy Conservation Technologies/Practical Application Development Phase/Development of Materials and Processes for Next-Generation High-Efficiency Displays

Implementation: FY2021–FY2023

Budget: Subsidy target expenses of 860 million yen, and subsidy of 450 million yen (FY2022)



Electroluminescence image of patterned RGB pixels formed with Cd-free QDs
Courtesy of Sharp Corporation

Strategic energy conservation

Completion of Japan's first demonstration facility for chemical recycling of plastics using microwave process

Toward the establishment of a decarbonized society, the chemical recycling method is considered a promising technology to turn waste plastics back into basic chemical raw materials through decomposition. In this project, NEDO has been aiming to construct a process that achieves energy savings of approximately 50% compared to conventional pyrolysis by using microwave technology, which can directly transfer energy to plastics.

▶ Achievements

NEDO has completed Japan's first comprehensive demonstration facility for chemical recycling technology with a processing capacity of one ton per day. NEDO has developed a new high-temperature complex permittivity measurement device that precisely measures the microwave absorption capacity of various plastics, and confirmed at the facility that waste plastics can be recovered as raw material monomers and converted back into plastics again.

▶ Going forward

Through a demonstration test, NEDO aims to develop the microwave plastic decomposition technology and make it a global standard and contribute to reducing GHG emissions in the industrial field.



Comprehensive demonstration facility for chemical recycling technology
Courtesy of Microwave Chemical Co., Ltd.

Project name: Strategic Innovation Program for Energy Conservation Technologies/Practical Application Development Phase/Development of a Novel Chemical Recycling Method for Plastics by Applying Microwave Process

Implementation: FY2020–FY2022

Budget: Subsidy target expenses of 220 million yen, and subsidy of 150 million yen (FY2022)

Strategic energy conservation

Development of a stand-alone ORC power generation system that achieves both excellent power output and Japan's highest level of energy conservation

The organic Rankine cycle (ORC) power generation system, which turns turbines by generating steam from a heat source, is used as a combined heat and power (CHP) system in binary power generation using hot springs and geothermal energy and in small woody biomass power generation. While there is great potential demand as measures to utilize unused waste heat, there is also a need for lower cost and higher efficiency.

▶ Achievements

By adopting a positive-displacement scroll expander, NEDO has developed a stand-alone ORC power generation system (5 kW class) that utilizes waste hot water from plants and other facilities as a heat source. The system has achieved a stable power generation output of 4.5 kW continuously at waste hot water temperatures of 80°C or higher and has also succeeded in achieving Japan's highest level of energy conservation of 40 to 50 kW compared to conventional systems. In addition, the power output can be stored in lithium-ion batteries (LIBs) and utilized.

▶ Going forward

In addition to further increasing power output and advancing the ORC power generation system developed this time, NEDO will also develop a system that works in conjunction with LIBs. NEDO will also conduct demonstration tests of the ORC power generation system using waste heat and exhaust gas from plants in various regions of Japan with the aim of commercializing its system by around 2025.



The stand-alone ORC power generation system (5 kW class) incorporating a scroll-type expander (above) for demonstration tests
Courtesy of Mabuchi Engineering



Project name: Strategic Innovation Program for Energy Conservation Technologies/ Practical Application Development Phase/Development of a Low-Cost ORC Power Generation System with a High-Speed, High-Performance Scroll Expander
Implementation: FY2020–FY2022
Budget: Subsidy target expenses of 130 million yen, and subsidy of 90 million yen (FY2022)

Strategic energy conservation

Promotion of the development of an innovative energy- and labor-saving production system for fine chemicals

In the field of fine chemicals, which is expected to grow in the future, eight companies from a variety of industries and one national research institute are collaborating to develop an on-demand continuous production process that can handle high value-added, high-mix and low-volume production by reconfiguring modules of fine chemicals.

▶ Achievements

NEDO has developed the iFactory, a reconfigurable modular pharmaceutical manufacturing facility that adopts a hybrid production system of continuous and batch production. The conversion to this production system is expected to save energy equivalent to 168,000 kL of energy (crude oil equivalent) by 2030.

▶ Going forward

NEDO will conduct operational verification tests at a demonstration facility and promote the implementation and widespread adoption of the system to help reduce energy consumption and boost the efficiency of production and use of resources in manufacturing fine chemicals such as active pharmaceutical ingredients.

Project name: Strategic Innovation Program for Energy Conservation Technologies/Cooperative Theme-Setting Scheme/Development of iFactory for Pharmaceutical Production Based on the Interconnection of Reconfigurable Module Unit Operation
Implementation: FY2018–FY2022
Budget: Subsidy target expenses of 540 million yen, and subsidy of 360 million yen (FY2022)



Exterior of iFactory demonstration facility
Courtesy of Takasago Chemical

Environment and Resource Conservation

NEDO has promoted the feasibility study of carbon recycling projects that will reduce CO₂ emissions, the development of technologies to reduce CO₂ emissions in the steelmaking process, and the development of technologies for responding to load fluctuations in thermal power generation as a power source that makes adjustments to the fluctuations. NEDO is also working on the research and development of low-GWP* refrigerants for use in refrigeration and air conditioning equipment, and so on.

*GWP: Global Warming Potential

CCUS

Evaluation of the effects and economic viability of CO₂ emissions reductions through cross-industry cooperation in the use of carbon recycling technologies at industrial complexes

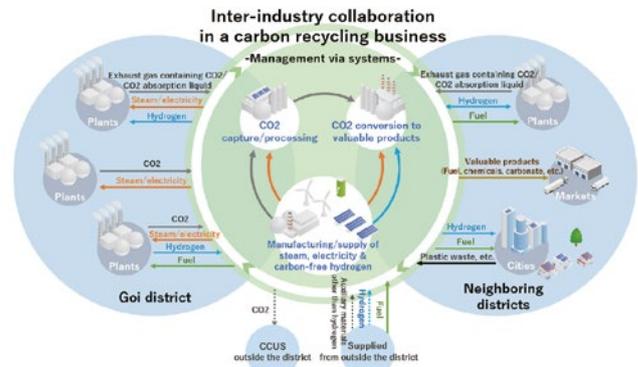
In order to reduce CO₂ emissions, in addition to improving the efficiency and cost reduction of individual technologies and manufacturing processes, it is important to develop an environment for cross-industry cooperation, especially in the use of carbon recycling technologies at industrial complexes. NEDO is conducting a feasibility study on carbon recycling projects that lead to the reduction of CO₂ emissions at existing industrial complexes consisting of multiple companies.

Achievements

NEDO conducted a study on energy balance, material balance, and so on based on the characteristics of each plant in the industrial complexes. Based on the results, NEDO evaluated the effects and economic viability of CO₂ emissions reductions of the entire industrial complex through the sharing of raw materials, products, and thermal energy between industries and the introduction of new carbon recycling technologies.

Going forward

NEDO will conduct more detailed studies on the effects and economic viability estimates of CO₂ emissions reductions and consider the specific implementation of carbon recycling technologies. In addition, NEDO will study management technologies related to CO₂ emissions reductions and the effective utilization of CO₂.



Outline of cross-industry cooperation projects
Courtesy of Yokogawa Electric Corporation

Project name: Development of Technologies for Carbon Recycling and Next-Generation Thermal Power Generation/Promotion of Carbon Recycling and Next-Generation Thermal Power/Feasibility Study of Carbon Recycling Projects Utilizing Cross-Industry Cooperation at Industrial Complexes

Implementation: FY2020–FY2022

Budget: 1.04 billion yen for the whole project (FY2022)

Iron and steelmaking processes

Promotion of technological development towards reduction of CO₂ in iron and steelmaking processes

The iron and steel industry accounts for around 12% (in FY2020) of Japan's CO₂ emissions from energy sources, most of which are released from blast furnaces. Aiming to establish technology to reduce CO₂ emissions from iron and steelmaking processes by more than 30% through the utilization of hydrogen reduction and CO₂ separation and capture technologies in blast furnaces, since FY2008, NEDO has worked on the development of elemental technologies as Phase I-STEP1, since FY2013 on a comprehensive demonstration test at a 12 m³ test blast furnace as STEP2, and since FY2018 on the maximization of hydrogen reduction as Phase II-STEP1.

Achievements

In a test blast furnace, NEDO succeeded for the first time in the world in reducing CO₂ emissions from a blast furnace by more than 10% by hydrogen injection. With regard to the CO₂ separation and capture technology, the world's top level energy intensity of 1.6 GJ/t-CO₂ was achieved by developing a new chemical absorption solution. As a result, NEDO has been able to put within its sight achieving the goal of a 30% reduction in CO₂ emissions.

Going forward

The results obtained will be used in the Green Innovation Fund/Hydrogen Utilization in Iron and Steelmaking Processes Project to demonstrate COURSE50* technology in an actual blast furnace and to develop Super-COURSE50 technology to maximize CO₂ emissions reductions using external hydrogen.



COURSE50 trial blast furnace
Courtesy of Nippon Steel Corporation

Project name: Development of Environmental Technology for Steelmaking Process/ Research and Development item 1. Development of Hydrogen Reduction and Other Technologies (Phase II - Step 1)

Implementation: FY2018–FY2022

Budget: 490 million yen (FY2022)

*COURSE50: CO₂ ultimate reduction system for Cool Earth 50 project

Thermal power generation

Promotion of the development of technologies to respond to load fluctuations in thermal power generation as a power line source that adjusts to the fluctuations

In order to maintain the balance between supply and demand of electricity for the increased adoption of renewable energy, NEDO is developing advanced technologies to further secure the adjustability of thermal power generation and to improve its reliability and operability.

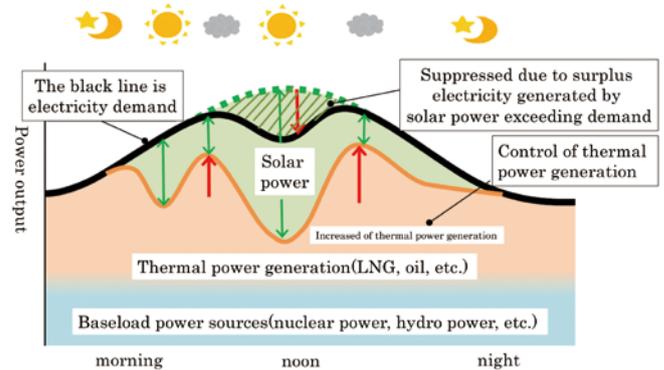
▶ Achievements

NEDO has developed a method for diagnosing the deterioration of main steam pipes (nondestructive inspection), technology for enhancing the rate of change in power output by applying a thermal storage system, and technology for failure prognosis and life prediction for steam turbines, and the like, and has set in its sights the technical prospect of using these technologies at commercial power plants.

▶ Going forward

The mass introduction of renewable energy requires ensuring the adjustability of electricity supply and demand. To achieve this, NEDO will promote research on the practical application of technology that improves the reliability and operability of thermal power generation.

Project name: Development of Technologies for Carbon Recycling and Next-Generation Thermal Power Generation/Development of Basic Technologies for Next-Generation Thermal Power Generation/Development of Technologies that Respond to Coal-Fired Load Fluctuations
Implementation: FY2020–FY2023
Budget: 430 million yen (FY2022)



Conceptual view of electricity supply and demand

Thermal power generation rapidly adjusts its output according to the increase or decrease in renewable energy output due to weather fluctuations, maintaining the balance between supply and demand of electricity.

Source: Agency for Natural Resources and Energy website

CFC substitutes

Mathematical models (equations of state) for hydrofluoroolefin (HFO) refrigerants have become the international standard (ISO17584 - Refrigerant properties)

This project has conducted research on low-GWP* refrigerants to replace hydrofluorocarbons (HFCs), including equipment development, consideration of safety and risk evaluation methods for refrigerants, high-precision measurement of refrigerant properties and development of equations of state. NEDO is focusing on the research and development of hydrofluoroolefin (HFO) mixed refrigerants, which are expected to enable safety and low GWP.

*GWP: Global Warming Potential

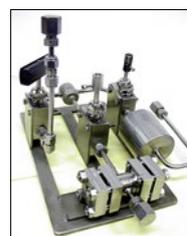
▶ Achievements

The equations of state for three HFO refrigerants with low GWP have been added to the International Standard Equation of State for Refrigerants (ISO17584) set by the International Organization for Standardization (ISO). This is the first revision of ISO 17584 in 17 years and the first time that the equations of state for HFO refrigerants have been included as a standard.

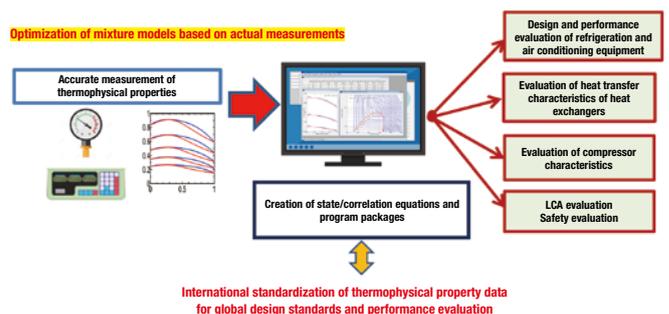
▶ Going forward

An environment will be developed in which the performance of other HFO refrigerants that have acquired international standards and mixtures with existing refrigerants can be appropriately evaluated. In addition, the development of new HFO mixed refrigerants using this HFO refrigerant and the optimal design and performance evaluation of refrigeration and air-conditioning equipment will be possible, which will lead to the widespread use of HFO refrigerant-compatible equipment in the future.

Project name: Development of Technology and Assessment Techniques for Next-Generation Refrigerants with a Low GWP Value
Implementation: FY2018 –FY2022
Budget: 550 million yen (FY2022)



High precision thermal property measurement device (Refrigerant critical point measurement device by the observation of meniscus)
 Courtesy of Kyushu University



Development of high precision computation model for thermal property
 Courtesy of Kyushu University

Robotics and AI

NEDO engages in the development and demonstration of technologies applied in robotics, drones, and artificial intelligence (AI). In FY2022, NEDO launched research and development necessary to realize Advanced Air Mobility (AAM), conducted demonstration tests aimed at the practical application of autonomous delivery robots, and promoted research and development for the social implementation of AI.

*Advanced Air Mobility(AAM) include drones,UAS and eVTOL

Advanced Air Mobility (AAM)

Started working on the development of methods for evaluating the performance of AAM, and the development of AAM traffic management technologies for low-altitude airspace harmonization

NEDO has launched 12 projects for the Realization of Advanced Air Mobility Project (ReAmo Project) to develop performance evaluation methods and traffic management technologies for AAM, this project will be carried out for the development of performance evaluation methodologies, enabling safe multiple drone operations by a single pilot, and low-altitude traffic management technologies among UAS,eVTOL and conventional aircraft.

▶ Background and significance

AAM is expected to provide unrestricted mobility of people and goods using less energy and without human intervention, in addition to enhancing operational efficiency, by compensating for labor shortages and coping with increased logistics volumes. To achieve this, the safety of AAM must be guaranteed while also establishing efficient flight operations through automation and autonomy.

▶ Going forward

NEDO will share and discuss the results of research and demonstrations obtained through this project with stakeholders both in Japan and overseas. NEDO will also contribute to the development of the AAM market represented by drones and AAM and disseminate information regularly through the ReAmo project.
<https://reamo.nedo.go.jp/en/>

Project name: Realization of Advanced Air Mobility Project: (ReAMO) Project
Implementation: FY2022–FY2026
Budget: 2.93 billion yen (FY2022)



Image of the AAM aimed for after the completion of the project

Robotics

Started demonstration tests aiming at practical application of automated delivery robots in last mile logistics

Regarding last-mile delivery, labor shortages and other issues are emerging. In response to the demand for the early realization of delivery services using automated delivery robots, the Act Partially Amending the Road Traffic Act, including the institutionalization of low-speed and small-sized automated delivery robots, came into effect in April 2023. NEDO has been working on technology development of automated delivery robots since FY2020 and is accelerating its development with the goal of achieving its practical application and commercialization in mind.

▶ Achievements

Aiming for the early social implementation of automated delivery robots, four research and development topics with different approaches were adopted and projects for practical application were initiated. Demonstrations are already underway in various areas of Japan.

▶ Going forward

In collaboration with municipalities and other bodies throughout Japan, NEDO will promote demonstration tests aimed at the practical application of automated delivery robots and examine how to enhance social acceptance of them. NEDO will also promote the development of a system that enables remote monitoring and operation of multiple robots.



Automated delivery robot (DeliRo)
 Courtesy of ZMP

Project name: Project to Construct a Basis for Research and Development of Innovative Robots
Implementation: FY2020–FY2024
Budget: 509 million yen (FY2022)

Development of AI not requiring the collection of vast actual image data by generating formula-driven mass image sets

In areas such as manufacturing and medical care in which it is not possible to prepare big data, there is a method to build an artificial intelligence (AI) system by creating a pre-trained model with large amounts of actual images and then additionally training it with a relatively small number of supervised images of applicable regions. However, these actual images have been faced with issues such as copyright, infringement of privacy, and data labelling burdens and errors.

Achievements

By generating images using fractal and contour formulae, NEDO has developed a technology to create a pre-trained model that does not raise rights or ethical issues, and has furthermore attained an image recognition standard with a higher precision than when using actual images. In addition, it was confirmed that the technology can be expanded to 3D and can be applied to object detection in 3D spaces.

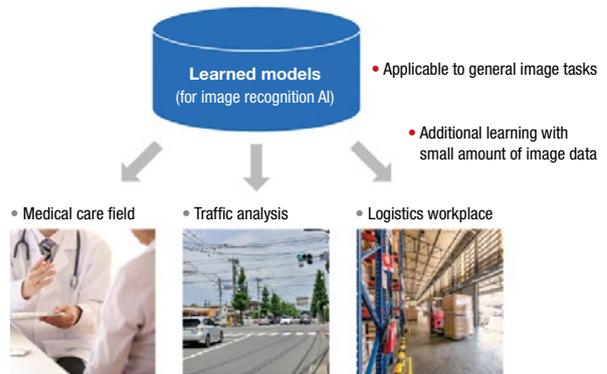
Going forward

NEDO will continue to expand this research and develop a foundation model applicable to multiple tasks without the use of actual data or manual supervised labels. It is expected that the model will be useful in the future when creating AI in all sorts of environments, such as the medical care field, the logistics workplace, and traffic analysis.

Project name: Technology Development Project on Next-Generation Artificial Intelligence Evolving Together With Humans Implementation
Implementation: FY2020–FY2024
Budget: 2.68 billion yen (FY2022)

Actual images		81.8 %
Images by fractal geometry		82.7 %

Comparison of image recognition precision between actual images and formula-driven images



Various fields of application Courtesy of AIST

Succeeded in AI-based traffic congestion prediction and demonstrations aimed at appropriate signal control

In the traffic signals currently installed in Japan, the period of time of green lights is controlled according to traffic load and queue length as measured by vehicle detection sensors. In order to measure the queue length, it is necessary to install a lot of traffic congestion measurement vehicle sensors, and the high running costs of the sensors has been an issue. In order to solve this issue, initiatives are being pursued in AI-based congestion prediction.

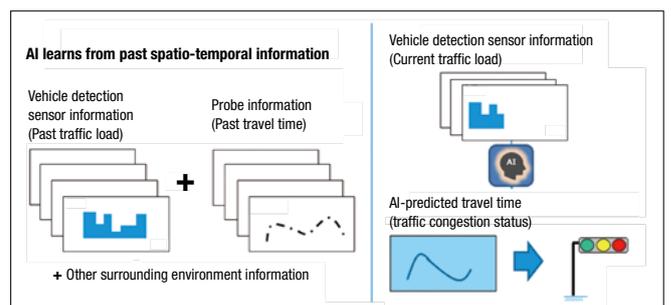
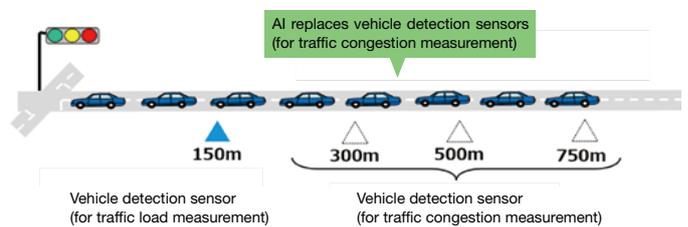
Achievements

By introducing AI to traffic control centers, queue length forecasts were conducted through the fusion of vehicle running information (probe data) and sensor information. By conducting signal control with the use of the values obtained, it was proved that it was possible to maintain the same level of signal control as is usual even with a 50% reduction in the number of vehicle detection sensors.

Going forward

By promoting the use of AI in traffic control systems throughout Japan, NEDO will aim to reduce costs. In addition, it will aim to achieve signal control that is flexibly adaptable to traffic situations through the further use of AI and contribute to the realization of reduced traffic congestion and a decarbonized society.

Project name: Realization of a Smart Society by Applying Artificial Intelligence Technologies
Implementation: FY2018–FY2022
Budget: 1.375 billion yen (FY2022)



Outline of congestion prediction using AI technology Courtesy of Sumitomo Electric Industries

IoT, Electronics, and Information Technology

NEDO is working on the development of devices such as chip technology that enables the efficient and high-speed operation of AI, control devices that enable high-speed communications, power devices that are the key to energy conservation, and quantum computers that are not an extension of existing technologies. Furthermore, it is also promoting systems development, such as communications technology, distributed processing technology, data integration technology, and security technology.

AI chips

Development of an AI chip achieving a maximum efficiency ten times greater than conventional technologies

With service robots and security cameras being utilized in many aspects of society, there is a need for the involvement of AI devices that are capable of sophisticated processing and real time responses. Meanwhile, since AI processing requires huge arithmetical operations, the heat produced due to increased electricity consumption with the current chips is proving to be an obstacle to commercialization.

▶ Achievements

Among the various representative AI model compression methods, NEDO focused on the “pruning” method that removes arithmetical operations with little impact upon recognition precision. In addition, by utilizing high flexibility dynamic switch circuit technology and so on, NEDO developed pruning technologies that remove arithmetical operations at the branch units meticulously and efficiently. NEDO achieved a maximum efficiency ten times faster than currently used technologies and a power efficiency of 10 TPOS/W*.

▶ Going forward

NEDO will continue to conduct detailed evaluations of the technologies developed and by establishing technologies will accelerate the digital transformation of the smart market, robotics, and many industries and will contribute to the creation of new services.

*TOPS/W: A unit expressing power efficiency in terms of tera operations per second (TOPS) per watt of electricity consumed.



AI system board mounted with DRP-AI chips
Courtesy of Renesas Electronics

Project name: Project for Innovative AI Chip and Next-Generation Computing Technology Development

Implementation: FY2016–FY2027

Budget: 10.04 billion yen (FY2022)

AI chips

Development of fundamental design technology for AI chip development and establishment of AI Chip Design Center (AIDC)

We need knowledge and technology related to both AI and chip design, software and hardware, as well as expensive design tools and design verification facilities in developing AI chips that can process large amounts of data at the edge field efficiently and while saving energy. AI chip development will be accelerated by the development of common fundamental technology for AI chip development and the establishment of a center that provides SMEs and startups with this knowledge and the development environments for design and verification.

▶ Achievements

The AI Chip Design Center (AIDC) has been working to enhance its EDA* tools and so on, and as of March 2023, the number of projects using the AIDC had reached 74. In addition, a design and evaluation platform of proprietary IP for AI chips, which is compatible with the 12 nm process and can realize everything from chip design to demo system development in a short period of time, was established.

▶ Going forward

The AIDC established under this project will be fully operational from April 2023 and is expected to be utilized by Japanese SMEs and startups. The AIDC aims to contribute to improving the global competitiveness of Japanese AI chips.

*Abbreviation for electronic design automation. Software that automates, supports, and assists the design of semiconductor integrated circuits and other electrical circuits.



AI Chip design booth



Evaluation chips and evaluation boards for design and evaluation platform of proprietary IP for AI chips
Courtesy of AIST and the University of Tokyo

Project name: Project for Accelerating Innovative AI Chip Development

Implementation: FY2018–FY2022

Budget: 2.22 billion yen (FY2022)

Energy-saving electronics

Development of the world's first IC chip that automatically provides optimal control of power semiconductors and reduces loss

Further energy saving of power electronics equipment is necessary to realize a decarbonized society. NEDO is developing a gate driver integrated circuit (IC) chip with a fully integrated automatic timing control function that integrates on a single chip the driving circuits of power semiconductors, which have been difficult to mount on actual products due to the size of circuit devices. This IC chip consists of a gate driver circuit with variable output current, a sensor circuit for determining appropriate timing, and a control circuit for changing the current waveform.

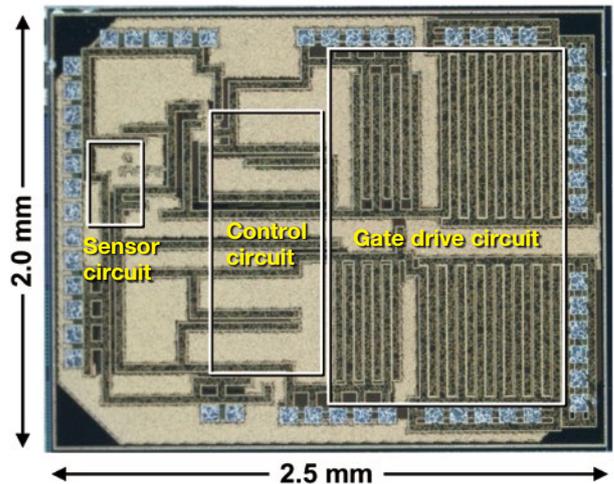
Achievements

NEDO has developed the world's first gate driver IC chip with a fully integrated automatic timing control function that reduces energy loss with a single chip by automatically and optimally controlling the gate terminals of power semiconductors. Through demonstration tests combining this IC chip and power semiconductors, it was confirmed that energy loss can be reduced by approximately 49% under 600 V and 80 A conditions.

Going forward

The project will develop and demonstrate an automatic optimization method to further reduce energy loss in high-voltage power semiconductors, sensor circuits with improved sensing error, and gate driver chip ICs utilizing them, thereby contributing to the reduction of CO₂ emissions through energy conservation in power electronics devices.

Project name: Technology Development Project to Enhance the Semiconductor Manufacturing Base of Energy-Saving Electronics
Implementation: FY2021–FY2025
Budget: 2.58 billion yen (FY2022)



A gate driver IC chip with a fully integrated automatic timing control function
 Courtesy of IIS, The University of Tokyo

Industrial DX

Started on the development of an infrastructure for linkage of various spatial information

Geospatial information is becoming increasingly diversified, and this includes 3D information data. To effectively utilize and expand the use of this information, it is important to efficiently distribute information and improve interoperability without being bound by the form of the data. To this end, after defining unique identifiers as spatial IDs to identify specific spatial areas, this project aims to easily and efficiently search, integrate, and utilize a wide variety of spatial information using the spatial IDs as a common index, as well as to provide the information in a machine-readable format.

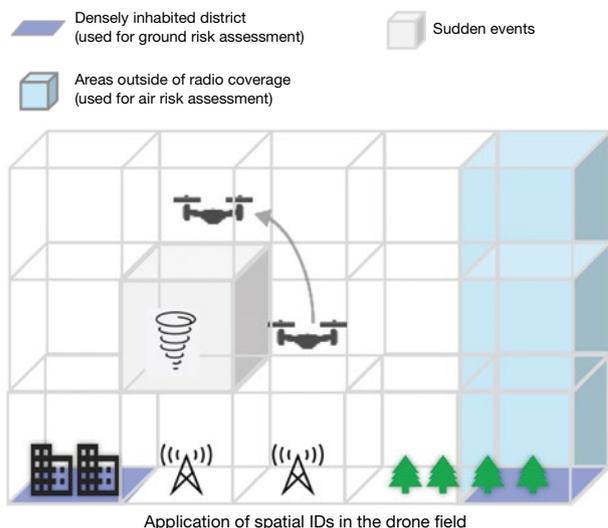
Achievements

The definition of spatial IDs was clarified, and guidelines summarizing its significance, specifications, usage, and the like, were prepared. In addition, a project has started on the development of an infrastructure for the efficient linkage of spatial information through spatial IDs and the verification of its effectiveness.

Going forward

By linking a variety of information to spatial IDs, it is expected that the safe and efficient operation of autonomous mobile robots such as drones will be realized and new services utilizing geospatial information will be created.

Project name: Digital Infrastructure Development Project for Digital Transformation of Industries/Research and Development of 3D Spatial Information Infrastructure
Implementation period: FY2022–FY2024
Budget: 1.7 billion yen (including other research and development items) (FY2022)



Application of spatial IDs in the drone field

Manufacturing Technologies

At all manufacturing sites, including those for devices, industrial machinery, and aerospace, the advancement, efficiency, and energy conservation of production facilities using IoT, artificial intelligence, and high performance devices and materials are becoming issues. To solve them, NEDO is engaged in research and development of high value-added, complex, and precise processing/modelling technologies and innovative semiconductor manufacturing processes and equipment.

Dynamic capabilities

Creation of a dynamic production line using a multi-skilled self-propelled robot that can work with existing production equipment

In order to realize production lines that are able to be flexibly and rapidly reconfigured and controlled even in the event of a supply chain disruption risk like the COVID-19 pandemic, NEDO is developing the technologies necessary for remote, integrated and optimal control of production facilities by utilizing 5G and other wireless communication technologies and digital technologies.

Achievements

A pilot line was developed and a cloud-based wireless cooperative control platform for existing production facilities and multi-skilled self-guided robots (equipped with measuring instruments), an NC linkage system, and machining assist module applications were introduced to conduct individual demonstrations of processing, monitoring, and evaluation functions.

Going forward

By reproducing a simulated environment with a variety of equipment configurations similar to existing manufacturing sites, NEDO will pursue future production lines that combine processing assist modules suitable for production facilities. It will continue to demonstrate the measures to promote their practical applications to reinforce the dynamic capabilities of the manufacturing industry.



Multi-skilled self-propelled robot with processing assist functions
Courtesy of DMG MORI

Project name: Research and Development Utilizing Wireless Communication Technologies to Reinforce the Dynamic Capabilities of the Manufacturing Industry
Implementation: FY2021–FY2025
Budget: 670 million yen for the whole project

Metal additive manufacturing

Confirmation of the efficacy of metal additive manufacturing, monitoring, and defect repair technologies during the metal additive manufacturing process by user verification

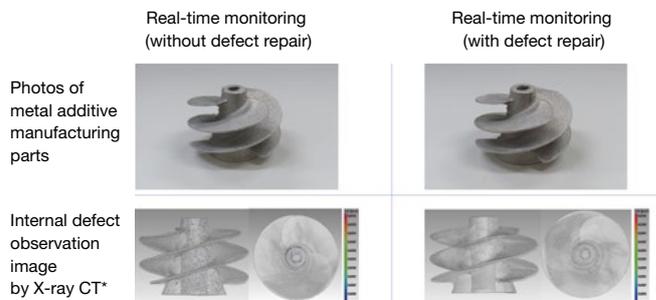
While metal additive manufacturing technology is attracting attention as a next-generation processing technology, significant cost and time are required to develop parts and ensuring part quality is difficult. Therefore, aiming to improve the quality and shorten the development period of metal additive manufacturing parts, NEDO is developing a system that uses machine learning to predict the occurrence of defects and set modelling conditions to minimize them, as well as technology that enables the real-time monitoring of modelling status and repair of defects.

Achievements

User verification of the system; which combines defect prediction, real-time monitoring, and defect repair technologies that have been developed to date; was conducted. As a result, the effectiveness in preventing the occurrence of defects has been confirmed.

Going forward

NEDO will continue verification by users to further enhance the system, which combines defect prediction, real-time monitoring, and defect repair technologies; and increase its practicality. By doing so, it aims to contribute to the spread of metal additive manufacturing technology in Japan as well as strengthen Japan's international competitiveness.



*The dots that appear in color are defects. No defects have occurred for the real-time monitoring (with defect repair).

Modeling results based on user verification Courtesy of TRAFAM

Project name: Basic Technology Development Project for Metal Additive Manufacturing Parts
Implementation: FY2019–FY2023
Budget: 350 million yen

Materials and Nanotechnology

NEDO is continuing its development efforts while building on Japan's industrial advantage in the materials manufacturing and nanotechnology industries. Ongoing activities include the development of innovative chemical manufacturing processes that do not rely on fossil resources, the development of a heavy rare earth element resources cycle and technologies contributing to the securement of those resources, the development of structural materials for providing lighter transport equipment, and the development of materials employing advanced artificial intelligence (AI) technologies.

Innovative material development technologies

Applied and tested performance of flame-retardant magnesium alloy floor panels on next-generation Shinkansen test train ALFA-X

Reducing the weight of transport equipment and thereby improving fuel efficiency has become an important issue towards reducing CO₂ emissions. Because magnesium is the lightest and strongest of the practical metals, it is drawing attention as a next-generation structural material. However, because it is also highly flammable and difficult to form, it is necessary to develop flame-retardant and easily processed magnesium materials.

▶ Achievements

Newly developed flame-retardant magnesium alloys were applied on the passenger cabin floor of one of the intermediate carriages of the next-generation Shinkansen test train ALFA-X, and as a result of the performance test implemented a weight reduction of around 23% (around 50kg/car) was attained while maintaining sound insulation properties.

▶ Going forward

NEDO will identify locations where it is possible to apply flame-retardant magnesium alloys, and with their fully-fledged application on high-speed railway carriages such as Shinkansen, it will contribute to carbon neutrality through reductions in the weight of transport equipment and subsequent fuel cost savings.



A passenger cabin floor panel of Shinkansen using flame-retardant magnesium alloys (Before floor sheet installation)



Next-generation Shinkansen test train ALFA-X undergoing performance testing
Courtesy of East Japan Railway

Project name: Research and Development of Innovative Structural Materials
Implementation: FY2014–FY2022
Budget: 2.4 billion yen (FY2022)

Data-driven materials development

Establishment of data-driven materials design methods towards the accelerated speed of functional material development

The Japanese material industry's share of the global market is high, and while it is becoming a source of industrial competitiveness in recent years, the situation is becoming increasingly fierce as the U.S., Europe, and the emerging nations catch up. It is thus that NEDO is aiming to replace the hitherto materials development methods; which depended upon intuition, experience, and countless exercises of trial and error; with data-driven materials development utilizing artificial intelligence (AI) and statistical analysis methods, and so on. It is in this way that NEDO will aim to establish basic technologies that greatly reduce the hitherto number of tests and development times and will contribute to the further strengthening of organic functional materials development.

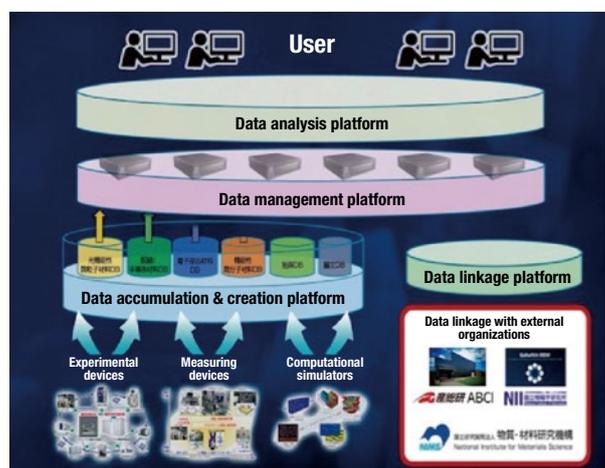
▶ Achievements

Data obtained from simulator development, including simulator testing devices and measurement devices, were initially classified as optical functional particles, wiring/semiconductor materials, electric component materials, functional polymers and catalysts. The data were then stored in a data platform (DPF) and a DPF operation system aimed at commercialization was developed.

▶ Going forward

With the DPF at the core and the Consortium for Data-driven Materials Design established by the National Institute of Advanced Industrial Science and Technology (AIST) in April 2022 as the contact point, NEDO will aim to link the achievements of the project with the accelerated commercialization of corporate new product development.

Project name: Introduction of Ultra High-Throughput Design and Prototyping Technology for Ultra Advanced Materials Development Project
Implementation: FY2016–FY2022
Budget: 2.5 billion yen (FY2021)



The data platform (DPF) concept

Biotechnology

Aiming for a bioeconomy society, NEDO is involved in the development and social implementation of biomass manufacturing products using the material production functions of plants and microbes, changes to the manufacturing structure, cellulose nanofiber-related technology development for a sustainable society, and technical developments aimed at the practical use of marine biodegradable plastics.

CNF Created samples of and implemented composite flooring materials by integrating the results of different development themes and the use of cellulose nanofibers

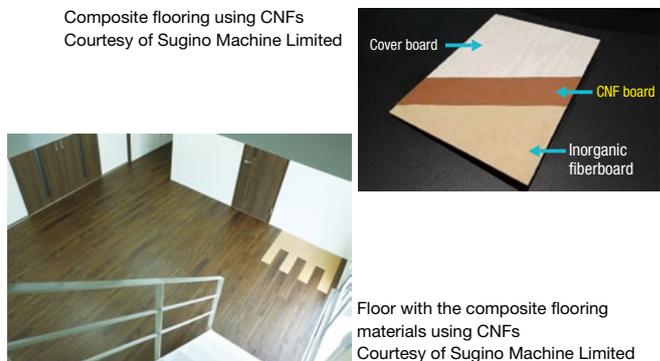
Cellulose nanofibers (CNFs) are excellent in terms of their lightness, strength, and expansion resistance and are a next-generation material derived from plants. Aiming to expand their market share through the pioneering of further uses and cost reductions, NEDO is involved in the development and safety evaluation of 15 development themes, including CNF-reinforced resins, which it is hoped will be used in many fields and many ways such as in automobiles, construction materials, and domestic electrical appliances.

Achievements

Sugino Machine Limited, a company involved in the technical development of high-quality, low-cost CNFs; manufactured CNFs and Risho Kogyo Co., Ltd., a company pursuing the development of residential and non-residential interior materials; formed and processed them into panels. Daiken Corporation then laminated them and processed them into high-strength, high-hardness composite flooring materials and installed them on the floors of their new offices. This is a good example in which the achievements of two different research themes have been merged and linked to testing and practical use.

Going forward

NEDO will contribute to reducing plastics usage and the realization of a carbon-neutral society through the early commercialization of CNFs, a plant-derived material.



Project name: Cellulose Nanofiber Related Technology Development to Contribute to a Carbon Cycle Society
Implementation: FY2020–FY2024
Budget: 642 million yen (FY2022)

Smart cells Achievement of the world's top level oil production (98g/L) using oleaginous yeast as a palm oil alternative

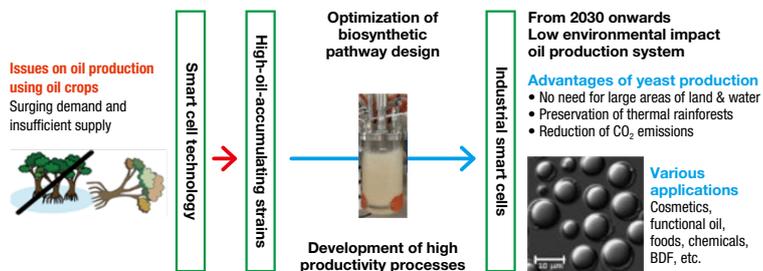
In order to promote the development of materials manufacturing technologies through biotechnology, which is considered important for the realization of a carbon-recycling society and sustainable economic growth, NEDO has conducted the Development of Bio-Based Production Technology to Accelerate Carbon Recycling project. As a part of the aim for a sustainable decarbonized society, NEDO is conducting research into oil production using oleaginous yeasts as an alternative production technology to oil crops, the stable supply of which is a concern.

Achievements

Through the introduction of information science technologies for the creation of industrial microorganism hosts (the development of which is underway), more productive industrial oleaginous yeasts were created, and this fermentation process has achieved the world-leading oil production of 98 grams per liter of culture medium in six days.

Going forward

NEDO will continue to improve the productivity of industrial oleaginous yeasts while simultaneously developing highly efficient production technologies for fermentation-produced oil and thereby aim for commercialization around 2023 and the realization of a carbon recycling-oriented domestic oil supply system in the future.



Research and development outline Courtesy of FUJI OIL HOLDINGS

Project name: Development of Bio-Based Production Technology to Accelerate Carbon Recycling
Implementation: FY2020–FY2026 (planned)
Budget: 2.96 billion yen (FY2022)

Support for SMEs and Startups

NEDO offers seamless support aimed at helping startups, as well as small- and medium-sized enterprises, to identify and match business seeds for viable commercial operations.

Startups

Support for the independent walking and movement of people with disabilities using the Ashirase walking navigation system

In addition to encouraging the investment and support activities of VCs, NEDO certified domestic and overseas venture capital companies and seed accelerators (VCs and so on) supporting technology-based startups. NEDO supports technology-based startups by utilizing their knowledge and support capabilities.

▶ Achievements

NEDO supported a company developing a device that intuitively conveys route information from the feet through a vibrating interface worn on the shoes and voice input and guidance functions via a smartphone app. The device provides a visually impaired person walking alone with an environment that makes it easier for them to check their route and concentrate on safety checks.

▶ Going forward

It aims to solve the problem of visually impaired people walking alone who are distracted by checking their route, leading to accidents, and to encourage them to go out and do independent activities without stress and anxiety.



Attached to a leg mold



Attached to sneakers. Courtesy of Ashirase, Inc.

Project name: Technology-Based Startup Support Program/Commercialization Support for Seed-Stage Technology-Based Startups/Development of Ashirase Walking Navigation System for Persons with Visual Impairments
Implementation: FY2022–FY2023
Budget: One billion yen for seed-stage technology-based startups overall

Promotion of Open Innovation

In order to encourage open innovation in Japan, NEDO collaborated with the Japan Open Innovation Council (JOIC) to organize NEDO Pitch events for Japanese startups.

Startups

Organization of NEDO Pitch, an event to support startups

About once a month, NEDO holds business matching pitch events in various sectors in which technology-based startups give short presentations to representatives of major corporations and venture capital firms. In FY2022, the events were held not only online but also offline in the Kansai and Chubu regions, providing opportunities for participants to network with each other.

▶ Achievements

Startups in various emerging fields, such as smart cities, agri-tech, health-tech, digital content, and food tech have participated in NEDO Pitch. A great number of participants have joined virtual and in-person pitch events, which have been positively received in terms of generating concrete business opportunities.

▶ Going forward

NEDO plans to gather feedback from pitch event participants and identify post-event success stories, encourage alliances between startups and major corporations by strengthening the JOIC functions and supporting technology-based startups, and create innovation through real-world applications of the latest technologies.



NEDO Dream Pitch in Kansai

Discovery of Technology Seeds and Fostering of Human Resources in Innovation

Through the NEDO Feasibility Study Program and the Intensive Support for Young Promising Researchers Program, NEDO is working on initiatives that will expand the technology seeds possessed by universities and others into industry-academia collaboration, which will lead to practical applications and social implementation in the future.

Feasibility study	Developed the ultra-fine MgB₂ 15 micrometer superconducting wire , the world's smallest
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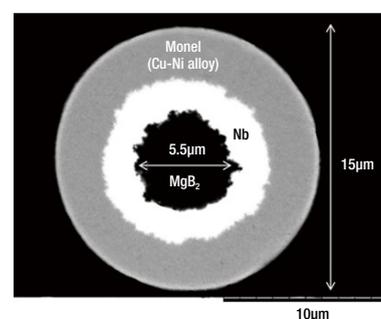
NEDO provides support with the aim of discovering promising technologies that will contribute to the realization of a decarbonized society and technology seeds that will lead to the creation of new industries, including in the fields of materials and biotechnology. NEDO is conducting feasibility study programs in order to link them to future national projects. In the energy and environment field, NEDO worked on the development of superconductivity-related technologies using hydrogen cryogenic energy for the construction of a hydrogen-based society.

▶ Background and significance

When liquid hydrogen, which enables efficient storage and transport of hydrogen, is converted back to room temperature gas for use, cryogenic energy of -253°C is lost. The development of technologies that can effectively utilize this energy is important to enhance energy efficiency and economic viability.

▶ Achievements

Superconducting wires are the key to realizing superconducting motors using liquid hydrogen cryogenic energy as the cooling refrigerant. NEDO has succeeded in developing the world's finest MgB₂ superconducting wire with a diameter of 15 micrometers. This has enabled great progress toward overcoming the challenges of improving resistance to bending strain (flexibility) when wrapping the wire around a coil and significantly reducing AC loss due to fluctuating magnetic fields.



Cross section of the ultra-fine MgB₂ 15 micrometer superconducting wire Courtesy of NIMS

Project name: NEDO Feasibility Study Program/Feasibility Study Program on Energy and New Environmental Technology/Ultra Fine MgB₂ Superconducting Wires
Implementation: FY2022
Budget: 35 million yen (FY2022)

Intensive Support for Young Promising Researchers	Succeeded in the visualization of dislocation and strain distribution inside semiconductor wafers
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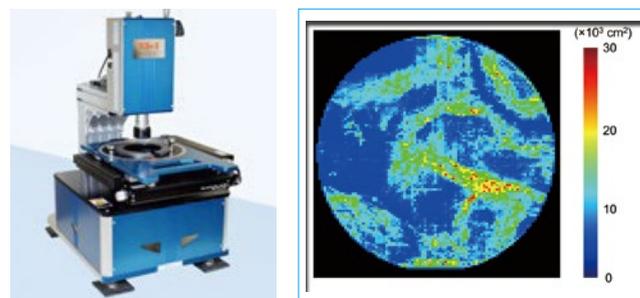
NEDO is identifying young researchers who are engaged in creative, practical, and goal-oriented basic or applied research at universities and assists them in moving to joint research with private companies to foster future human resources that will lead the next generation of innovation and create new industries. In the field of semiconductor manufacturing, NEDO is supporting the development of an automatic killer defect inspection system to improve productivity.

▶ Background and significance

When manufacturing substrates for power semiconductor devices such as silicon carbide (SiC) and gallium nitride (GaN), which enable the improved efficiency and miniaturization of power converters, semiconductor crystal wafers may often contain internal crystal defects, which can become killer defects. Therefore, highly accurate and efficient defect inspection technology to accurately determine the area and density of defects is needed.

▶ Achievements

NEDO has developed a dislocation counting system and a heat map display function that shows dislocation and strain distributions over the entire wafer in an intuitive and easy-to-understand way. This function has been incorporated into the products of a joint research partner. The heat map display function can be used to observe dislocations inside semiconductor wafers, epi-wafers, and single crystal samples (SiC, GaN, diamond, aluminum nitride, and so on) and to observe wafer bending.



XS-1 Sirius crystal dislocation visualization equipment and heat map displaying the results of the dislocation counting system Courtesy of Nagoya University and Mipox

Project name: Intensive Support Program for Young Promising Researchers/Joint Research Phase (environment and energy)/Development of an Automatic Killer Defect Inspection System That Improves Semiconductor Manufacturing Productivity
Implementation: FY2020–FY2022
Budget: 24 million yen (subsidy) (FY2022)

To realize achieving carbon neutrality by 2050 with bold investments

Green Innovation Fund Projects

In October 2020, within the growing global momentum for decarbonization, the Japanese government declared that it aims to achieve carbon neutrality by 2050, with the specific goal of reducing overall greenhouse gas emissions to zero by 2050. Based on this policy, the Japanese government established the Green Growth Strategy Through Achieving Carbon Neutrality in 2050 whereby it commits to pursuing a balanced approach to realize both economic growth and environmental protection. In line with this approach, the Green Innovation Fund was established at NEDO to support ambitious private sector efforts to realize carbon neutrality, and the Green Innovation Fund Projects have started.

The Green Innovation Fund Projects target priority areas with action plans developed in line with Japan’s Green Growth Strategy and supports companies committed to ambitious goals related to achieving carbon neutrality through the research, development, demonstration, and practical application of their technologies over the next decade.

In FY2022, based on the research and development and public implementation plans for priority fields identified by the government, for 19 projects NEDO promoted research and development and solicited proposals.

*Based on funding allocation policy for each field (as of May 2023)

Projects

 Projects in which research and development was started by FY2022

■ Field of Green Power Promotion, etc

● Cost Reductions for Offshore Wind Power Generation

NEDO is promoting the development, integrated design, and demonstrations of components (e.g., wind turbine components, floats, and cables) to reduce the cost of floating offshore wind generation.

● Development of Next-generation Solar Cells

NEDO is promoting the development and demonstration of perovskite and other types of low-cost next-generation solar cells that can be installed in challenging locations such as the exterior walls of buildings.

● Development of CO₂ Reduction Technology for Waste Treatment and Circulation of Resources

NEDO will develop and demonstrate raw material and fuel conversion technologies using incineration with CCUS, pyrolysis, methane fermentation with bio-methanation. NB: this project is under consideration.



■ Field of Energy Structure Transformation

● Large-scale Hydrogen Supply Chain Establishment

NEDO is promoting the development and demonstration of technologies related to hydrogen production, transportation, storage, power generation, etc. to expand the supply of hydrogen and reduce the cost of hydrogen.

● Hydrogen Production through Water Electrolysis Using Power from Renewables

NEDO is promoting development and demonstrations aimed at reducing the cost of hydrogen-producing water electrolyzers.

● Hydrogen Utilization in Iron and Steelmaking Processes

NEDO is promoting the development and demonstration of technology to manufacture steel with hydrogen instead of coal using hydrogen-based steelmaking technology.

● Fuel Ammonia Supply Chain Establishment

NEDO is promoting the development and demonstration of technologies related to ammonia production and power generation to expand the supply of ammonia and reduce the cost of ammonia.





- **Development of Technology for Producing Raw Materials for Plastics Using CO₂ and Other Sources** 🌱

NEDO is promoting the development and demonstration of technologies to manufacture raw materials for plastics from CO₂, plastic waste, and rubber waste.

- **Development of Technology for Producing Fuel Using CO₂, etc.** 🌱

NEDO is promoting the development of technologies to use CO₂ for the manufacture of industrial gases and fuels for cars, jets, and the household.

- **Development of Technology for Producing Concrete and Cement Using CO₂** 🌱

NEDO is promoting the development of technology to lower the cost and increase the durability of concrete manufactured with CO₂.

- **Development of Technology for CO₂ Separation, Capture, etc.** 🌱

NEDO is promoting the development of technologies by comparing various technology systems for separating and collecting CO₂ according to the scale and concentration of CO₂ emissions.



■ Field of Industry Structure Transformation

- **Next-generation Storage Battery and Motor Development** 🌱

NEDO is promoting the development of components and materials for batteries and motors needed for electric vehicles, drones, and agricultural machinery, as well as production processes and recycling technologies.

- **Development of In-vehicle Computing and Simulation Technology for Energy Saving in Electric Vehicles** 🌱

NEDO is promoting the development of in-vehicle computing technology to carry out high-level information processing in areas such as autonomous driving, as well as simulation performance analysis platforms.

- **Smart Mobility Society Construction** 🌱

NEDO is promoting the development and demonstration of autonomous driving and digital technologies to promote the use of electric vehicles in the tourism and logistics sectors.

- **Next-generation Digital Infrastructure Construction** 🌱

NEDO is promoting the development of technologies to reduce energy consumption by data centers and power semiconductors.

- **Next-generation Aircraft Development** 🌱

NEDO is promoting the development of component technologies for engines, fuel tanks, and fuel supply systems needed for hydrogen-powered and electric-powered aircraft.

- **Next-generation Ship Development** 🌱

NEDO is promoting the development of component technologies for engines, fuel tanks, and fuel supply systems needed for hydrogen-fueled and ammonia-fueled ships.

- **Development of Negative Emission Technologies in Agriculture, Forestry, and Fisheries Industries** 🌱

NEDO is promoting the development of CO₂ reduction and absorption technologies marketable in the agriculture, forestry, and fishery sectors.

- **Promotion of Carbon Recycling Using CO₂ from Biomanufacturing Technology as a Direct Raw Material**

NEDO is promoting the development of microorganisms that absorb large quantities of CO₂ through the creation of a microorganism modification platform.

- **Decarbonization of thermal processes in manufacturing**

NEDO is promoting the development of carbon-neutral-adaptable industrial furnace combustion technologies, and lower power reception capacity/higher efficiency technologies to enable the switch from combustion furnaces to electric furnaces.



Moonshot Research and Development Program

The Japanese government established the Moonshot Research and Development Program with nine specific goals to promote ambitious research and development activities based on bold ideas that are not just extensions of conventional technologies, with the aim of stimulating disruptive innovation in Japan. NEDO is engaged in ambitious research and development activities to achieve Moonshot Goal 4.

Moonshot Goal 4

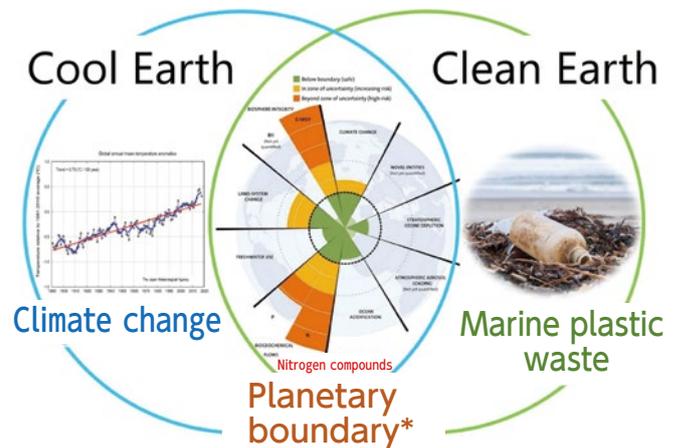
Realization of sustainable resource circulation to recover the global environment by 2050.

Solutions to the global warming problem (the Cool Earth) and environmental pollution problem (the Clean Earth) through realization of sustainable resource circulation for the global environment.

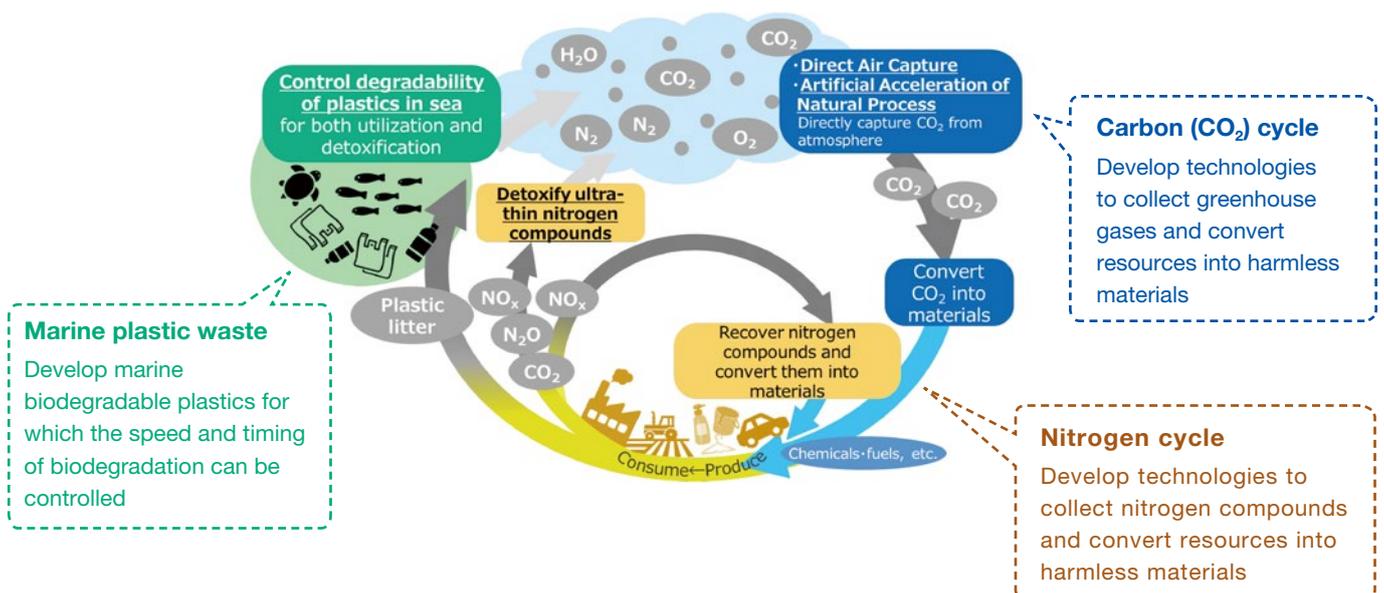
Rationale for Goal 4

Greenhouse gases, nitrogen compounds, and marine plastic waste are constantly being released, thereby causing adverse impacts on the environment. In addition to reducing the production volume of these substances, measures are also needed to recycle them.

*This term refers to the threshold limit for sustaining the development and prosperity of human society. Exceeding this limit will cause irreversible damage to the natural resources people depend on.



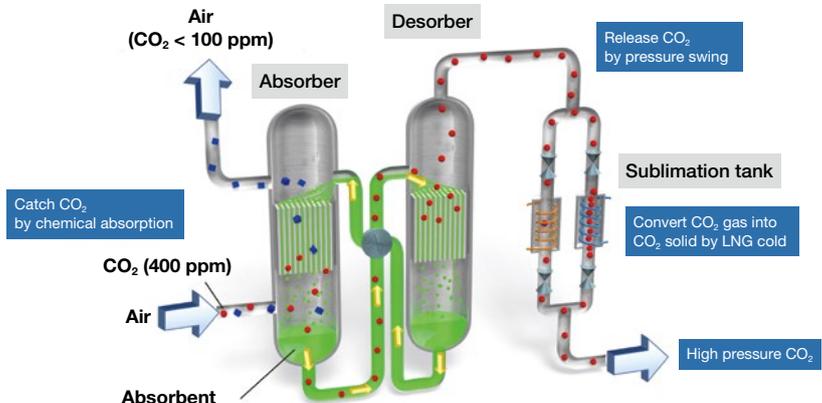
Conceptual diagram of Goal 4



Moonshot Goal 4

Promotion of CO₂ capture research and development using untapped LNG cryogenic energy

NEDO is developing a new technology that significantly improves the efficiency of direct air capture (DAC) by utilizing untapped cold energy from liquefied natural gas (LNG). The goal is to establish a series of processes that recover CO₂ as dry ice from the CO₂ absorbent solution by harnessing the coldness generated during the vaporization of LNG.



A pressure swing amine process driven by the cryogenic pumping with LNG cold
Courtesy of Nagoya University

Project name: Research and Development Toward Saving Energy for Direct Air Capture With Available Cold Energy

Achievements

NEDO identified a promising absorbent solution that provides a sufficient CO₂ solubility difference in the pressure range of 40 Pa for atmospheric CO₂ partial pressure and 10 Pa for the desorber pressure (dry ice sublimation pressure at -150°C).

Going forward

NEDO will complete a series of systems that can capture and recover CO₂ from the atmosphere. Then, following the design, construction, and operation of a bench-scale plant, NEDO will design, construct, and operate a pilot plant with a CO₂ recovery rate of 50 t-CO₂/year.

Moonshot Goal 4

Compact and dispersible DAC-U system to capture CO₂ directly from the atmosphere with a membrane

NEDO is developing a compact and decentralized CO₂ circulation system that directly captures CO₂ from the atmosphere using a separation membrane and converts it into value-added chemicals on site. This will reduce CO₂ emissions, the main cause of global warming, and realize carbon resource recycling. Specifically, NEDO is developing a CO₂ capturing unit consisting of an innovative CO₂ separation nanomembrane with an extremely high CO₂ permeability developed using proprietary nanomembrane technology, and a unit that efficiently converts the captured CO₂ into carbon fuel.



DAC-U systems and CO₂ separation membrane
Courtesy of Kyushu University

Project name: Development of Global CO₂ Recycling Technology towards a "Beyond-Zero" Emission Society

Achievements

NEDO has developed basic separation membrane materials that exhibit high CO₂ selectivity. It has also demonstrated the conversion of CO₂ mixed gas into basic chemicals such as carbon monoxide (CO), methane (CH₄), and ethylene (C₂H₄).

Going forward

NEDO will manufacture and demonstrate a compact unit that integrates a CO₂ capture unit (concentration: 1000 times or more; the amount of captured CO₂ : 2 kg/day or more) and a CO₂ conversion unit that converts 80% or more of the separated CO₂ into C1/C2 compounds.

Aiming to strengthen information and communication technologies and manufacturing infrastructures toward the 5G expansion phase

Research and Development Project of the Enhanced Infrastructures for Post-5G Information and Communication Systems

In many countries, 5G mobile communication systems more advanced than their 4G predecessors have already been launched as commercial services. Post-5G systems, which possess even more advanced capabilities, such as ultra-low latency and multiple simultaneous connections, are expected to become a cornerstone for Japanese competitiveness in years to come. Post-5G technologies are also expected to be utilized in a variety of industrial applications, such as smart manufacturing and autonomous driving. In addition, such technologies are essential to realizing both a digital society and carbon neutrality.

This project aims to develop core post-5G technologies and enhance Japanese research and development and manufacturing infrastructure for post-5G information and communication systems.

More specifically, as well as developing post-5G information and communication systems and advanced semiconductors to be used in such systems, the project promotes the development of technologies for manufacturing advanced semiconductors so that Japan ensures its manufacturing capability in this sector.

Overview of research and development items

1. Development of post-5G information and communication systems (Commission, Subsidy)

The item aims to promote the development of systems important for realizing the levels of performance required in the post-5G era, and development of technologies for semiconductors used in these systems.

2. Development of manufacturing technologies for advanced semiconductors (Subsidy, Commission)

- Through the creation of pre-commercial manufacturing "pilot lines" and other activities, the item aims to promote the development of manufacturing technologies for leading-edge products, such as logic semiconductors which are not currently available in Japan. (Subsidy)
- The item also promotes the development of core technologies where Japan ensures a competitive advantage, such as system design technologies for advanced semiconductors, technologies for realizing commercial-scale manufacturing technologies related to packaging and miniaturization. (Commission)

3. Feasibility Study (Commission, Subsidy)

Feasibility studies related to research and development items 1 and 2 are also conducted. This item covers technologies that may not be ready for commercialization in the post-5G era but may be promising in the latter half of the post-5G era and the next generation.

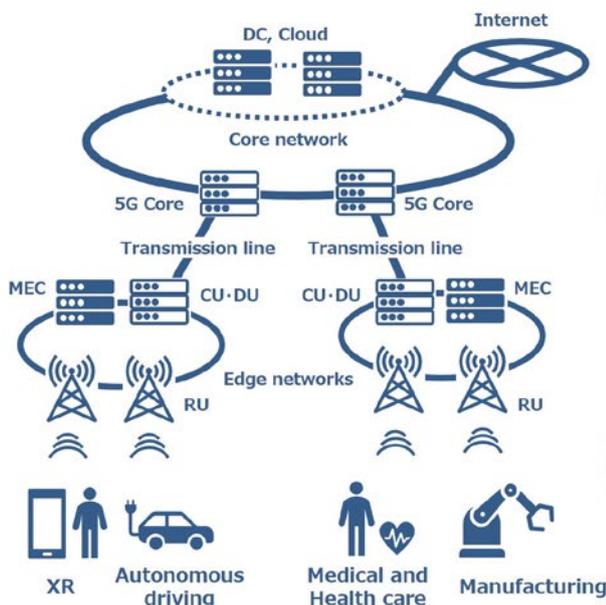
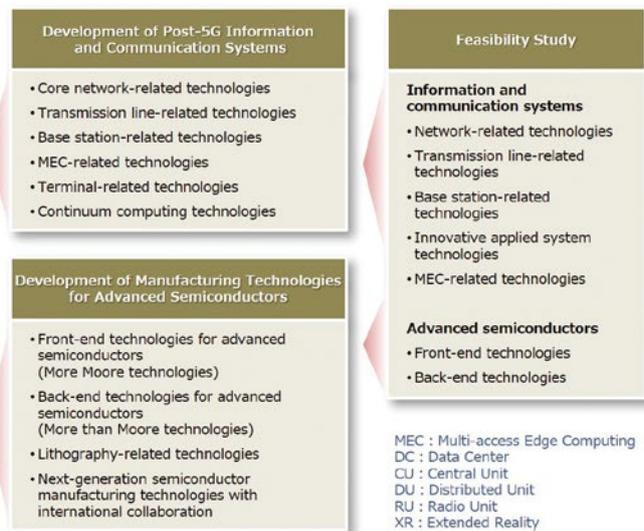


Diagram of research and development project



Post-5G

Succeeded in advanced 5G slice orchestration using artificial intelligence (AI)

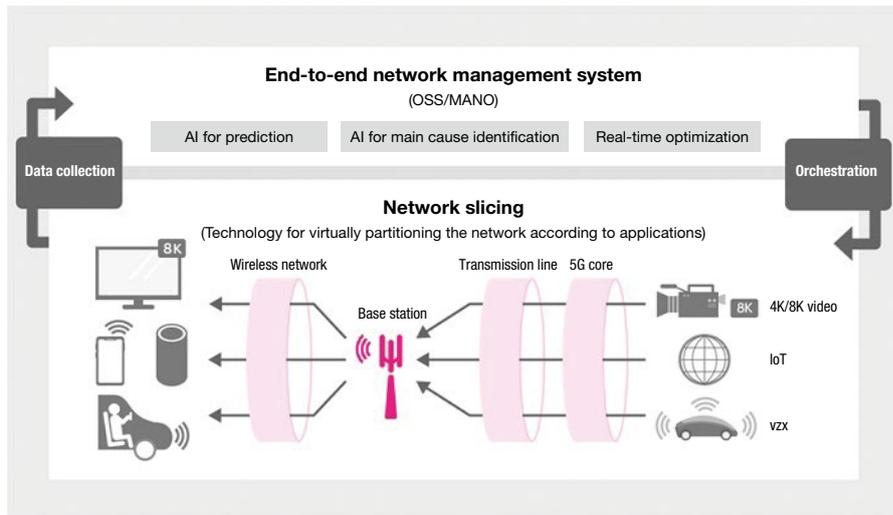
Post-5G mobile networks require advanced technologies for virtualization and computational resource management that will enable the efficient use of limited wireless/network resources, while meeting the requirements of diverse services. We are developing software technologies to incorporate advanced functions in operation support systems (OSS) and management and network orchestration (MANO) in cloud-based networks.

Achievements

We have succeeded in developing "Network Slicing Orchestration Technology," which operates network slicing autonomously and automatically between two communicating systems (end-to-end) in stand-alone (SA) 5G mobile networks, and "Advanced 5G Slice Orchestration Technology with AI," which combines AI with an orchestrator to advance 5G network operations. In the mobile networks that deployed these technologies, we have achieved a 77.5% automation rate from configuration to operation of network slicing.

Going forward

Mobile networks have traditionally been operated and managed manually. Automatic operation and management is expected to eliminate an enormous number of daily tasks such as network configuration changes and service additions, thereby reducing costs and improving quality.



End-to-end network slicing orchestration
Courtesy of Rakuten Mobile, Inc.

Post-5G

Developed a false-lock-aware locking technique for 56 Gbps PAM4 transceivers

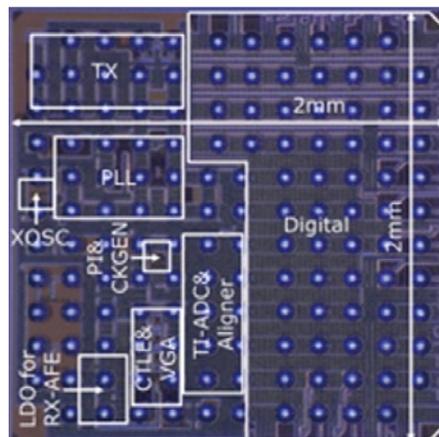
In order to realize low latency, one of the features of post-5G mobile networks, the widespread deployment of multi-access edge computing (MEC) servers, which enable data processing in areas closer to the user, is needed as well as conventional data-intensive and processing type cloud servers. We are developing design technology for low power consumption, high bandwidth, and large capacity memory modules that are required to realize big data analysis in MEC servers.

Achievements

In order to expand the transmission capacity of data communications, one of the high-speed communication methods of PAM4 (4-level Pulse Amplitude Modulation) has started to be used. However, when PAM4 is used, a clock recovery can occasionally fail and then as a result the performance of receivers can be seriously degraded by the incorrect clock signals. We have recently developed a false-lock-aware locking technique to prevent the failure of the clock recovery and successfully demonstrated its operation with a prototype transceiver.

Going forward

Application of this technology to the interface between the NAND flash memory and the memory controller will enable a memory module with higher bandwidth and larger capacity. By deploying MEC servers equipped with this memory module in a 5G network for performing big data analysis, it is expected to make IoT and other industries smarter.



Chip micrograph of transceiver using 16nm-FinFET technology
Courtesy of Kioxia Corporation

Key and Advanced Technology R&D through Cross Community Collaboration Program (K Program)

In order to strengthen and promote economic security in Japan, the Cabinet Office, the Ministry of Economy, Trade and Industry (METI), and other relevant ministries and agencies will work together to promote the research and development process of advanced key technologies through to technology demonstration in a rapid and flexible manner. Taking into account the ambiguous nature of science and technology, NEDO promotes research and development projects that lead to not only commercial use but also public use and encourages the utilization of research and development results based on the vision and concept set forth by the government.

Projects for implementation

Based on the research and development concept formulated by the government, NEDO is promoting the research and development. In FY2022 it solicited proposals for eight projects, of which three projects were selected for adoption.



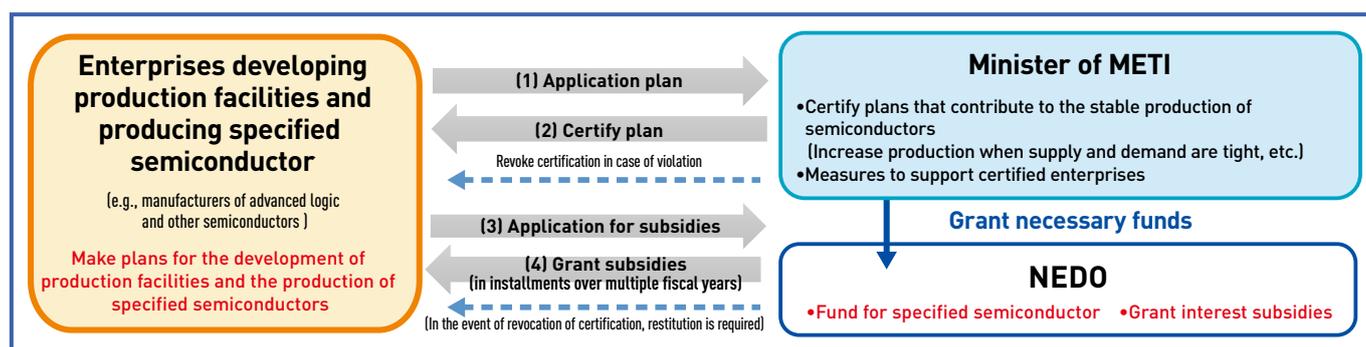
Programs for Specified Semiconductor Production-Related Development

Support for facilities producing advanced logic semiconductors and memory semiconductors

Specified Semiconductor Funding Program/ Program for Specified Semiconductor Interest Subsidies

Performed in close cooperation with METI and in accordance with Article 29 of the Act on Promotion of Developing/Supplying and Introducing Systems Making Use of Specified Advanced Information Communication Technologies (Act No. 37 of 2020), NEDO will create a fund and grant subsidies to businesses that have been certified under the Act (hereinafter referred to as “certified enterprises”), and will be engaged in the grant interest subsidies to financial institutions that provide loans to certified enterprises.

Funding mechanism



Awards and commendations

In addition to receiving awards in Japan and overseas for its projects, NEDO has instituted its own award programs to encourage the practical application of NEDO project outcomes as well as the emergence of new players.



NEDO project wins first place at international artificial photosynthesis competition

Utilizing the results of NEDO's artificial photosynthesis project, The University of Tokyo and INPEX CORPORATION (INPEX) participated in the international artificial photosynthesis competition, "Fuel from the Sun: Artificial Photosynthesis," with the support of the Artificial Photosynthetic Chemistry Process Technology Research Association (ARPCChem), and they won first place out of a total of 22 teams. The competition tested the technical ability to construct a functional prototype device for practical fuel synthesis using artificial photosynthesis technology. The University of Tokyo utilized the results of the NEDO project to produce hydrogen and, together with INPEX, constructed a device that converts the obtained hydrogen and CO₂ (supplied by the organizer) into methane to produce methane fuel.



Fuel from the Sun: Artificial Photosynthesis award ceremony



Award for Academic Startups 2022

Awards presented to promising startups and their supporting universities and companies

This award was started by NEDO and the Japan Science and Technology Agency in FY2014. In FY2022, 34 applications were received, and eight university-launched ventures and their supporting universities and companies were given awards. The purpose of the award is to further promote startups that utilize the results of research and development at universities and challenging efforts after starting a business, as well as support for university-launched ventures.

- NEDO Chairman's Award
ElevationSpace Inc.
- METI Minister's Award
bitBiome, Inc.
- MEXT Minister's Award
Chordia Therapeutics Inc.

NEDO Energy Conservation Technology Development Awards

Promoting early social implementation of technology development results that contribute to energy conservation

Of the research and development projects that were conducted under the Strategic Innovation Program for Energy Conservation Technologies and were completed by FY2021, NEDO presented awards to 20 businesses in 11 categories that had achieved outstanding results. The purpose of the awards is to encourage businesses to continue their research and development even after the completion of their projects and to accelerate the social implementation of the project results.

- NEDO Chairman's Award
Mazda Motor Corporation

NEDO Energy Conservation Technology Development Awards ceremony



NEDO Supply Chain Data Challenge, NEDO's first prize-awarding initiative

Prize money awarded for excellent ideas and systems that contribute to building a stronger supply chain

This is NEDO's first prize-awarding initiative to solicit ideas and systems for services that enable the rapid understanding of supply chain conditions and flexible reconfiguration of logistics through the use of satellite data, and so on. Various players, including domestic and foreign businesses, universities, research institutes, researchers and individuals, participated in the competition, and various ideas and systems were proposed.

Ideas category: 1st prize

Project name: Business Solution to Design Disaster-Resistant Supply Chain by Incorporating Satellite Data and Disaster Simulator
Winner: Space BD Inc.

System development category: 1st prize

Theme 1 (ports): Project name: Platform for Procurement and Production
Winner: Fujitsu Limited

Theme 2 (disasters): Project name: Visualizing Disaster Situations Using SAR Satellite Data and AI to Support Supply Chain Maintenance
Winner: Space Shift Inc.



International Partnerships

UK

Developing safe, sustainable, smart life jacket

Azul Energy Inc. has developed a next-generation smart life jacket that combines an ultra-high-capacity metal air battery that can be safely used underwater with a recyclable, moisture-permeable waterproof textile made by a British company. This jacket is equipped with a global positioning system (GPS) that enables real-time location information acquisition.



GPS Module



AZUL Battery



Smart life jacket

Slovenia

Successfully completed demonstration operation of cloud-based advanced energy management system in Slovenia



NEDO successfully completed the demonstration operation of a cloud-based advanced energy management system, which has functions such as islanding (autonomous operation in the event of a power grid accident), voltage dips mitigation measures, and ancillary services (provision of flexibility to electricity transmission system operators). Going forward, based on the results confirmed in the actual power grid, this project aims to establish an energy service business for large-scale power consumers.

Europe

Europe

Middle East/
Central Asia

East/
Southeast
Asia

East/
Southeast
Asia

Saudi Arabia

Commenced demonstration operation of energy-efficient seawater desalination plant



Collaboration between NEDO and Saudi Arabia's Saline Water Conversion Corporation is underway to demonstrate an energy-saving seawater desalination plant with a daily water production of 10,000 tons. This plant combines a low-pressure two-step high-yield reverse-osmosis system with low-pressure reverse-osmosis membranes. The test operation of the plant was completed in February 2023, and demonstration operation commenced in the same month. Demonstration operation is scheduled to continue until December 2023 to demonstrate the energy-efficiency.

India

International demonstration project for optimal control technology of Energy Center for steel plants in India



In cooperation with the Steel Authority of India Limited (SAIL), the third largest steel producer in India, NEDO introduced the Energy Center, featuring Japanese advanced technology that enables energy supply-demand forecasting and operational optimization, and demonstrated its energy conservation and greenhouse gas reduction effects based on the data about the energy consumption at the entire plant and by the total optimization in the energy supply and demand at SAIL's ISP Burnpur plant. NEDO also disseminated the Energy Center to other "integrated steelworks" that need total optimization of energy supply and demand.

NEDO shares unique Japanese solutions with the international community to address diverse needs and social conditions. It also encourages the development of useful technologies by facilitating joint international R&D and conducting international demonstration projects.

Projects conducted around the world

North America

North America

United States

A microgrid using a redox flow battery system successfully operated on commercial distribution network; co-organized a debriefing session in California



Photo courtesy of San Diego Gas & Electric

In collaboration with Japanese and U.S. partners, NEDO successfully demonstrated the operation of a microgrid of 66 electricity consumers connected to a commercial distribution network. The microgrid using a large-scale redox flow battery system is designed to produce revenue from transactions of electricity in normal times and it can be operated off-the-grid in emergency situations. NEDO and the Governor's Office of Business and Economic Development co-organized a debriefing session in California.

Thailand

Contributed to the effective use of energy by taking advantage of Japanese membrane separation technology



Thailand is a country with a large amount of biomass and a well-developed industrial infrastructure. In the country, NEDO demonstrated energy-saving system technology to co-produce cellulosic sugars, which will be used as raw materials for bioethanol or other chemical products, and high value-added products such as polyphenol and oligosaccharide, using surplus bagasse from sugar mills as raw material. Stable and continuous operation of the demonstration plant was carried out, and the evaluation of production and customer assessment was promoted.

Demonstrated international WEEE recycling system in Thailand



NEDO used the first recycling system introduced in Thailand that shreds and sorts waste electrical and electronic equipment (WEEE), and verified the effectiveness of the system. NEDO also exchanged opinions with the Thai government on the design of a system for proper disposal of WEEE, and co-hosted the public meeting to report on results of the project in December 2022.

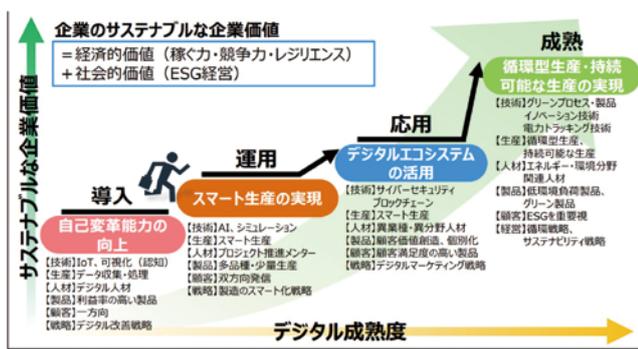
Research activities in the fields of manufacturing and materials

Publication of DX report

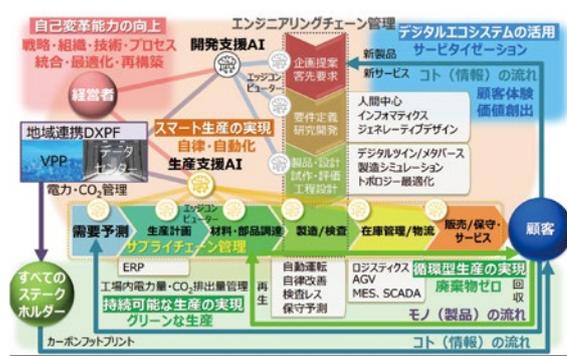
In April 2020, the NEDO Technology Strategy Center (TSC) redefined its mission to “Catch Moves, Design Our Future, and Show Strategies Forward.” Given this redefined mission, TSC is working together with policy authorities in Japan on the planning of important technology development projects as well as the formulation of technology strategies to address environmental and energy issues and strengthen industrial capabilities in Japan. TSC’s achievements are regularly reported in its TSC Foresight publication. Through research and analysis in a variety of technology fields, NEDO continues to contribute to solving issues facing the world. In FY2022, as a bird's-eye view of industrial and technology trends in Japan and abroad, NEDO compiled action guidelines for DX progress in small and medium-sized enterprises (SMEs) in the manufacturing industry, and concrete recommendations on how DX should be implemented in the materials industry, publishing two brief reports: DX in the Manufacturing Field: Five Action Guidelines Towards the Advancement of Digital Maturity (Manufacturing DX); and Strengthening the Competitiveness in the Materials Industry through the Utilization of Digital Technology (Materials DX).

■ The necessity and action guidelines for DX promotion in SMEs

In order to identify matters to be aware of in promoting DX in the manufacturing field, the Manufacturing DX report analyzed research reports and papers related to DX, conducted interviews with enterprises and public experimental research institutions nationwide, and summarized the current issues and their solutions along with case studies. The report pointed out that SMEs need to promote DX by increasing their digital maturity in stages, which are introduction, operation, application, and maturity. It also analyzed the importance of initiatives based on the five action guidelines of “enhancing self-improvement capabilities,” “enabling smart production,” “utilizing the digital ecosystem,” “achieving circular production,” and “enabling sustainable production” to realize DX in the manufacturing field.



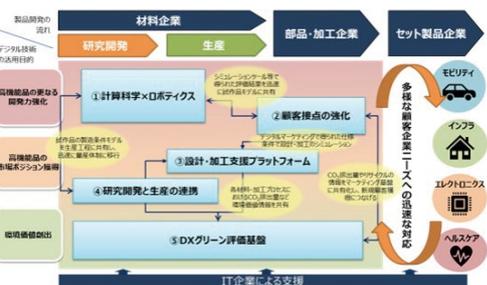
Relationship between the five action guidelines and digital maturity



Ideal future of manufacturing

■ The importance of digital technology emphasized for strengthening competitiveness in the materials industry

Materials DX reports results of investigations and analyzes, from the industrial viewpoint, regarding both the sources of strength and the current status of the materials industry in Japan, creating so far many material products of high added-value and enhanced functionality with advanced technologies in terms of performance, quality, energy conservation and environmental friendliness. In the report, NEDO recommended that for improving competitiveness, digital technology is necessary in the following three directions: accelerating R&D and manufacturing with enhanced efficiencies for new highly functional products, securing market positions upon business expanded overseas, and then creating so-called the green value on the products. The report also provided case-studies on the digital technology utilization in the initiatives of each direction.



Purposes and initiatives of utilization of digital technologies for strengthening industrial competitiveness



Scene of TSC Foresight online seminar on Materials DX

TSC Foresight special seminar

Expectations for innovation to achieve carbon neutrality in 2050

The trend of the Green Transformation which can transform economic, social, and industrial structures toward carbon neutrality, an urgent global-scale issue, is rapidly expanding both in Japan and overseas.

In response to this movement, NEDO is formulating “the Comprehensive R&D Principle for Sustainable Society 2023” which can be a guideline for future actions towards carbon neutrality. In this principle, the future direction of technology development for demonstrating a sustainable society is discussed, and the CO₂ reduction potentials and costs of various promising technologies are estimated.

In February 2023, NEDO organized the TSC Foresight special seminar 2022 where the challenges and strategies that Japan should tackle were shared with audience in order to accelerate the various plans and projects toward carbon neutrality by 2050. A wide range of stakeholders, including opinion leaders from industry, academia, and government, gave lectures and discussed various issues at the seminar.



TSC Foresight special seminar

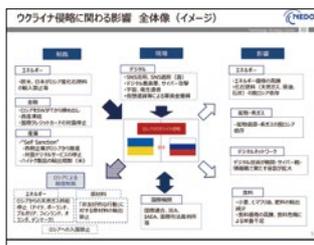
TSC Foresight published in FY2022

TSC Brief Reports



TSC publishes the TSC Brief Report series, which describes research and analysis results in response to changes in social trends.

- Manufacturing DX
- Ukraine & Russia Report
- Materials DX
- Expectations for NETs and the technical challenges of enhanced weathering
- International trends: Competition for resources in the renewable energy era
- International trends: Trends in key countries for carbon neutrality heading into COP27 (U.S., China, EU, U.K., Germany, Indonesia, Egypt, India)



TSC Foresight Brief Report (Ukraine & Russia Report)

TSC Technology Strategy



TSC identifies social issues to be solved and future visions to be realized based on technological, industrial, and policy trends both in Japan and abroad and publishes technology strategies with practical implementation processes to resolve these issues.

- Diversification of raw materials for basic chemicals (C4 and C5 for rubber raw materials)
- Autonomous decentralized energy systems in rural areas



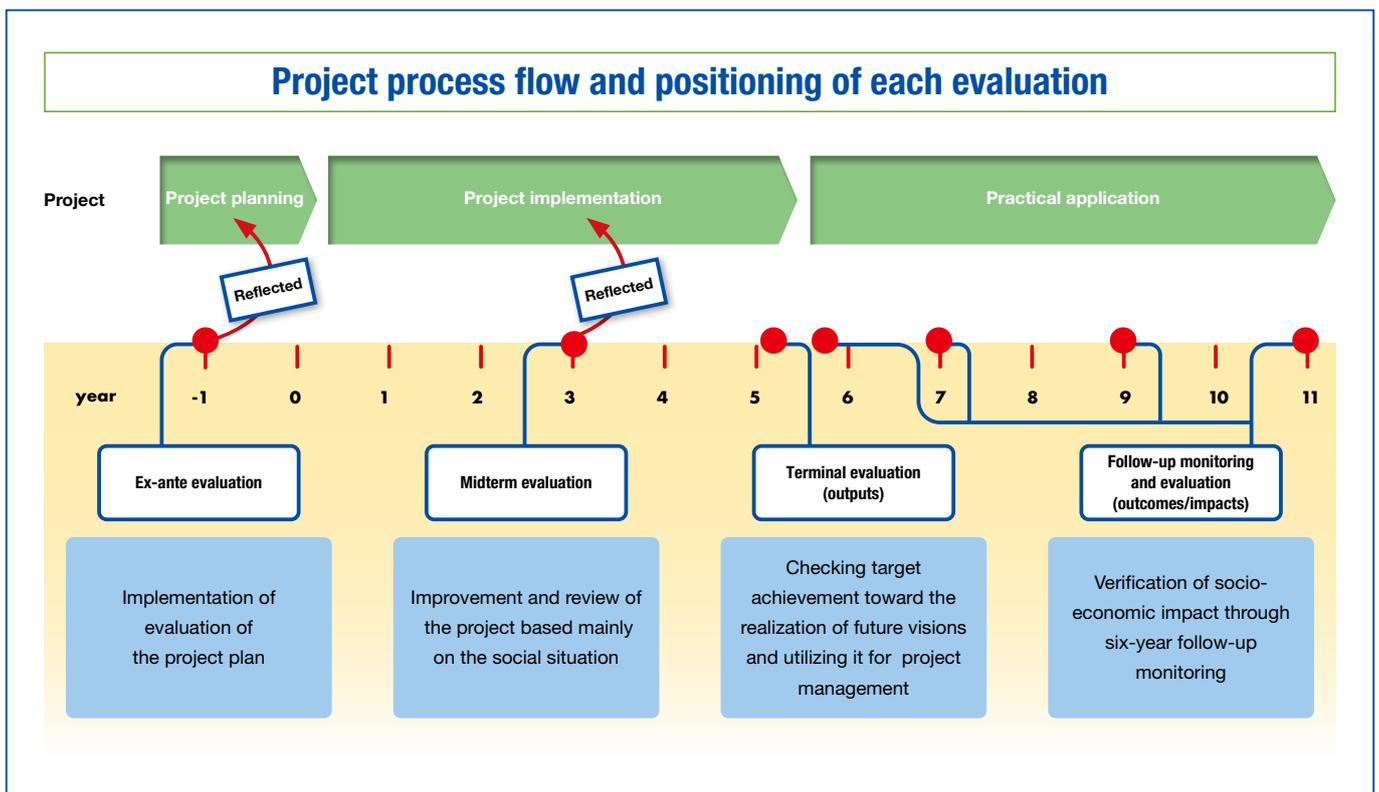
TSC Foresight Technology Strategy Report (Autonomous decentralized energy systems in rural areas)

Project Evaluations

In addition to planning and implementing technology development projects, NEDO conducts evaluations of ongoing projects. Using a plan-do-check-act cycle that incorporates evaluation results in the planning process, NEDO endeavors to improve its management to conduct appropriate technology development that achieves excellent development results.

NEDO carries out ex-ante evaluations during the planning stage, midterm evaluations about three years after the start of project implementation, and terminal evaluations after project completion. Midterm evaluation results are incorporated into tasks such as revising technology development plans, and terminal evaluation results are used to improve future planning and management of technology development projects. In FY2022, 15 midterm and 16 terminal evaluations were conducted.

For a period of five years after a project ends, follow-up monitoring of project participants is carried out using surveys and other information collection techniques. This monitoring is used to determine the utilization of NEDO project results and to analyze key issues for transferring them to practical application. In FY2022, follow-up monitoring surveys were conducted for a total of 1,066 companies, organizations, and other entities. After the results are introduced to the market as products or services, they are designated as “NEDO Inside Products” and NEDO publishes an estimated sales performance forecast on its website. In addition, reports on the researchers involved and how they achieved practical application are published as “NEDO Project Success Stories”.



Case Studies on the Practical Application of NEDO Project Outcomes



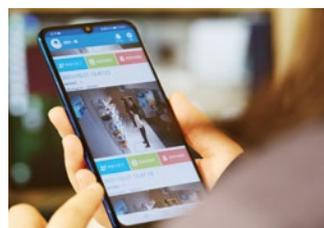
NEDO Project Success Stories

NEDO conducts follow-up monitoring to ascertain how the technology developed through a project has been utilized in products and services and how project results have been disseminated throughout society. NEDO then interviews businesses and developers about the products and services it has discovered and shares this information through NEDO Project Success Stories.

- **Five new articles published in NEDO project success stories**



High-Reliability, Low-Cost, High-Speed, High-Precision Electron Beam Metal 3D Printer



Commercialization of the “Five Senses” AI-Enabled Camera That Predicts and Prevents Crimes and Accidents by Implementing AI in Security Cameras



Commercialization of a Single-Effect Double-Lift Absorption Chiller for More Effective Utilization of Unused Thermal Energy in Industrial Plants



Shifting from Large Wind Tunnel Experiments to Simulation Drastically Improves Environmental Assessment Efficiency for Geothermal Energy Generation



New Fluorescent Imaging with PID High-Brightness Fluorescent Nanoparticles

NEDO Inside Products

NEDO Inside Products are products and processes that use the results of NEDO projects as core technologies* and have been found to have a considerable socio-economic impact. A total of 122 products had been selected as of FY2022. To clarify the medium- and long-term effects of these products, NEDO calculates their actual sales, CO₂ emission reductions, and primary energy consumption reductions.

*“Core technologies” refer to technologies at the research and development stage that a NEDO project took the opportunity to commercialize and without which new products or processes would not have resulted.

- **Example of recently registered NEDO Inside Products**



■ Defect inspection device for EUV mask blanks

- An EUV source with an extremely short wavelength was successfully employed to perform defect inspections on the surface of a mask blank.
- Compared to conventional devices, this successfully commercialized product can inspect deeper into mask blanks with considerably greater sensitivity in terms of defect detection, thereby improving the yield and defect management.
- In the oligopolistic markets found in both Japan and abroad, this device has given its manufacturer a leading competitive edge over its competitors.

NEDO Special Courses



NEDO offers special courses aimed at establishing a venue to cultivate individuals who will lead the way in developing technologies in advanced and cross-sectoral fields as well as promote, in terms of interpersonal exchanges, industry-academia collaboration.

▶ Special course to develop engineers for advanced cellulose nanofiber development

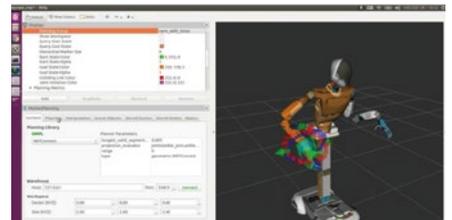
To accelerate commercial applications of cellulose nanofiber (CNF), NEDO offers a 21-day lecture and practical training course twice a year (1st half and 2nd half) at four locations: the University of Tokyo, Kyoto University, the Kyoto Municipal Institute of Industrial Technology and Culture, and the National Institute of Advanced Industrial Science and Technology Chugoku Center. A total of around 120 people have attended the course since its inception. The dissemination and research and development of CNF have progressed through the course, including the sharing of insights through peripheral research and the development of joint research between the lecturers and participating companies.



Practical training at AIST

▶ Special course to stimulate human resource development, networking, and research for the maintenance, promotion, and development of a common software contribute for robots to accelerate system integration

This course provides training to promote the use of robots in wide-ranging fields using a common software technology for robots, as well as networking and peripheral studies to maintain, promote, and develop the common software technology for robots.



Teaching materials about a common software technology for robots

▶ Special course to stimulate human resource development, networking, and research for the promotion and development of delivery services using autonomous mobile robots

The aim of this course is to accelerate the application of services by summarizing NEDO project results, providing businesses planning delivery services using autonomous mobile robots with information such as the performance needed to guarantee the safety of the robot and guidelines for increasing social receptivity, and holding networking opportunities and peripheral studies at the same time.



Demonstration of delivery service using autonomous mobile robot Courtesy of Panasonic Holdings

▶ Training course for human resources utilizing Robot Operating Systems (ROS) in small and medium construction industry

The aim of this course is to train engineer who can use and develop artificial intelligence software that small and medium construction industry need to achieve low-cost automation of civil engineering sites and construction machinery. In addition, it provides opportunities to talk to diverse stakeholders and activities to explore new technology needs, including related technologies, and to apply and develop technology.

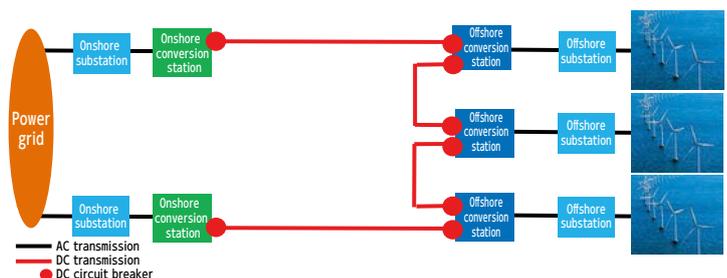
In FY2022, the first year of the course, three sessions were held and 61 people applied for the course, exceeding expectations. In addition, we co-hosted an online public lecture and received 32 registrations, and we will further brush up the content in FY2023, including feedback on the lecture.



Demonstration of automatic earth and stones transport by large dump truck

▶ Special course to activate human resource development, networking, and research on multi-purpose and multi-terminal high-voltage direct current transmission system technology

This course is held to spread the development results of NEDO's Next Generation Offshore HVDC System Research and Development Project (FY2015–2019) and Research and Development of a Multi-Purpose and Multi-Terminal High Voltage Direct Current Transmission System (FY2020–2023) more widely and to train people who can contribute the high-voltage direct current transmission technology that supports the widespread adoption of offshore wind power generation.



Multi-purpose and multi-terminal high-voltage direct current transmission system

Initiatives as an Organization

[Environmental Report](#)

[Human Resource Management](#)

[Creating a Positive Workplace Environment](#)

[Response in Emergency Situations](#)

[Compliance Activities](#)

[Communication with Society](#)

[Conveying Information](#)

[Background Information](#)

Environmental Report



Goals of activities to reduce environmental impact

By engaging in business with others and through its actions, NEDO is actively pursuing initiatives to address energy and environmental problems. A particular area of focus is the problem of global warming, which is attracting rising concern worldwide. Accordingly, with the goal of reducing its environmental impact by FY2030, NEDO established its Implementation Plan for Curbing Emissions of Greenhouse Gases at the New Energy and Industrial Technology Development Organization on March 22, 2018.

Reference Contents of Plan to Reduce Emissions of Greenhouse Gases (version drafted on March 22, 2018)

I Applicable Office Work and Operations
Office work and operations carried out primarily by NEDO (e.g., head office, branch offices)

II Applicable Period
FY2017 to FY2030, to be reviewed as necessary in accordance with the FY2021 implementation plan onward in line with revisions to the government's action plan and other relevant factors.

III Goal
By FY2030, NEDO aims to reduce total greenhouse gas emissions directly resulting from its office work and operations by 40% compared to the FY2013 baseline. The interim target is a 20% reduction by FY2020.

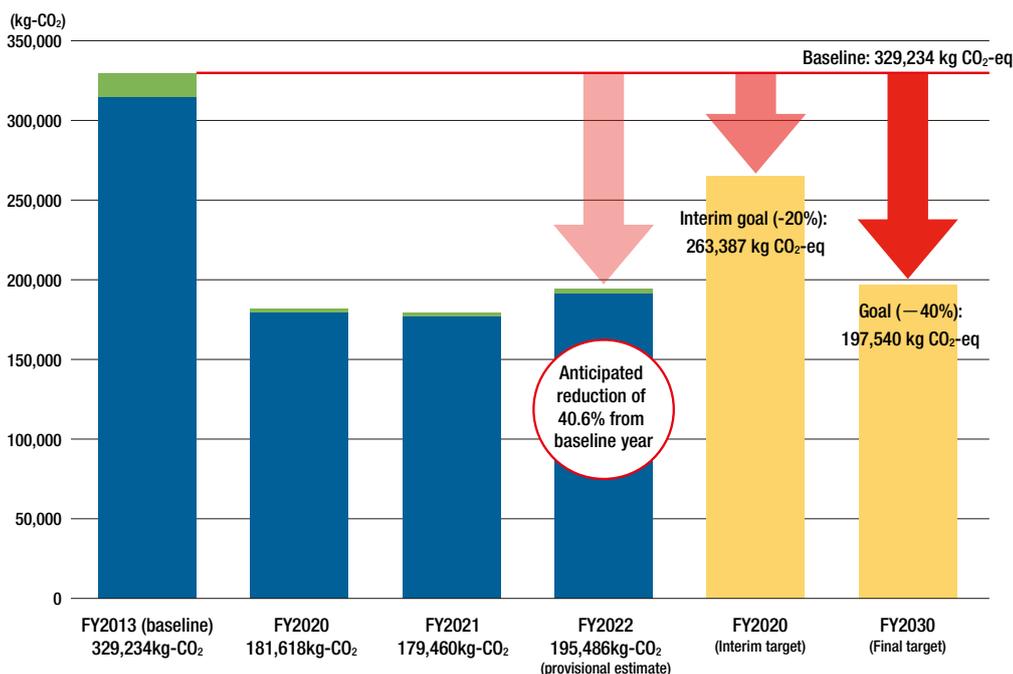
IV Review of Implementation Plan
A review of the implementation plan will be conducted every year and posted on NEDO's website or other suitable platforms.

V Details of Specific Measures

- 1. Proportion of next-generation vehicles used by NEDO**
NEDO only uses next-generation vehicles and will continue to do so to ensure that the interim emissions reduction target is met.
- 2. Fuel consumption by NEDO vehicles**
Fuel consumption of NEDO vehicles will be halved by FY2020 compared to the FY2013 baseline.
- 3. Share of LED lighting in use**
The share of LED lighting will be increased to at least 90% by FY2020.
- 4. Paper consumption**
Paper consumption will be reduced by at least 40% by FY2020 compared to the FY2013 baseline.
- 5. Power consumption per unit of office area**
Power consumption per unit of office area will be reduced by at least 15% by FY2020 compared to the FY2013 baseline.

Greenhouse gas emissions

In FY2022, greenhouse gas emissions were reduced to 195,486 kg of CO₂ equivalent (provisional estimate).



Planned reduction targets and greenhouse gas emissions in FY2022 (provisional estimate)

Future efforts

In line with its mission to develop technologies for addressing energy and global environmental issues, NEDO will continue its efforts to reduce energy consumption and environmental impacts and strive to achieve the FY2030 reduction targets stipulated in the implementation plan.



Efforts related to green procurement

When purchasing goods and services, NEDO promotes green procurement, which is a system of selecting goods and services that have a low environmental impact. Every year, NEDO drafts and publishes its Policy for Promoting the Procurement of Environmental Goods and Services (referred to below as the “procurement policy”).

Specified procured goods

For specified procured goods, goods that meet judgment criteria for each item are procured in accordance with the procurement policy.environmental impact.

Environmental goods and services other than specified procured goods

For other environmental goods and services, NEDO endeavors to procure goods and services that have either received eco-label or green mark certification or possess equivalent environmental characteristics. In the procurement of office equipment and home appliances, NEDO selects models that are energy-efficient and use recycled materials. NEDO goes beyond just meeting the judgment criteria specified in the procurement policy and endeavors to procure goods with as little environmental impact as possible. NEDO will report on its procurement of environmental goods and services during FY2022 to Japan’s Ministry of the Environment and disclose this information on the NEDO website.

Energy conservation measures

NEDO implements a variety of initiatives to reduce its energy consumption.

Energy conservation in offices

- Turning off all lights during lunchtime
- Establishing workdays when all employees leave work on time
- Switching lights to LEDs



Alternate lights (LED lamps) are turned off.

Power saving through the optimal use of air conditioning

Every year, NEDO rigorously enforces an organization-wide campaign to save power by optimizing the use of air conditioning from May to September. Office temperatures are adjusted to save power by encouraging employees to work in more casual clothing (i.e., without ties, jackets, etc.).

This policy applies to NEDO employees as well as visitors, who are advised of the policy and encouraged to cooperate.

Adoption of cloud computing

Since it adopted cloud computing in FY2010, NEDO has eliminated its dedicated server room and replaced the desktop terminals of all personnel with laptops. This has enabled a major reduction in power consumption.

In addition, by switching to an information infrastructure service in FY2015, NEDO has reduced the number of its network devices and multifunction printers, thereby achieving a reduction of nearly 40% in energy consumption.

Measures to conserve resources

NEDO takes various steps to promote a 3R (reduce, reuse, and recycle) policy within its facilities.

Reduction in paper use

The steps shown on the right are being taken to reduce the amount of paper used by NEDO. In FY2022, the amount of paper used was reduced by 52% in terms of weight compared to FY2013.

Future efforts

NEDO is committed to reducing and sorting waste in compliance with city initiatives to reduce waste generation, encourage recycling, and reduce the amount of incineration through approaches such as improved sorting and collection of recyclable paper as well as plastic containers and packaging.

In addition, NEDO encourages the reuse of office supplies and office equipment. For example, folders and paperclips are sorted and stored with priority given to making effective use of existing resources.

- Promotion of paperless meetings and briefings (using a paperless meeting system and laptop computers)
- Promotion of double-sided printing and photocopying, and printing of multiple pages per sheet
- Simplification and digitalization of documents
- Adoption of an electronic approval system



Containers for sorting garbage on each floor

Human Resource Management

Recruitment and Development of Human Resources

NEDO hires new graduates from universities and graduate schools who are expected to become core members. Moreover, NEDO accepts experienced professionals who have diverse careers and backgrounds from private entities, governmental organizations, and other entities.

Project Management (PM) is a key function of NEDO. In order to train PM personnel, NEDO plans and provides various training sessions and practical experiences. NEDO also conducts other practical training such as accounting and public relations.

In addition, to enhance its overall organizational operations, NEDO provides level-adjusted training sessions based on the roles and positions of its employees, and various training programs in areas such as supervisory skills and employee management for managers. NEDO also implements programs aimed at facilitating employee self-improvement, self-motivation, and career development, such as study programs in Japan and abroad.

Furthermore, to expand PM personnel who will contribute to innovations and work at the core of technology development at private companies and universities, NEDO actively accepts PM personnel and candidates from private companies, universities, and public research institutes.

Project management training

The following types of project training are provided to develop PM personnel:

- PM basic training: Participants acquire basic knowledge related to PM operations, mainly through classroom courses, and learn basic concepts and practical methods.
- Senior PM personnel development course: Through classroom courses and practical training (group work), participants gain the advanced knowledge required for senior PM personnel and learn the way of thinking.

Training by level

- New employee training: This training aims for new employees to acquire the knowledge and the way of thinking necessary for NEDO personnel through design thinking training including business manners, business English conversation and other basic skills for working adults.
- Second-year personnel training: This program provides second-year permanent NEDO personnel with presentation, teaching and other training to help them acquire knowledge in a practical format and develop their ability to respond immediately to practical situations.
- Training for each level: This training improves the thinking, communication, and personnel and organization management skills needed to play the role required for positions such as manager, deputy director and chief officer.

Outside study and temporary transfer programs

- Domestic and overseas study abroad program: Personnel master capabilities that enable them to handle a wide range of work by acquiring a master's degree or doctorate in technology management science, engineering, or another related field at a graduate school in Japan or overseas.
- Program for temporary transfer of personnel to administrative agencies: Personnel learns about the policymaking process and related topics by gaining work experience from a policy perspective at administrative agencies such as the Ministry of Economy, Trade and Industry.

Practical training

NEDO holds monthly trainings for new employees. In addition, the entire NEDO workforce regularly undergoes training on matters such as inspections, audits, compliance, and accounting standards for independent administrative institutions to help employees acquire specialized skills for carrying out assignments in their respective areas of responsibility.

Employee award program

To ensure vigorous organizational growth and enhance its productivity, NEDO implements an employee award program with the aim of motivating its employees to continue their professional development and contribute further to the organization.

Training subsidy system

- Employees are helped with self-improvement through partial support of the cost of correspondence and classroom courses, e-learning, or other education related to work.

Language training

- Employees develop the linguistic skills needed for conducting international activities through small-group English conversation lessons, as well as business English courses that help them to give English presentations and discussions.



Business English course

Personnel evaluations

Personnel evaluations are carried out along two axes: evaluation of goal achievements, where attainment of goals set at the beginning of a period is evaluated at the end of the period; and evaluation of conduct, which assesses fulfillment of conduct requirements needed to produce results and carry out a necessary role.

NEDO has developed a system that clearly identifies the skills that employees need to improve. Motivation is provided by reflecting evaluation results in staff treatment, such as bonuses and raises, and providing feedback on goal setting and evaluation results.

Creating a Positive Workplace Environment

Improving the workplace environment

Establishment of various programs

To support employees raising children or caring for their family members, NEDO has adopted programs for childcare leave, care leave, time off to care for pre-school children, time off to care for family, and shorter working hours. In addition, it has also adopted telework and flexible working to realize support for parenting, caregiving, and employee work-life balance.

Health Committee

A Health Committee has been established to improve the workplace environment, and efforts are regularly made to prevent employee accidents and health problems, improve the workplace environment, and achieve a work-life balance.

Training

- Training to care for the mental health of subordinates: Mental health care training: Managers are taught about caring for the mental health of their subordinates and creating a positive working environment.
- Labor management training: Employees are taught about everything from the basics of personnel management to recent trends in the field. They also learn precautions for managing the working hours of subordinates.

Measures to prevent harassment

NEDO has established internal rules to prevent harassment and is working to ensure awareness among all employees through compliance training and other approaches. A help desk on workplace harassment has been established in the Personnel Affairs Department, and NEDO is working to maintain and improve the workplace environment by utilizing a law office as an outside notification contact.

Initiatives to support balancing work and child rearing

NEDO is building a framework for balancing work with family life by establishing an action plan based on the Act on Advancement of Measures to Support Raising Next-Generation Children. This effort has been recognized by the awarding of certification from the Minister of Health, Labour and Welfare.

Maintaining and promoting employee health

Regular health checkups are provided to employees to detect health problems at an early stage. A blood pressure monitor is available for use at any time, and it helps maintain employee health. Employees are also encouraged to undergo comprehensive medical examinations that are available to those belonging to union-managed health insurance.

In addition, NEDO supports health consultations by industrial physicians and public health nurses, follow-up on the results of health diagnoses, mental health consultations, and annual stress check tests.

Response in Emergency Situations

Establishment of a system for disasters and other emergencies

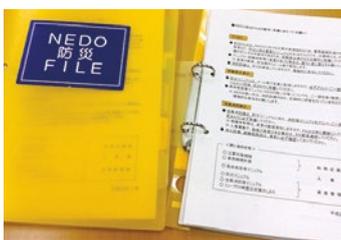
NEDO has drawn up disaster management rules that set out the basic policy for disaster responses and require the establishment of a disaster response headquarters. Measures to ensure the safety of employees and respond to disasters are described in NEDO's disaster response manual. In addition, NEDO's continuity plan specifies the preparations and procedures necessary for NEDO to continue operations in the event of a disaster.

NEDO continued operating during the COVID-19 pandemic by establishing a disaster response headquarters to prevent further infections and ensure the safety of its personnel.

NEDO conducts various types of disaster preparedness training, including fire drills and courses on using automated external defibrillators. Disaster response awareness is also instilled by an e-learning course for all employees.

To enable business continuity and aid those who have difficulty returning home, NEDO stockpiles three days of emergency provisions (drinking water, food, and daily necessities). The following equipment is provided in offices:

- Boxes with emergency tools for securing an escape route in case of an emergency (Boxes are placed at various locations on each floor.)
- AED lifesaving equipment (One is located on each floor.)
- A NEDO disaster response notebook (containing a disaster response manual, a fire self-protection manual, a business continuity plan, and other information) is positioned at various locations on each floor. Employees can easily refer to the notebook during normal times, or in an emergency, so necessary action can be taken immediately.



Disaster Response Notebook containing rules, disaster manual, and other information



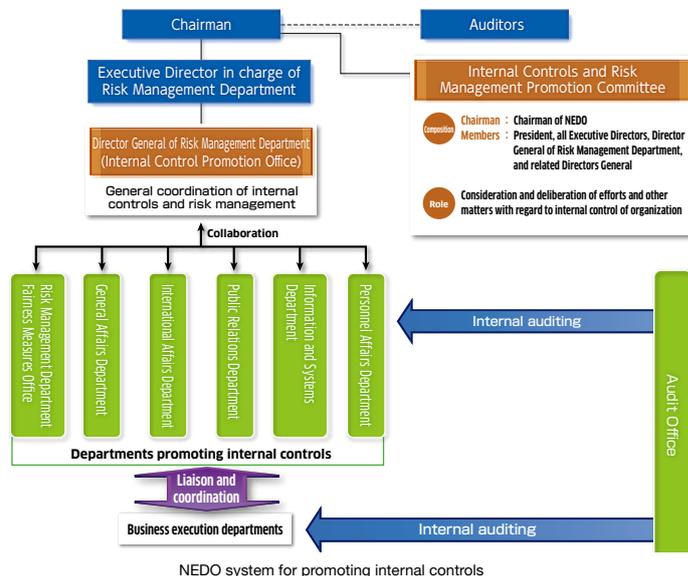
Disaster response equipment

Compliance Activities



Establishing system for promoting internal controls

As an organization that handles state-of-the-art technical information, NEDO recognizes the need for a controlled environment that ensures reliable business practices and maintains a high level of ethical standards so as to earn the trust of society. To promote legal compliance through strengthening of internal controls and risk management, NEDO has established a governance system based on policies set by the Internal Controls and Risk Management Promotion Committee, which is led by NEDO's chairman. The Risk Management Department is responsible for supervising the entire internal control system.

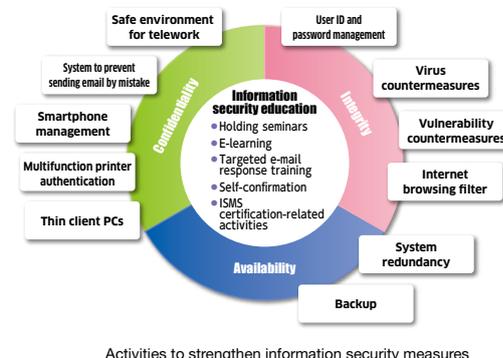


Strengthening compliance

NEDO internal instructors provide compliance training to new employees promptly after they start working. Training of executives and staff is also provided by external instructors. Furthermore, in order to eliminate in advance any potential hazards that may emerge throughout the organization, NEDO works to increase each employee's awareness of compliance through initiatives such as intranet posts about compliance violations being reported in the news, various training materials, reports on examples of near-miss incidents, and alert messages. In addition, as a measure to prevent fraud by NEDO project participants and in light of a case involving misuse of research expenses that occurred in FY2017, NEDO is working to strengthen and improve its governance system and ensure that the system is fully understood by all concerned.

Strengthening information security measures

NEDO has implemented an environment for safe teleworking by introducing thin client PCs that do not store information on the terminal, thereby preventing information leakage in the event of accidental loss. Furthermore, NEDO has implemented the latest technological measures such as introducing multifunction printers with authentication functions to prevent documents from being accidentally left or lost, and a system to download attachment files from online storage as a measure to prevent misdirected e-mails. At the same time, NEDO has also implemented educational measures for executives and regular employees by holding information security seminars, e-learning programs, and self-inspections, to address information security from both technical and educational perspectives. In addition, an external auditor annually conducts information security audits to ensure that various information security measures are properly and effectively implemented.



Maintenance of international standard ISO/IEC 27001 (ISMS) certification

As part of its internal control strategy, from 2016, NEDO has been engaged in activities to maintain its information security management system (ISMS) certification under international standard ISO/IEC 27001:2013 with the aim of establishing and operating appropriate and relevant information security measures. NEDO will continue to undertake information security measures through ISMS activities to maintain and improve its internal controls.



Organization name: New Energy and Industrial Technology Development Organization
 Registration number: IC22J0547
 Date of registration: December 15, 2016
 * Coverage does not include foreign offices.

Information disclosure

Based on the Act on Access to Information Held by Independent Administrative Agencies, NEDO is actively working to disclose the information it holds. On its website, information is disclosed regarding NEDO's organization, finances, and other matters. Information is also disclosed on all types of procurement, as well as NEDO's efforts to ensure transparency in contracts.



Information disclosure



Procurement

Communication with Society

Events

NEDO hosts various events to expand the public's use of technologies developed through its projects as well as its support programs. In FY2022, NEDO worked with the Ministry of Economy, Trade and Industry (METI) to host conferences, including the 5th Hydrogen Energy Ministerial Meeting, the 4th International Conference on Carbon Recycling, and the 9th Innovation for Cool Earth Forum (ICEF), with the aim of reviewing the potential for international partnerships and building a stronger international industry-academia-government network.



5th Hydrogen Energy Ministerial Meeting

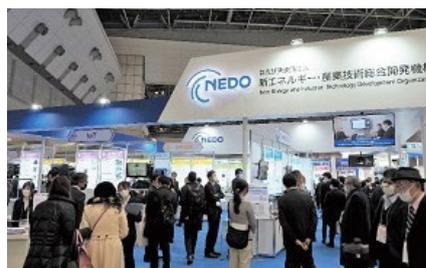


4th International Conference on Carbon Recycling 2022

NEDO also participated in the International Robot Exhibition 2022, CEATEC 2022, Bio Japan 2023, ENEX 2023, Renewable Energy 2023, and other exhibitions to encourage practical applications of its project results and provided opportunities for sharing information on research and development results and supporting business networking. In addition, NEDO promoted the building of networks and information gathering by hosting events such as debriefing sessions, seminars, and symposiums.



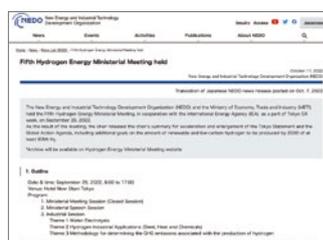
NEDO's booth at CEATEC 2022 ONLINE



NEDO's booth at the nano tech 2023

News releases and press conferences

NEDO communicates widely with the public through news releases, press conferences, study tours, and various other kinds of media aimed at deepening public understanding of NEDO's activities and their importance to society.



Sample news release



Press conference

Social media and online content

NEDO opened an official Twitter account in FY2020 and a Facebook account in FY2021 to share the latest information posted on its official website, such as news releases, public solicitations, and event announcements.

In FY2022, the NEDO LABO TALKS video series, in which project managers explain their projects, were newly produced and released on YouTube.



Announcement on Twitter



Screenshot of NEDO LABO TALKS

Initiatives as an Organization

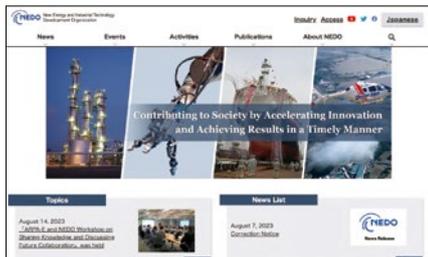
Conveying Information

NEDO publicizes information about its activities widely so that the public can utilize the know-how and results from NEDO's technology development and demonstration projects by maintaining databases, issuing white papers and other documents, and so on.

Website



NEDO's website is constantly updated with new information on NEDO projects, such as public solicitations and news releases. Various databases and white papers as well as useful information for technology development are also available on the website.



Twitter



NEDO's official Twitter account provides the latest information on NEDO, such as news releases, events, and public solicitations. Please follow our official Twitter account!



YouTube



Video content on the NEDO Channel on YouTube offers information regarding technologies and achievements resulting from NEDO projects. In addition, the channel also features various other videos, such as presentations by startups, lectures given at seminars, and the latest technology trends.



NEDO Web Magazine



This web-based magazine provides information regarding NEDO's activities and achievements in addressing energy and global environmental problems and enhancing industrial technologies. The magazine also includes NEDO Project Success Stories illustrating how NEDO project results are benefiting society.



Public outreach magazine Focus NEDO



This reader-friendly magazine features information on technologies currently being developed, project results, and relevant policy frameworks. It also provides detailed information on case studies describing the successful practical applications of NEDO project results and commentaries on topics covered in NEDO news releases.



Progress reports



NEDO publishes numerous progress reports that describe the results of its projects, surveys, and other activities on its website. These reports can be searched and downloaded for up to ten years after original publication.

*User registration is necessary (free of charge).

Databases and support tools

Solar Radiation Database



Based on meteorological data measured at 837 sites in Japan from 2010 to 2018, NEDO has published its Solar Radiation Database for estimating solar radiation using a solar radiation model based on observed sunshine hours at each site.

NEDO Management Guideline for Standardization



NEDO has created this guideline as a reference to promote the strategic use of standards, thereby achieving social implementation of its project results. The guideline is open to the public so that it may be useful in the development management of each company.

White papers and guidebooks

Introduction requirements and technical guidelines on self-sustaining local biomass energy systems (6th edition)



With the aim of expanding the use of biomass energy, NEDO has developed the guidelines based on interviews with business operators and experts as well as related materials. The guidelines compile points to note and information to consider when creating business plans for business operators who are considering starting biomass energy projects.

You Can Achieve Energy Conservation! A General Guidebook for Industrial Heat Pumps

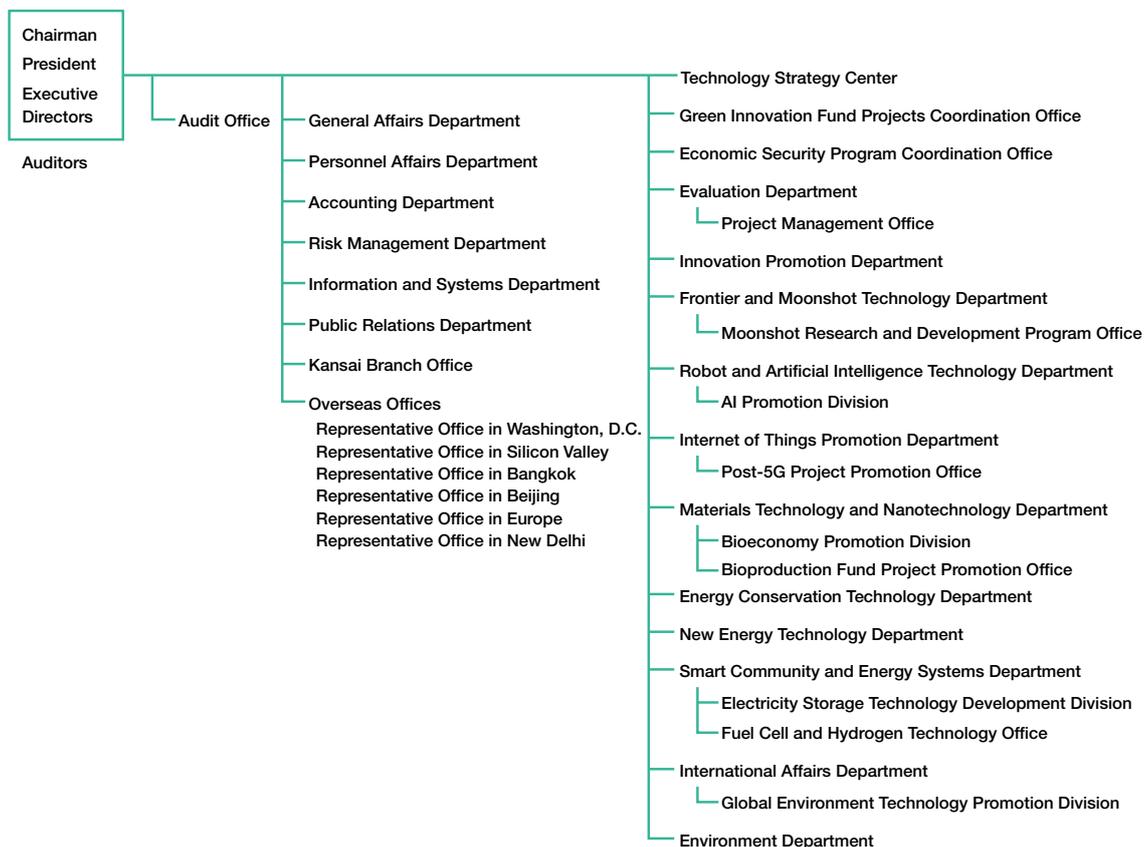


This guidebook includes detailed information for those who are considering energy conservation in plants to learn more about industrial heat pumps and case studies of heat pump installations.

Background Information

Designation	National Research and Development Agency New Energy and Industrial Technology Development Organization (NEDO) Business name: New Energy and Industrial Technology Development Organization (NEDO)
Foundation	Originally established on October 1, 1980; reorganized as an incorporated administrative agency on October 1, 2003
Foundation Purpose	The purpose of NEDO is to enhance industrial technology and promote commercialization by comprehensively performing functions such as: promoting research and development carried out using skills from the private sector; promoting research and development carried out by the private sector with regard to technology for non-fossil energies, combustible natural gas, and coal; promoting the technology required for the rational use of energy and technology in mining and industry; and promoting the utilization of such technology in cooperation with the international community; to thereby contribute to ensuring a stable and efficient energy supply in accordance with the changes in the domestic and foreign economic and social environments and to the development of the economy and industry.
Details of Major Operations	Operations relating to research and development management (national projects and practical application promotion activities)
Minister in Charge	Minister of Economy, Trade and Industry
Governing Laws	Act on General Rules for Incorporated Administrative Agencies Act on the New Energy and Industrial Technology Development Organization
Personnel	1,464 (as of April 1, 2023)
Budget	Approximately 1.14 billion US dollars (initial budget for FY 2023) <small>*Converted at the exchange rate of 1 US dollar = 133.04 yen</small> Additional funding programs are also being implemented.
Executives	Chairman Mr. SAITO Tamotsu President Mr. YOKOSHIMA Naohiko Executive Directors Mr. YOSHIOKA Masatsugu, Dr. YUMITORI Shuji, Mr. HAYASHI Shigekazu, Mr. NISHIMURA Tomoyasu, Dr. IIMURA Akiko Auditors Mr. YABUTA Keisuke, Ms. FUKUSHIMA Michi (as of October 1, 2023)

Organization



(as of July 1, 2023)



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