METI
Ministry of Economy, Trade and Industry

Progressive Environment Innovation Strategy

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What we aim for with this strategy

○ In the “Long-Term Strategy under the Paris Agreement” (approved by the cabinet in June 2019, hereafter “Long-Term Strategy”), Japan’s government set an ambitious target of a “decarbonized society” as a final goal that should be achieved as early as possible in the last half of the twenty-first century. The government stated the drastic actions required for realizing an 80% reduction of GHG by 2050. Moreover, the government clearly expressed Japan’s contribution to the Paris Agreement including the 1.5-degree goal by sharing Japan's mind and actions in the world.

○ However, a large additional annual cost for reducing GHG emissions, roughly estimated as seven trillion USD, is expected for achieving the 2-degree goal written in the Paris Agreement and further additional cost is needed for the 1.5-degree goal. Therefore, disruptive innovation that enables the early introduction of the new technology with reasonably acceptable cost is absolutely necessary for reducing global GHG emissions. (Japan has contributed through innovation; e.g., one-two hundred fiftieth cost reduction in the photovoltaic cell.)

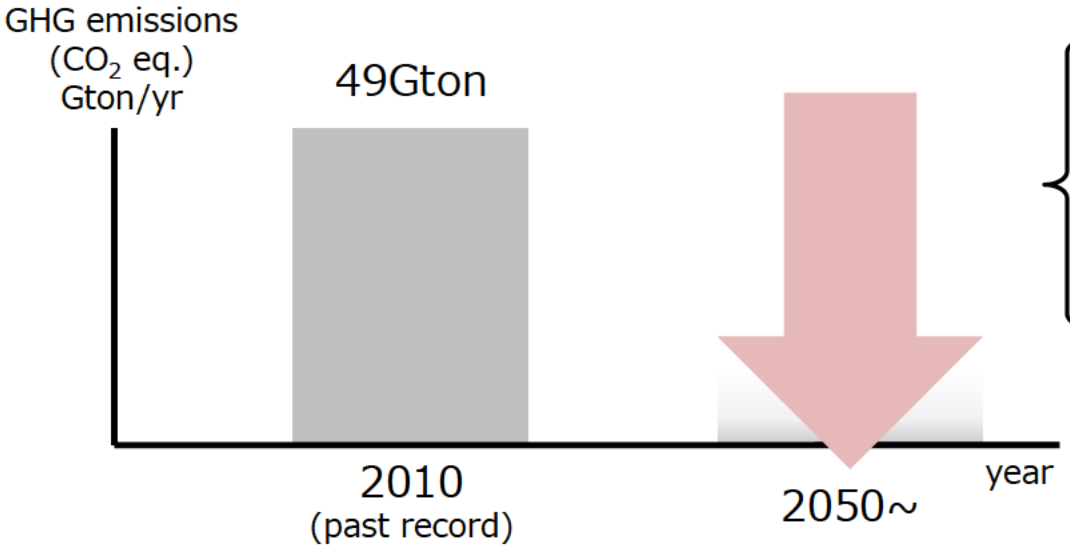
○ “Progressive Environment Innovation Strategy”, here formulated based on the Long-Term Strategy consists of:

1) “Innovation Action Plans” which describe 16 technological challenges with cost targets.

2) “Acceleration Plans” which detail research frameworks and investment promotion policies.

3) “Zero-Emission Initiatives” which depict collaborative works and outreach activities with global leaders for social implementation.

Progressive Environment Innovation Strategy aims to establish innovative technologies that enable the reduction of global GHG emissions toward carbon neutral and further reduction of the accumulated atmospheric CO_2 level ”Beyond Zero” by 2050.



An additional annual cost of 7 trillion USD is needed for GHG reduction by 70% by 2050, which corresponds to the 2-degree goal. [1)]

A further additional annual cost is needed for GHG reduction by 100% by 2050, which corresponds to the 1.5-degree goal.

1) A model-based simulation by RITE. The annual additional cost for GHG reduction by 100% is expected to be over ten trillion USD.

Innovation Action Plans

: Potential for reduction of global GHG emissions

◆ : Examples of the technology challenges

I. Energy transformation

More than 30 billion tons

- ◆ Renewable energy as a main power source
- ◆ Low-cost hydrogen supply chain
- ◆ High-efficiency, low-cost power electronics technology

II. Transportation

More than 11 billion tons

- ◆ Green mobility (EV, FCEV, etc.)
- ◆ Bio-jet fuel

III. Industry

More than 14 billion tons

- ◆ Zero-carbon steel with the innovation technologies
- ◆ Polymer by artificial photosynthesis technology
- ◆ Cement from CO_2 / concrete absorbing CO_2

IV. Business, household, cross-sectoral

More than 15 billion tons

- ◆ Green refrigerant with extremely low greenhouse effect
- ◆ Energy saving by sharing economy, telework, work style reform, behavior modification

V. Agriculture, forestry and fisheries / Carbon Sinks

More than 15 billion tons

- ◆ Blue carbon (carbon capture by the coastal ocean ecosystems)
- ◆ Smart agriculture, forestry, and fishery that leads to better efficiency with the ICT
- ◆ DAC (Direct Air Capture) technology

Outline of Progressive Environment Innovation Strategy

Innovation Action Plans

- Action plans for establishment of the innovative technologies by 2050 -
(16 challenges in 5 fields)

Describing i) cost targets, estimation of GHG reduction potential, ii) contents & formation of R&D, and iii) the process from basic research to demonstration.

Acceleration Plans - 3 measures for accelerating the "Innovation Action Plans" -

①Promotion by headquarters

[Green Innovation Strategy Promotion Meeting (tentative name)] Long-term support from basic research to implementation with overcoming of sectionalism. Overhaul of existing projects. Revision of Innovation Action Plans by using the latest knowledge.

②Gathering the wisdom of the world

[Zero-Emission Research Bases] Establishment of the "Global Zero Emission Research Center" to connect 120,000 researchers in G20 member countries, "Advanced energy technology R&D center" and the site of research for demonstration on Carbon Recycling. Launch of the "The zero-emission innovation area" to strengthen industry-academia-government collaboration in Tokyo bay area.
[Zero-Emission Creators 500] Intensive support to promising young researchers.
[Strengthen support to promising technologies] Utilization of "advanced research program" and "the Moonshot R&D Program". Creation of "Circulating and Ecological Economy".

③Increase in private investment

[Promoting green finance] Disclosure of corporate climate-related information in the line with the TCFD recommendations. Promotion of dialogue between the industrial sector and the financial sector.
[Zero-Emission Challenge] Improvement of investors' access to corporate information through commendation and information disclosure of excellent projects
[Zero-emission stat-up support] Promotion of VC investment for R&D startups

Zero-Emission Initiatives - for global collaboration throughout the international conferences -

Green Innovation Summit, RD20, ICEF, TCFD Summit, Hydrogen Energy Ministerial Meeting, and International Conference on Carbon Recycling

①Non-fossil

Photovoltaics installed anywhere

Efficiency more than twice as high as that of current solar cells

- Target cost: Equal to or less than conventional power sources
- Potential of CO_2 reduction: 7 billion tons/year**

【R&D】

- Solar cells : Establishment of extremely lightweight, highly-efficient (more than 35%), and flexible module manufacturing technologies using new materials (e.g., perovskite) and new structures (e.g., tandem, quantum dot), which enables installation of the solar cells anywhere (e.g., facade of buildings).

【Measures】

- Strengthening international cooperation through Global Zero Emission Research Center (GZR) and RD20.
- Organized enforcement from leading study to practical use.

↑Perovskite-type (lightweight･flexible) ↓For cars

②Energy network

Digital electricity network

Cost equivalent to current electric rate, including energy management cost

- Target cost: Equal to current power source
- Inevitable for regulating the variable renewable energy source***

【R&D】

- Technologies that enables renewable energy as main power source (e.g., VPP, DR*, energy management system as next-generation regulating technology, battery, high-efficiency power electronics technology).

*VPP: Virtual Power Plant, DR: Demand Response

【Measures】

- International cooperation through international conferences such as RD20.
- Collaboration between industry and academia.

Image for next-generation energy management system

**Potential for reduction of global GHG emissions is estimated by NEDO.
***Since the technology acts as a regulation of the renewable energy, individual GHG reduction potential is not calculated.

③Hydrogen

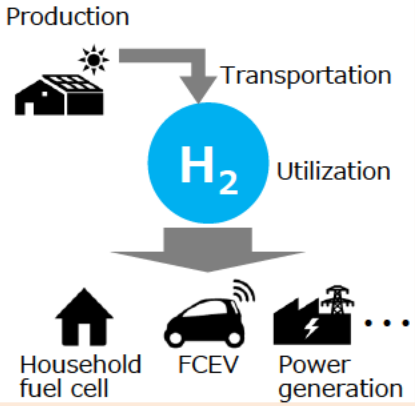
Hydrogen society

Cost equivalent to that of existing energy

- Target cost: 1/10 or less than current production cost
- Potential of CO_2 reduction: 6 billion tons/year*

【R&D】
- Cost reduction to produce CO_2-free hydrogen from renewable energy or fossil fuel with CCUS.
- Transportation and storage of hydrogen (compressed hydrogen, liquefied hydrogen, organic hydride, metal hydride, etc.).
- Establishment of the international supply chain.
- High efficiency fuel cell. Low NOx hydrogen power generation. Utilization of artificial photosynthesis.

【Measures】
- International cooperation through International conferences.
- Collaboration of industry, university, and public institute activated by national R&D projects.



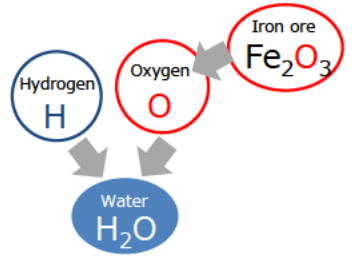
Zero-carbon steelmaking process

Utilization of CO_2-free hydrogen as the reducing agent instead of carbon

- Target cost: Equal to current steel
- Potential of CO_2 reduction: 3.8 billion tons/year*

【R&D】
- Breakthrough technologies for the reduction of iron ore by hydrogen.
- CCUS technology such as CO_2 capture by unused waste-heat.

【Measures】
- Start of feasibility study, and development for practical use by industry.



The reduction of iron ore by hydrogen

④Carbon Recycling, CCUS

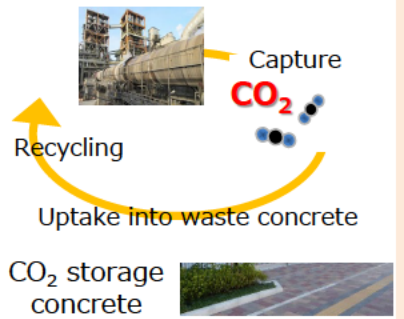
CO_2 uptake using cement and concrete

Utilizing CO_2 emitted during production

- Target cost: Equal to or less than current products
- Potential of CO_2 reduction: 4.3 billion tons/year*

【R&D】
- Capturing of CO_2 from cement burning process. Recycling of CO_2 as cement raw materials and construction materials by uptaking CO_2 into waste cement and concrete.
- CO_2 storage under infrastructure by concrete materials.

【Measures】
- Acceleration of development, including scale-up test, by national R&D projects.



*Potential for reduction of global GHG emissions is estimated by NEDO, etc.

DAC (Direct Air Capture)

Low concentration CO_2 capture from ambient air

- Target cost: Acceptable cost as an industry
- Potential of CO_2 reduction: 8.0 billion tons/year*

【R&D】
- Pursuing technologies for CO_2 capture from ambient air.
- Development of CO_2 fixation technology for the captured CO_2.

【Measures】
- Considering utilization of the Moonshot R&D Program.

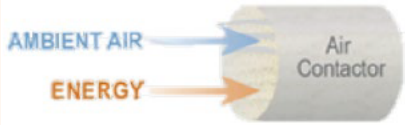


Image for DAC

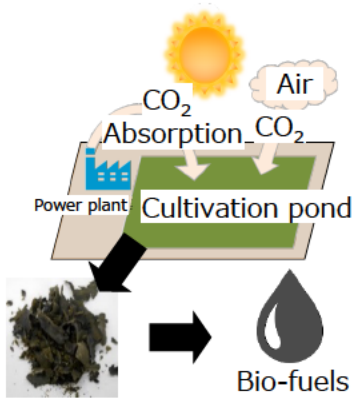
Bio-jet fuel from CO_2

Production of bio-jet fuels and diesel by absorbing CO_2 into Microalgae that grow 1000 times faster than usual

- Target cost: Equal to or less than current jet fuel
- Potential of CO_2 reduction: A part of 2.0 billion tons/year*

【R&D】
- Large-scale demonstration project under various conditions to establish large and constant cultivation systems of Microalgae in the natural environment.
- Establishing a research hub in Hiroshima to conduct the cultivation test using CO_2 from coal-fired power plants. Promoting research to maximize CO_2 absorption efficiency.

【Measures】
- Realizing commercial flights powered by bio-jet fuel in 2030.
- Project operation such as demonstration project in a large-scale cultivation pond.



⑤Zero-emission agriculture, forestry and fisheries

CO_2 absorption and fixation to the farmland, forest, and ocean

Enlarging carbon sinks source by innovative technology

- Target cost: Enabling to continue the business
- Potential of CO_2 reduction: 11.9 billion tons/year*

【R&D】
- Blue carbon such as culture technology of marine algae.
- Biochar application to agricultural soil. Fast-growing trees and elite trees.
- Wooden high-rise buildings. Low-cost mass production technology of biomass materials such as Glycol lignin.

【Measures】
- Advancement of underlying technology through biotechnology.
- Organized enforcement from leading study to practical use.


Upper left : Blue carbon
Upper right : Elite trees
Bottom : Glycol lignin

*Potential for reduction of global GHG emissions is estimated by NEDO, etc.

Expectation for the “Global Zero Emission Research Center”

Objective for establishment of the center: For GHG reduction toward carbon neutral, and with the view to further reduction of the accumulated atmospheric CO_2 level “Beyond Zero”, this center aims to implement fundamental researches in energy and environmental fields, which enables creation of innovative technologies required for strengthening the measures for GHG reduction.

Expectation for the center

① **Powerful acceleration for innovation:** Implement of the prioritized theme in the “Progressive Environment Innovation Strategy”, enabling to establish innovative technologies earlier against the climate change.

② **Acceleration of global collaboration:** Taking a role of a secretariat for annual RD20, where leaders of research institutes share R&D activities and best practices, offering “innovation hub” for the global collaboration.

③ **Acceleration of domestic collaboration:** Hosting “Zero Emission Forum” as a secretariat to promote domestic collaboration among the ministries and public-private partnership.

④ **Acceleration of constructing demonstration area:** Participating in the Tokyo Bay “Zero-emission” innovation area as a major institute/secretariat, supporting public-private demonstration project toward GHG emission for net zero.