NEDO

NEDO's Activities to Realize the Carbon Neutrality by 2050

April 28, 2022

Shigeru Niki

Sustainable Energy Unit,
Technology Strategy Center (TSC) ,
New Energy and Industrial Technology Development Organization (NEDO)

CIRCULAR BIO ENERGY

NEDO and its Missions

History:

1980 **New Energy Development Organization** established

1988 **Industrial Technology** research and development added

Name changed to "New Energy and Industrial Technology Development Organization"

Two basic missions:

1. **Addressing energy and global environmental problems**
2. **Enhancing industrial technology**

Positioning:

Technology Strategy Center (TSC) Established in April 2014

NEDO's Technology Strategy Center (TSC) is a technology strategy research institute that contributes to the promotion of technology development that realizes NEDO's missions of addressing energy and global environmental problems and enhancing industrial technology.

Missions: Catch Moves, Design Our Future and Show Strategies Forward

Executive Director
Dr. Kikuo Kishimoto

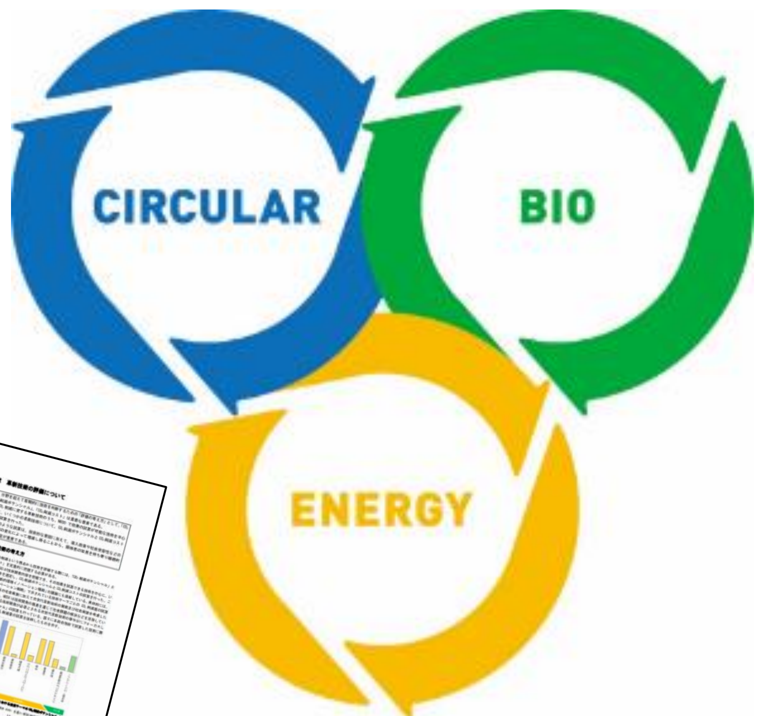
- Director General
  - Global Technology Research
  - Macroanalysis
  - Standardization and Intellectual Property
  - Digital Innovation
  - Nanotechnology and Materials
  - Sustainable Energy
  - Environment and Green Chemistry
  - Bioeconomy
  - New Technology Frontier and Multi-disciplinarity (Collaborative Zero Emission in AFF Fields)
- Coordination Division
- Planning Division

Fellow, Advisor

Comprehensive R&D Principle for Sustainable Society

- NEDO published "Comprehensive R&D Principle for Sustainable Society" in 2020.〔The NEDO's Principle〕

3 Essential Social Systems for Sustainable Society

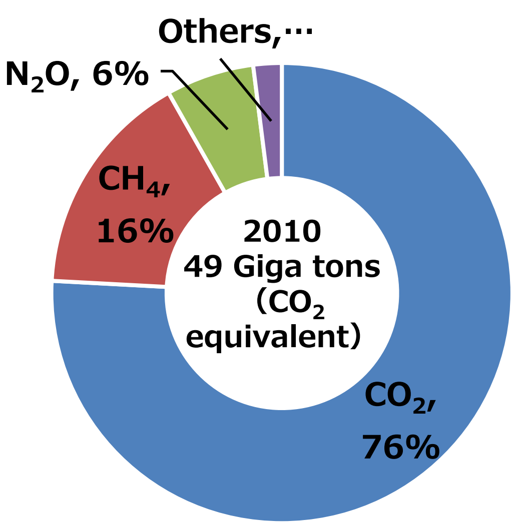


The 3 Essential Social Systems, which are indispensable to realizing a sustainable society, can continue developing, relate with each other, affect each other, and are optimally harmonized.

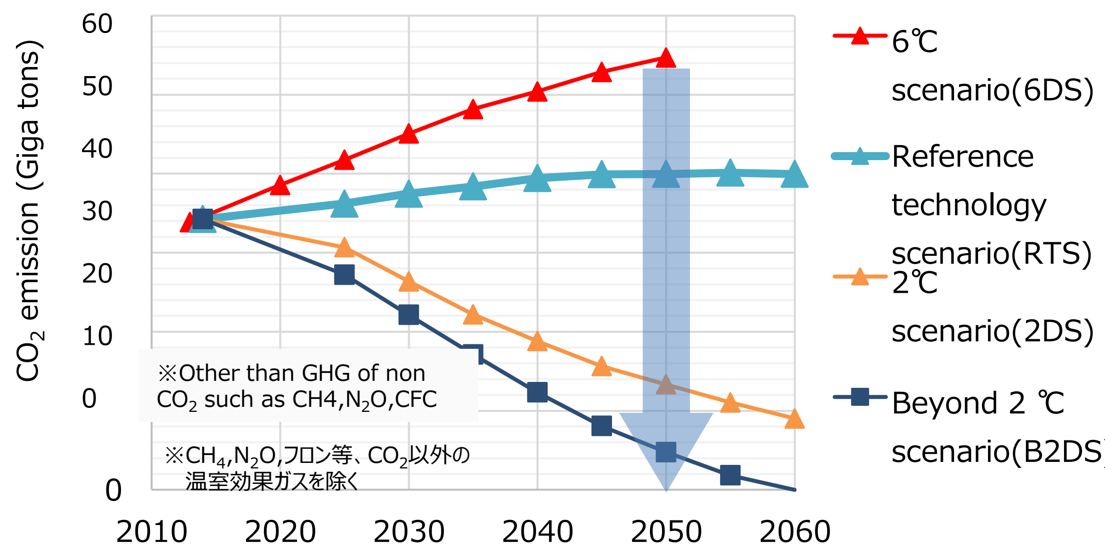
https://www.nedo.go.jp/content/100925057.pdf

Current Status and Future Perspective of GHG Emissions

- The GHG emissions in 2010 were about 49 Gt CO_2. Of these, 76% is attributable to CO_2, followed by CH_4 (16%), N_2O (6%) and fluorine gases (2%) .
- In 2050, approximately 15 Gt is expected to be reduced by expanding conventional technologies(RTS), and 40 Gt CO_2 still remains.
- This Comprehensive Principle mainly discusses reduction of CO_2 emissions though reduction of other GHGs is also a future challenge.



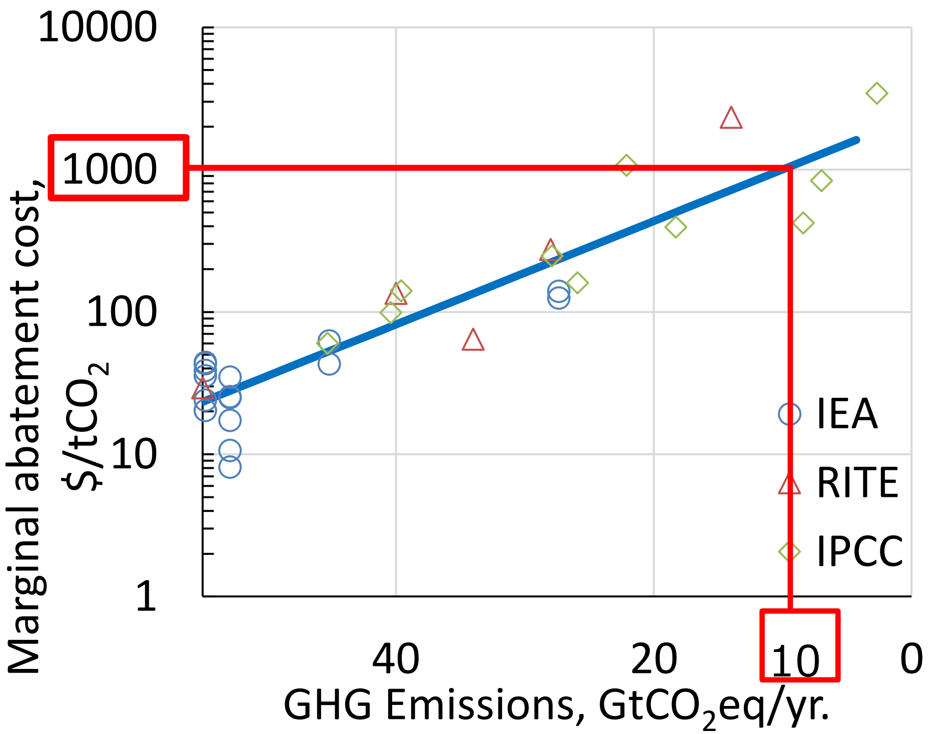
Source： Compiled by NEDO Technology Strategy Center based on Climate Change 2014 Synthesis Report(IPCC2014) (2020)

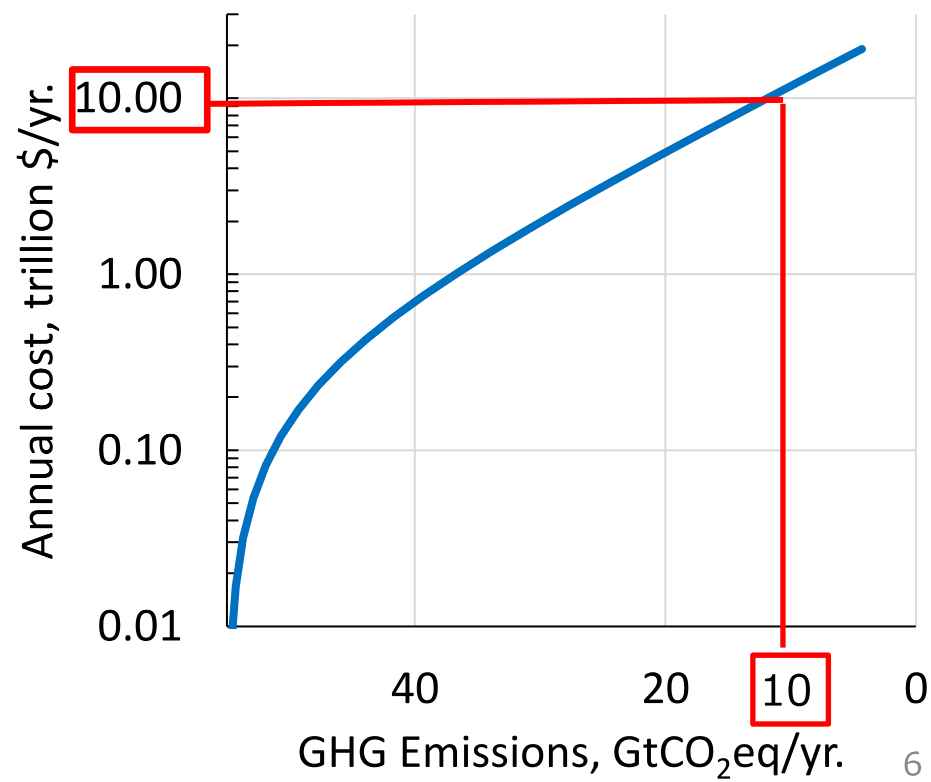


Source： Compiled by NEDO Technology Strategy Center based on Energy Technology Perspectives 2016 and Energy Technology Perspectives（2020）

CO_2 Abatement Cost Estimation

- In case of reducing up to 10 $GtCO_2$ eq. of GHG emissions (80% of global GHG emissions) with only conventional technologies, marginal abatement cost would become around \$1,000/tCO_2.
- The costs for countermeasures reach around 10 trillion dollars, approximately 12 % of global GDP) each year globally, and it is not acceptable.
- Discontinuous innovation to lower this huge cost to a globally acceptable level is indispensable.

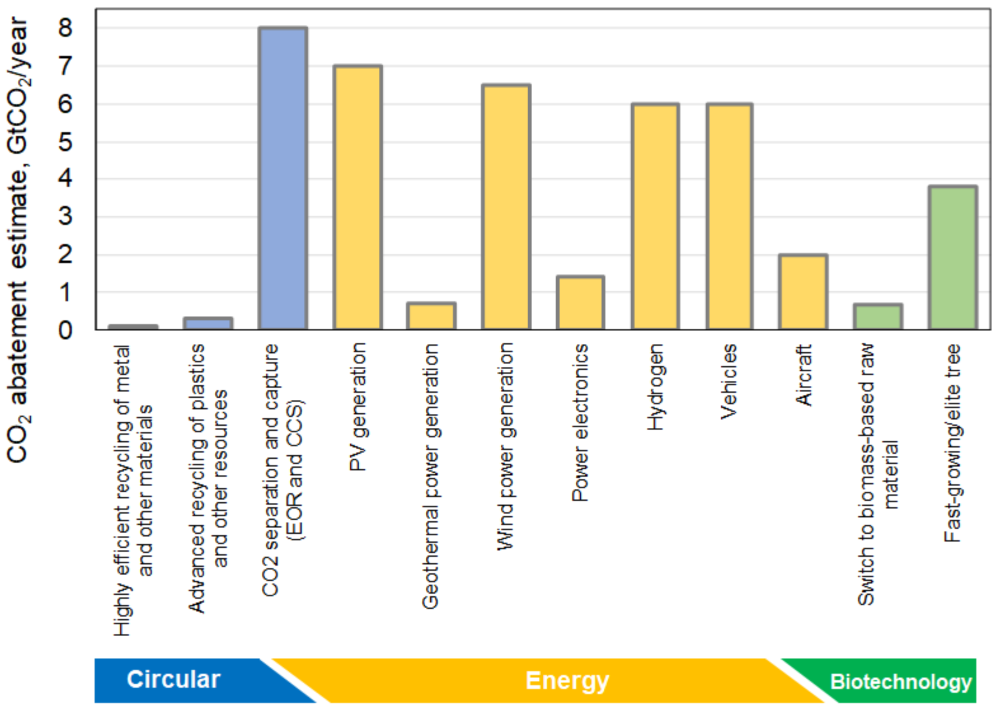




Source : Compiled by NEDO Technology Strategy Center

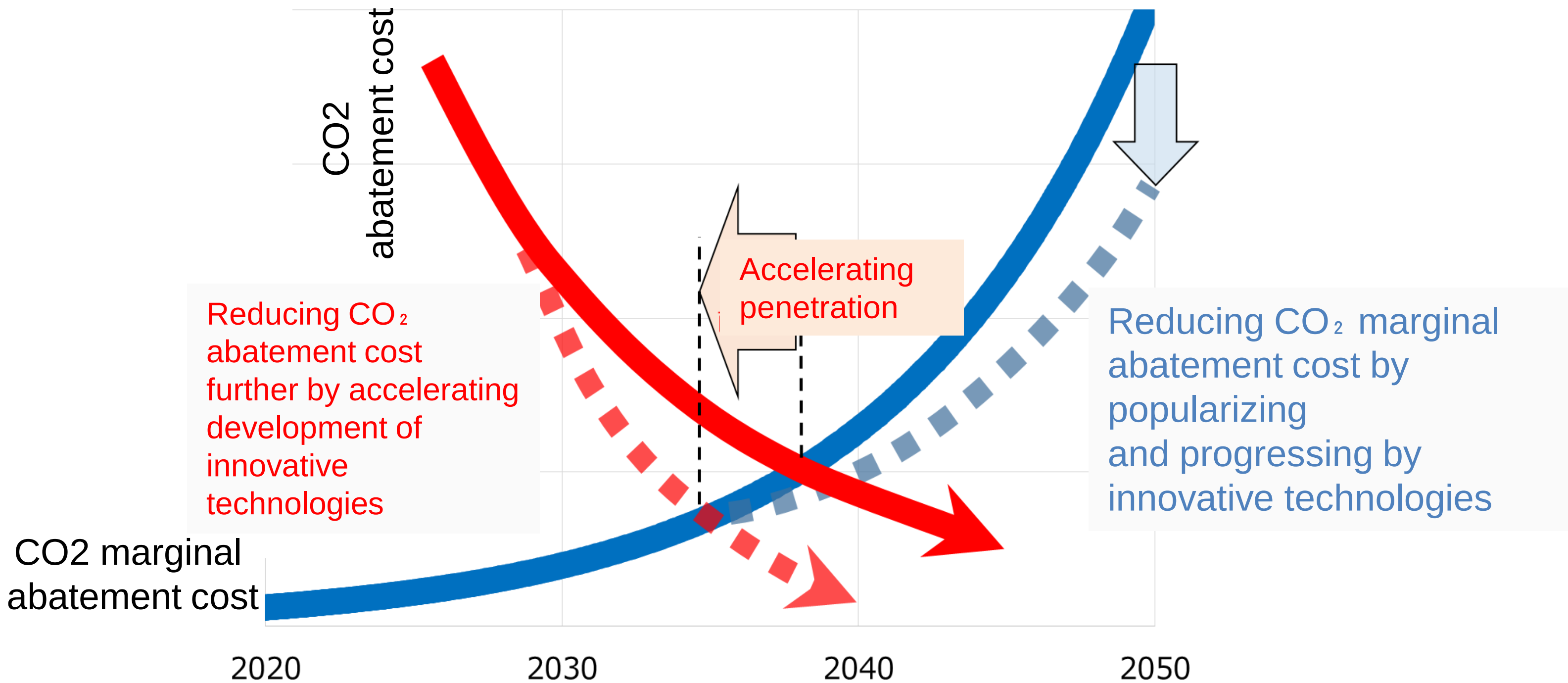
Global CO_2 Reduction Potentials

- *CO_2 reduction potential* and *CO_2 abatement cost* are two important *evaluation factors* for the objective assessment of technologies across various fields.
- NEDO has estimated the CO_2 reduction potential and CO_2 abatement cost of each innovative technology which NEDO can measure their impacts.
- The CO_2 reduction potential of each technology discussed here can be high at 0.1-10 Gt, indicating that CO_2 emissions can be dramatically reduced by promoting the development of these technologies.
- We have to use all the possible technologies to achieve carbon neutrality.



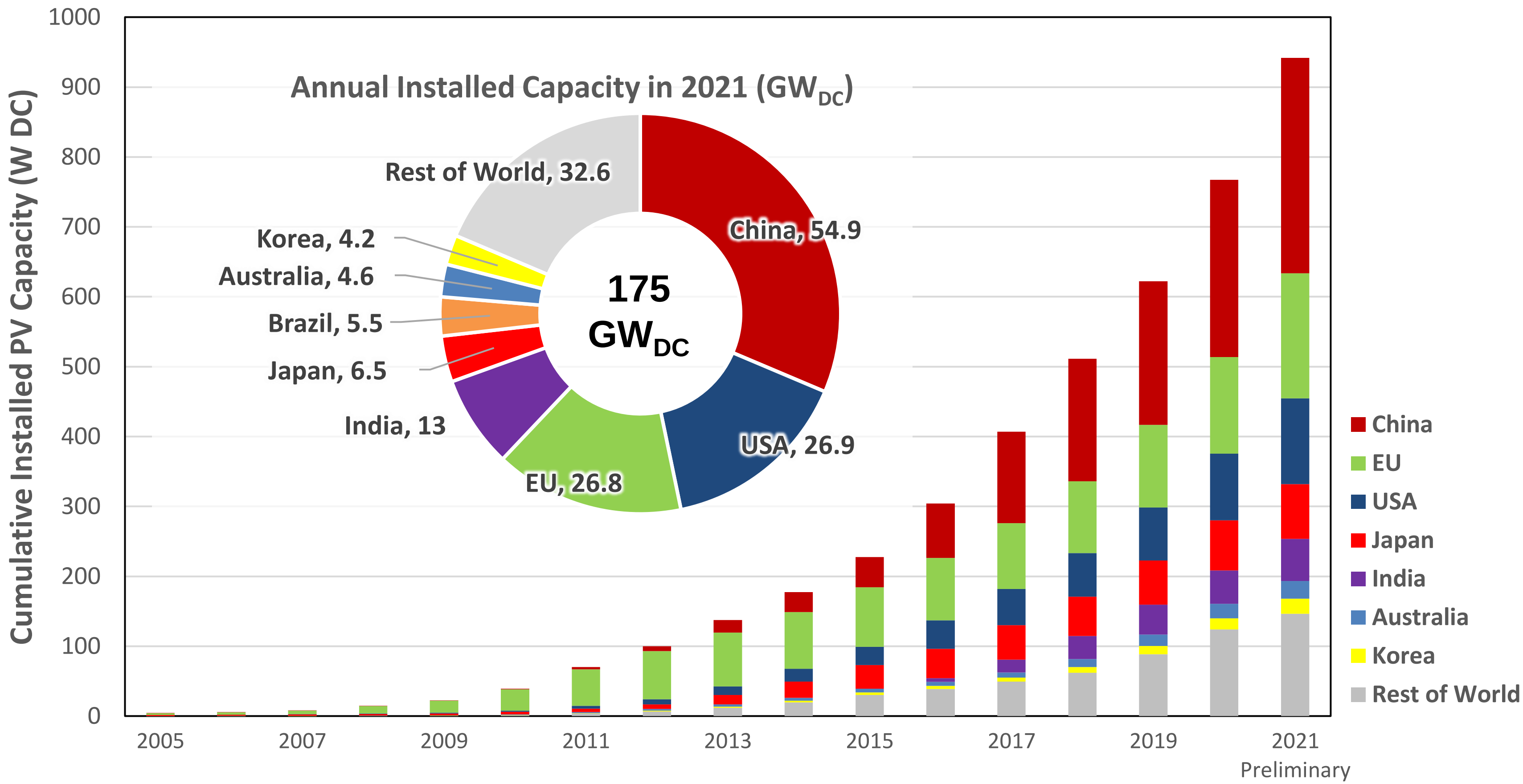
Promoting Strategical Development of Innovative Technology

- The figure shows the relationship between the CO_2 abatement cost of a target technology (red line) and the marginal CO_2 abatement cost of its counterpart traditional technology (blue line).
- The social implementation will progress rapidly from the point where CO_2 abatement costs of innovative technologies intersects with the marginal abatement cost.
- With the introduction of innovative technologies, the CO_2 abatement cost as well as marginal CO_2 abatement cost can be significantly lowered. This, in turn, will enable the social implementation schedule to be brought forward, helping dramatically reduce the costs of countermeasures.



World Cumulative PV Installation

- Cumulative PV installation exceeded 900GW and annual PV installation reached 175GW in 2021, PV becoming one of the primary energies.
- PV became the cheapest electricity option in some regions.



Reference：Compiled by NEDO TSC based on IEA PVPS “Trends in Photovoltaic Applications 2021”, ”Snapshot of Global PV Markets 2022”

New PV Applications

- Electricity demand will increase through increased electrification, and expectations for PV are expanding.
- The penetration of new PV applications in addition to mega solar and rooftops is expected.
- Within new applications, side-wall and mobility (cars and aircrafts) applications need high-efficiency (η>30%), light-weight, high quality design, long-term stability at special environment, etc.
- Single junction solar cells almost reached the efficiency limit of η~30%, therefore new type of PV modules have to be developed in order to satisfy the needs for these new applications.

＜Floating＞ reference：Yamakura dam（Kyocera）

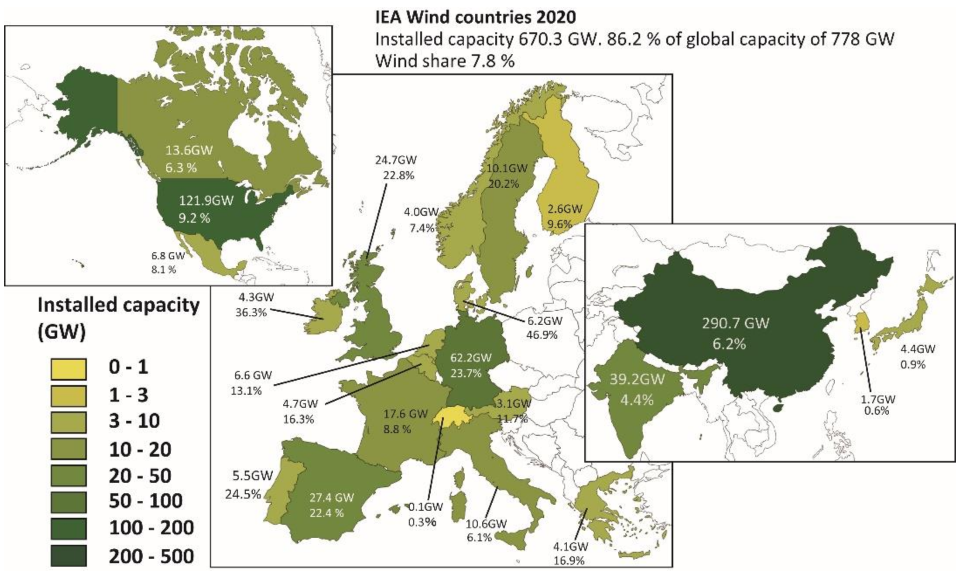
＜Farmland＞ 出典：営農型発電設備の現状について（農林水産省,2018）

＜Side wall＞ reference：https://www.taisei.co.jp/about_us/wn/2014/140616_3948.html （大成建設HP）

＜Car＞ Reference：: https://global.toyota/jp/newsroom/corporate/28781301.html?_ga=2.7594312 3.774819704.1599699649-2016341029.1598338298（トヨタHP）

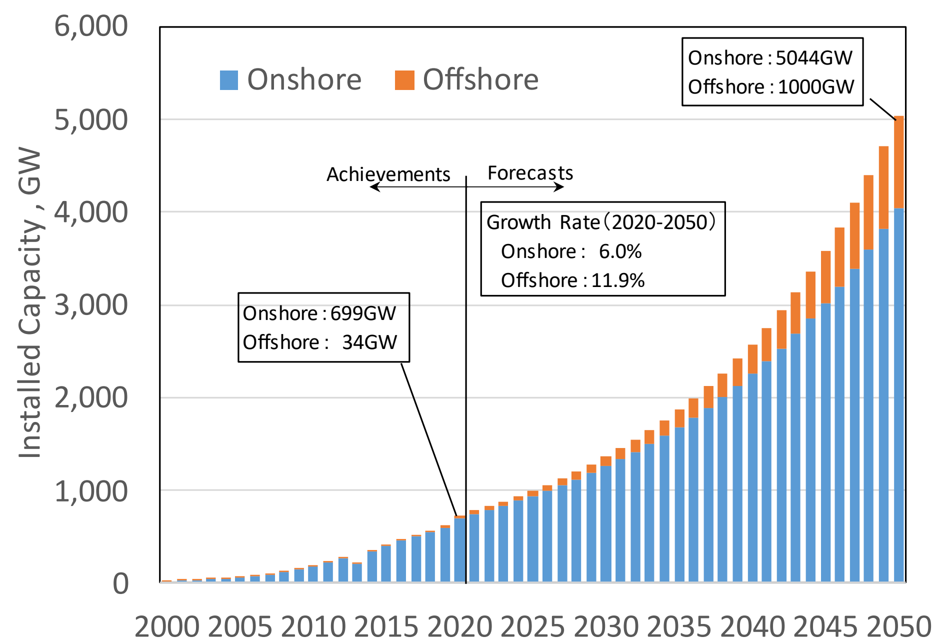
Current Status and Outlook of Wind Power Generation

- World cumulative installation of wind power reached 778GW including 35GW of offshore wind power in 2020.
- IRENA estimated the expansion of wind power installation up to 5044GW (onshore) and 1000GW (offshore) in 2050.



Total installed Wind Power System by 2020

Source : Compiled by NEDO TSC based on IEA Wind TCP Annual report 2020



Cumulative Wind Power Installation

Source : Summarized by NEDO TSC from IRENA Renewable Capacity Statistics 2021 and Future of Wind (2019)

Offshore Wind Industry Vision

Basic strategy

1. Creating an attractive domestic offshore wind power market.
2. Promoting investment and raising up domestic supply chain.
3. Developing next-generation technology and enhancement of international cooperation aiming at Asian market.

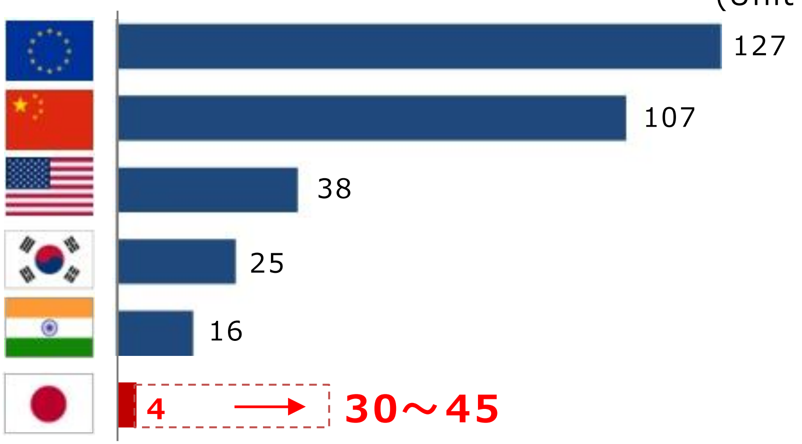
Major Targets

1. 10GW projects by 2030, 30 to 45GW projects by 2040
2. Japan content : 60% by 2040
3. Cost Reduction : 8 to 9 JPY/kWh by 2030-2035

Source : JWPA HP, http://jwpa.jp/page_301_englishsite/jwpa/detail_e.html (modified by NEDO TSC)

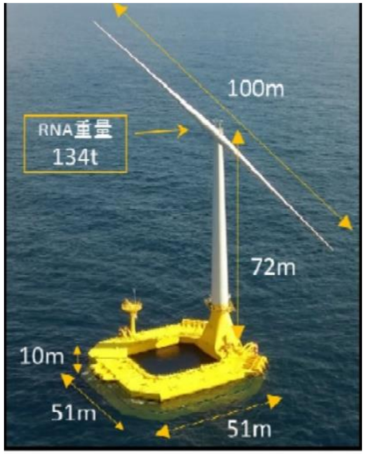
Government Target of Offshore Wind for 2040

(Unit : GW)



Source : Modified by NEDO TSC from Overview of the Vision for Offshore Wind Power Industry（1st）based on IEA Offshore Wind Outlook 2019 (Stated Policies Scenario)

Demonstration of Floating Wind Power System



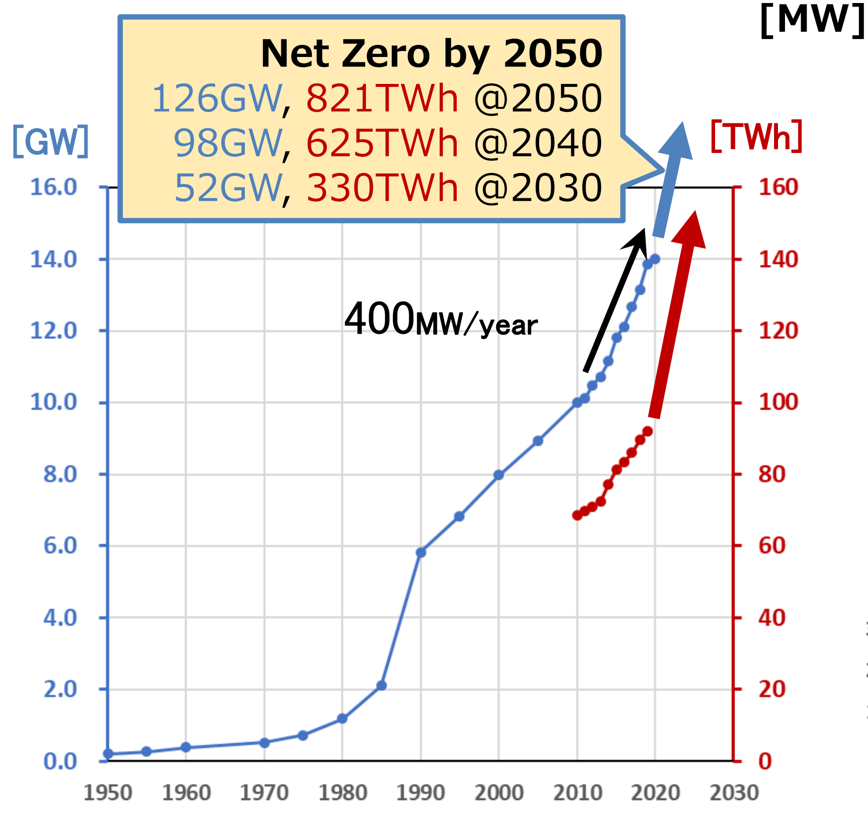
Demonstrator: Hibiki

Source : Overview of NEDO's Offshore Wind Power Technology Development(2019)

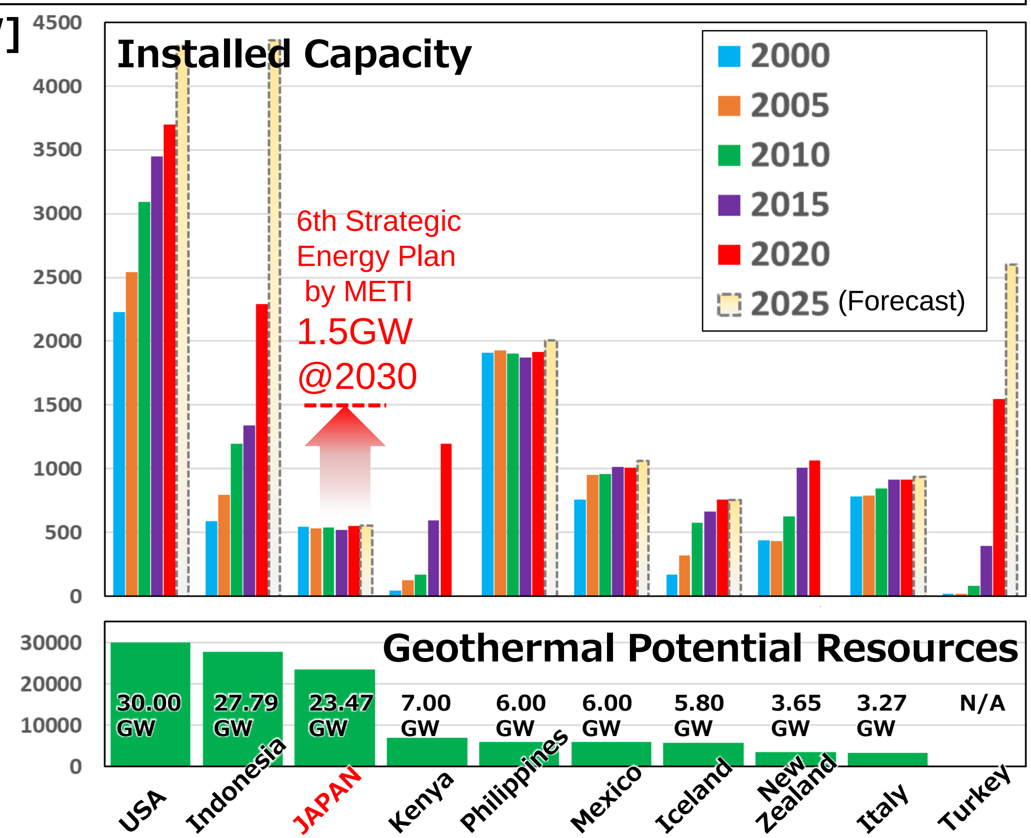
Geothermal Power Generation

Technology Strategy Center

- World cumulative installed capacity of geothermal power plants increases rapidly, particularly after 2010 with the average annual installation of 400MW/year.
- IEA Net Zero by 2050 requires much larger capacity for contributing to the CN.
- Despite the steady/fast growth of geothermal power generation in many countries (e.g. USA, Indonesia, Kenya Iceland, New Zealand and Turkey), the capacity of geothermal power plants in Japan does not increase in the past decades.



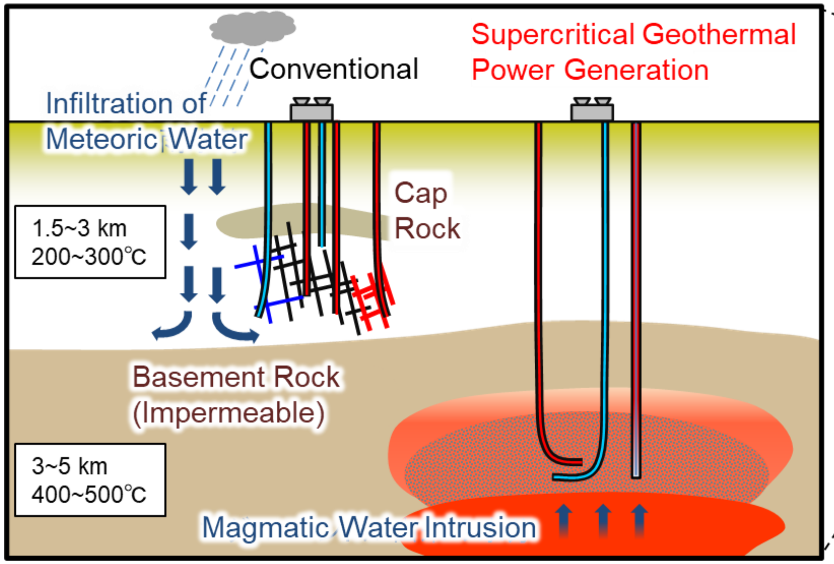
World Total Installed Capacity and Generation
Source: Bertani (2015), IRENA

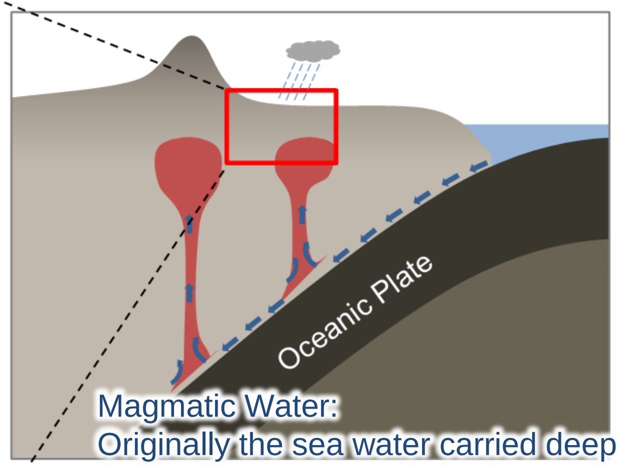


Geothermal Power Generation Capacity and Resource
Source: Bertani, 2021 (WGC); Hutter, 2021, (WGC)

Supercritical Geothermal Power Generation

- Supercritical geothermal fluid is estimated to be in the basement rock below the brittle-ductile transition zone (3~5 km), in association with oceanic plate subduction in Japan.
- Significantly higher power output than conventional one is expected, based on high temperature and pressure of the supercritical geothermal reservoirs.



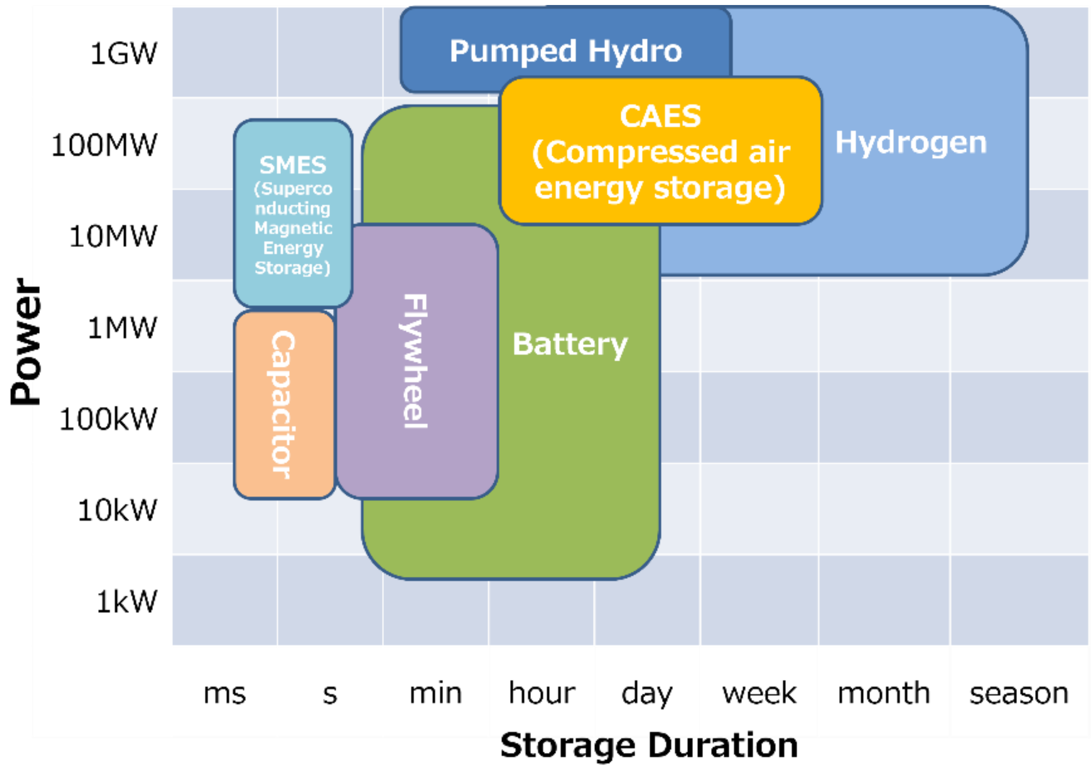


Magmatic Water:
Originally the sea water carried deep into the Earth's crust/mantle by the subduction of oceanic plate.

	Conventional	Supercritical
Depth	1500~3000 m	3000~5000 m
Temperature	200~300℃	400~500℃
Fluid Type	● Meteoric water infiltrated from the surface, ● Steam / liquid.	● Magmatic water caused by plate tectonics, ● Supercritical condition beyond the critical point of water (374℃, 22.1 MPa) ● Acidic fluid due to the ionic minerals originally contained in the sea water

Energy Storage (Power and Storage Duration)

- The integration of large shares of various renewable energy into the energy system will go hand-in-hand with the need to increase the operational flexibility of power system.
- Electricity storage systems can be classified by size according to their input and output power capacity and their discharge duration (hours).”
- Hydrogen-based technologies are best suited to large-scale electricity storage applications at the megawatt scale, covering hourly to seasonal storage.”



Source: Prepared by Technology Strategy Center, NEDO

Hydrogen Technology

Hydrogen can be produced without CO_2 emission

- electrolysis utilizing renewable energy
- fossil fuel with CCUS (Carbon Capture and Utilization or Storage)

Hydrogen can be transported for a long distance and stored for a long time

- Large amount and long distance transportation and long time storage of hydrogen is possible (by pipe line, liquid hydrogen, high pressure tank)
- Converted to Ammonia or MCH (Methylcyclohexane C_7H_{14}) for long distance transportation and for long time storage

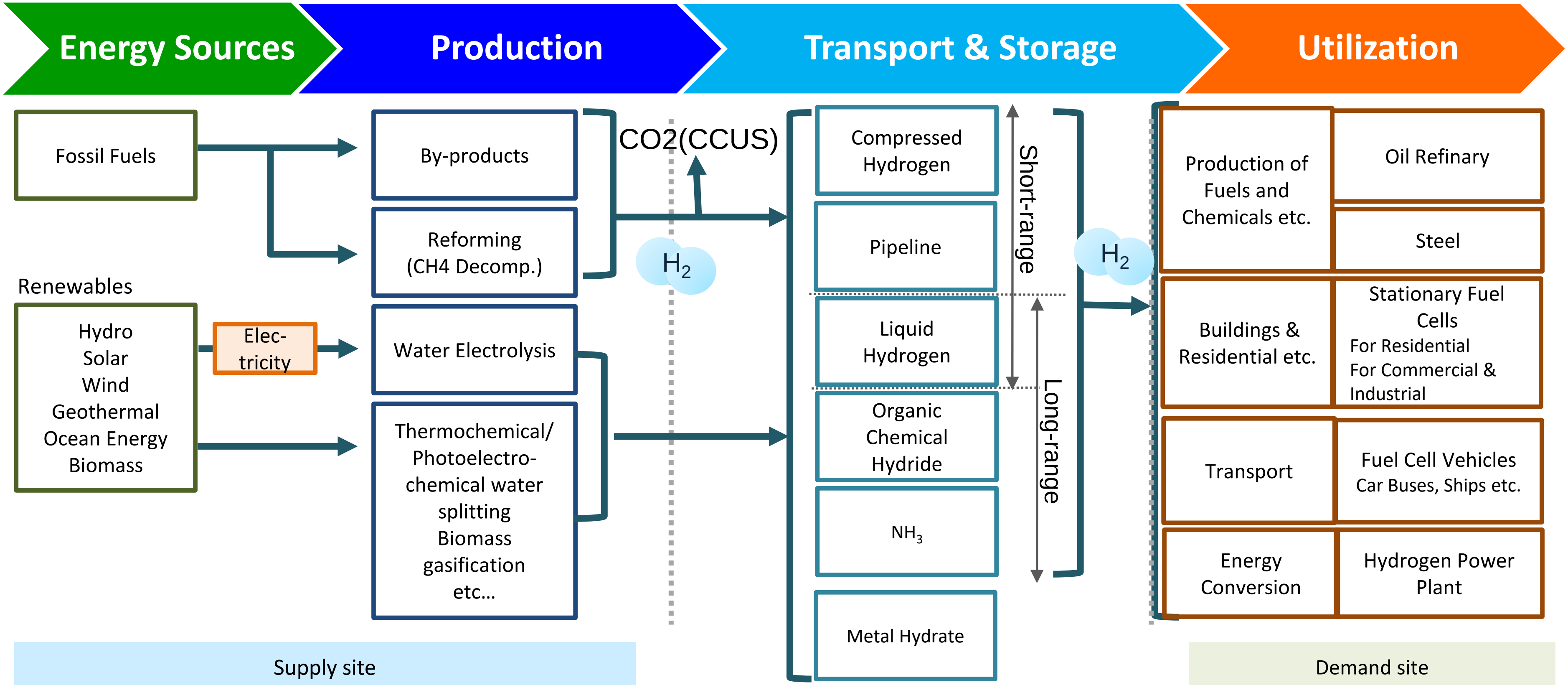
Hydrogen can be utilized without CO_2 emission

- Hydrogen can be burned w/o CO_2 emission (Hydrogen power generation)
- Combined with O_2 for Electric Power Generation (Fuel Cell)
- Promotion of energy conservation in industrial areas without CO_2 emission by utilizing hydrogen as deoxidizer

Hydrogen is one of the most important technologies for realizing zero emission of CO_2

Overview of Hydrogen Technology

- Hydrogen provides various options in Japanese energy supply chain, and is one of the most important technologies for realizing carbon neutrality.
  - Flexibility in energy supply, Improvement in energy security
  - Decarbonization of various fields such as electricity, industry and transportation



Summary

- In order to realize carbon neutrality by 2050, decarbonization based on renewable energy is essential. Renewable energies with lower cost and higher reliability are needed.

- Large penetration of variable renewable energies requires various technologies such as batteries with high performance and low cost, hydrogen production and utilization, and robust energy network.

- Issues of global warming can not be solved only by one country, international collaboration and formulation of international rules are mandatory.

ご清聴ありがとうございました。

Thank you for your attention!!

Contact: report@tky.ieej.or.jp