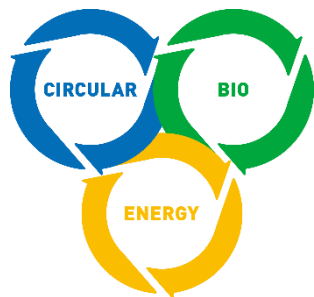




# NEDO's Activities to Realize the Carbon Neutrality by 2050

Apr. 28<sup>th</sup>, 2022

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



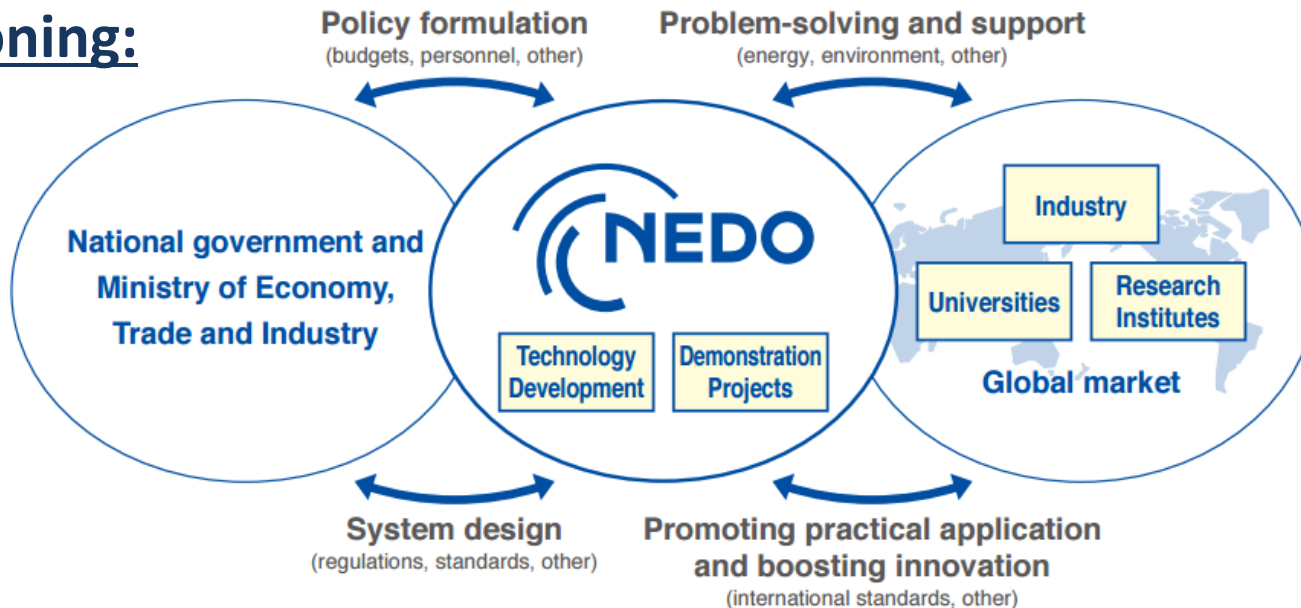
## History:

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:

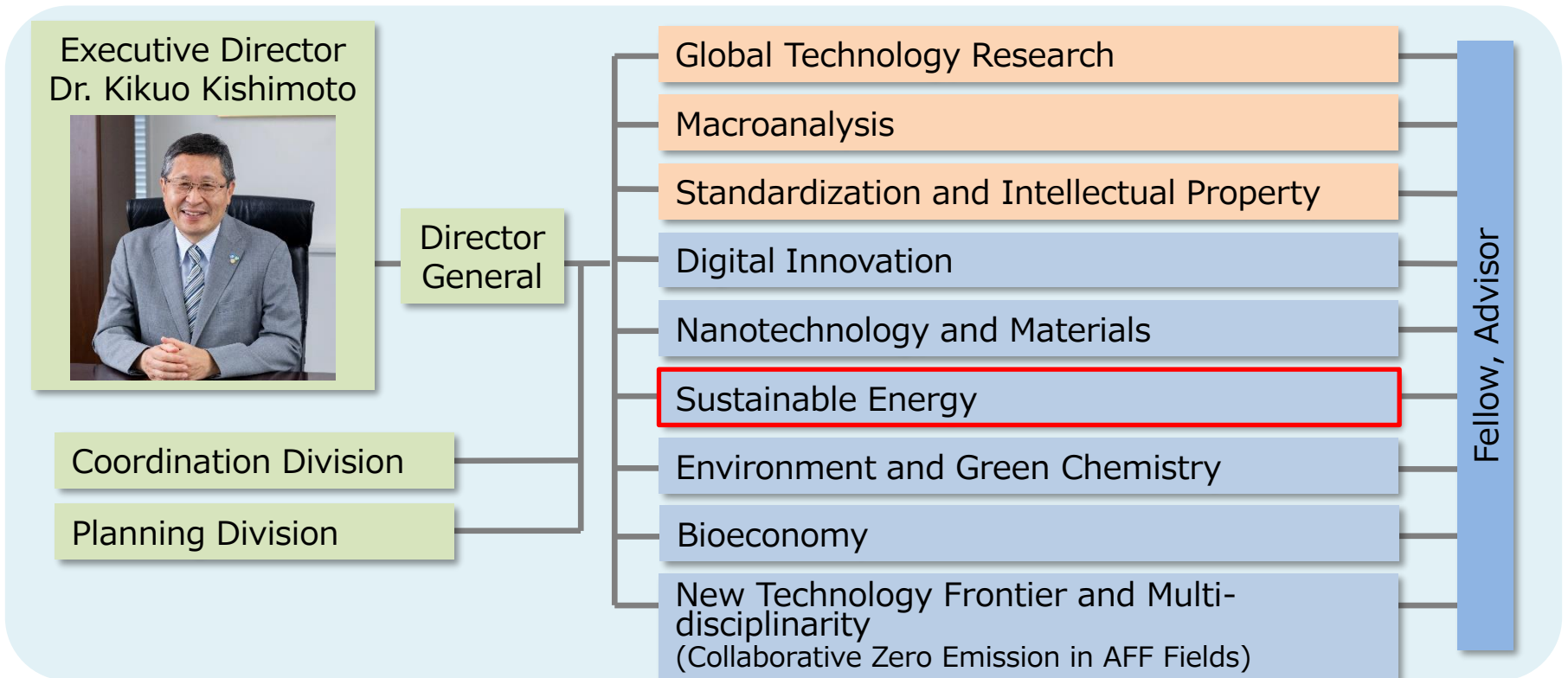
1. Addressing energy and global environmental problems
2. Enhancing industrial technology

## Positioning:



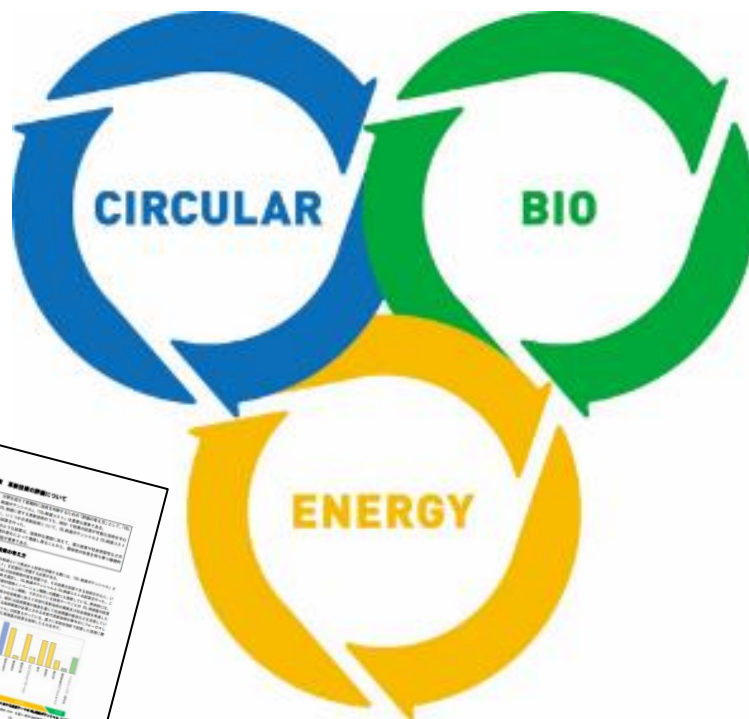
NEDO's Technology Strategy Center (TSC) is a technology strategy research institute that contributes to the promotion of technology development that realizes NEDO's missions of addressing energy and global environmental problems and enhancing industrial technology.

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



- In cooperation with “**Progressive Environment Innovation Strategy**” (Japanese Cabinet Office, Jan. 2020), NEDO established “Comprehensive R&D Principle for Sustainable Society”. (The NEDO’s Principle)

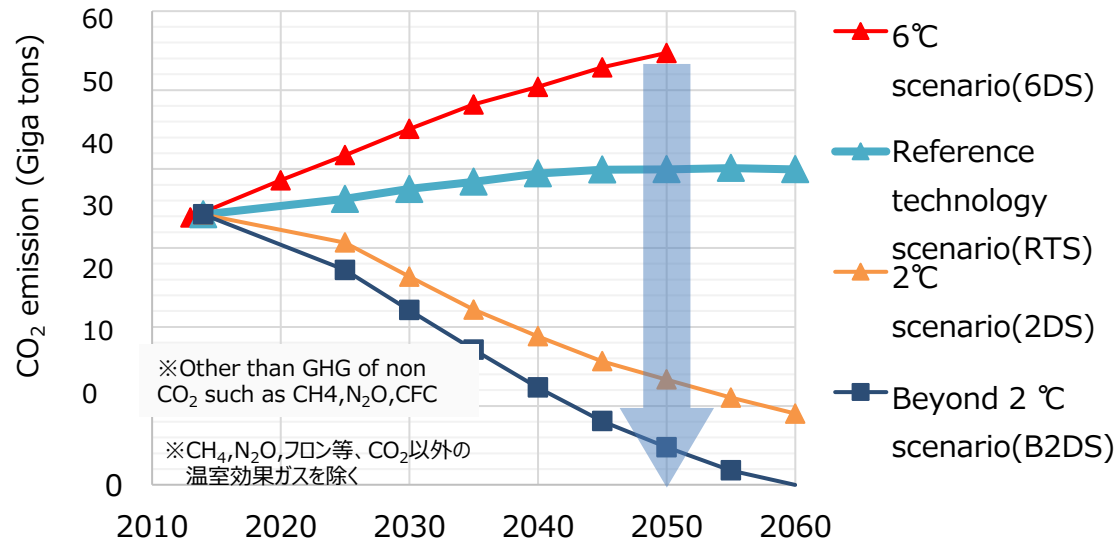
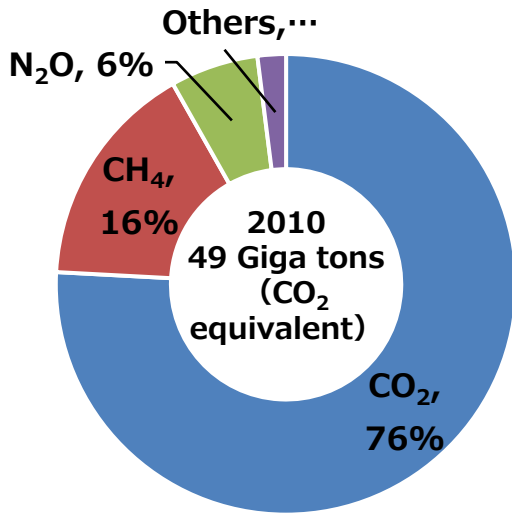
## 3 Essential Social Systems for Sustainable Society



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.



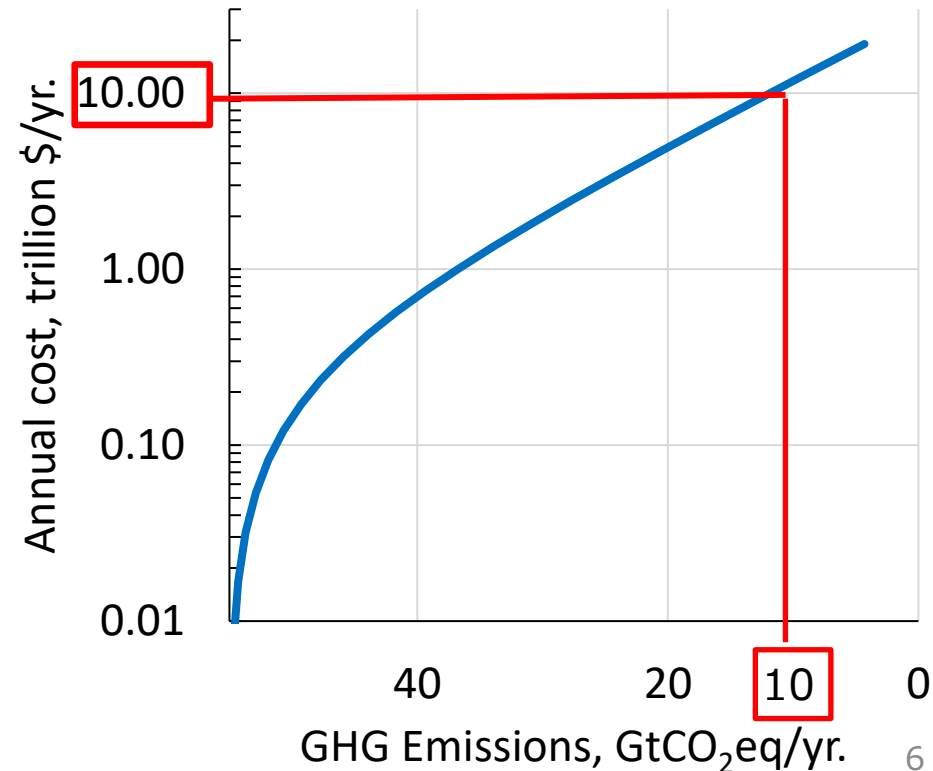
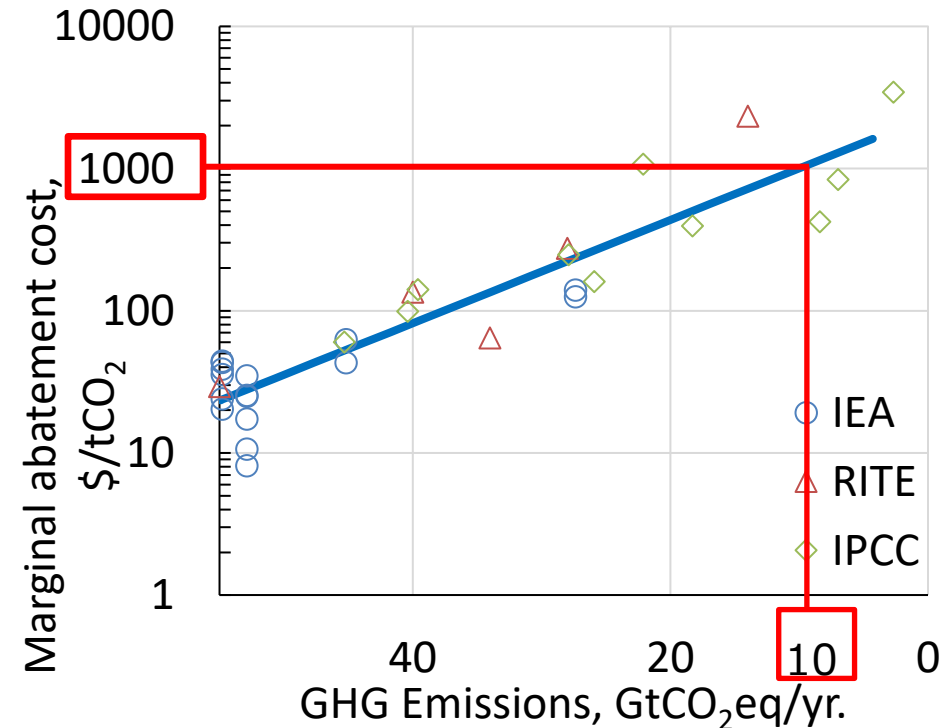
- The GHG emissions in 2010 were about 49 Gt CO<sub>2</sub>. Of these, 76% is attributable to CO<sub>2</sub>, followed by CH<sub>4</sub> (16%), N<sub>2</sub>O (6%) and fluorine gases (2%) .
- **In 2050**, approximately 15 Gt is expected to be reduced by expanding conventional technologies(RTS), and **40 Gt CO<sub>2</sub>** still remains.
- This Comprehensive Principle mainly discusses reduction of CO<sub>2</sub> emissions though reduction of other GHGs is also a future challenge.



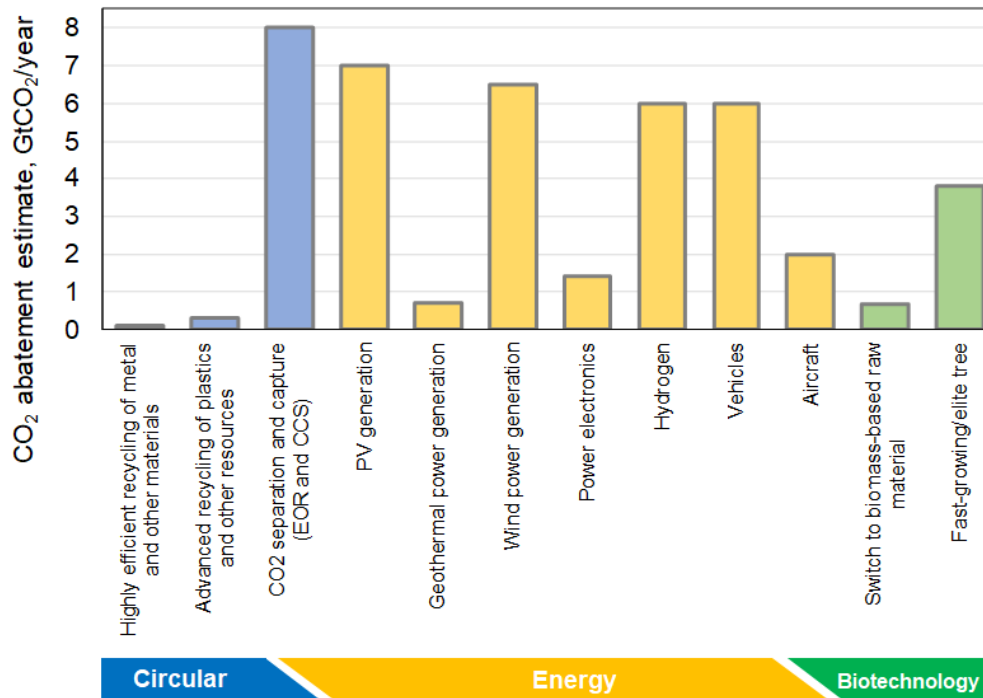
Source : Compiled by NEDO Technology Strategy Center based on Climate Change 2014 Synthesis Report(IPCC2014) (2020)

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

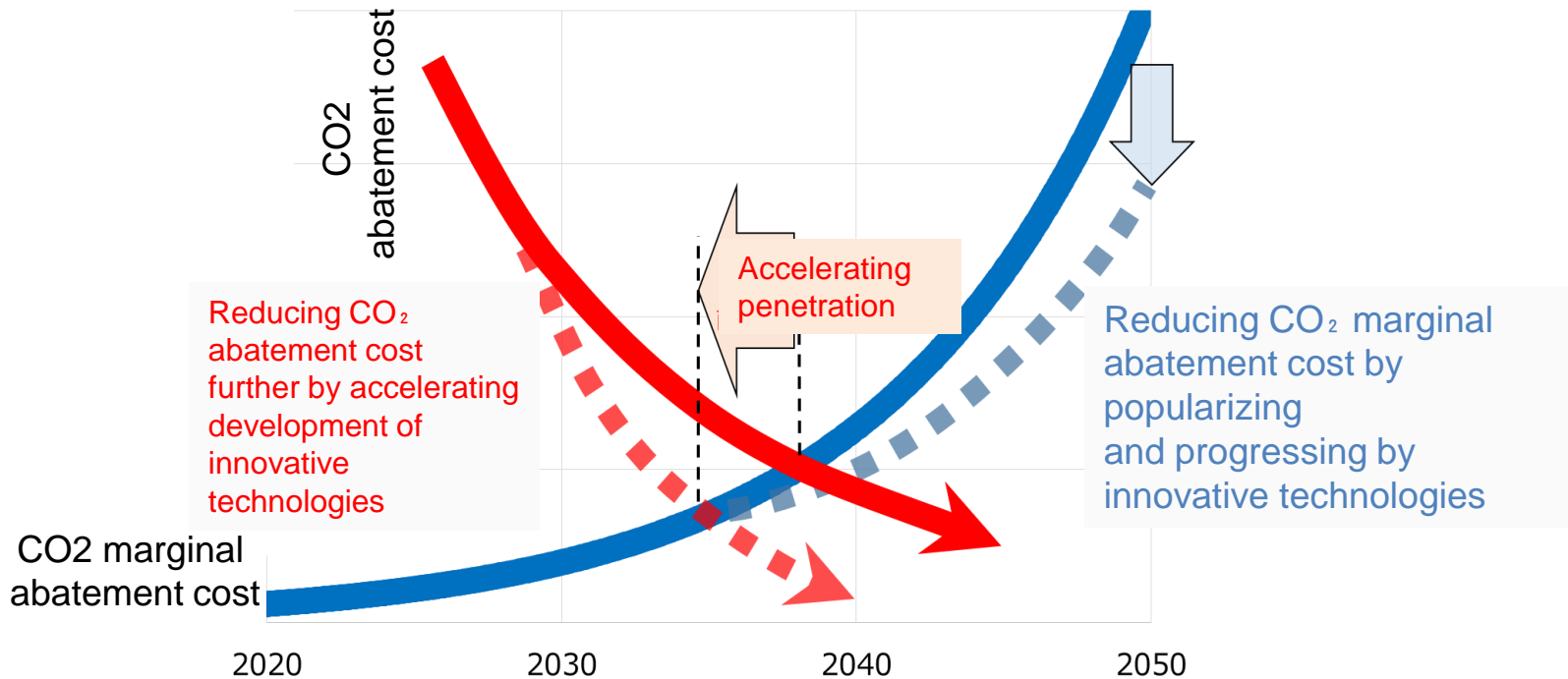
- In case of **reducing up to 10 GtCO<sub>2</sub>** eq. of GHG emissions (80% of global GHG emissions) with only conventional technologies, marginal abatement cost would become around **\$1,000/tCO<sub>2</sub>**.
- The costs for countermeasures reach **around 10 trillion dollars, approximately 12 % of global GDP** each year globally, and it is not acceptable.
- Discontinuous innovation to lower this huge cost to a globally acceptable level is indispensable.



- **CO<sub>2</sub> reduction potential and CO<sub>2</sub> abatement cost** are two important *evaluation factors* for the objective assessment of technologies across various fields.
- NEDO has estimated the CO<sub>2</sub> reduction potential and CO<sub>2</sub> abatement cost of each innovative technology which NEDO can measure their impacts.
- The CO<sub>2</sub> reduction potential of each technology discussed here can be high at 0.1-10 Gt, indicating that CO<sub>2</sub> emissions can be dramatically reduced by promoting the development of these technologies.
- We have to use all the possible technologies to achieve carbon neutrality.

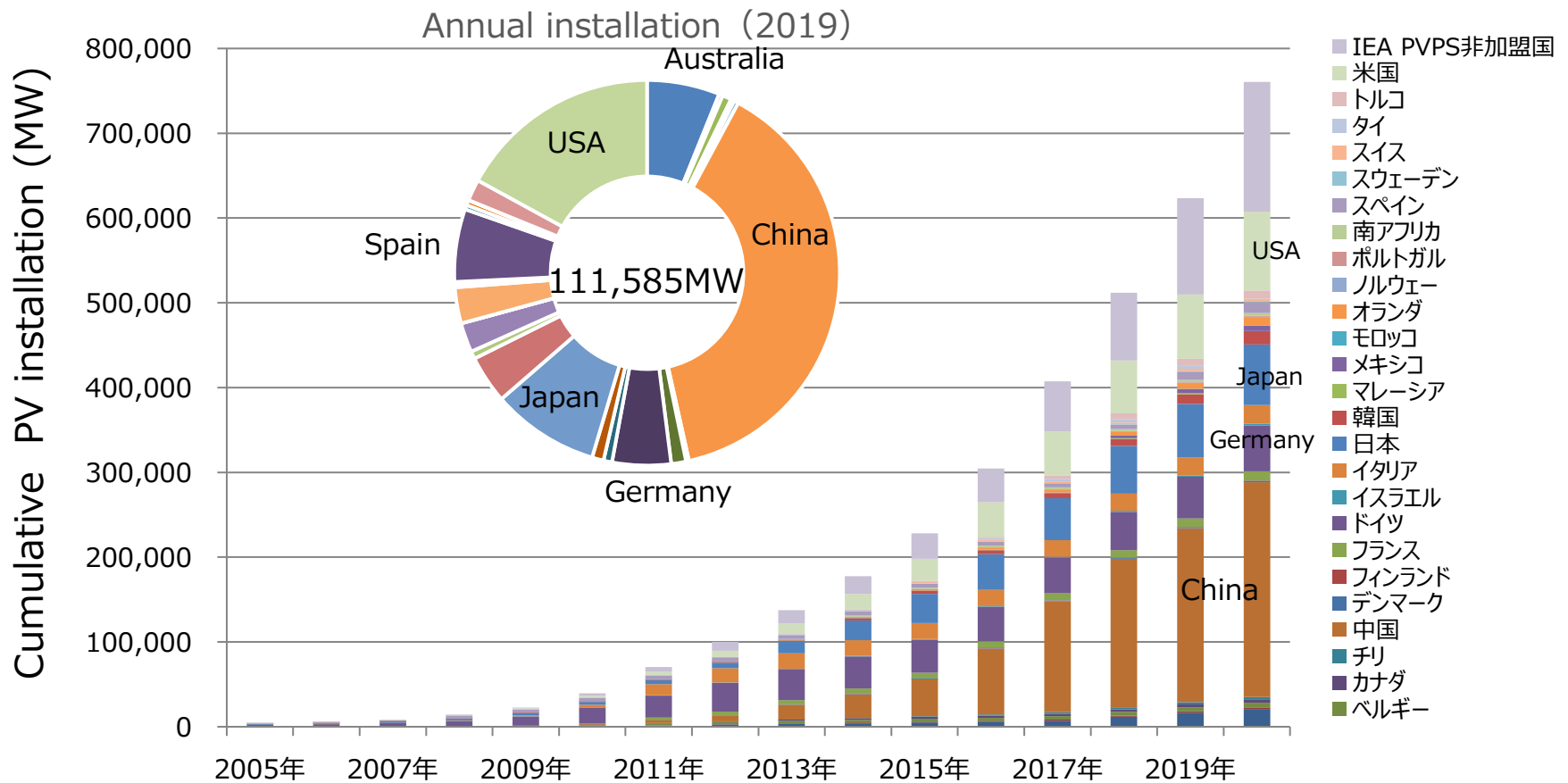


- The figure shows the relationship between the CO<sub>2</sub> abatement cost of a target technology (red line) and the marginal CO<sub>2</sub> abatement cost of its counterpart traditional technology (blue line).
- The **social implementation will progress rapidly from the point where CO<sub>2</sub> abatement costs of innovative technologies intersects with the marginal abatement cost.**
- With the introduction of innovative technologies, the CO<sub>2</sub> abatement cost as well as marginal CO<sub>2</sub> 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.





- Cumulative PV installation exceeded 700GW and annual PV installation reached 112GW in 2020, PV becoming one of the primary energies.
- PV became the cheapest electricity option in some regions.



- 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 ( $\eta > 30\%$ ), light-weight, high quality design, long-term stability at special environment, etc.
- Single junction solar cells almost reached the efficiency limit of  $\eta \sim 30\%$ , 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)

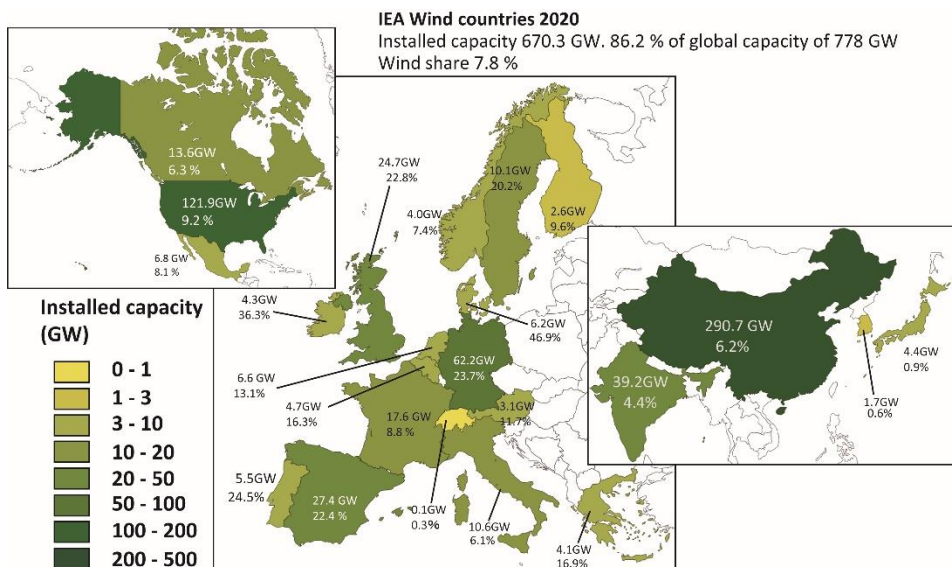


<Side wall> reference: [https://www.taisei.co.jp/about\\_us/wn/2014/140616\\_3948.html](https://www.taisei.co.jp/about_us/wn/2014/140616_3948.html) (大成建設HP)



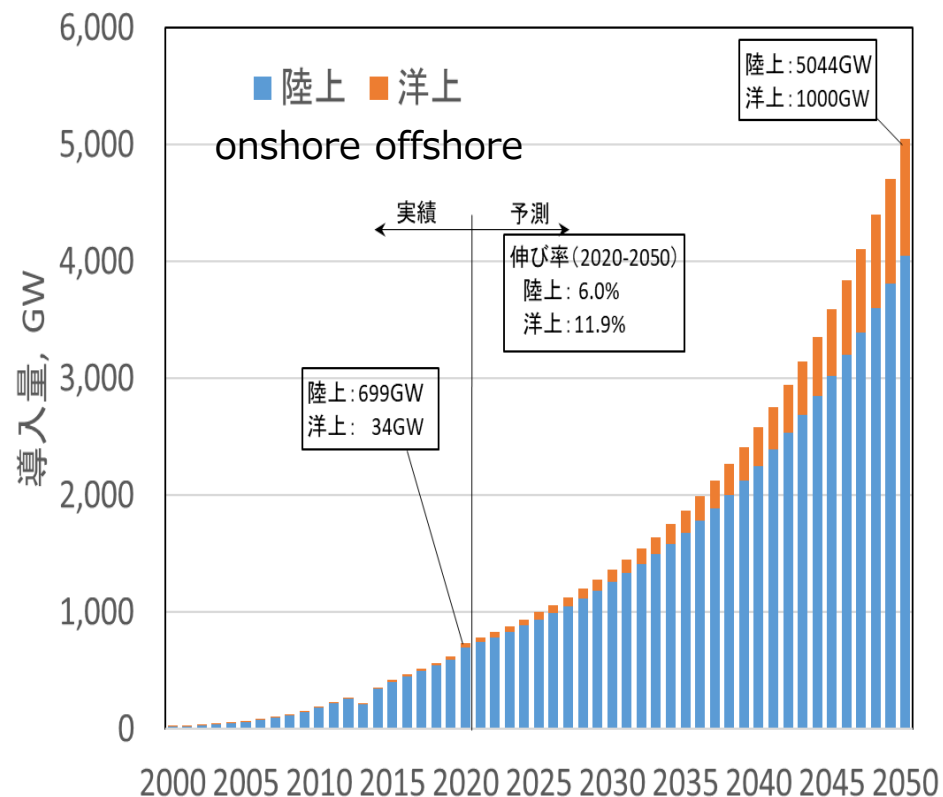
<Car> Reference: [https://global.toyota.jp/newsroom/corporate/28781301.html?\\_ga=2.7594312.3.774819704.1599699649-2016341029.1598338298](https://global.toyota.jp/newsroom/corporate/28781301.html?_ga=2.7594312.3.774819704.1599699649-2016341029.1598338298) (トヨタHP)

- 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.



## Newly installed Wind Power System in 2020

reference: IEA, IEA Wind Annual report 2020(2021)<sup>※1</sup>に基づき  
NEDO TSCにて作成



## Cumulative Wind Power Installation <sup>※2</sup>

実績は、IRENA Renewable Statistics 2020<sup>※2</sup>  
2030年、2050年予測は、Future of Wind - A Global Energy Transformation Paper 2019<sup>※3</sup>などを根拠にNEDO TSCにて作成

## Basic strategy

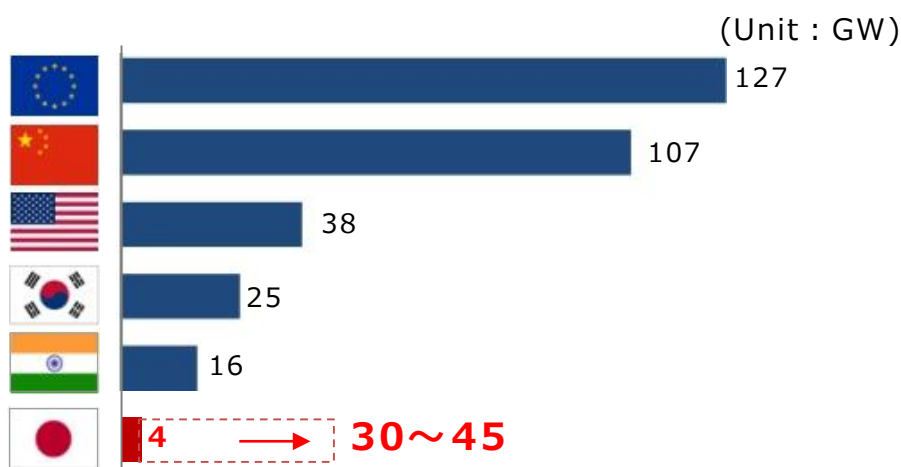
1. Creating an attractive domestic offshore wind power market.
2. Promoting investment and raising up domestic supply chain.
3. Developing next-generation technology and enhancement of international cooperation aiming at Asian market.

## 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

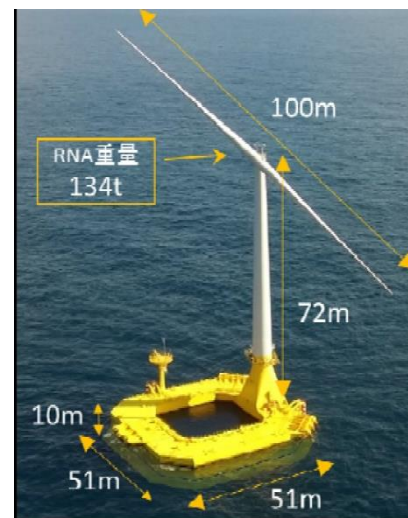
Source : JWPA HP, [http://jwpa.jp/page\\_301\\_englishsite/jwpa/detail\\_e.html](http://jwpa.jp/page_301_englishsite/jwpa/detail_e.html)  
(modified by NEDO TSC)

Government Target of Offshore Wind for 2040



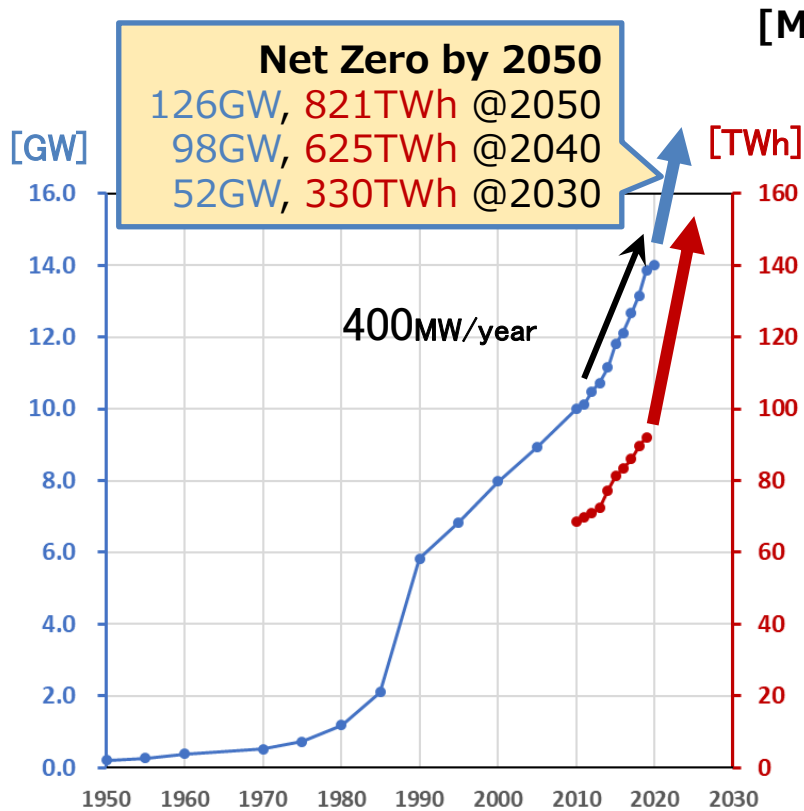
Source : IEA Offshore Wind Outlook 2019(Stated Policies Scenario)

Demonstration of Floating Wind Power System

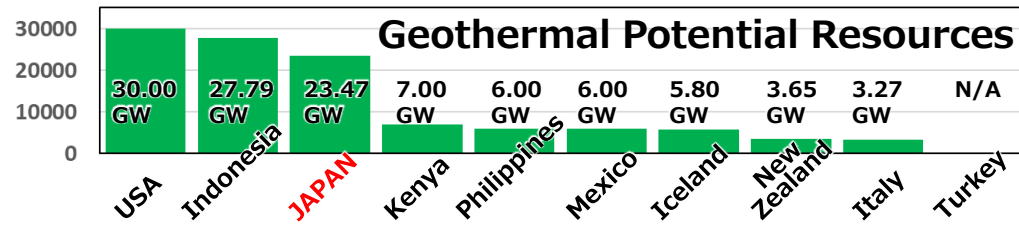
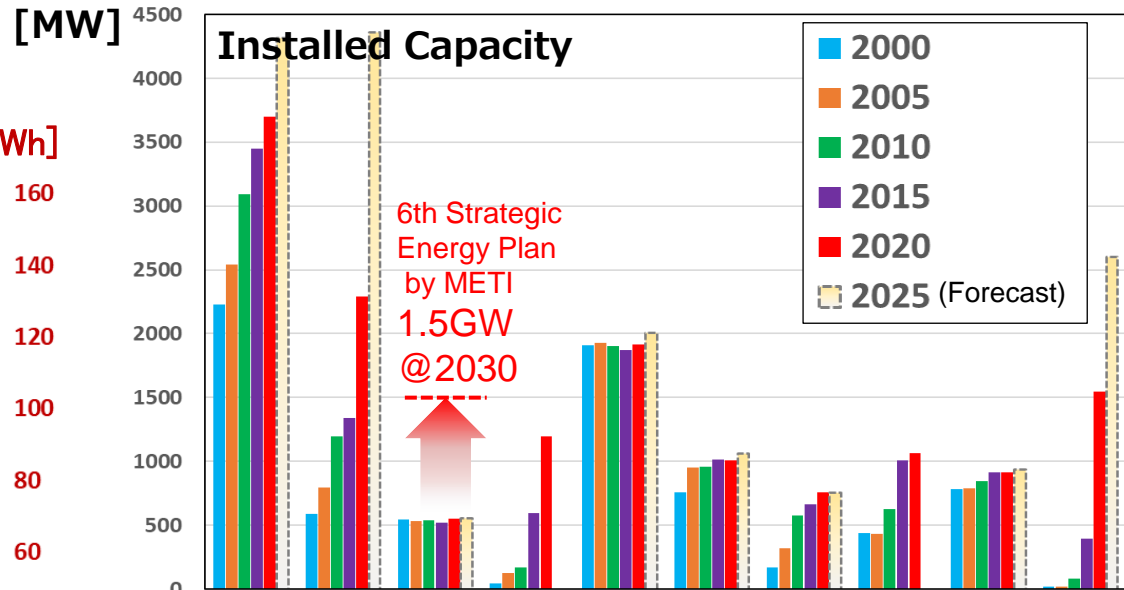


Demonstrator: Hibiki

- 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.

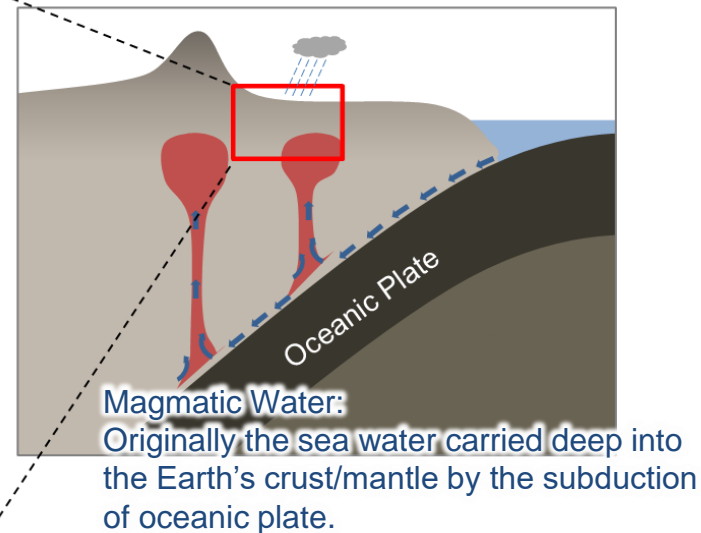
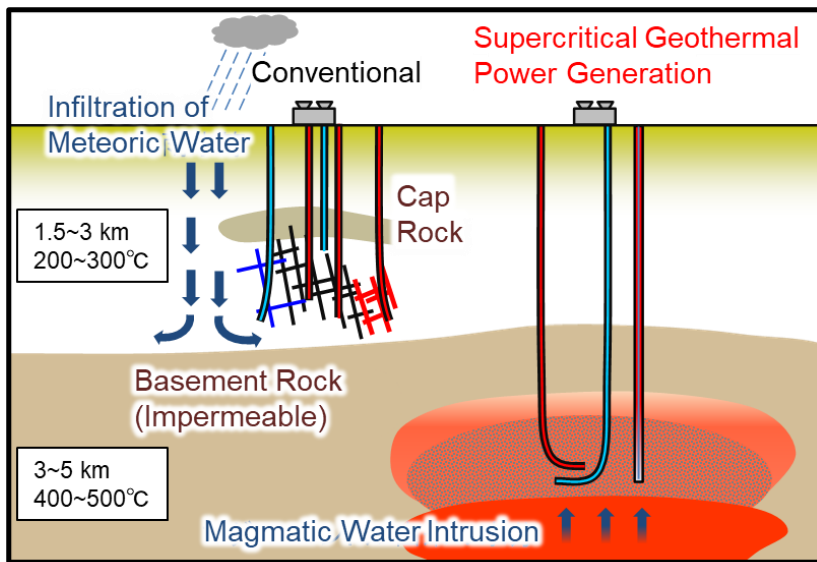


**World Total Installed Capacity and Generation**  
 Source: Bertani (2015), IRENA



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

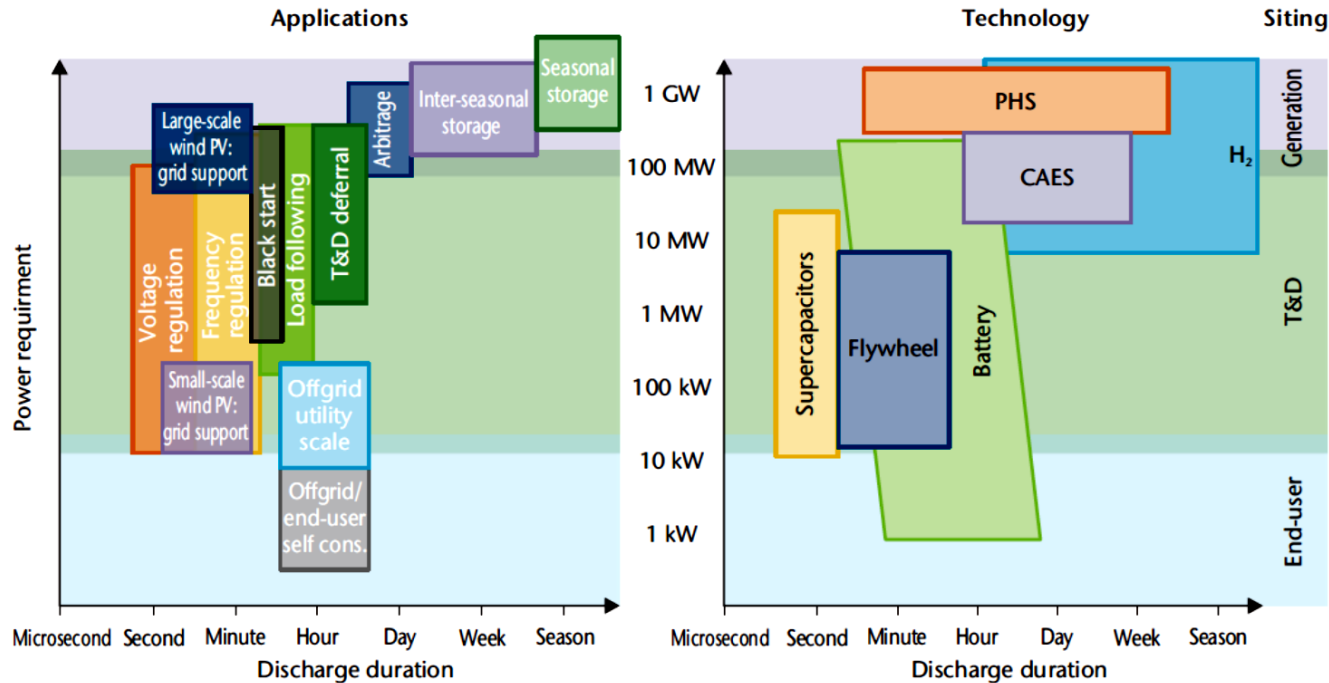
- Supercritical geothermal fluid is estimated to be in the basement rock below the brittle-ductile transition zone (3~5 km), in association with oceanic plate subduction, in Japan.
- Significantly higher power output than conventional is expected, based on the size of the geothermal reservoir.



	Conventional	Supercritical
Depth	1500~3000 m	3000~5000 m
Temperature	200~300°C	400~500°C
Fluid Type	<ul style="list-style-type: none"> <li>● Meteoric water infiltrated from the surface,</li> <li>● Steam / liquid.</li> </ul>	<ul style="list-style-type: none"> <li>● Magmatic water caused by plate tectonics,</li> <li>● Supercritical condition beyond the critical point of water (374°C, 22.1 MPa)</li> <li>● Acidic fluid due to the ionic minerals originally contained in the sea water</li> </ul>



- 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."



Note: CAES = compressed air energy storage; PHS = pumped hydro energy storage.

## Hydrogen can be produced without CO<sub>2</sub> 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<sub>7</sub>H<sub>14</sub>)** for long distance transportation and for long time storage

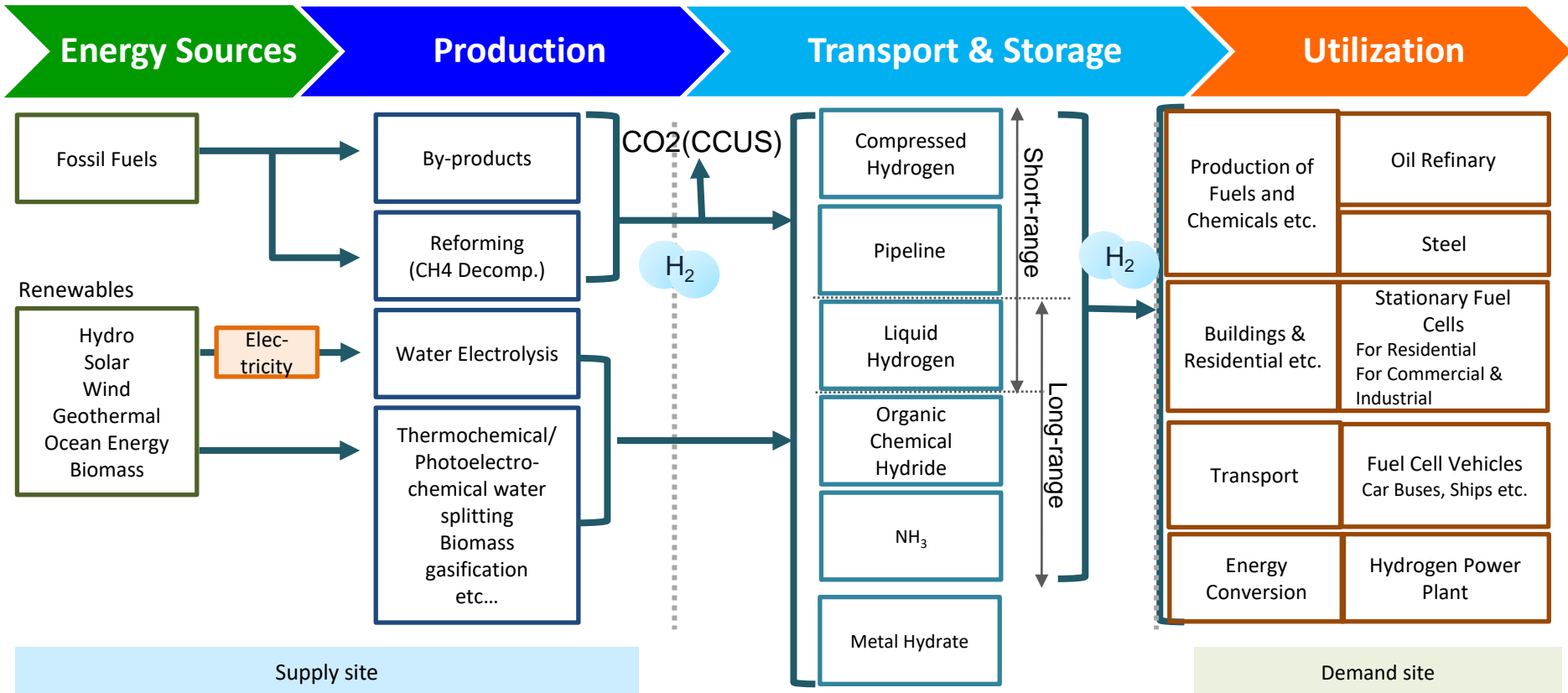
## Hydrogen can be utilized without CO<sub>2</sub> emission

- Hydrogen can be burned w/o CO<sub>2</sub> emission (**Hydrogen power generation**)
- Combined with O<sub>2</sub> for Electric Power Generation (**Fuel Cell**)
- Promotion of **energy conservation in industrial application area** without CO<sub>2</sub> emission by utilizing hydrogen as deoxidizer

Hydrogen is one of the most important technologies for realizing zero emission of CO<sub>2</sub>



- 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



- 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 by only 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!!*

