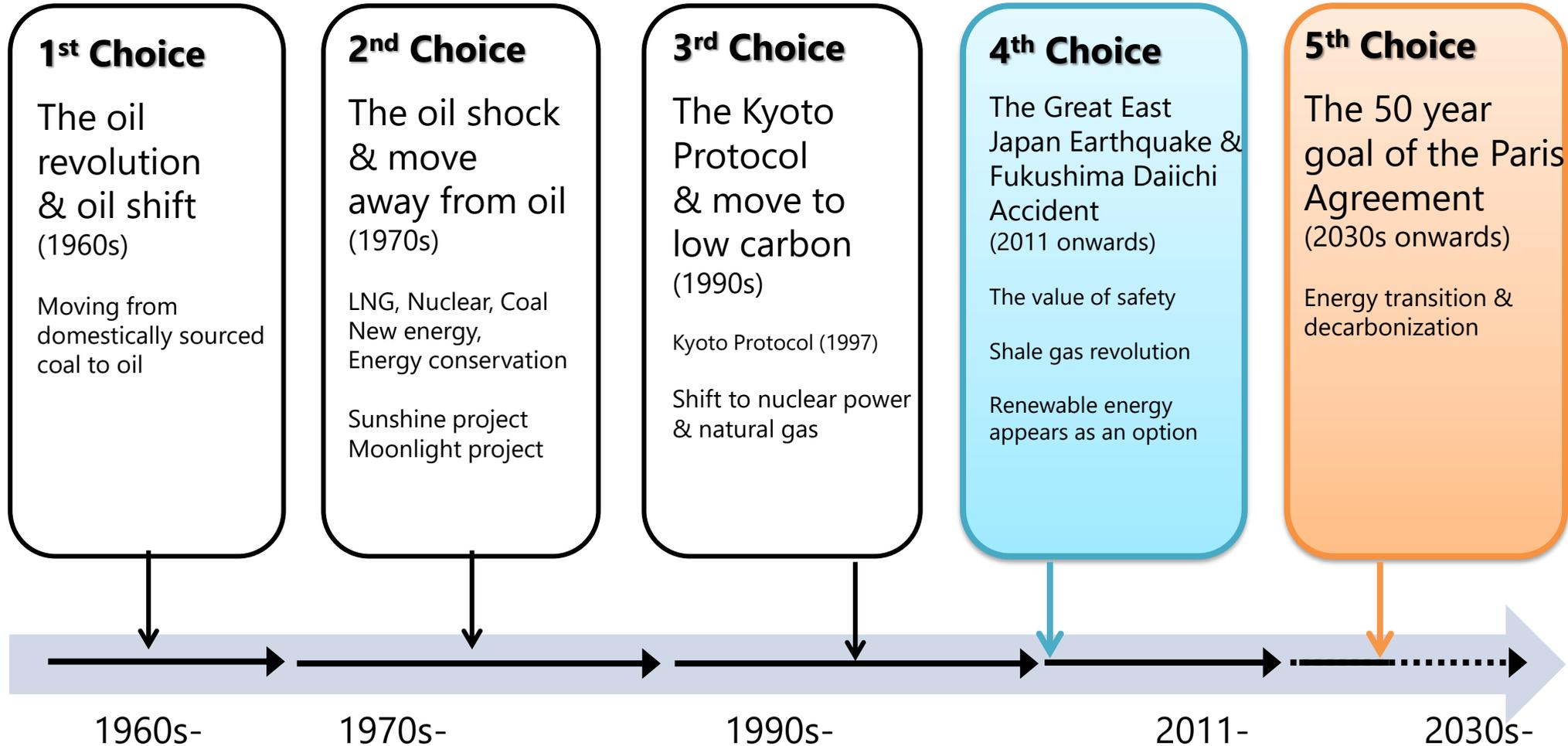


# **Innovation for Energy Transitions**

**September, 2018**

**METI**

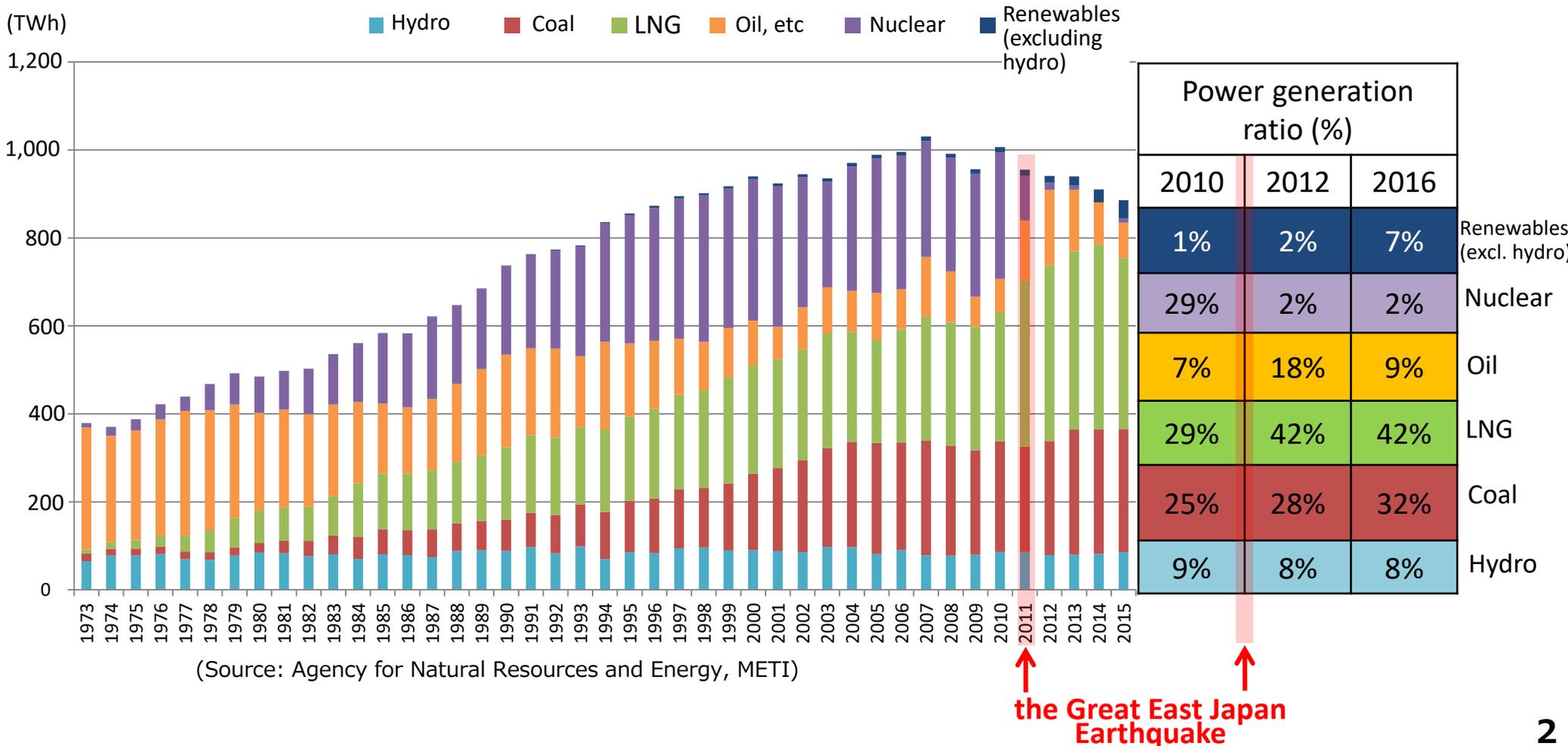
# The history of energy choice & the 5<sup>th</sup> energy choice



# Change in generation mix

- Nuclear has been rapidly replaced by fossil fuels since the Great East Japan Earthquake and the nuclear accident in March 2011

## Trend in domestic power generation by technology



# Strategic Energy Plan and Energy mix plan

## FY2002 **Basic Act on Energy Policy**

- The 1<sup>st</sup> Strategic Energy Plan, 2003
- The 2<sup>nd</sup> Strategic Energy Plan, 2007
- The 3<sup>rd</sup> Strategic Energy Plan, 2010

## FY2014 **The 4<sup>th</sup> Strategic Energy Plan**

- Nuclear power: To reduce as much as possible and restart with safety priority.
- Renewable energy: >20%

## FY2015 **Long-term Energy Supply and Demand Outlook (Energy mix plan)**

- Nuclear power: 20-22% (Before the earthquake: 30%)
- Renewable energy: 22-24%

## FY2018 **The 5<sup>th</sup> Strategic Energy Plan**

- Towards 2030 ⇒ To achieve energy mix target
- Towards 2050 ⇒ Challenges towards energy transitions and decarbonisation

# Japan's Strategic Energy Plan

- Based on the Strategic Energy Plan, Japan tackles the policy targets related to **Safety, Energy security, Economic efficiency, and Environment** simultaneously. (3E+S)
- The Plan also refers **reducing dependence on nuclear power generation as much as possible** by promoting energy efficiency and conservation, introduction of renewable energy, and introduction of efficient thermal power plants.

## <Policy target for 3E+S>

Safety

**Safety is the top priority.**

**Energy  
security**

**Self-sufficiency: About 25%, higher than  
before the earthquake (about 20%)**

**Economic  
efficiency**

**Electricity cost: To lower from the current level  
(9.7 trillion yen in FY2013 to 9.5 trillion yen in FY2030)**

**Environment**

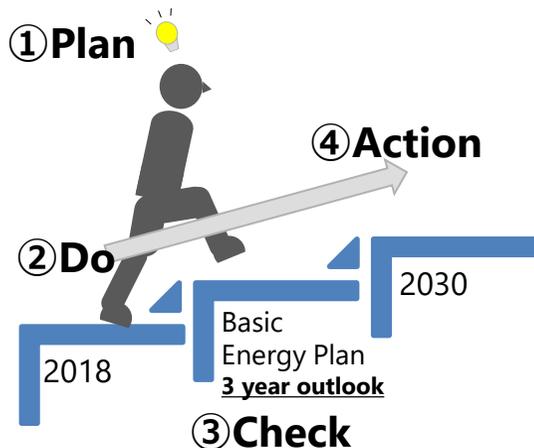
**Greenhouse gas emission reduction target:  
(reduction of 26.0% in FY 2030 compared to FY 2013)**

# Renewables introduction toward 2030 target

	Before FIT (June 2012)	After FIT [A] (as of Sep 2017)	Target [B] (FY2030)	Progress [A]/[B]
Geothermal	0.5GW	0.5GW	1.4 - 1.6GW	33%
Biomass	2.3GW	3.5GW	6.0 - 7.3GW	53%
Wind	2.6GW	3.4GW	10GW	34%
Solar PV	5.6GW	42.4GW	64GW	66%
Hydro	48.1GW	48.4GW	48.5 - 49.3GW	99%

# Ambitious Multi-Path Scenario

## 2030 Single target

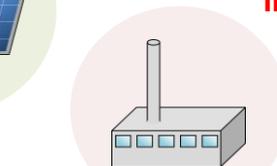


Peak

Base



Renewables with thermal backup (lower costs) 22~24%



Thermal (achieve high efficiency) 56%



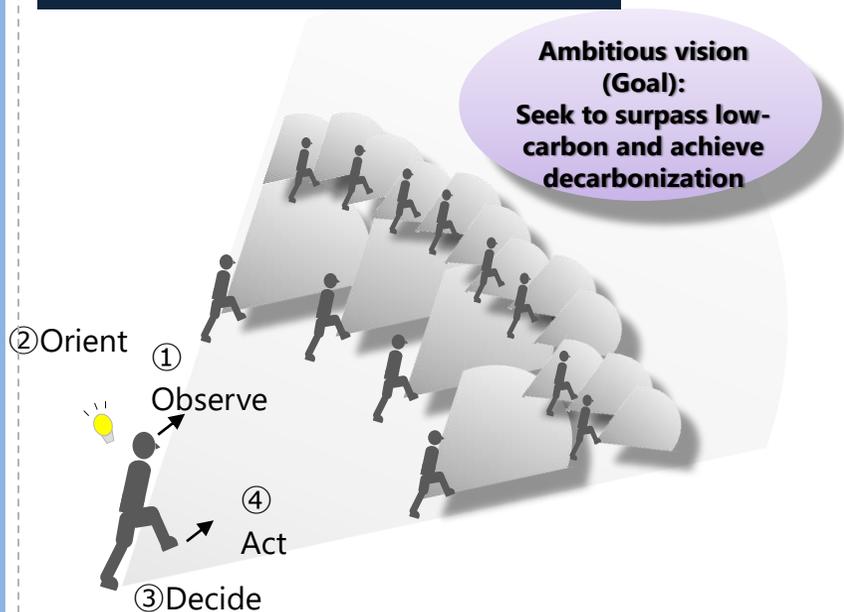
Nuclear (restarts with priority on safety) 22~20%

CO<sub>2</sub> -26%

44% zero-emission power

Improve energy efficiency by 30%

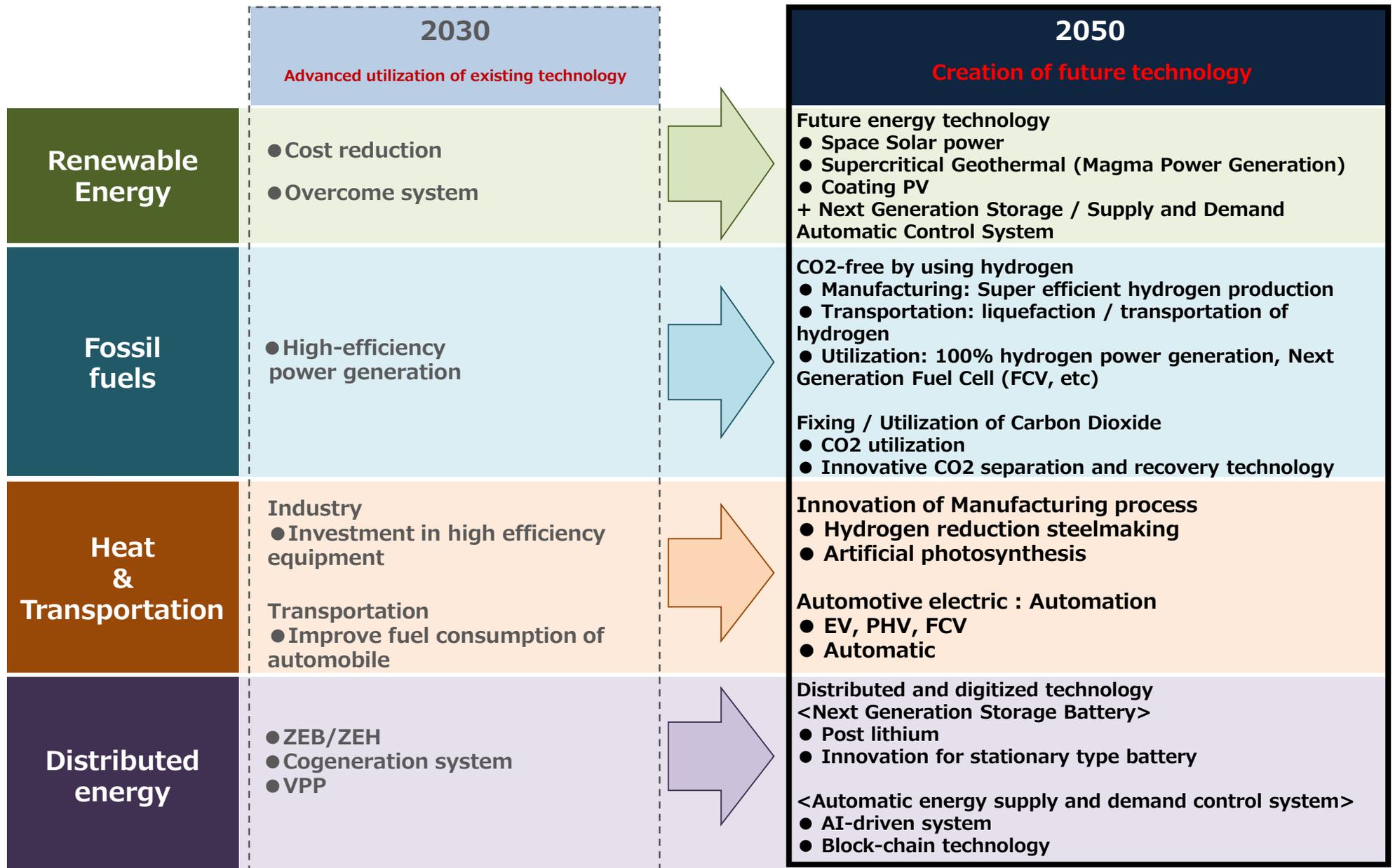
## 2050 towards multiple goals



Domestic renewables + Storage batteries	Domestic renewables + Hydrogen	Overseas renewables + Hydrogen	Overseas Fossil fuel with CCS + Hydrogen	Maximum introduction renewables + (Thermal)	Next-generation nuclear (safety, etc.)

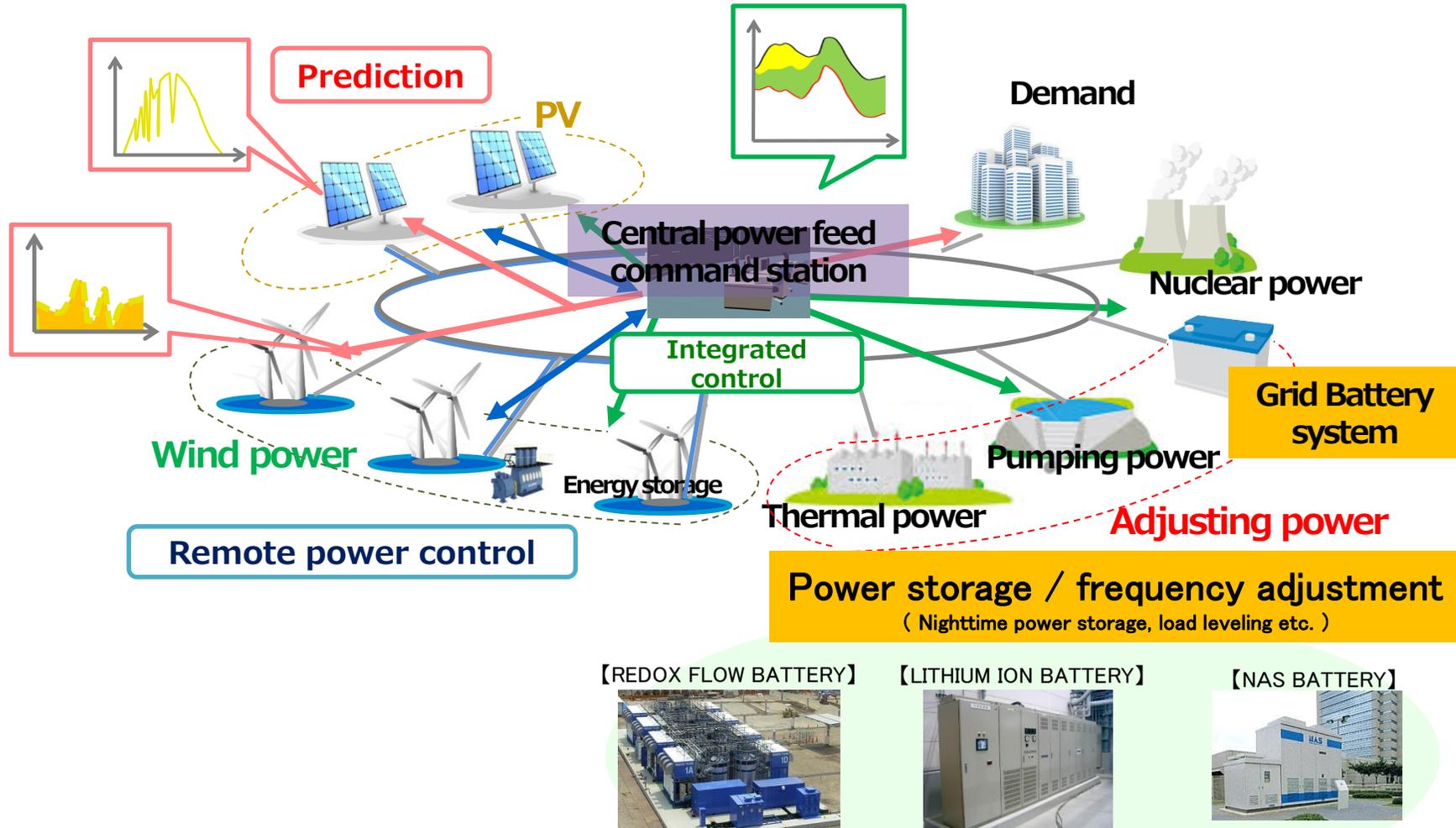
Mainstreaming of renewable energy based on Fukushima accident  
Priority on energy technology

# Towards 2050: Challenges towards energy transitions and decarbonisation



# Effect of introducing grid battery system

- The grid battery system promotes the introduction of renewable energy, energy conservation, stable power supply and greenhouse gas reduction, etc.



# Basic Hydrogen Strategy

## ● “Basic Hydrogen Strategy” (Prime Minister Abe’s Initiative)

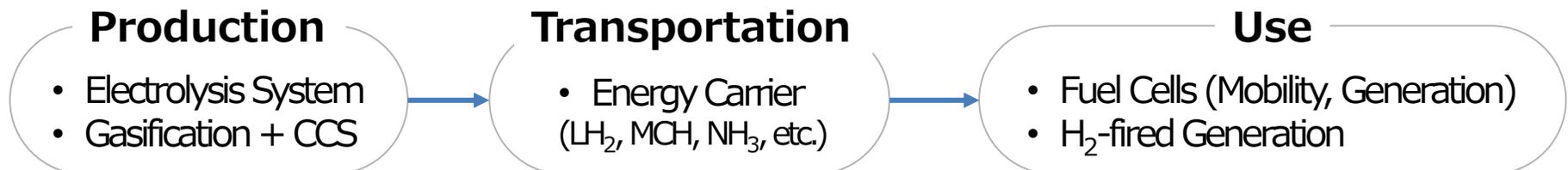
- ✓ World’s first national strategy
- ✓ 2050 Vision: position H<sub>2</sub> as a new energy option (following Renewables)
- ✓ Target: make H<sub>2</sub> affordable (\$3/kg by 2030 ⇒ \$2/kg by 2050)



### 3 conditions for realizing affordable hydrogen

- 【Supply】 { ① **Inexpensive feedstock** (unused resources, renewables)  
                  ② **Large scale H<sub>2</sub> supply chains**
- 【Demand】 ... ③ **Mass usage** (Mobility ⇒ Power Generation ⇒ Industry)

## ● Key Technologies to be Developed



# Scenario



Supply



Volume (t/y)	200	4k	300k	5~10m
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Cost (\$/kg)	~10		3	2
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Demand

Gene-ration

**Large Power Plant**    -- (RD&D) -----> **1GW** → **15~30GW**

**FC CHP\***    **250k** ————— **1.4m** ————— **5.3m** → **Replace Old Systems**  
\*Primary energy: natural gas.

**HRS**    **100** ————— **160** ————— **320** ————— **(900)** → **Replace Filling Stations**

**FCV**    **2.5k** ————— **40k** ————— **200k** ————— **800k** }  
**FC Bus**    **5** ————— **100** ————— **1.2k** } → **Replace Conventional Mobility**  
**FC FL**    **50** ————— **500** ————— **10k** }

**Industry Use** ----- (RD&D) -----> **Expand H<sub>2</sub> Use**

# Ongoing Projects (Supply-side)

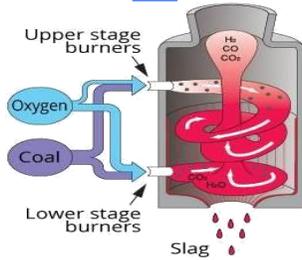
## International H<sub>2</sub> Supply Chain

### Japan-Australia Pilot Project

2020~



Brown Coal + CCS



Gasification



Liquefied H<sub>2</sub> Carrier\*



Loading Facility\*

### Japan-Brunai Pilot Project

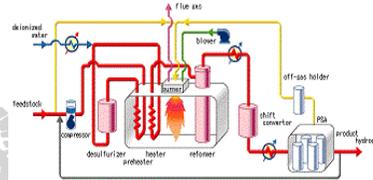
2020~



Off-gas



Steam Methane Reforming



Hydrogenation\*  
(TOL→MCH)



Chemical Tanker



Dehydrogenation\*  
(MCH→TOL)



## Power-to-gas

### Fukushima Renewable H<sub>2</sub> Project

2020~

**TOSHIBA Iwatani**



Power-to-Gas Plant\*



Electrolysis System (Alkaline)



H<sub>2</sub> Olympic Flame



\* Image

# Ongoing Projects (Demand-side)

## H<sub>2</sub> Mobility

### H<sub>2</sub> Station Network



### H<sub>2</sub> Applications



## Joint Venture for H<sub>2</sub> Infrastructure Development

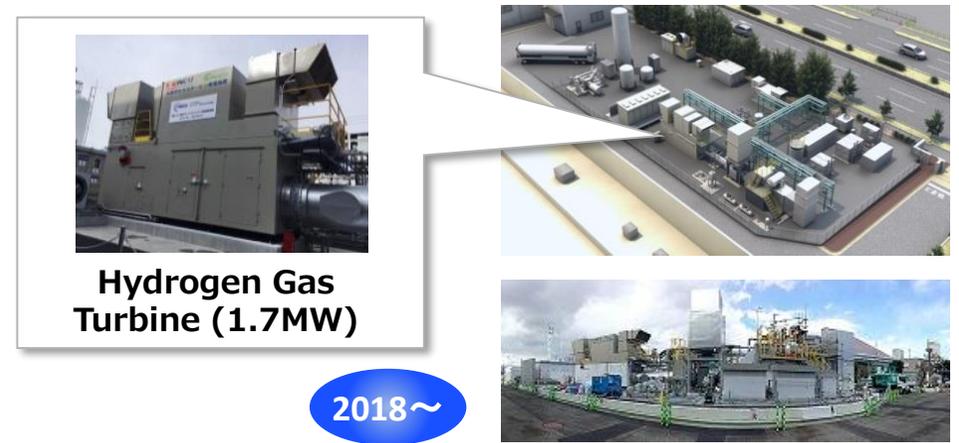
2018~

JHym

For Power Generation <500MW

## H<sub>2</sub> Power Generation

### H<sub>2</sub> Co-generation Demonstration Project



## R&D of H<sub>2</sub> Burner Systems

For Power Generation <500MW

Burning Simulation (H<sub>2</sub> + CH<sub>4</sub>)

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# Hydrogen Energy Ministerial Meeting

## 【Purpose】

- **Realize hydrogen as key technology and to be a new energy alternative for de-carbonization by connecting resources such as fossil fuel and Carbon Capture, Utilization and Storage(CCUS), or renewable energy**
- **Harmonize and cooperate for enhancing utilization of hydrogen at a global scale**
- **Verify and Discuss on**
  - ✓ **Innovative challenges and latest knowledge**
  - ✓ **Possibility of international cooperation**
  - ✓ **Future direction****for formulating global initiative on hydrogen**

- Date: 23<sup>rd</sup> October 2018
- Venue: DAI-ICHI HOTEL TOKYO, Japan
- Host: Ministry of Economy, Trade and Industry, Japan
- Attendees : Ministers, Government officials, Private Sectors
- Invited Countries: Australia, Austria, Brazil, Brunei, Canada, China, France, Germany, Iceland, India, Indonesia, Italy, Netherlands, New Zealand, Norway, Poland, Qatar, Russia, Saudi Arabia, South Africa, South Korea, United Arab Emirates, United Kingdom, United States of America, EC, IEA (24 countries, 1 region, and 1 organization)

