Multi scenario approach for long-term energy transition in Japan

LTES webinar
December 2018

Strategic Energy Plan and Energy Mix

Basic Act on Energy Policy

- October 2003: 1st Strategic Energy Plan
- March 2007: 2nd Strategic Energy Plan
- June 2010: 3rd Strategic Energy Plan

April 2014 4th Strategic Energy Plan

○Considered at Advisory Committee for Natural Resources and Energy → Cabinet decision
○**Nuclear: To be reduced as much as possible**
Renewable energy: To be expanded (to more than 20% of total power generation)
○ Considered every 3 years (Revised as necessary)

July 2015 Long-term Energy Supply and Demand Outlook (Energy Mix)

○Considered at Advisory Committee for Natural Resources and Energy → Decision by Minister of Economy, Trade and Industry
○Nuclear: 20-22% (30% before the Great East Japan Earthquake)
Renewable energy: 22-24% (double the present level)
○To be revised as necessary for considering the Strategic Energy Plan

July 2018 5th Strategic Energy Plan

○Plans for 2030 and scenario for 2050
○For 2030: To achieve energy mix target
○For 2050: Challenges towards energy transitions and decarbonization

Energy Mix for 2030 ～Realizing 3E＋S simultaneously ～

✓ For 2030, outlook for energy demand and supply was drawn up as a vision to be realized.

<Policy targets for 3E+S>

Safety

Safety is the top priority

Energy self-sufficiency (Energy security)

Energy self-sufficiency rate: About 25%, higher than before the Great East Japan Earthquake (about 20%)

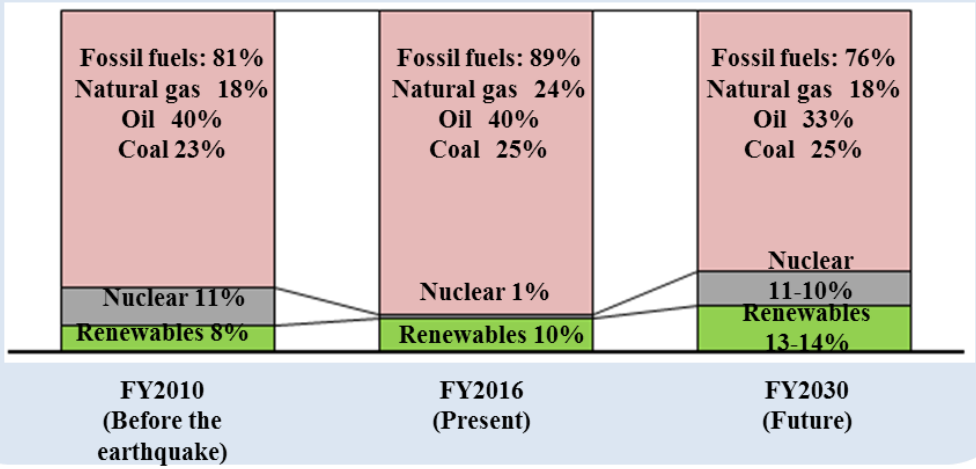
Efficiency (electric power cost) (Economic Efficiency)

Lower compared to present

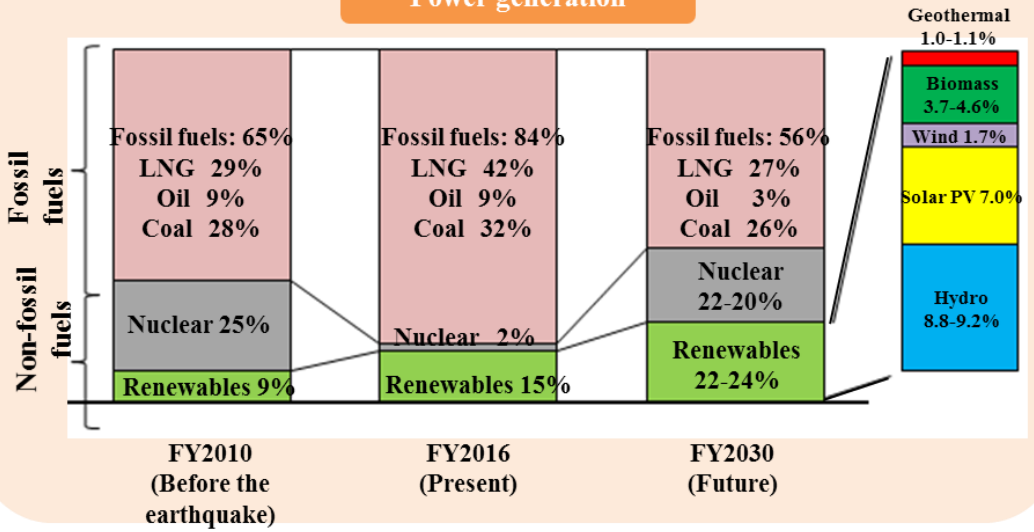
Greenhouse gas emissions (Environment)

A GHG emission reduction target comparable to EU and the U.S.

Primary energy supply



Power generation



Multi-track scenario suitable for developing 2050 scenario in complex, unpredictable environment

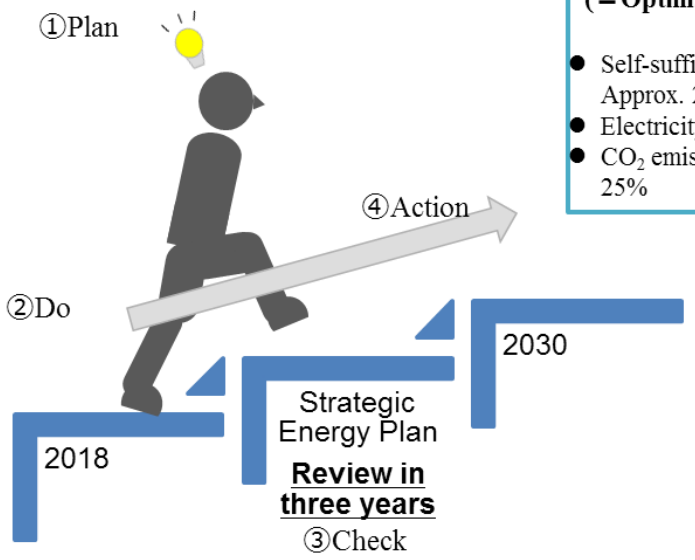
✓ For 2050, importance of multi track scenario and technological innovation is stressed.

～ A process for taking action while always monitoring the latest changes and technologies is required for developing "a flexible scenario into which diversity is taken into account"

- **Predictable future with a reasonable likelihood**
  (Predictability⇔Realistic)
- **Given infrastructure and system**
  - ✓ Existing human resources
  - ✓ Existing technologies
  - ✓ Existing infrastructure

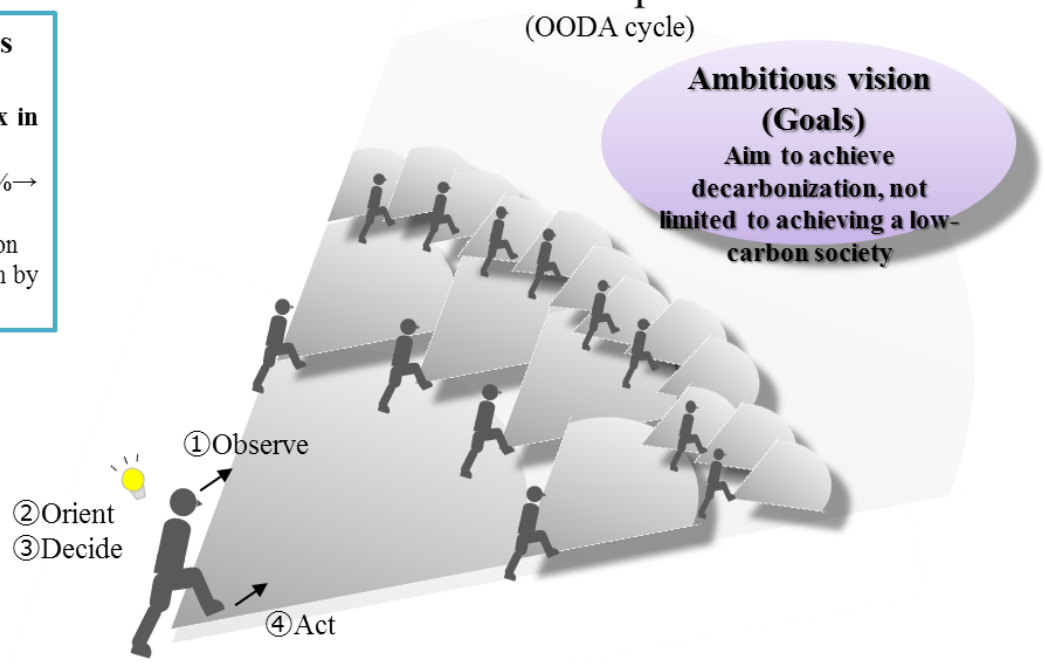
Straight-line efforts to achieve realistic targets
(PDCA cycle)

Concrete actions (Targets)
(＝Optimal energy mix in 2030)
- Self-sufficiency rate:6%→ Approx. 25%
- Electricity cost reduction
- CO_2 emission reduction by 25%



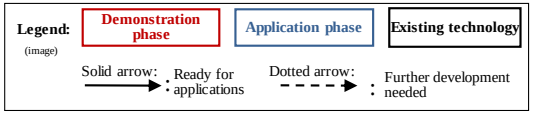
- **Uncertain future containing diverse possibilities**
  (Uncertainties⇔Ambitious)
  (VUCA: Volatility, Uncertainty, Complexity, Ambiguity)
- **Changeable infrastructure and system**
  - ✓ Human resource development
  - ✓ Technological innovation
  - ✓ Updated Infrastructure

Multi track scenario with diverse options
(OODA cycle)



Decarbonized technologies for each sector

✓ Competition among technologies is important



Electric power

Industrial thermal

Transportation

* The number in parentheses represents the scenario No. for each simplified estimate

Base

Middle & Peak

(1) Domestic renewables: Storage battery

Larger storage capacity

Development of small and large storage batteries

(2) Domestic renewables: Hydrogen

Hydrogen power generation technology

Hydrogen production technology (electrolysis)

(3) Overseas renewables: Hydrogen / Methane

Hydrogen power generation technology

Hydrogen production technology (electrolysis)
Methanation technology
Hydrogen liquefaction & transportation technologies

(4) Overseas fossil w/ CCS: Hydrogen / Methane

Hydrogen power generation technology

Hydrogen production technology (brown coal gasification + CCS)
Methanation technology
Hydrogen liquefaction & transportation technologies

Nuclear, Hydro, etc.

High

Temperature zones (image)

Low

Coal

Oil

Gas

Establishment of hydrogen reduction methods

Hydrogen

Hydrogen-powered equipment

Hydrogen production technology

Syngas (methane)

Gas-powered equipment

Hydrogen production technology
Methanation technology

Applied to the middle temperature range

Zero-emission power Electrification

Heat pump

Passenger vehicles (gasoline-powered)

Commercial vehicles (diesel-powered)

Development of automotive storage batteries

EV

Innovation for driving range per charge

PHV

Development of automotive storage batteries

There is the need to develop new applications such as commercial trucks

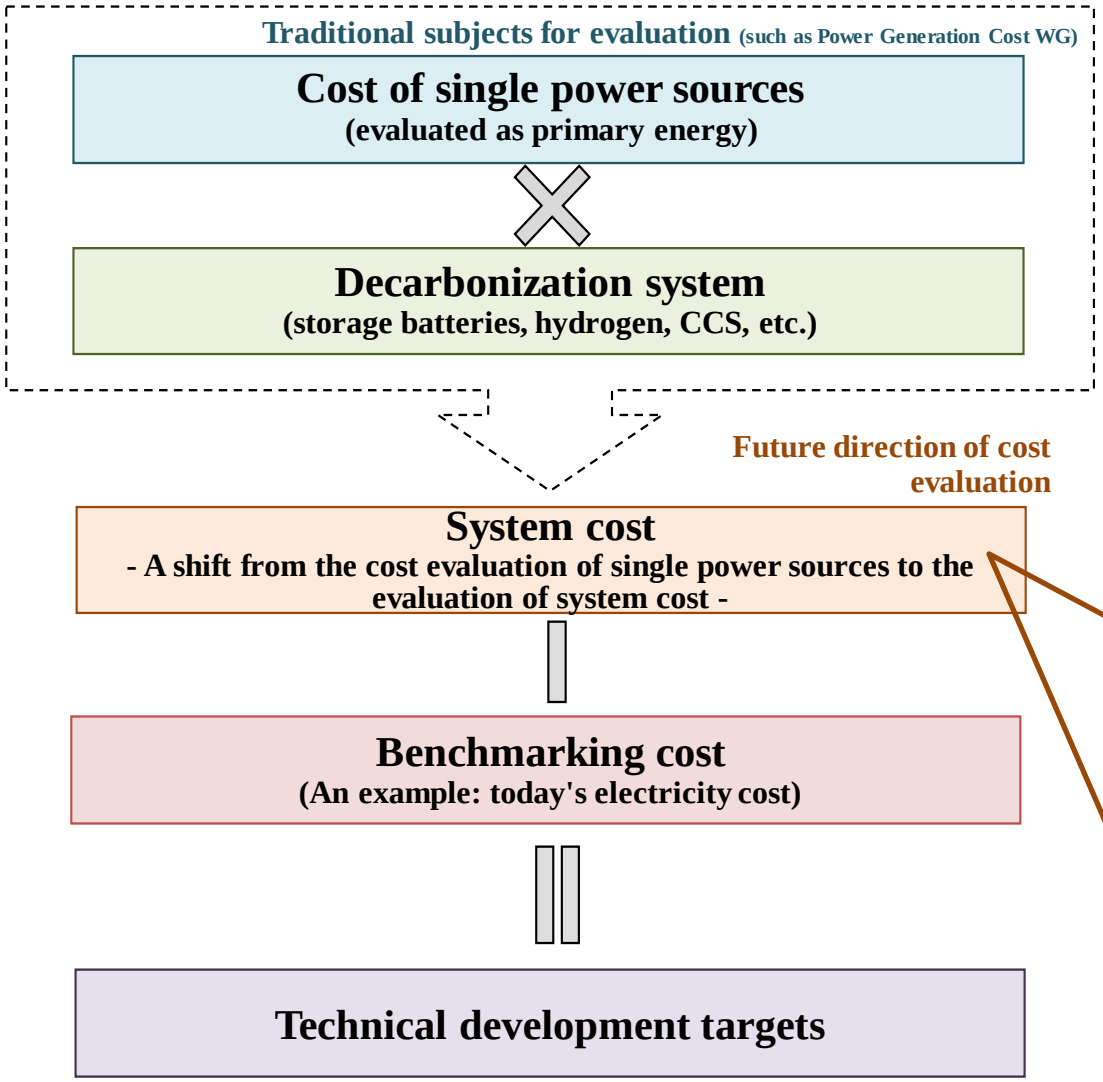
FCV

Development of automotive fuel cells

* The use of coal in the low temperature range may be possible, but it is not included in the above simplified image.

Example of scenario analysis in power sector (1/3)

- ✓ A shift from the cost evaluation of "each power source" to "system" is required.
- ✓ Possible decarbonized scenarios were drawn up.



As simplified trial calculations, technological development targets are estimated by the trial calculation of the following system costs as base or middle/peak power sources.

(1) Storage battery system
- Renewables (Japan) + Storage battery (distributed, large-sized)
- Nuclear (Japan, middle/peak) + Storage battery

(2) Hydrogen system
- Renewables (Japan) + Hydrogen
- Renewables (overseas) + Hydrogen
- Nuclear (Japan) + Hydrogen

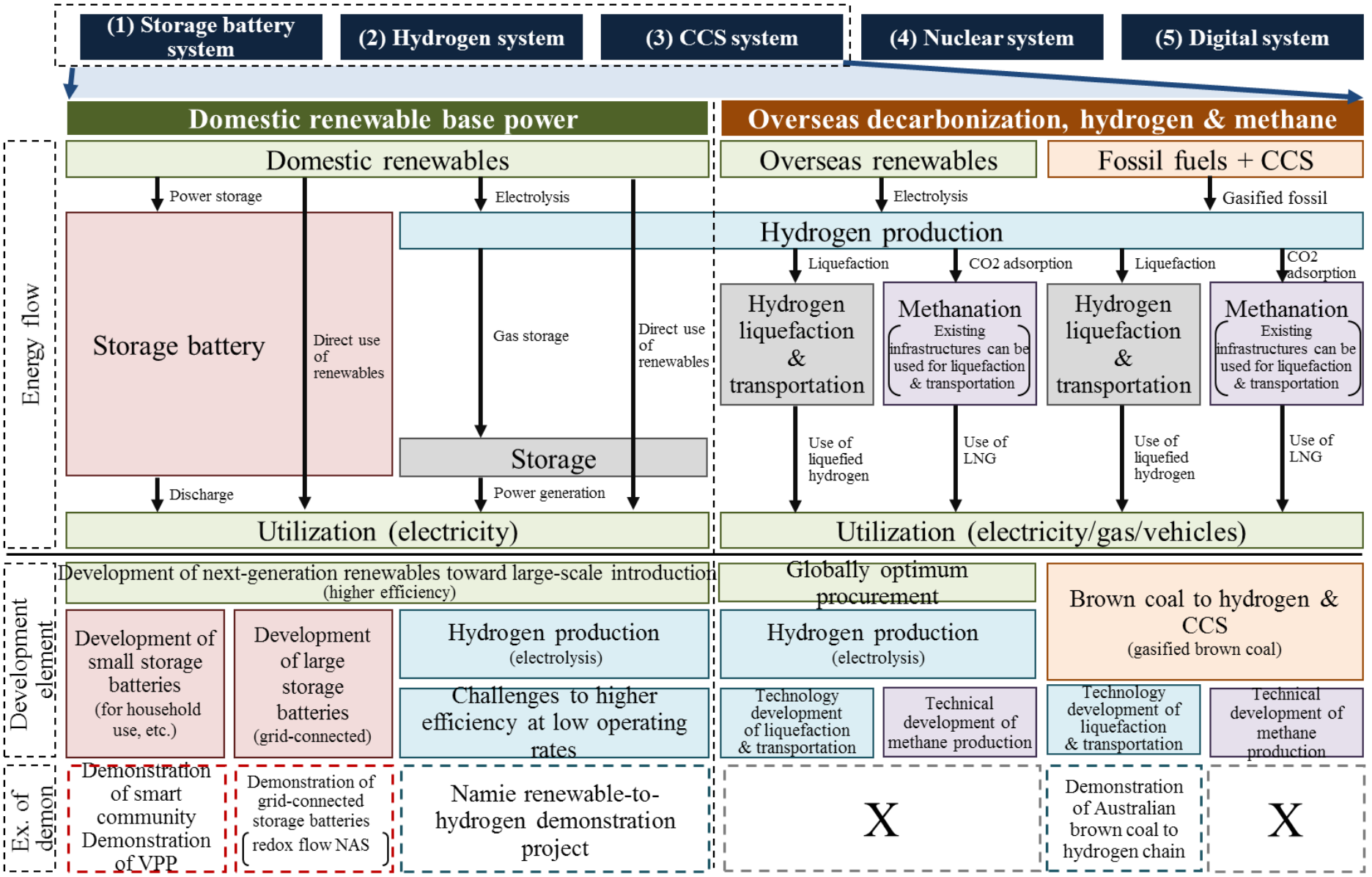
(3) Carbon capture storage system
- Fossil (Japan) + CCS
- Fossil (overseas) + CCS + Hydrogen
- Fossil (overseas) +CCS + Hydrogen + Methanation

(4) Nuclear system
- Nuclear (Japan, base)

(5) Digital system
- Renewables (Japan) +DR

Example of scenario analysis in power sector (2/3)

✓ For some of the scenarios, energy flows are specified and illustrated.

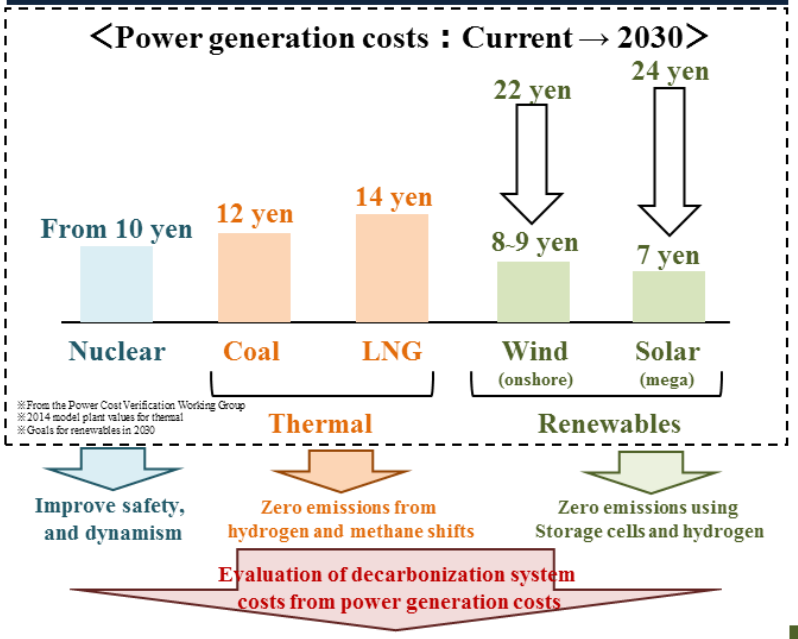


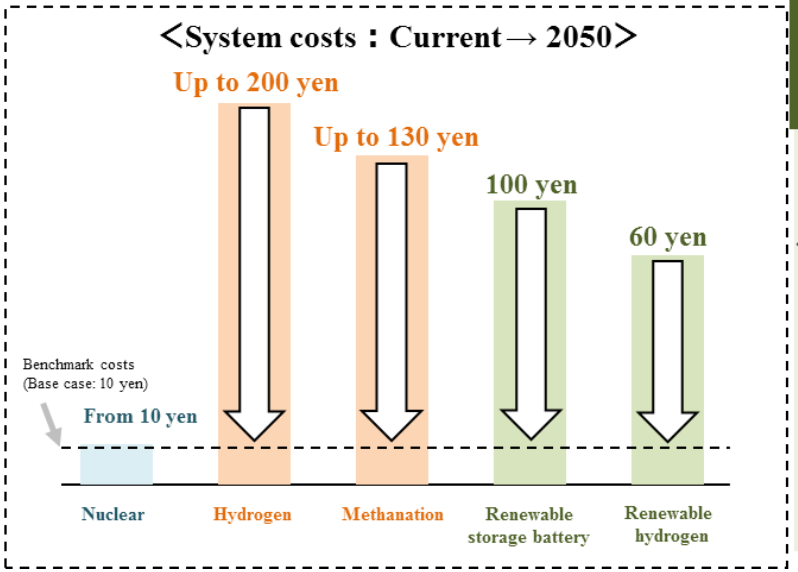
Example of scenario analysis in power sector (3/3)

✓ Quantitative cost analysis was carried out for some extreme scenarios.

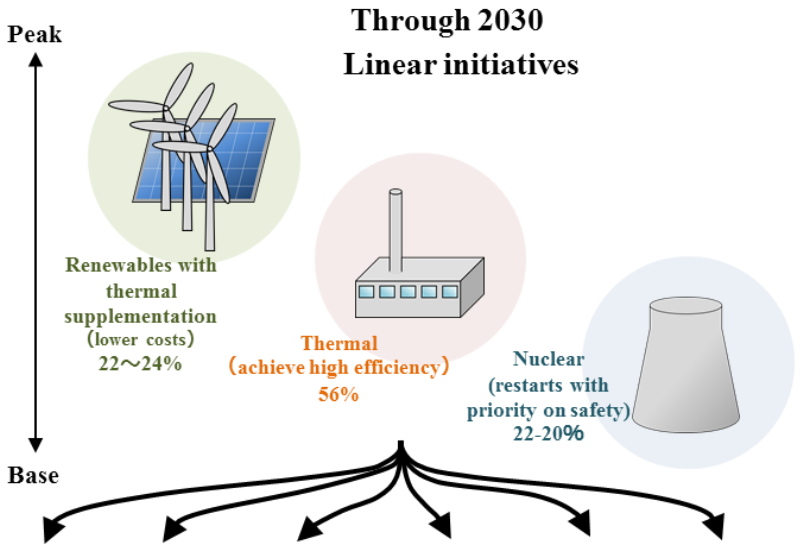
* 1 euro ≒ 130 yen

Evaluation of system costs from power generation costs





Shift from single targets in 2030 to multiple goals in 2050



Ambitious multi-path scenario through 2050