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Liberalization, de-carbonization, and nuclear recovery in Japan's electric power sector: Outlook for long-term energy prices

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Methodology, outlook, and conclusions

Questions we asked, and method of approach



Questions

- ▶ What do Japan's 2030 climate and energy targets imply for the mix of power generation sources?
- ▶ What needs to happen to get there?
- ▶ What is the implication for the price of energy?



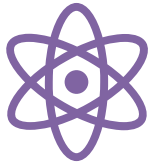
Methodology

- ▶ Examine market structure, liberalization, and energy price starting point
- ▶ Examine details of METI 5th Strategic Energy Plan to 2030 and beyond
- ▶ Examine status of nuclear fleet
- ▶ Assume energy prices converge towards the levelized cost of a new entrant in the long run
- ▶ Use METI's projections for levelized costs of a variety of technologies
- ▶ Develop scenarios based on key uncertainty

Key takeaways: Meeting the modest 2030 targets will require faster recovery of nuclear power than seen in the past 10 years



- ▶ **Japan's energy and climate targets are, at the moment, modest through 2030 and can be achieved by a recovery of the remaining nuclear units which were shut down in the wake of the Fukushima accident**



- ▶ **Nevertheless, though modest, Japan will have to re-start far more of the nuclear fleet in the next 9 years to 2030 than recovered in the past 10 years since 2011. Without the nuclear plants, targets for reduced need for oil, gas, and coal; and lower carbon emissions, are unlikely to be met. In our view, this points to the possibility of Japan extending licenses for existing nuclear plants as a partial solution**



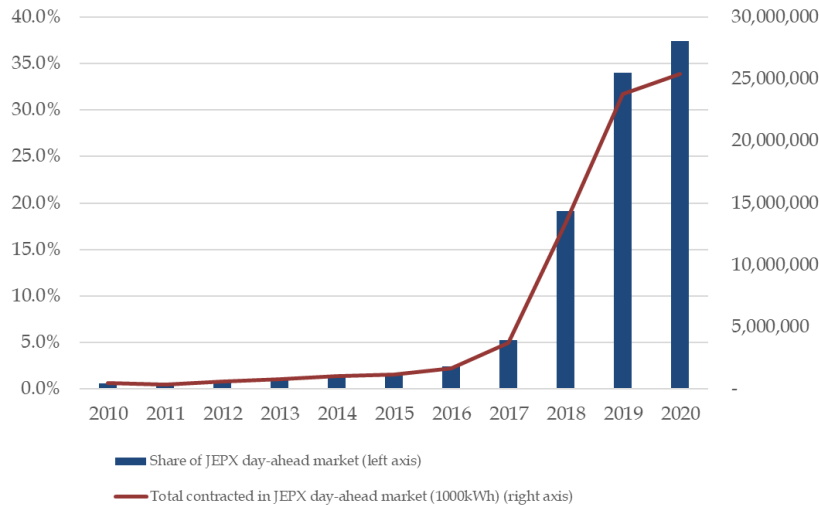
- ▶ **For the mid- and long-term, energy prices can be expected to converge towards the levelized cost of a new entrant. Thus, energy prices will be shaped by the levelized cost of nuclear power or new offshore wind power, depending on the outcome of Japan's policy post-2030**



- ▶ **Our analysis suggests that the path for real long-term prices excluding transmission and distribution ("T&D") costs could be ¥10/kWh on the low end, to ¥20/kWh on the high end (excluding government subsidies). Including subsidies for offshore wind brings the high end of the range to ¥30/kWh**

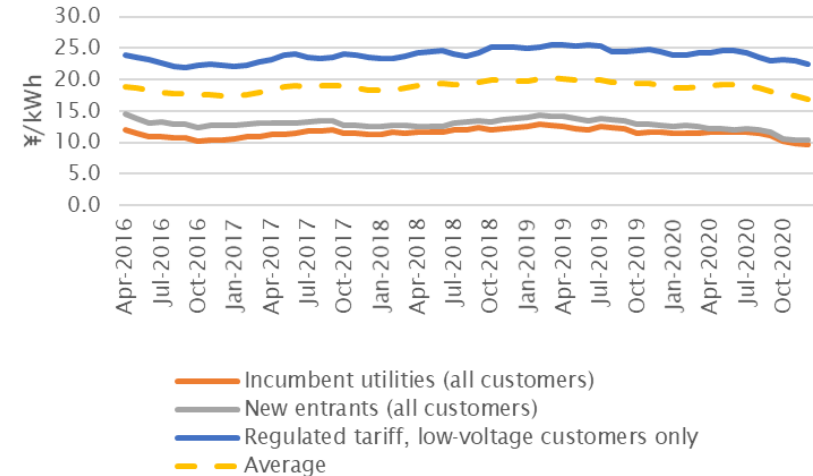
Must-offer energy markets went live in April 2020

Annual day-ahead volumes traded on JEPX



Source: <https://www.renewable-ei.org/en/statistics/electricitymarket/> and JEPX "Trading results of day-ahead market".
<http://www.jepx.org/english/market/index.html>

Average retail energy prices



Source: Electricity and Gas Market Surveillance Commission, "Monthly Electricity Trading Report"
<https://www.emsc.meti.go.jp/info/business/report/results.html>

- ▶ Average retail prices are about ¥19/kWh (including an estimated ¥5/kWh for T&D)

The energy price of ¥13- ¥ 14/kWh (excluding T&D) gives us a baseline to compare against projected costs assumed by METI in its 5th Strategic Energy Plan, and a starting point for our outlook

Japan's first capacity market auction was held in 2020 for delivery year 2024/25

- ▶ **Structure of capacity auction**
 - About 177 GW was sought
 - Net CONE was set at ¥9,425/kW (\$87/kW), the cost of a new LNG plant
 - Offer cap at 150% of net CONE, i.e., ¥14,137/kW
 - Technology eligibility was wide and included nuclear power
 - Single clearing price
- ▶ **Bids ranged from ¥0/kW to the maximum offer cap**
 - Clearing price of ¥14,137/kW
 - Rules for next auction might be different
- ▶ **The construction cost of a new nuclear plant is estimated by METI at ¥370,000/kW**

Generation types offered into Japan's first capacity auction

Generation type	GW
LNG	70.9
Coal	41.3
Pumped storage	21.4
Oil	13.4
Hydro	13.3
Could not be determined	7.0
Renewable	0.3
Total offered	167.6

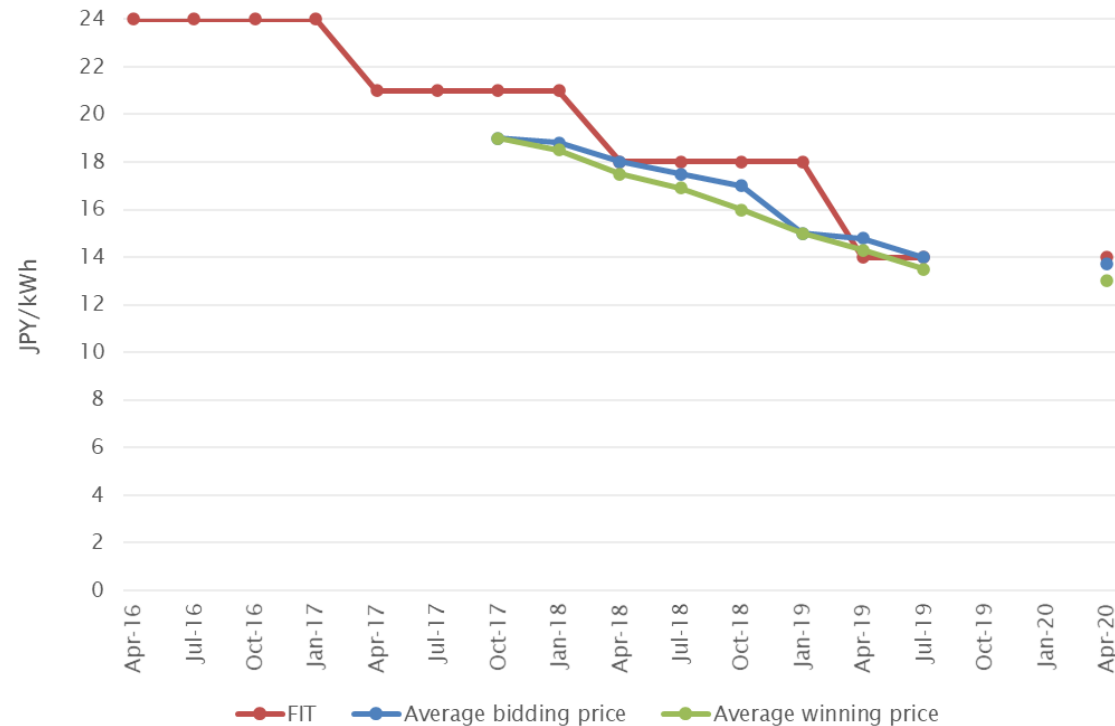
Source: Argus Media September 23, 2020.
<https://www.argusmedia.com/en/news/2143671-japans-power-sector-urged-to-review-auction-rules>

Conclusion: The capacity market is not a tool for achieving Japan's de-carbonization targets

Japan is re-structuring its renewable subsidy, the feed-in-tariff (“FIT”) to reflect market forces

- ▶ In 2012, Japan instituted the FIT system to support new renewable power
- ▶ In 2017 it began auctions for solar, which reduced prices
- ▶ The Amendment Act of 2020 will provide a premium in addition to energy market prices, rather than a fixed FIT payment. It will apply as of April 2022, initially to wind power and large-scale solar

FIT versus auction prices for solar power in Japan

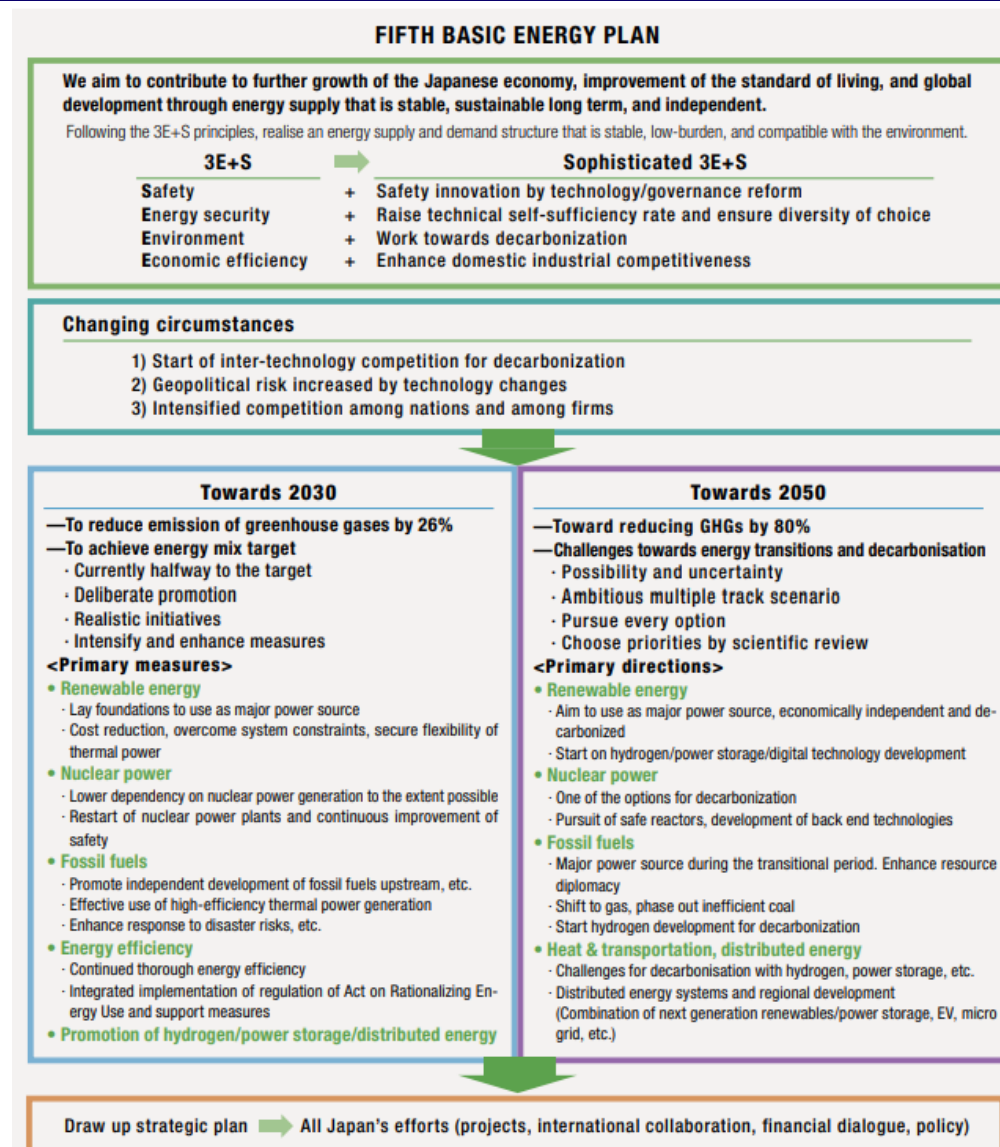


Source: Renewable Energy Institute. <https://www.renewable-ei.org/en/statistics/policies/>

Conclusion: The FIT is not going away; renewable developers can continue to expect a premium to market-based energy prices

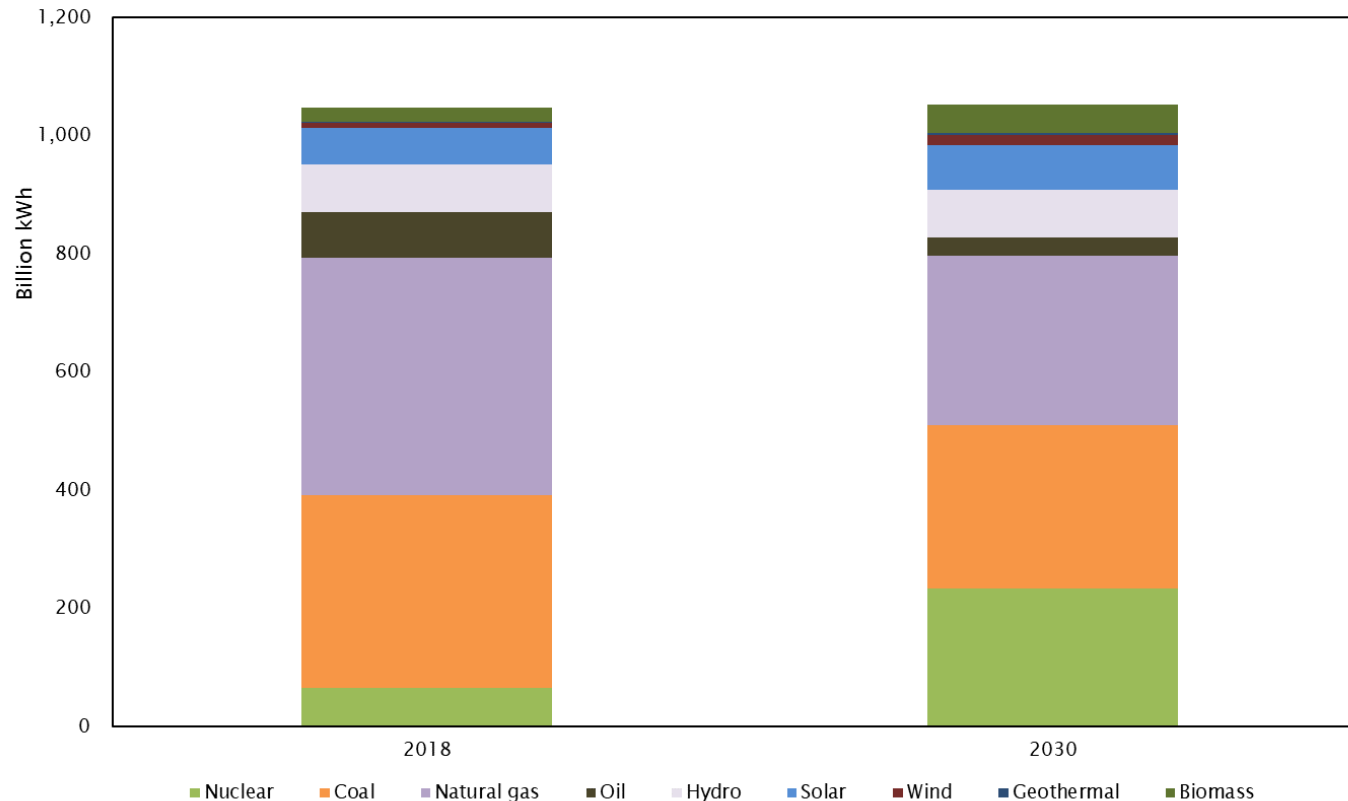
METI's 5th SEP targets for electric power are specific through 2030, but more general towards 2050

- ▶ METI's targets are not mandatory, but developed in consultation with industry participants, so we expect the industry to do its best to achieve them
- ▶ Japan also promised to cut carbon emissions by 26% below 2013 levels by 2030 (under Paris Agreement); 2013 levels reflected loss of nuclear power
- ▶ In 2021, Prime Minister Yoshihide Suga raised the GHG reduction target to 46% by 2030 compared to 2013
- ▶ The SEP is set to be updated in 2021, and we expect it to reflect more aggressive carbon reduction targets



METI's 5th SEP targets for electric power sector are not a dramatic change, but do depend on accelerating nuclear re-starts

Japan's generation mix in 2018, and METI 2030 target



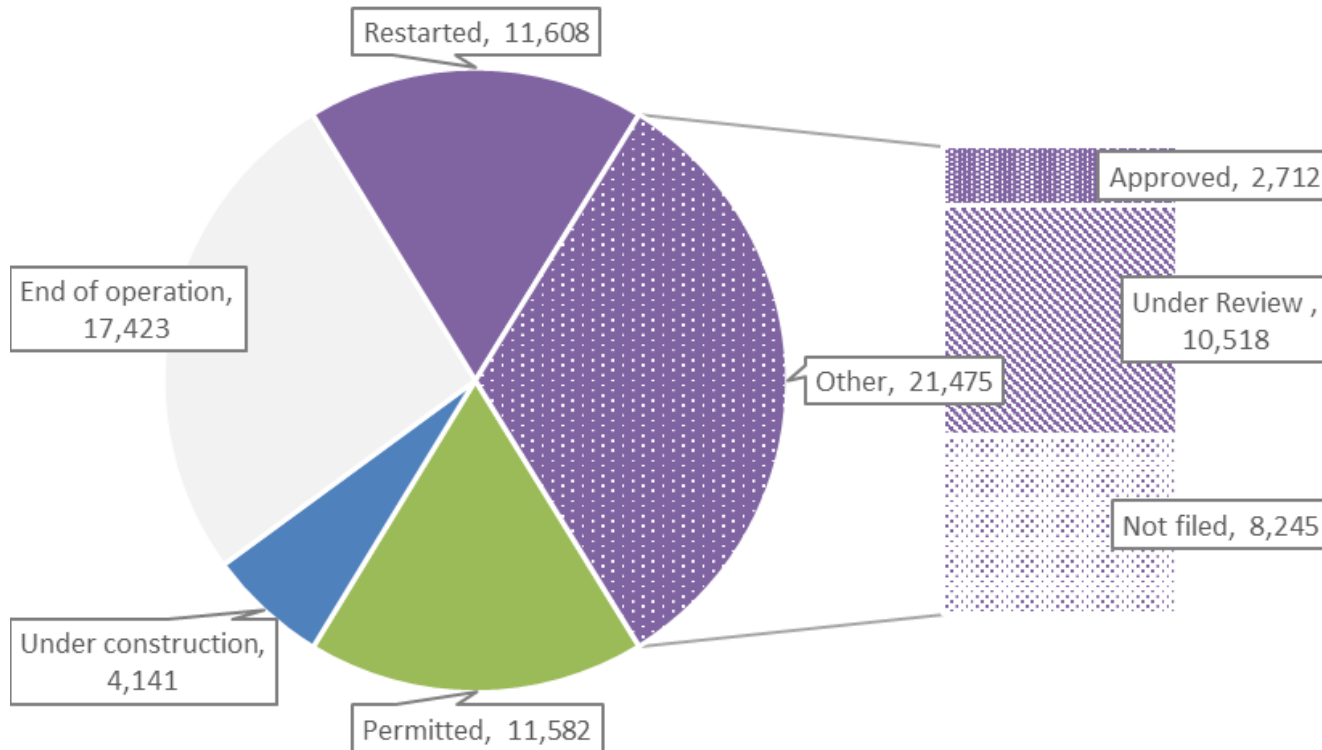
Source: METI. *Total energy statistics*. 2018.

https://www.enecho.meti.go.jp/statistics/total_energy/results.html#headline7

METI's nuclear generation target of 234 billion kWh for 2030 is lower than the 288 billion kWh produced by nuclear plants in 2010, before the Fukushima Daiichi accident

Only about 1/3 of the nuclear fleet which shut down after the Fukushima Daiichi accident in 2011 has been restarted

Status of Japan's nuclear fleet as of May 2021 (MW)



- ▶ Government agencies refer to ALL the plants classified here in purple and purple shading as “In Operation” but the fine print shows that only about 1/3 of them have been re-started

Source: Federation of Electric Power Companies. April 14, 2021.

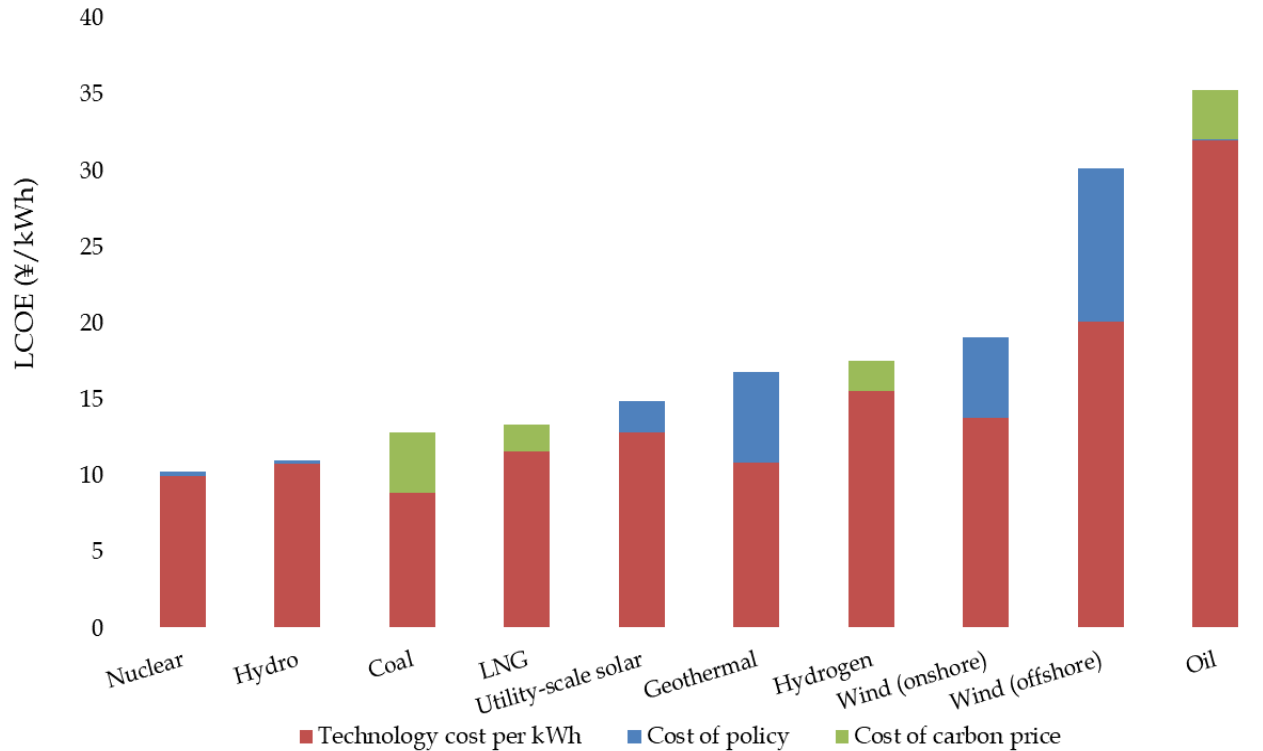
https://www.fepec.or.jp/english/library/electricity_eview_japan/_icsFiles/afieldfile/2021/04/14/2020ERJ_full.pdf and Nikkei Asia. “Japan allows 1st restarts of nuclear reactors older than 40 years.”

April 28, 2021. <https://asia.nikkei.com/Business/Energy/Japan-allows-1st-restarts-of-nuclear-reactors-older-than-40-years>

Japan will need to re-start far more nuclear units in the next 9 years than it did in past 10 years, to recover nuclear capability

A key input to our price outlook is METI's assumption for the cost of a variety of new power plants by 2030

METI 5th SEP assumptions for the cost of power generation technologies in 2030



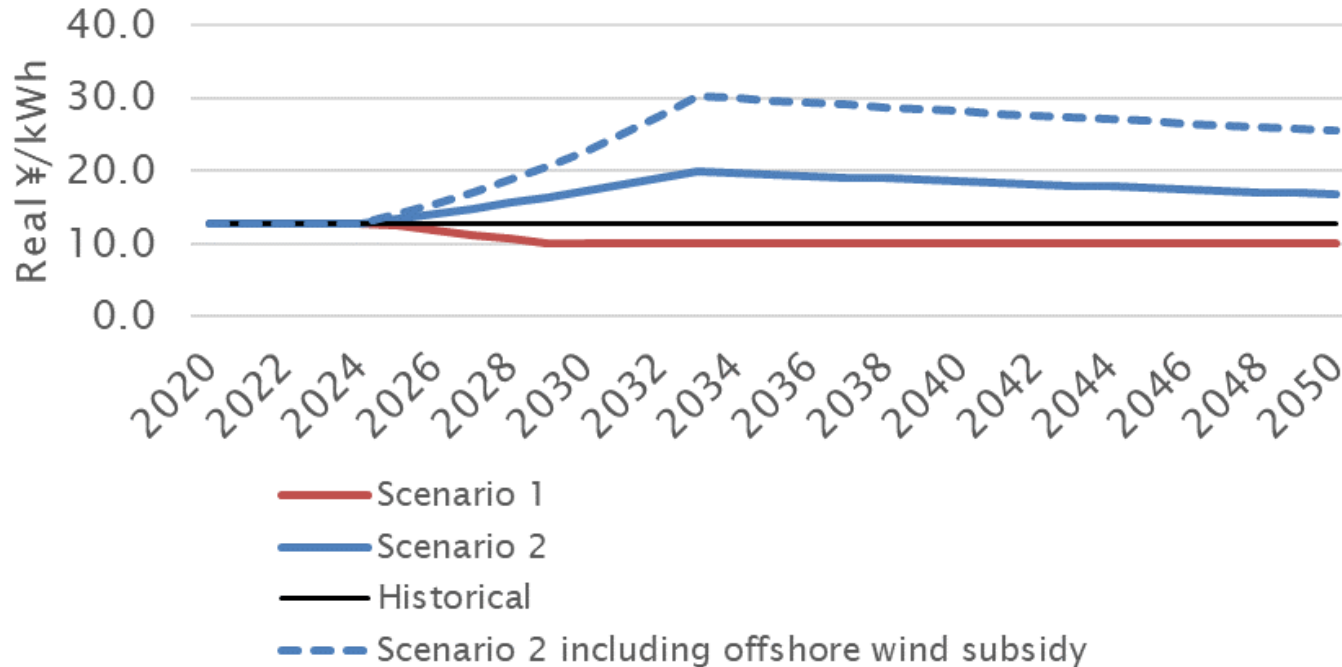
Technology (¥/per kWh)	Nuclear	Hydro	Coal	LNG	Utility-scale solar	Geothermal	Hydrogen	Wind (onshore)	Wind (offshore)	Oil
Technology cost (¥/per kWh)	10.0	10.8	8.9	11.6	12.9	10.9	15.6	13.8	20.1	32.1
Cost of policy	0.3	0.2			2.0	5.9	0.03	5.3	10.1	0.0
Cost of carbon price			4.0	1.8			2.0			3.2
Total	10.3	11.0	12.9	13.4	14.9	16.8	17.6	19.1	30.2	35.3

Source: METI. Power Generation Cost Analysis Working Group. "Report on Analysis of Generation Costs, Etc. for Subcommittee on Long-term Energy Supply-Demand Outlook." May 2015. P. 13. <https://www.meti.go.jp/english/press/2015/pdf/0716_01b.pdf>

Note: Hydrogen power cost (for hydrogen-based fuel cells) implies a very large reduction from current costs of ¥70/kWh

Our indicative scenario outlooks turn on the public acceptance and cost of nuclear power

Our scenario outlooks for mid to long-term energy prices in Japan

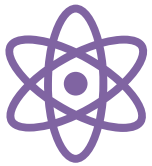


- ▶ **Scenario 1 assumes new nuclear power plants are built at the cost projected by METI**
- ▶ **Scenario 2 assumes the public does not accept nuclear power, and offshore wind is needed to provide non-fossil energy at large scale**
- ▶ **More risk to upside than downside**

Japan's energy price depends on nuclear power's recovery, its acceptance by the public, and the cost to build new plants



- ▶ Japan's current energy and climate targets to 2030 can be achieved by a recovery of the remaining nuclear units which were shut down in the wake of the Fukushima accident



- ▶ Japan will have to re-start far more of the nuclear fleet in the next 9 years to 2030 than recovered in the past 10 years since 2011.
- ▶ In our view, this points to the possibility of Japan extending licenses for existing plants as a partial solution



- ▶ The path for real long-term prices excluding T&D costs could be ¥10/kWh on the low end, to ¥20/kWh on the high end (excluding government subsidies)



- ▶ The ongoing liberalization of the electricity industry will likely neither help nor hurt Japan's climate targets or impact long-term costs