Power generation cost by technology: A Japanese perspective

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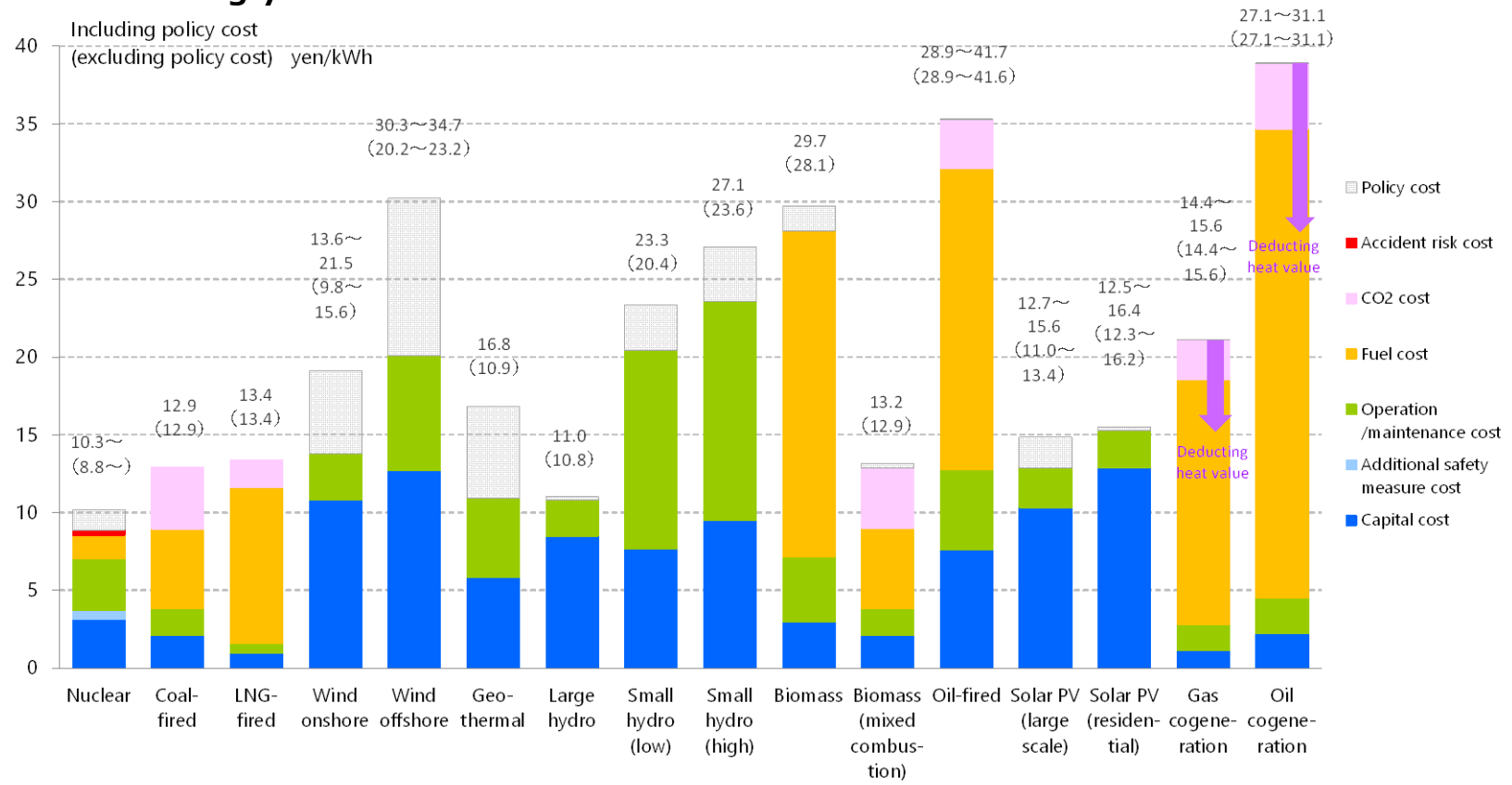
Data submitted from Japan: METI (2015)

Unit: JPY/kWh
Real discount rate: 3%
Commissioning year: 2030

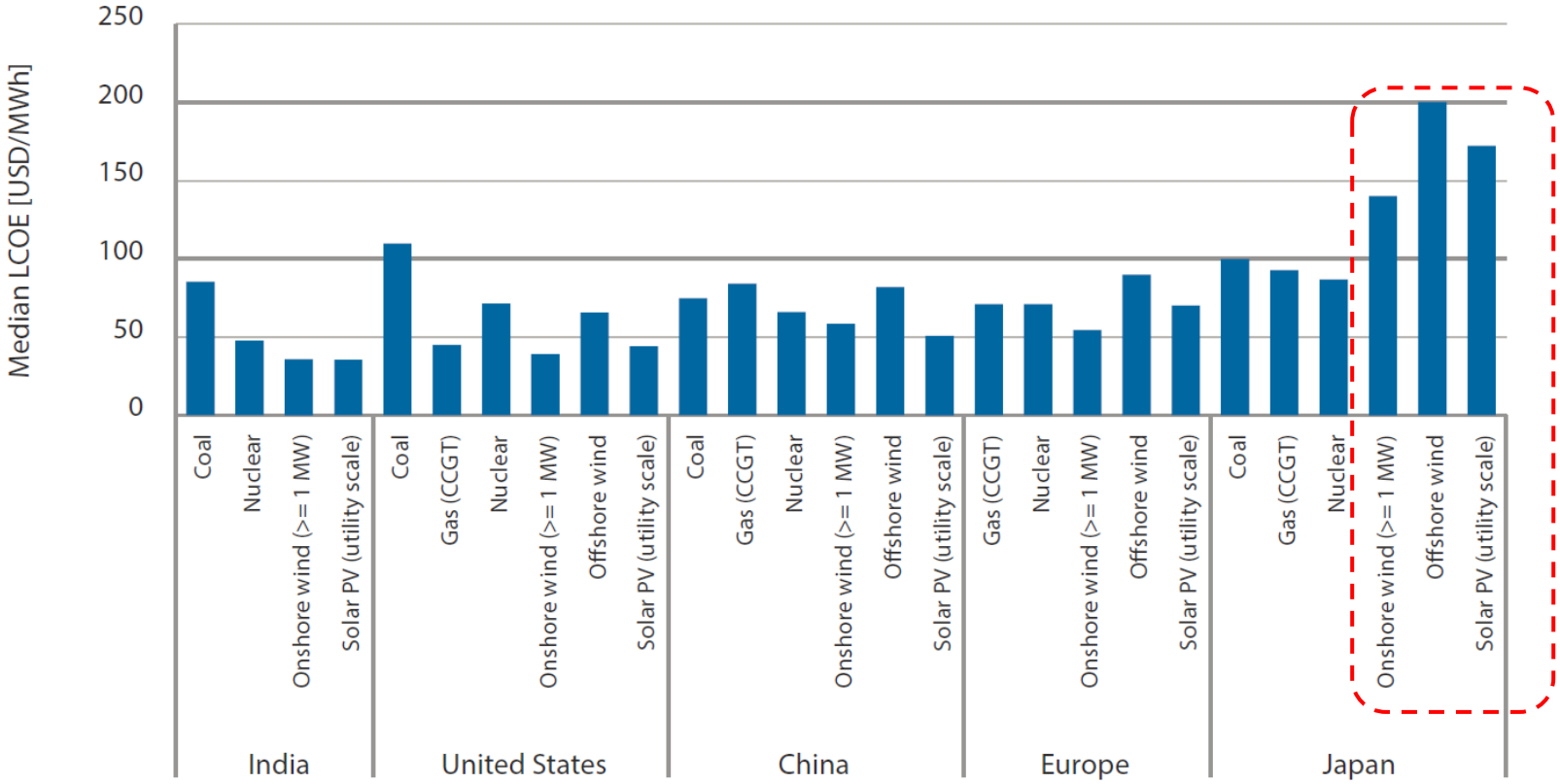
Source: Power generation cost analysis working group (2015)
https://www.meti.go.jp/english/press/2015/pdf/0716_01b.pdf
(発電コスト検証ワーキンググループ)



- The latest version of LCOE estimation published by the Japanese government.
- Difference in the definition of LCOE: Including/excluding policy cost, fixed asset tax, etc.
- 2030 data have been submitted for wind and solar PV, considering the cost declines after 2015.

Interregional comparison of LCOE

Source: OECD/NEA & IEA, Projected costs of generating electricity 2020 Edition



Note: Values at 7% cost of capital.

- 100 USD/MWh equals 10 cent/kWh, which is roughly equivalent to 10 JPY/kWh.

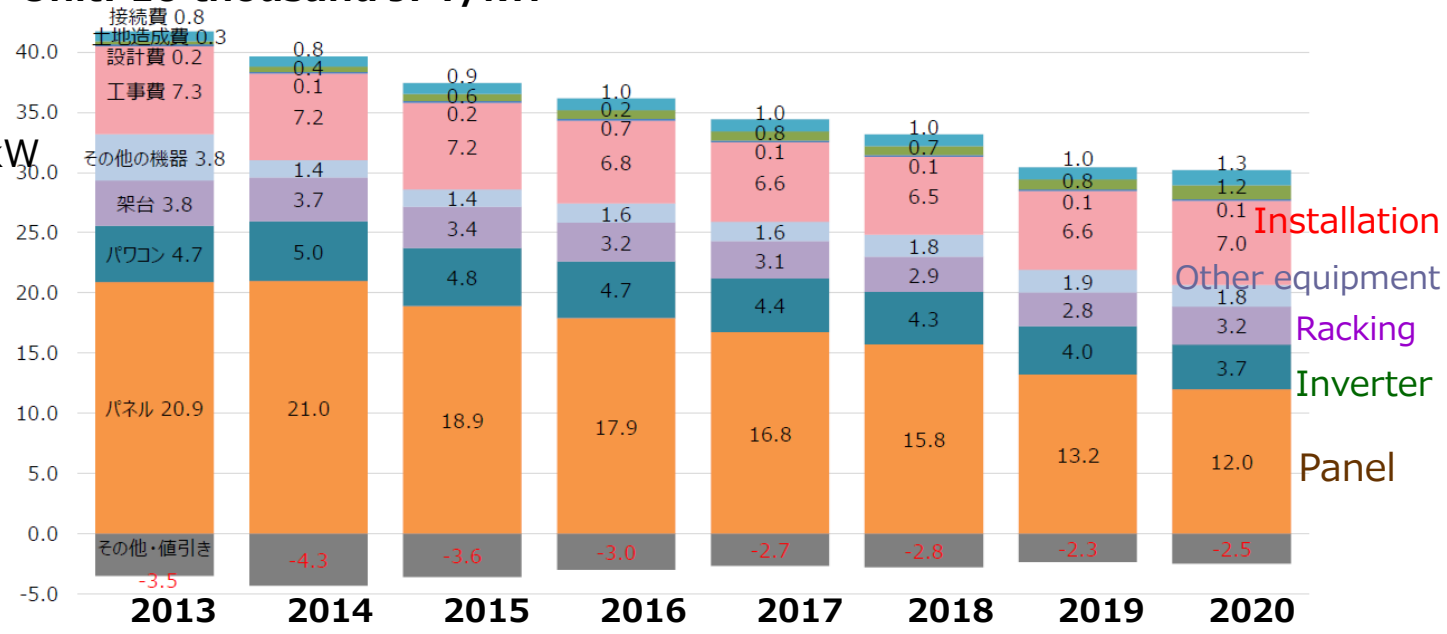
Overnight cost (unit construction cost)
Solar PV (residential) 2333 USD/kW, Solar PV (utility scale) 2006 USD/kW
Onshore wind 2282 USD/kW, Offshore wind 4039 USD/kW.

Historical trends: Overnight cost (solar PV)

Utility scale

2020:
278 thousand JPY/kW

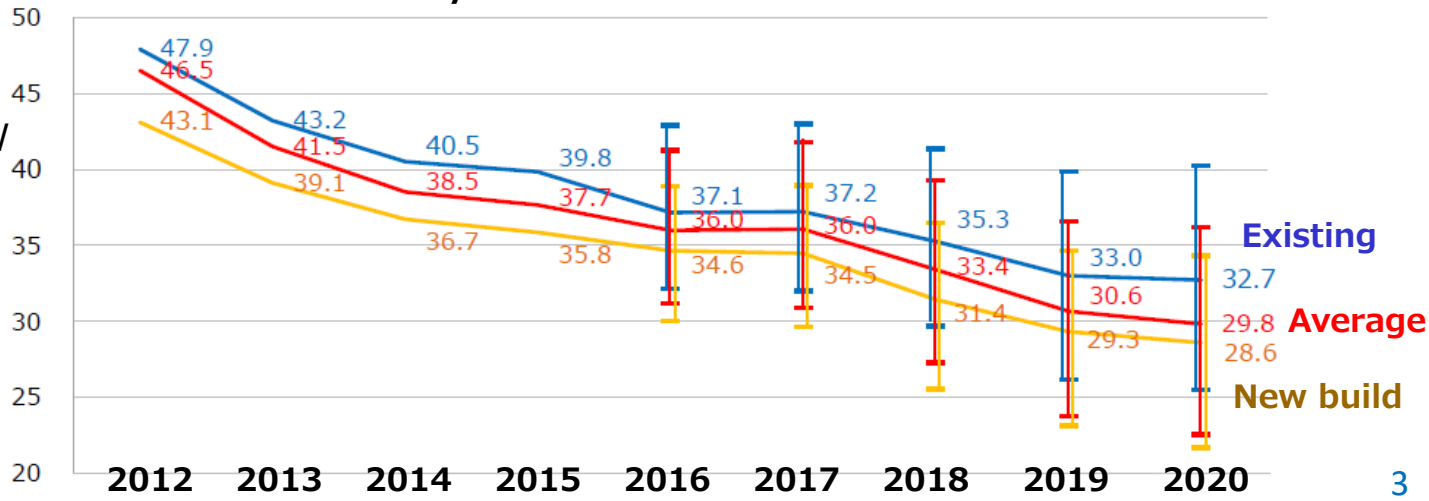
Unit: 10 thousand JPY/kW



Residential

2020:
298 thousand JPY/kW

Unit: 10 thousand JPY/kW



Source:
Calculation Committee for Procurement Price, etc.
(調達価格等算定委員会)
https://www.meti.go.jp/shingikai/santeii/063.html

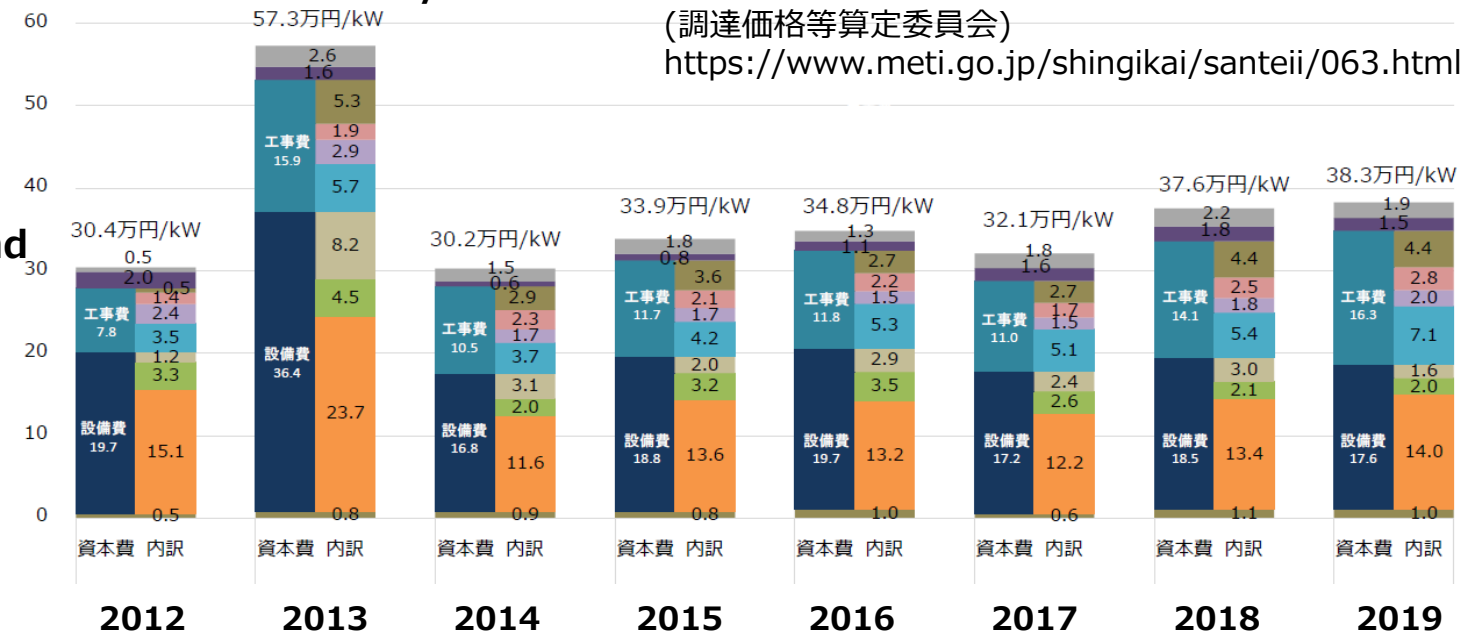
Historical trends: Overnight cost and LCOE (onshore wind)

Overnight cost

2019:
383 thousand JPY/kW

Unit: 10 thousand JPY/kW

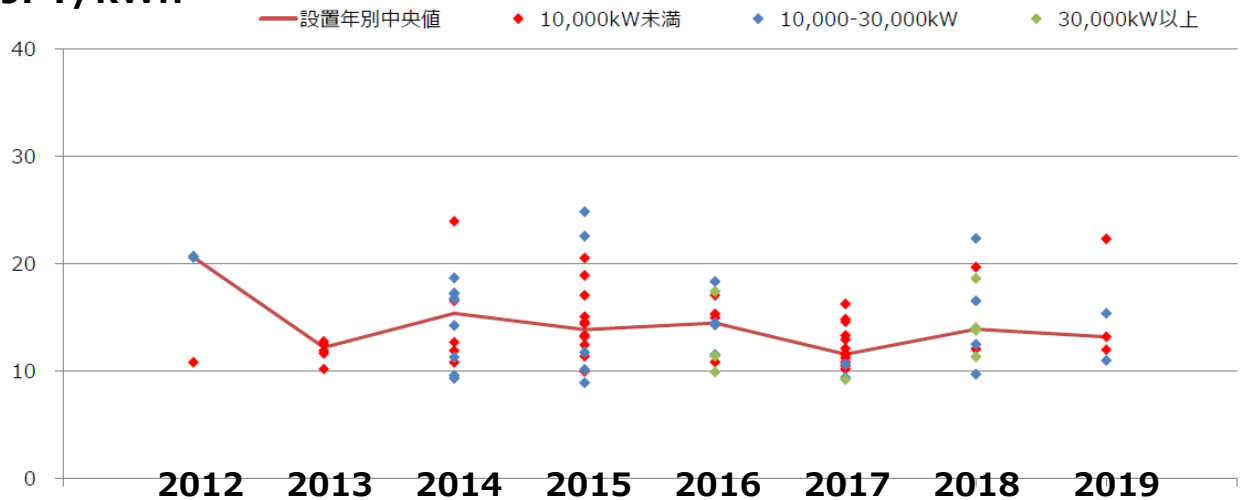
Source: Calculation Committee for Procurement Price, etc. (調達価格等算定委員会)
https://www.meti.go.jp/shingikai/santeii/063.html



LCOE with 3% discount rate

2019:
～**13** JPY/kWh

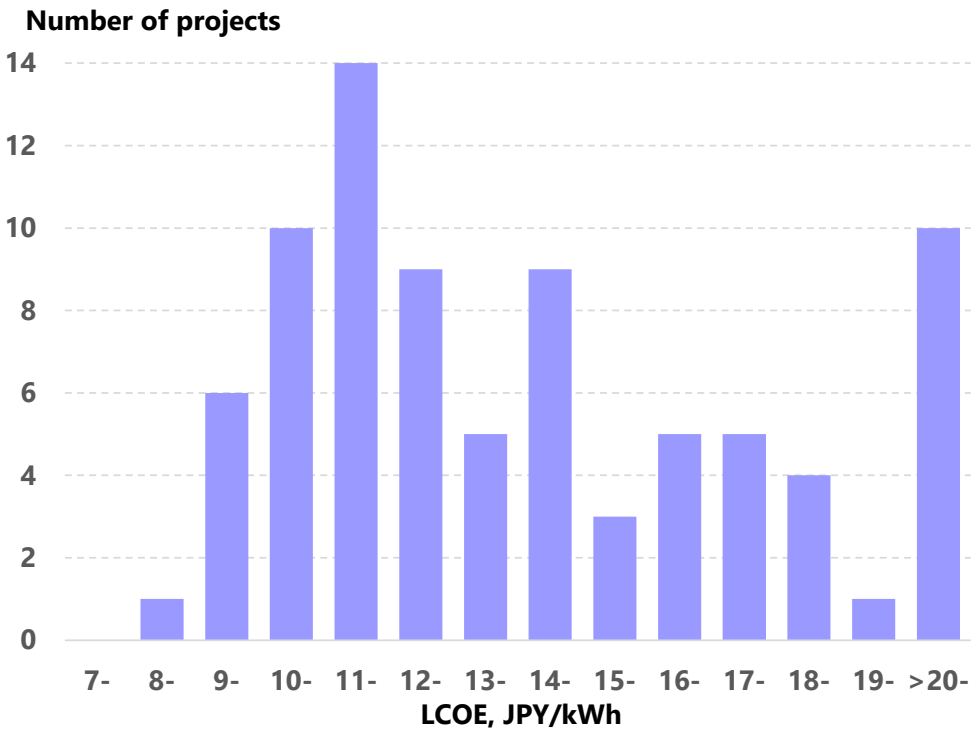
Unit: JPY/kWh



Distribution of LCOE (onshore wind)

Number of projects with different LCOE (3% discount rate)

機械的・簡易的に計算したLCOE	件数
7円/kWh未満	0件
7円/kWh～8円/kWh	0件
8円/kWh～9円/kWh	1件
9円/kWh～10円/kWh	6件
10円/kWh～11円/kWh	10件
11円/kWh～12円/kWh	14件
12円/kWh～13円/kWh	9件
13円/kWh～14円/kWh	5件
14円/kWh～15円/kWh	9件
15円/kWh～16円/kWh	3件
16円/kWh～17円/kWh	5件
17円/kWh～18円/kWh	5件
18円/kWh～19円/kWh	4件
19円/kWh～20円/kWh	1件
20円/kWh以上	10件
合計	82件

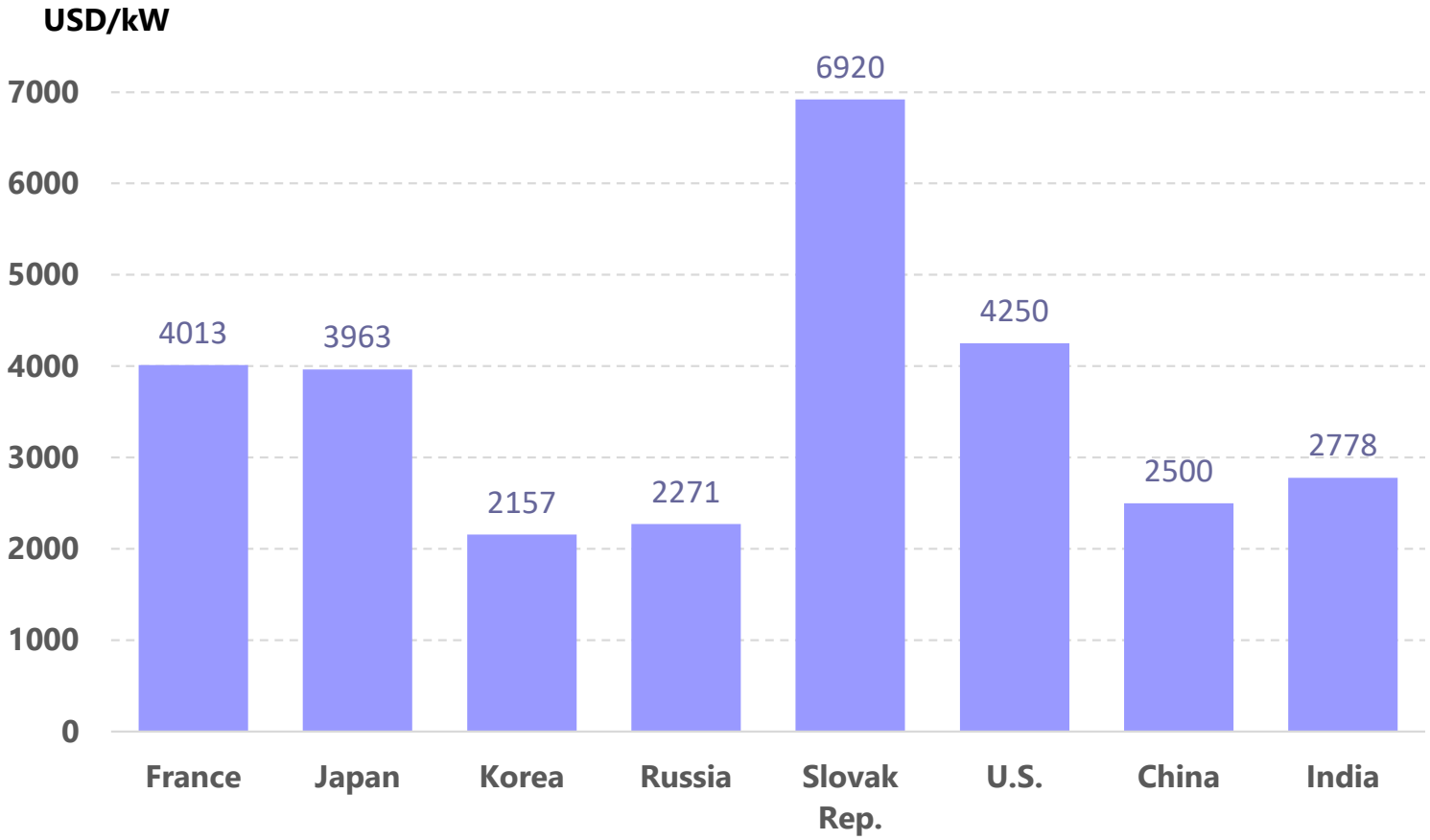


- LCOE of variable renewable energies range widely from below 10 JPY/kWh to over 20 JPY/kWh.

Source: Calculation Committee for Procurement Price, etc. (調達価格等算定委員会)
https://www.meti.go.jp/shingikai/santeii/063.html

Overnight cost by country: Nuclear

Source: OECD/NEA & IEA, Projected costs of generating electricity 2020 Edition

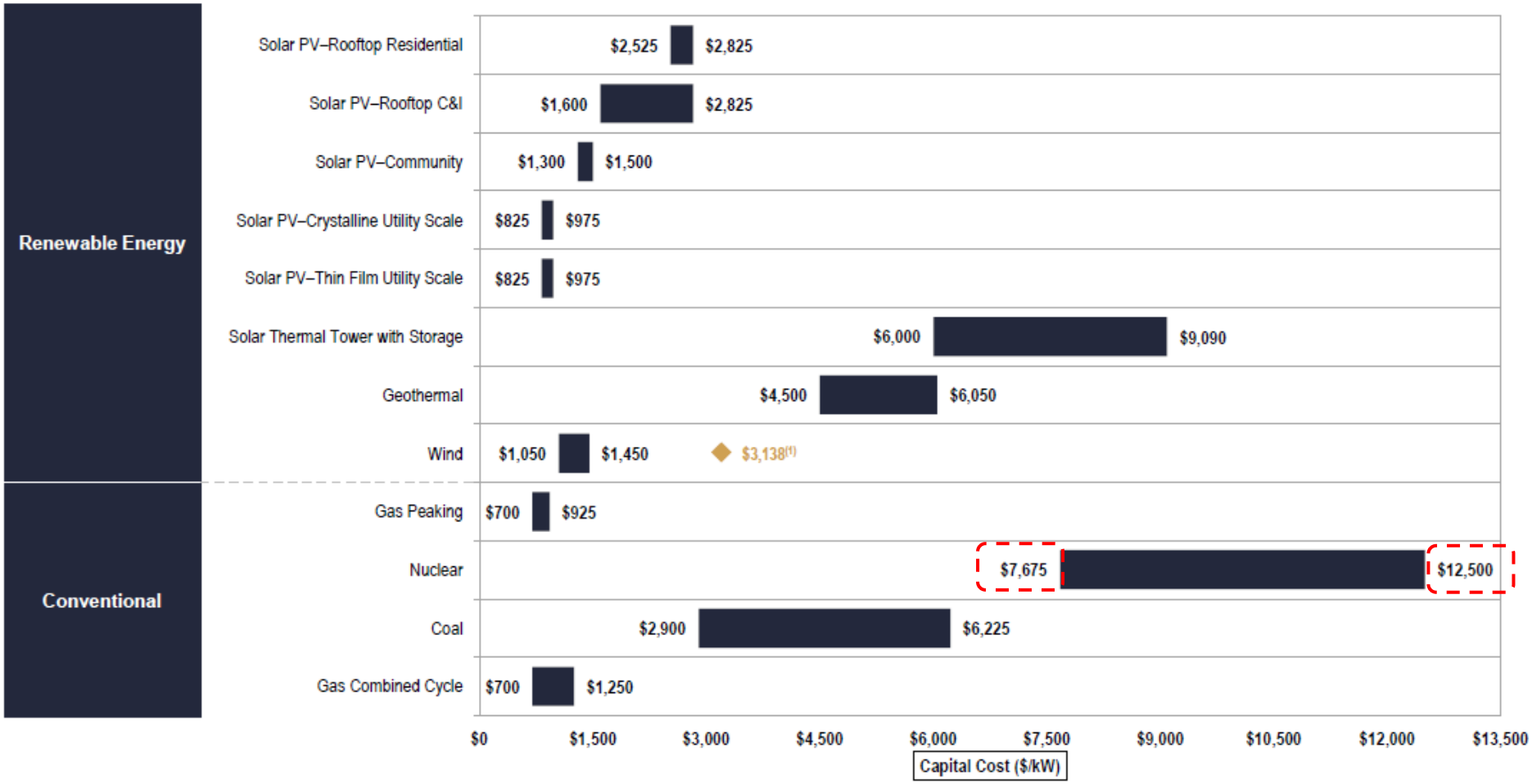


- “Overnight cost” (一夜費用) refers to the construction cost *excluding* interest during construction.

- Overnight unit cost of nuclear ranges from 2,000 to 7,000 USD/kW.

Lazard's LCOE analysis

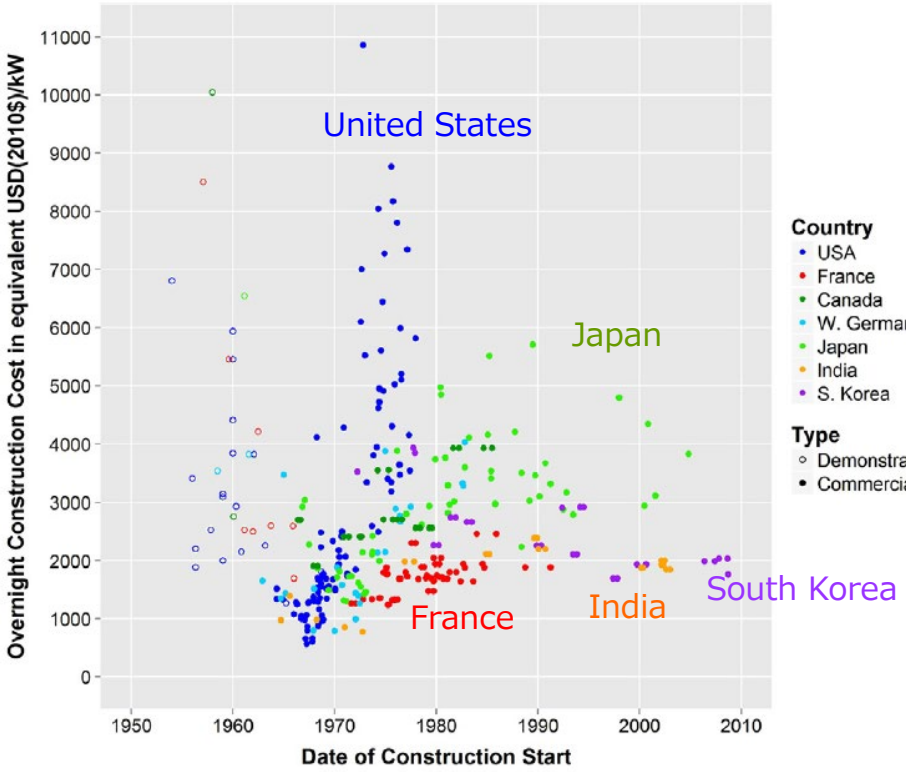
Source: Lazard's levelized cost of energy analysis ver. 14.0



- Lazard's LCOE analysis expects higher overnight costs of nuclear power generation, probably reflecting recent cost hikes in Europe and in North America - Olkiluoto3, Hinkley point C, Vogtle 3&4, etc.

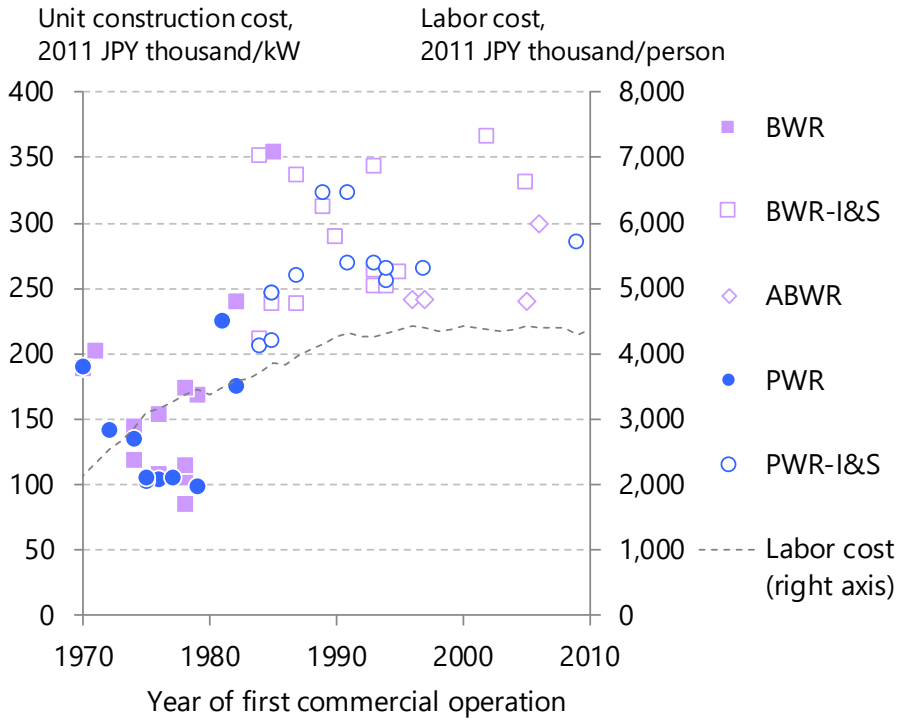
Historical trends in unit construction cost of nuclear power

Selected countries



Lovering et al., (2016). *Energy Policy*, 91, 371-382.

Japan

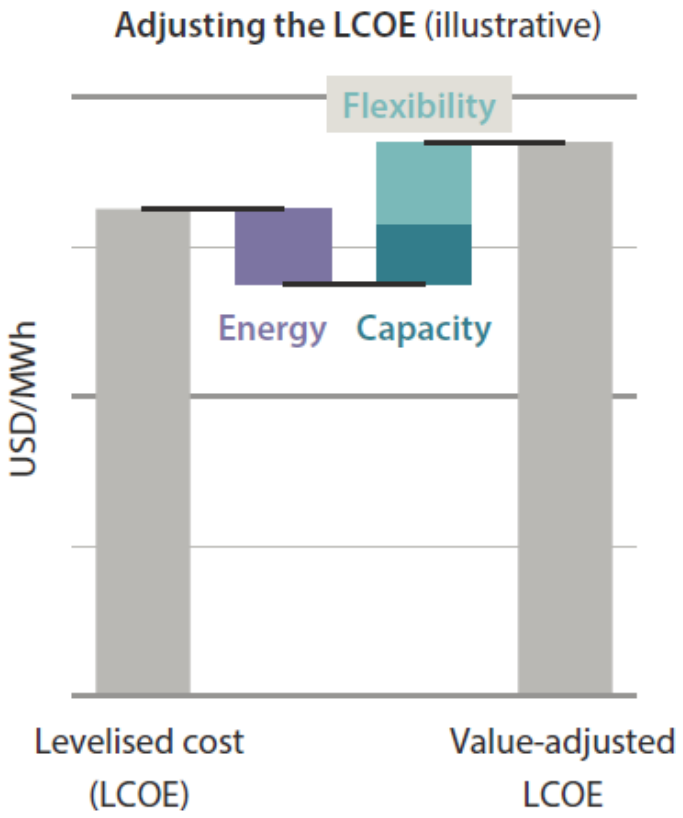


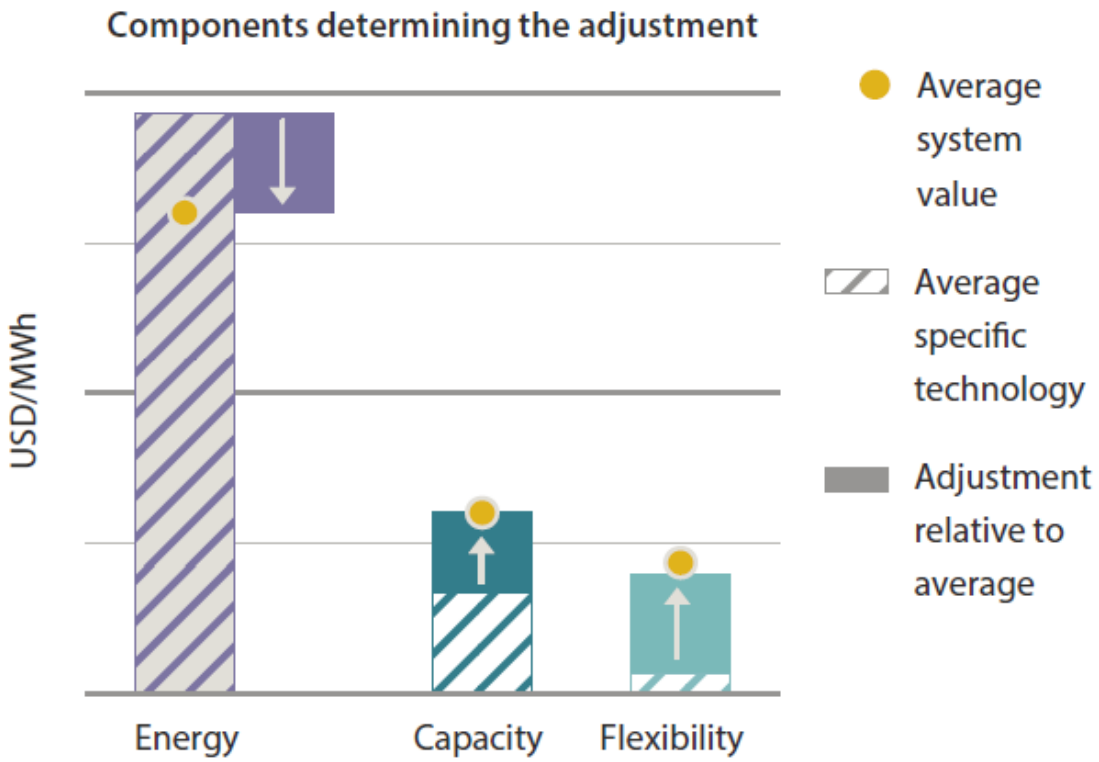
Matsuo and Nei, (2019). *Energy Policy*, 124, 180-198.

- In the United States, the unit construction cost of nuclear rose sharply in the 1970s.
- In Japan, it remained roughly stable after 1985. This is probably thanks to the stable construction period (around five years).

Value-adjusted LCOE (VALCOE)

Source: OECD/NEA & IEA, Projected costs of generating electricity 2020 Edition

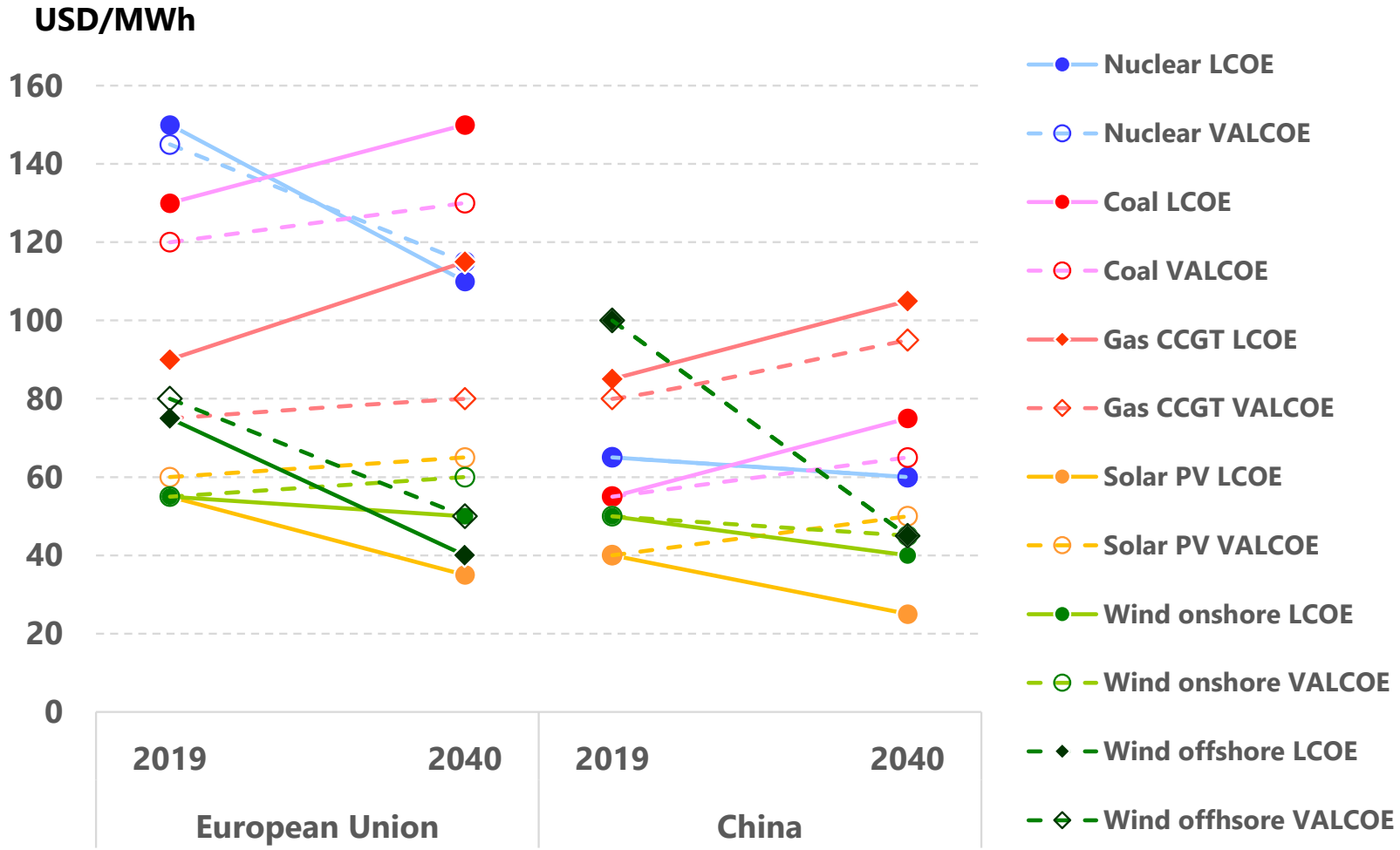




- VALCOE modifies the LCOE of an individual technology in a particular electricity system according to its system value, or its contribution to enabling all aspects of securely operating the system.

Examples of VALCOE: World Energy Outlook 2020

Source: IEA, World Energy Outlook 2020



Similar metrics: Marginal costs of power sources

L. Hirth, F. Ueckerdt and O. Edenhofer, (2016). *The Energy Journal*, 37(3). Doi:10.5547/01956574.37.3.lhir.

Y. Matsuo and R. Komiyama, (2021). *Sustainability Science*. Doi:10.1007/s11625-021-00914-1

System LCOE (Hirth et al., 2016)

$$L_{HUE,\,i} = c_i - v_i + v_L$$

c_i : LCOE of source i
v_i : Unit value of source i
v_L : Unit value of demand

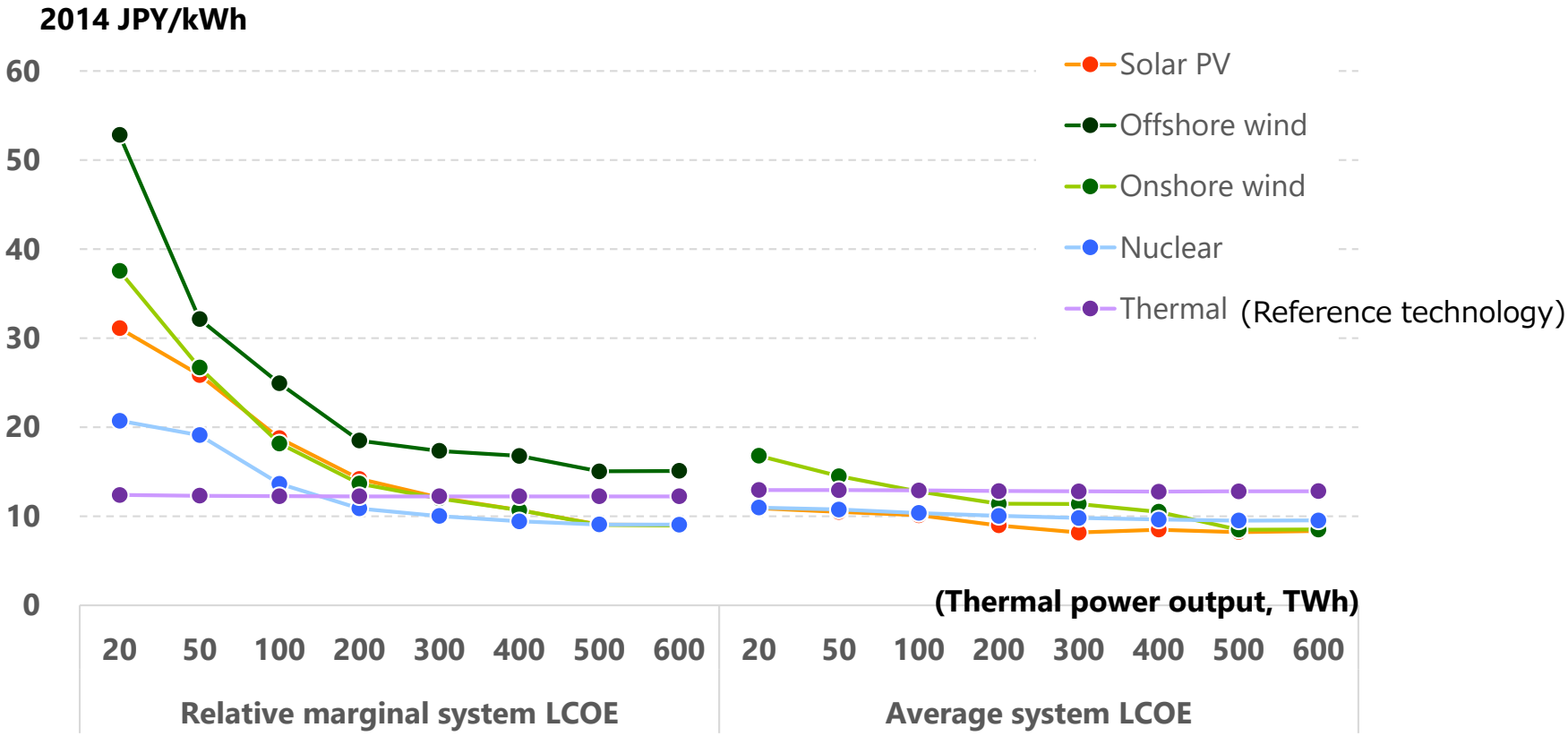
Relative marginal system LCOE (Matsuo and Komiyama, 2021)

- Measures the changes in the total cost of the power system caused by the substitution of two types of power sources.

- The relative marginal system LCOE of the “reference technology” L_0 is assumed at a constant number, while that of technology i L_i is defined by $L_i = L_0 + L_I$, where L_I denotes the total cost increase with the substitution of technologies 0 and i by 1kWh.

Marginal and average costs of electricity: Case of Japan

Y. Matsuo and R. Komiyama, (2021). *Sustainability Science*. https://doi.org/10.1007/s11625-021-00914-1



- Assumes that electricity is supplied by renewables, nuclear, and zero-emission thermal power (e.g. thermal power with CCS or hydrogen thermal power) in 2050 in Japan.

- Marginal costs of variable renewables (solar PV and wind) increase significantly with very high shares of VRE, or very low shares of thermal power.

Thank you for your attention!

Merci beaucoup pour votre attention!

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