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Challenges for boosting renewables under soaring energy prices

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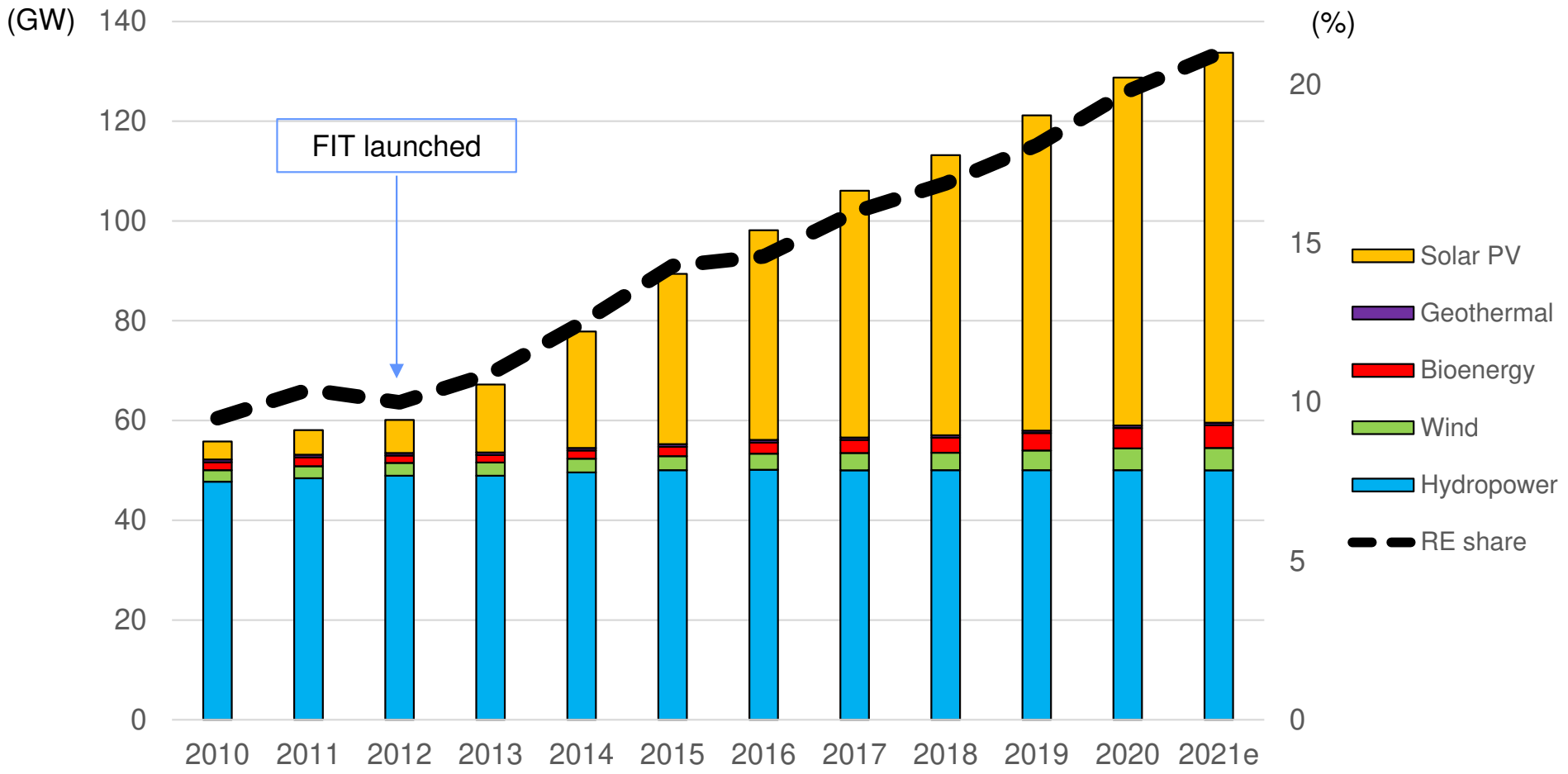
Massive increase in RE capacity and its share over the past 10 years

- RE capacity massively increased over the past 10 years after FIT launched in 2012
- Solar PV has overwhelmingly dominated the RE growth, up from 4 GW^{DC} in 2010 to 74 GW^{DC} in 2021, in contrast to little growth of other RE resources such as hydro, wind and biomass
- RE share in total generation has also increased; from 10% in 2010 to around 21% in 2021

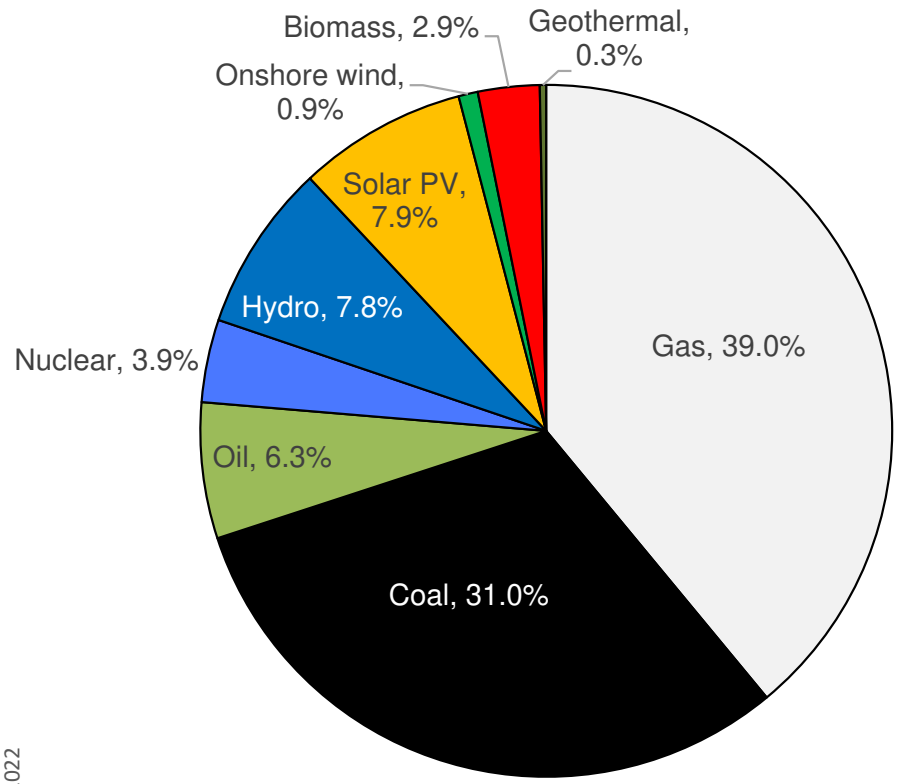


Source：IRENA Renewable Electricity Capacity and Generation Statistics and others

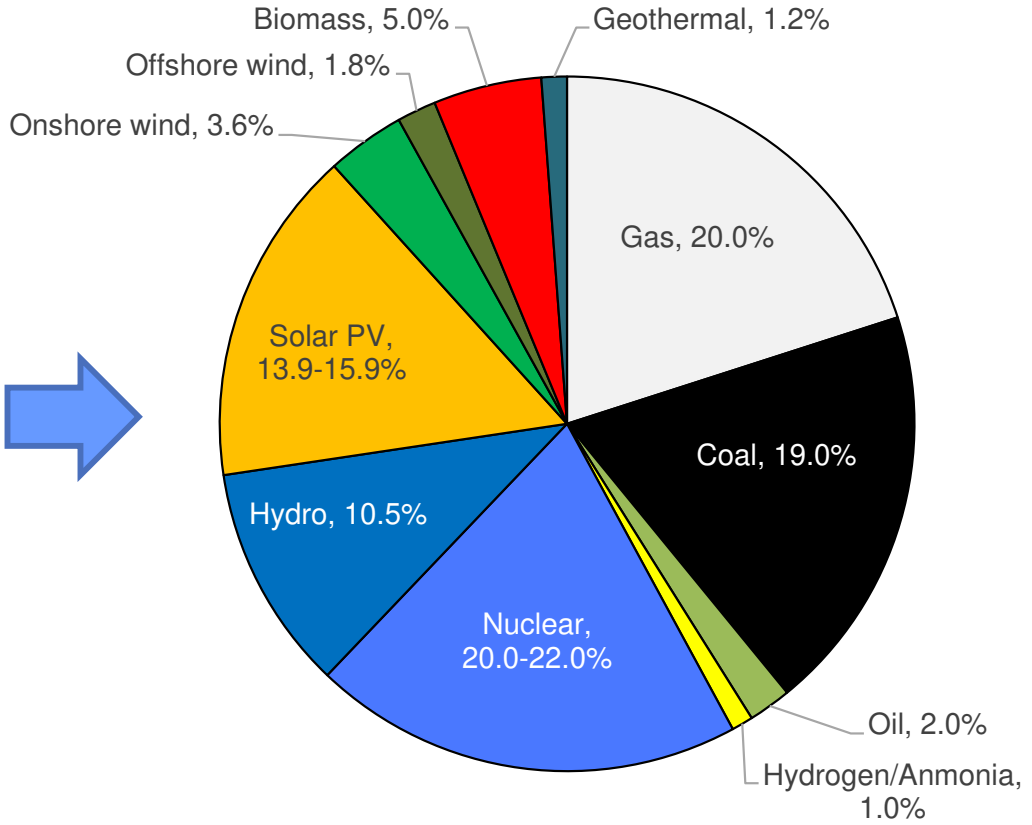
RE 2030 target requires further rapid growth over the next 10 years

- RE target was set at 36 - 38% RE electricity by 2030, up from 19.8% in 2020
- To meet the target, share of RE in electricity generation needs to be continuously increased by 1.6 % point p.a. which is higher than the average of 1.2% point p.a. over the past 5 years
- Particularly, the share of solar PV is expected to increase substantially from 7.9% in 2020 to 13.9-15.9% in 2030

Elecricity generation in FY 2020（1001TWh）
（RE share 19.8 %）



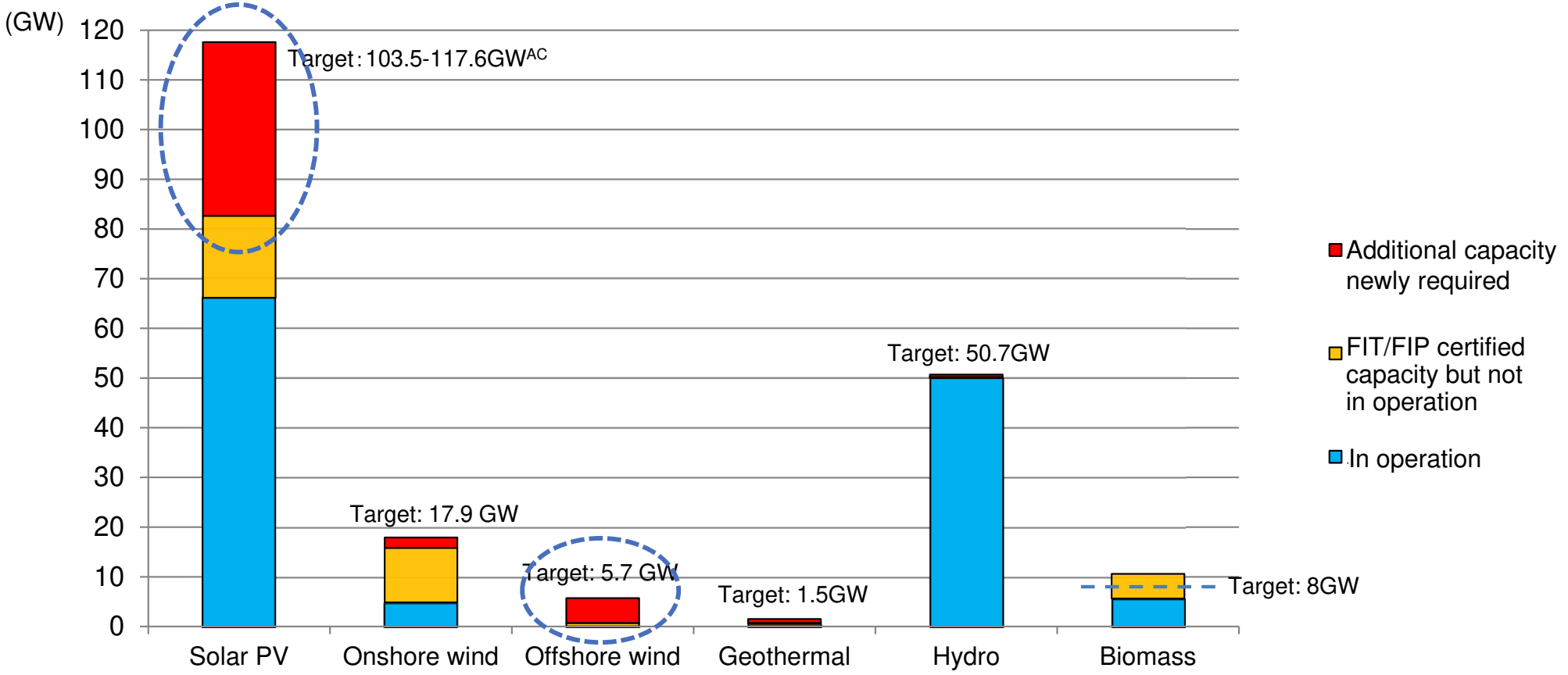
Electricity generation in FY 2030（934TWh）
（Targeted RE share 36 - 38%）



Source：Energy Statistics FY 2020 (in Japanese), 6th Energy Strategies (in Japanese)

How far we need to increase RE capacity to reach 2030 targets?

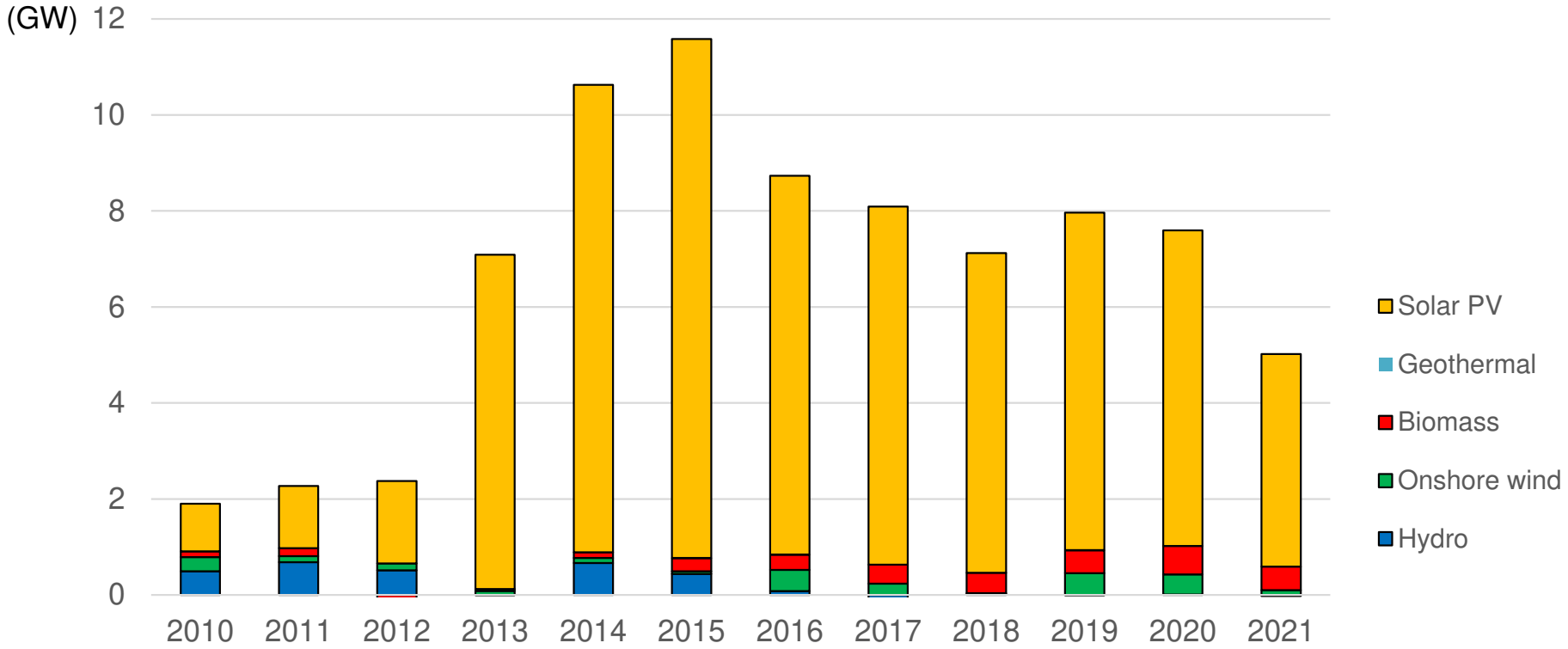
- Significantly large amount of newly capacity addition, around 35GW^{AC}, requires for solar PV
- Offshore wind also requires capacity addition of at least 5GW up from almost zero in 2021
- Due to such huge volume of capacity addition over the next decade, RE policies primarily focus on solar PV at the present, and secondly on offshore wind



Source：Author based on METI published date as of 31 March 2022 (in Japanese)

However, annual addition of RE has diminished recently

- Annual addition of RE capacity, notably solar PV, diminished significantly in 2021, the lowest record of 5GW since 2012
- A number of reasons can be given for this decline including:
  - FIT price for large scale solar PV sharply declined becoming less attractive due to competitive auction
  - FIT for large scale solar PV has been gradually phased out, shifting to newly introduced FIP in 2022
  - Unused land suitable for large scale solar PV has been not much left any more after massive development over the past 10 years
  - Conflict b/w local community and RE developer has increasingly occurred, leading to tougher regulation on RE development on the municipality level



Source：IRENA Renewable Electricity Capacity and Generation Statistics

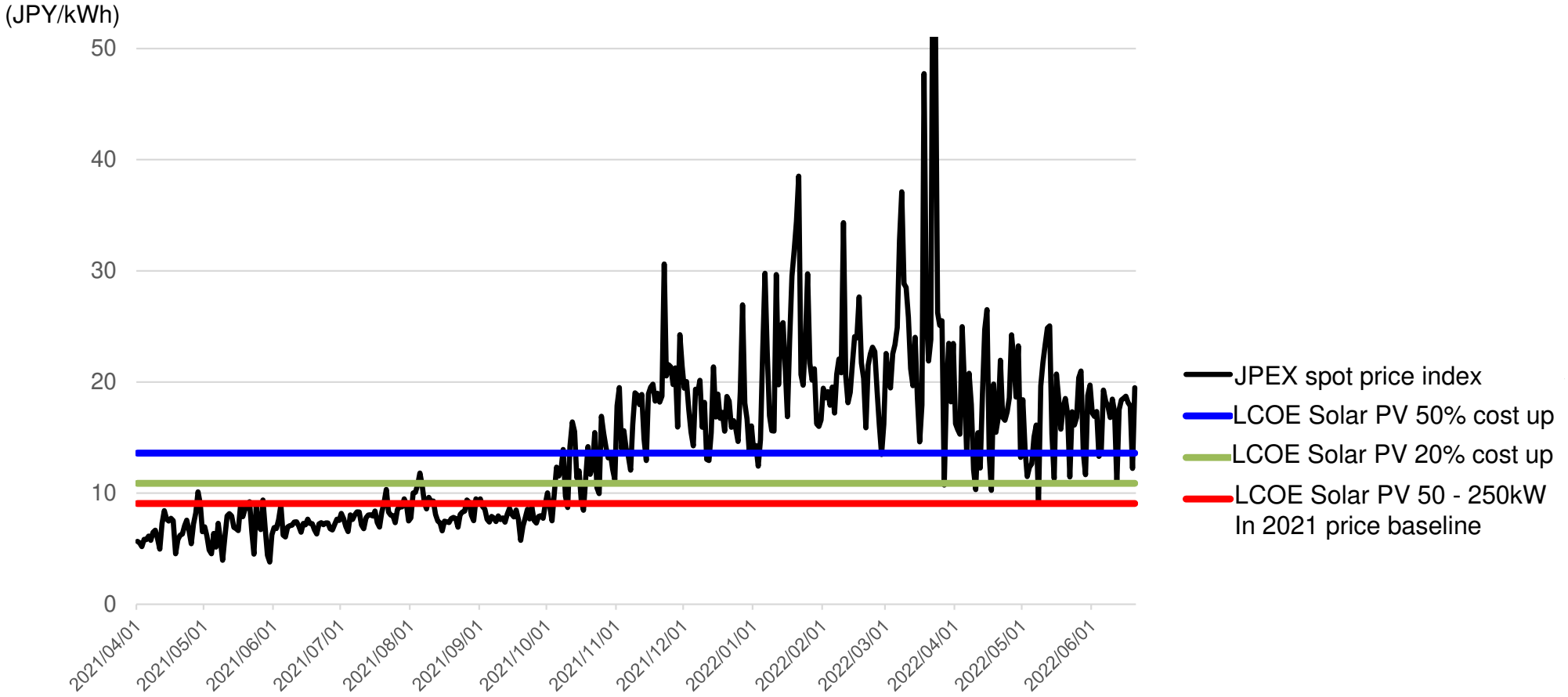
Challenge #1: How to increase RE capacity to meet the 2030 target?

- While further rapid expansion of RE capacity is necessary to meet the 2030 RE target, at the same time, the declining trend of RE growth is observed, calling for stronger/additional policies including…

Individual Issues	Stronger/additional policies needed for further RE capacity growth
Decline of FIT prices due to competitive auction	• Boosting RE capacity growth for self-consumption being independent from public financial support of FIT/FIP • Promotion of RE business model from “feeding into the grid” to “self-consumption” like PPA (10GW)
Shifting of public financial support scheme from FIT to FIP	• (same as above) • Fostering new business such as innovative aggregators and accurate forecasting of VRE generation as part of infrastructure for RE business under FIP
Shortage of unused land suitable for large scale solar PV like dismantled factory site and abandoned golf course	• Utilisation of unused lands whose owners are legally unregistered; • Development of abandoned farmlands and reservoir for solar PV • Promotion of further installation of solar PV over farmland • Utilisation of unused public lands around airports for solar PV installation (2.3GW) • Promotion of installation of roof-top solar PV on newly built dwellings (3.5GW); Obligation in Tokyo Metropolitan area currently under discussion (1.4GW) • Obligation of roof-top solar PV installation on newly built public buildings under national/local governments (6GW)
Conflict b/w local community and RE developer leading to tougher regulation on RE development on the municipality level	• Transition from the conventional unrestrained RE development to legal positive zoning that officially designates areas to promote active formulation of RE projects proactively (4.1GW) • Active involvement of national government in overcoming of land constraint for RE development faced by local governments

Solar PV has become cost competitive as wholesale price ramped up

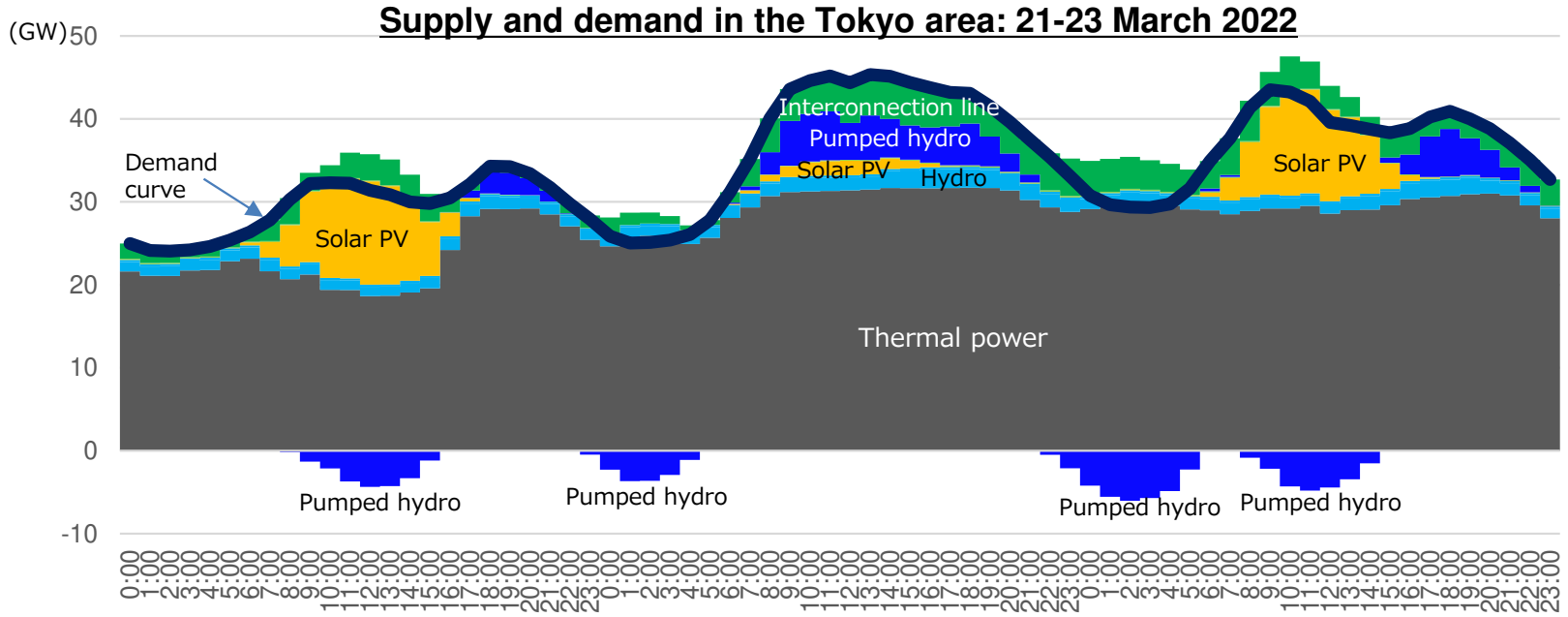
- Since November 2021, LCOE of solar PV is broadly lower than the wholesale price in JPEX market even when 50% increase of capital/operation cost of solar PV compared to the baseline case in 2021 price
  - Under this circumstance, solar PV is highly competitive implying that rooftop solar PV for self-consumption is likely to be an attractive option for factories, commercial buildings and households



Source：Author based on JPEX spot price index and other published materials (in Japanese)

Challenge #2: How to ensure sufficient amount of flexibility of grid to accommodate VRE?

- As rapid growth of VRE generation, ensuring of flexibility of the power grid to accommodate a large volume of VRE has become a critical issue
  - On 22 March 2022, during heavy load in winter cold rainy day, only 1.7 GW of solar PV could generate out of 15GW installed capacity in the Tokyo area
  - A large scale power outage was almost about to occur, but eventually avoided by full mobilising of additional thermal power, pumped hydro, interconnection line inflow and DR

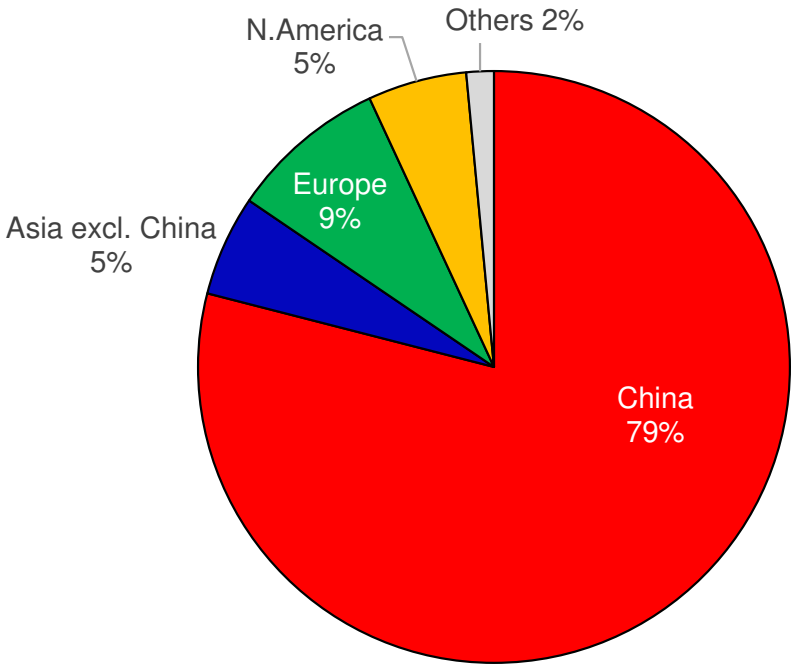


- It is absolutely vital to ensure sufficient amount of flexibility resources continuously over the next decades in order to accommodate significant volume of VRE
  - In short-run: DSM incl. DR, VPP and energy efficiency improvement are only possible solutions
  - In short/medium-run: Dispatchable power plants, improvement of grid operation and installation of battery storage
  - In long-run: Reinforcement/expansion of grid, interconnection line, P2G of excess RE electricity

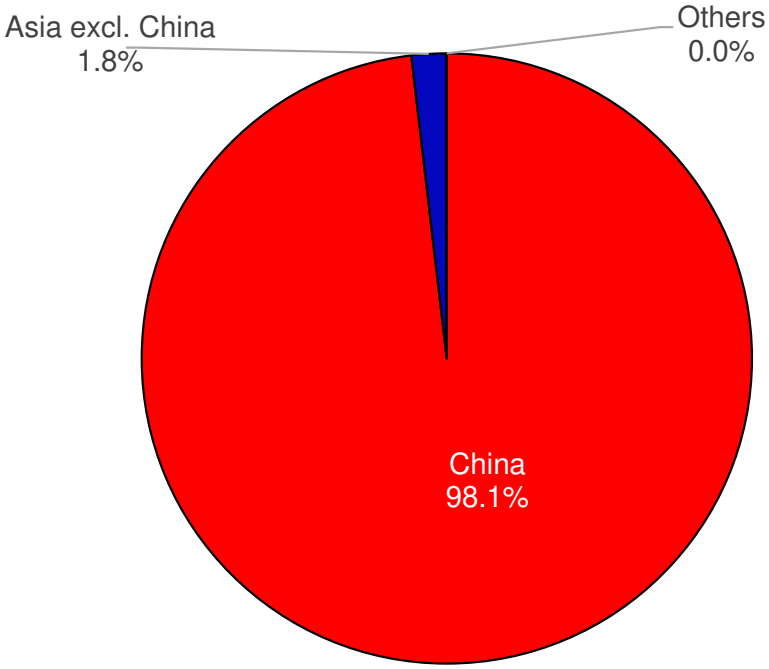
Challenge #3: How to diversify solar PV supply chain?

- Since the Ukrainian crisis occurred, security risks of over-dependent on specific countries for energy supply have become apparent
  - As every production stage of solar PV supply chain is highly concentrated in a single country, diversification of solar PV supply chain is required to reduce the security risks; however, no clear answer is given yet
  - It is also highlighted importance of end-of-life management and recycling of solar PV modules

Share of polysilicon production capacity



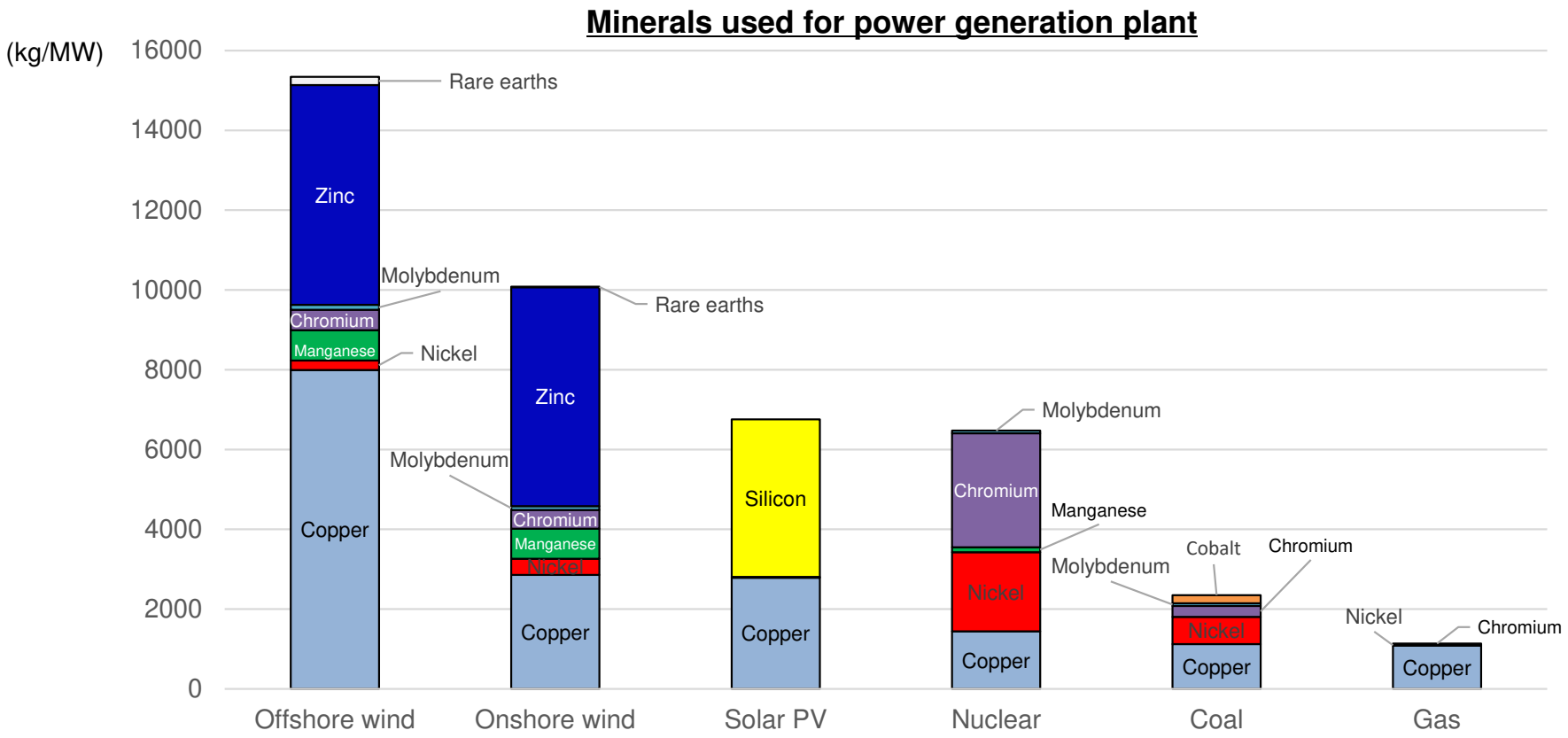
Share of wafers production capacity



Source：IEA Special Report on Solar PV Global Supply Chains 2022

Challenge #4: How to ensure reliable supply of critical minerals?

- Compared to thermal power plants, solar and wind generation equipment is relatively higher dependent on scarce critical minerals
  - In particular, solar PV is heavily dependent on silicon implying that price and supply would be greatly affected depending on supply of silicon
  - There is growing concern about risk of supply constraints on the critical minerals
  - It will be necessary to build a global cooperation to secure a stable supply of critical minerals as well as efforts to reduce dependence on these minerals in solar/wind generation equipment



Source：IEA The Role of Critical Mineral in Clean Energy Transitions 2021

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