

Renewable Energy Policy Challenges in 2024 —Expansion of Renewable Energy Concentrated in China and Focused on Solar Power—

The Institute of Energy Economics, Japan

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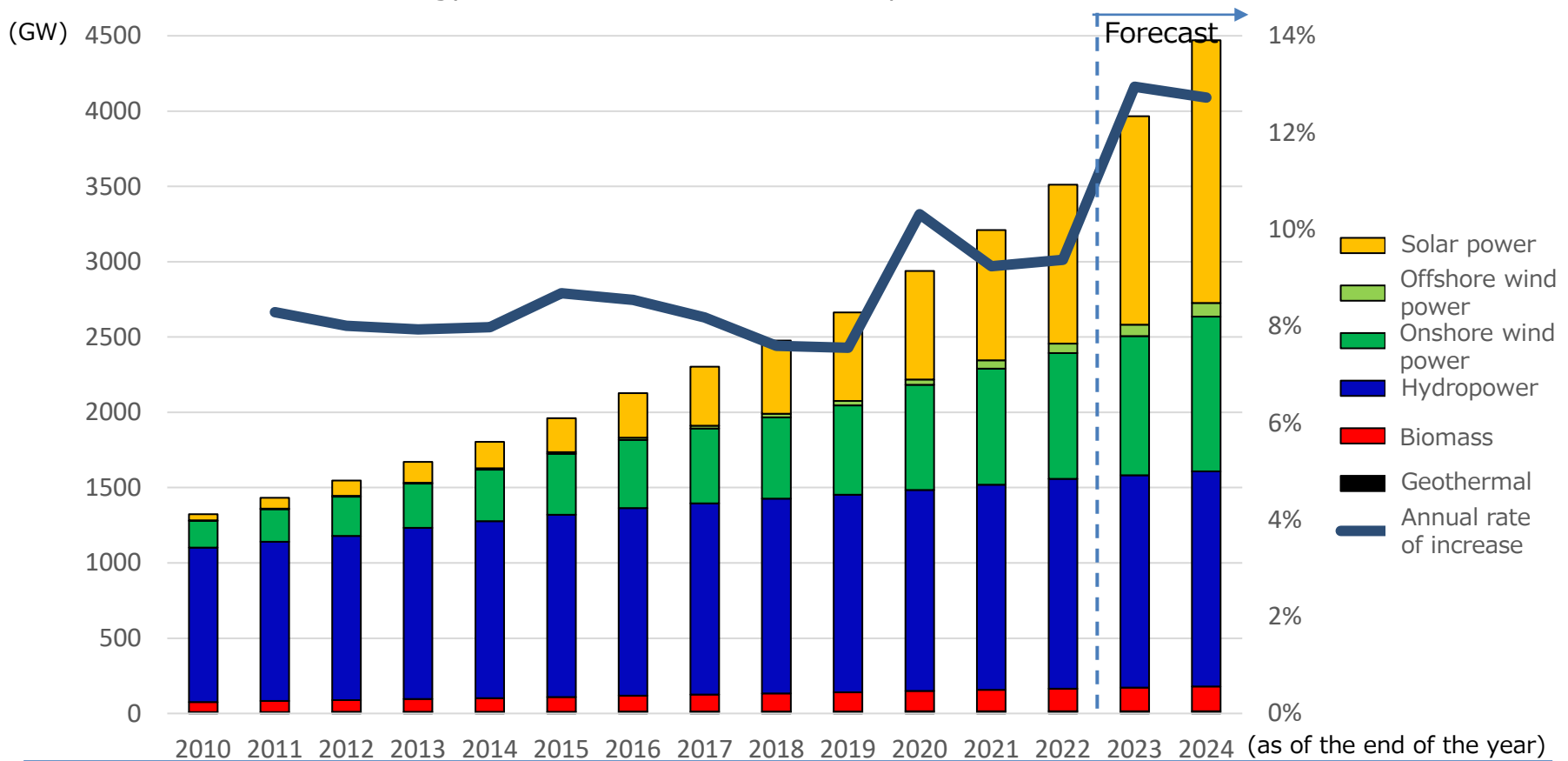
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Key points of this report

- ✓ Global renewable energy generation capacity is expected to accelerate further in 2023 and 2024, with adoption advancing at a high level of 450-500 GW per year, significantly exceeding the 300 GW per year increase in 2022. Amidst growing interest in global energy security and decarbonization, the momentum for growth in the renewable energy sector will be thrown into sharper relief.
- ✓ Particularly in China, the annual rate of increase in 2023 and 2024, compared to 2022, will double for solar power and increase by 50% for onshore wind power; this is a significant increase when compared to the rest of the world (excluding China). China is becoming a driving force behind the rise of renewable energy worldwide.
- ✓ Solar power will make up more than 70% of the global increase in renewable energy generation capacity in 2023 and 2024, indicating a pronounced trend of a heavy emphasis on solar power. On the other hand, wind power, which makes up a large percentage of equipment production outside of China, will see sluggish growth due to the strong impact of soaring material prices and rising interest rates.
- ✓ China will make up 60% of the total growth in renewable energy worldwide in 2023 and 2024. Moreover, 80% of the world's solar panels are produced in China, and the heavy emphasis on solar power in the growth of renewable energy will lead to further concentration in China even in terms of renewable energy facilities supply. There may be growing global interest in the implications of such concentration in China.
- ✓ As a result of the increase in renewable energy generation capacity, the share of renewable energy (including hydropower) in the world's total power output is expected to increase up to a maximum of about 34% in 2024. Hence, there is a possibility that renewable energy may overtake coal, which had been the largest power generator previously, and take the top place for the first time.
- ✓ The annual rate of increase in the amount of renewable energy adopted in Japan peaked in FY2014 and has since remained on a long-term trend of decline. The volume of increase in FY2024 is expected to remain at the same level as the previous fiscal year at about 6.5 GW per year.
- ✓ Challenges accompanying the adoption of renewable energy in 2024, which are shared by countries around the world, include rising production and installation costs of renewable energy facilities due to global inflation and rise in interest rates, project delays due to the wait for connection to the power grid, delays in approval processes by administrative agencies, and ensuring the flexibility of the power grid accompanying the increase in VRE share, among other challenges.
- ✓ Challenges that confront Japan in 2024 include the decline in the number of locations to install renewable energy generation facilities, building consensus with the community on renewable energy projects and the approach to coexist with the local community, and the need to establish new renewable energy business models such as FIP and PPA in a post-FIT environment.

Cumulative global renewable energy output: Expected to further accelerate to an annual rate of increase of 13% to reach 4,500 GW by the end of 2024

- The cumulative renewable energy output worldwide will increase by 1.5 times in the four years since 2020, reaching 4,000 GW by the end of 2023 and 4,500 GW by the end of 2024.
 - The annual rate of increase rose from about 8% per year before 2020 to 10% per year after 2020 and will accelerate further to about 13% per year in 2023 and 2024.
 - Amidst growing interest in global energy security and decarbonization, the momentum for growth in the renewable energy sector will be thrown into sharper relief.

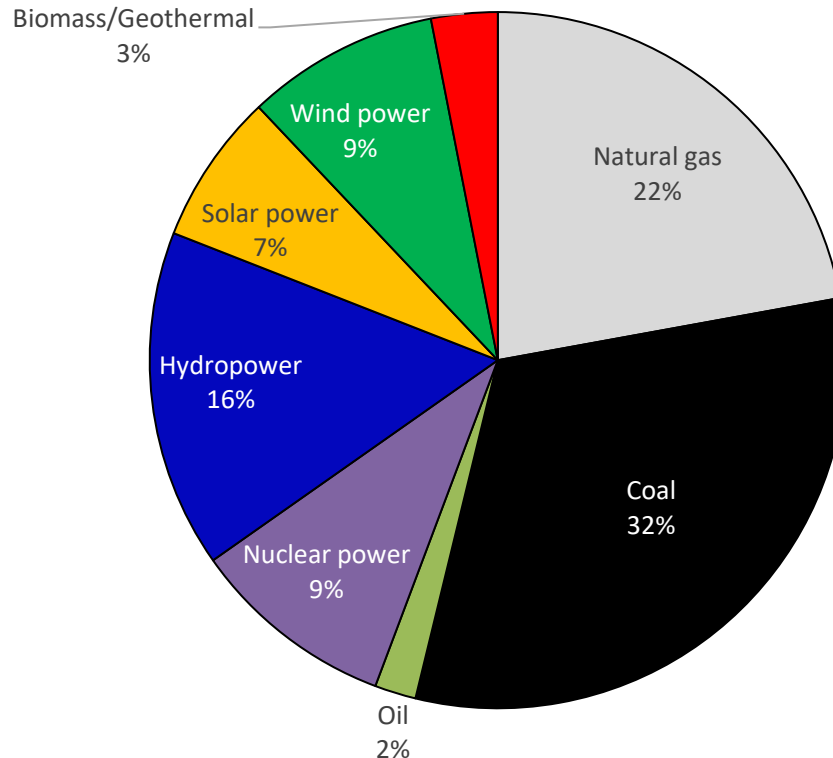


Source: Estimated by the Institute of Energy Economics, Japan

Potential for renewable energy to make up the top share of global power output in 2024

- The share of renewable energy (including hydropower) in the world's total power output is expected to increase up to a maximum of about 34% in 2024.
 - The share of coal is estimated to be about 32% in the same year, so there is a possibility that renewable energy may overtake coal and take the top place for the first time.
 - However, as hydropower is greatly influenced by the amount of precipitation, the share of renewable energy may fall by about 2% due to abnormal drought conditions.
 - The share of naturally variable renewable energy (VRE) is expected to grow to 16% during the same year, and there is an increasingly real possibility that the implementation of measures to integrate high-share VRE, will become a medium- to long-term challenge.

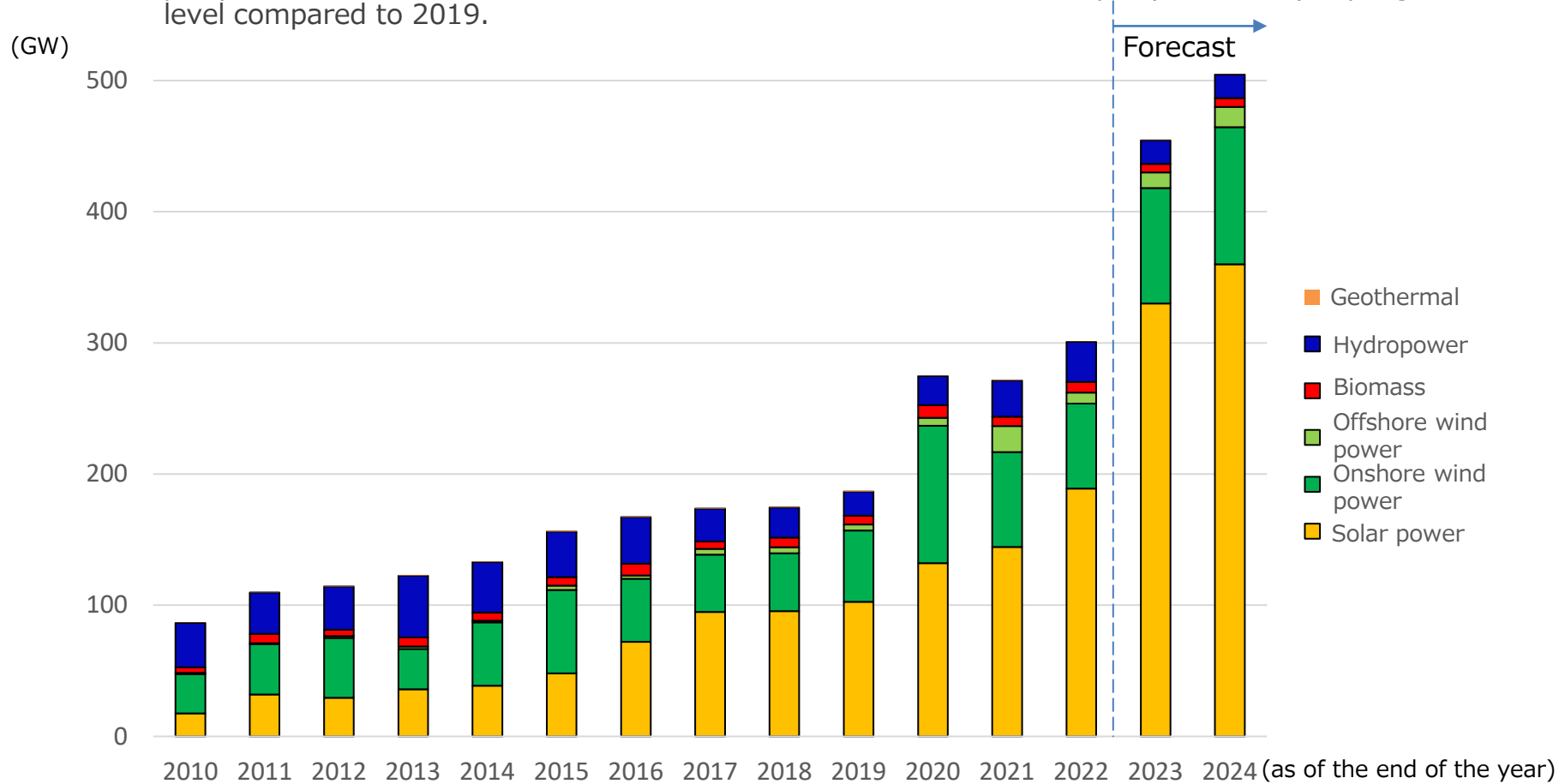
Share of global power output of 29,800 TWh in 2024 by power sources (forecast)
(Forecast: Renewable energy share to increase up to 34%)



Source: Estimated by the Institute of Energy Economics, Japan

Annual increase in global renewable energy power output: Expected to exceed 450 GW in 2023 and 500 GW in 2024, significantly exceeding previous records

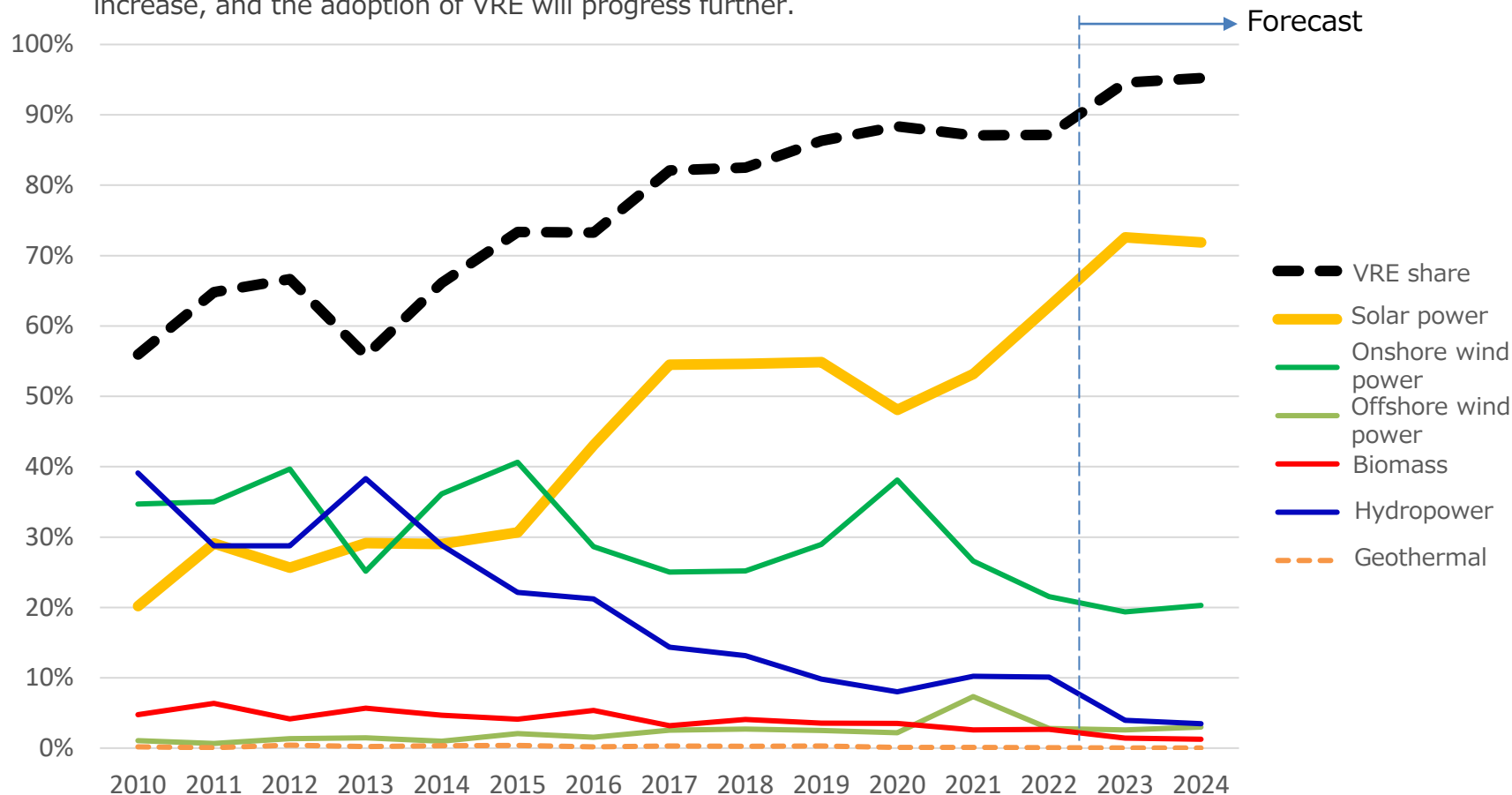
- The global output of renewable energy will exceed 450 GW in 2023, a rapid jump of 1.5 times compared to the previous year, and is expected to exceed 500 GW in 2024, significantly exceeding previous records of highest adoption volumes.
 - While the baseline had been just under 200 GW per year until 2019, this rose suddenly to 250 GW per year in 2020 and will increase further from 2023 to 450-500 GW per year, nearly tripling the level compared to 2019.



Source: Estimated by the Institute of Energy Economics, Japan

Share of the annual increase in global renewable energy generation capacity by renewable energy source: Solar power to make up more than 70% of the increase in renewable energy generation capacity in 2024, and VRE share to exceed 95%

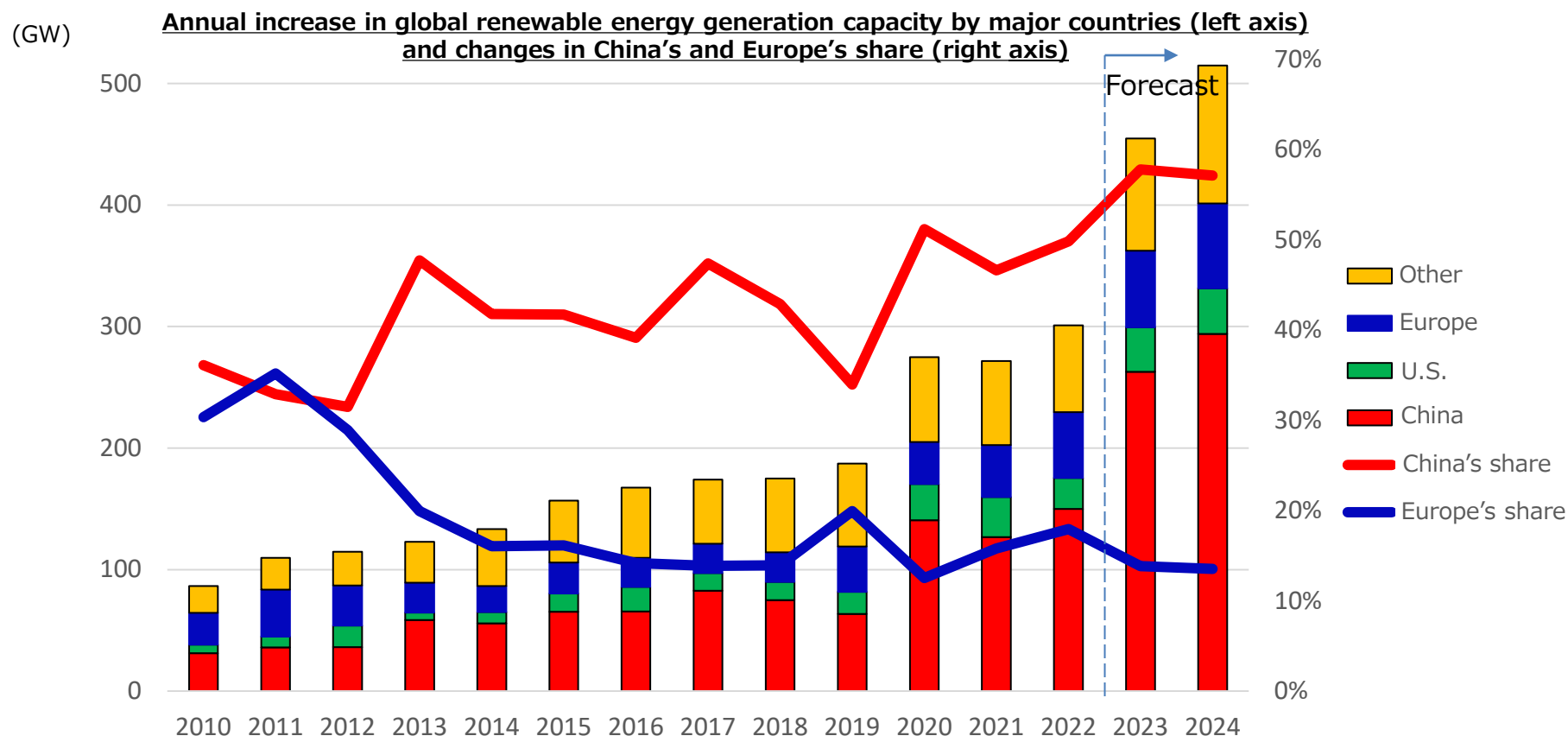
- Solar power will make up more than 70% of the global increase in renewable energy generation capacity and the trend of a heavy emphasis on solar power will become even more pronounced.
 - On the other hand, wind power (onshore/offshore), which makes up a large percentage of equipment production outside of China, will see sluggish growth due to the strong impact of soaring material prices and rising interest rates.
 - Naturally variable renewable energy (VRE) sources, such as solar and wind power, will make up 95% of the increase, and the adoption of VRE will progress further.



Source: Estimated by the Institute of Energy Economics, Japan

More prominent concentration related to renewable energy generation in China in 2024

- China will make up 60% of the total growth in renewable energy worldwide in 2024, and there will be further concentration in China.
 - China will make up 60% of the total growth in renewable energy worldwide in 2023 and 2024. Moreover, 80% of the world's solar panels are produced in China, and the heavy emphasis on solar power in the growth of renewable energy will lead to further concentration in China even in terms of renewable energy facilities supply.
 - Going forward, there may be growing global interest in the implications of such concentration in China.

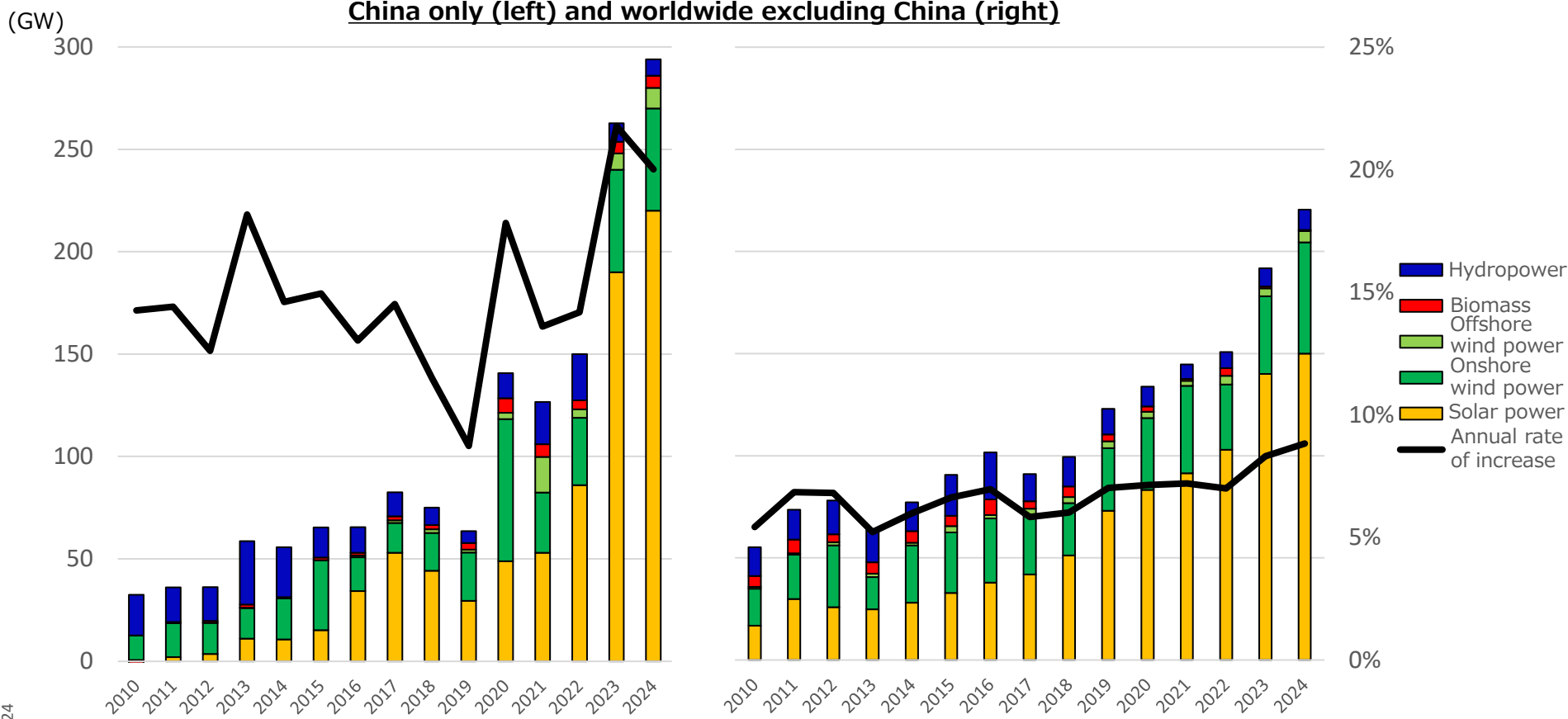


Source: Estimated by the Institute of Energy Economics, Japan

Renewable energy generation capacity for the world, excluding China, will increase at an annual rate of 9% in 2024, but at a much higher annual rate of 20% in China

- In 2023 and 2024, solar power will grow significantly worldwide (excluding China) at 40% compared to 2022, but in China solar power is expected to continue growing at a significantly high level that is more than double the capacity of 2022.
 - In addition to solar power, onshore wind power is also expected to increase at a faster rate in China, at 50% more compared to 2022 (20% increase worldwide excluding China).

Annual increase in renewable energy generation capacity and annual rate of increase: China only (left) and worldwide excluding China (right)



Source: Estimated by the Institute of Energy Economics, Japan

What are the background factors behind the rapid expansion of renewable energy in China?

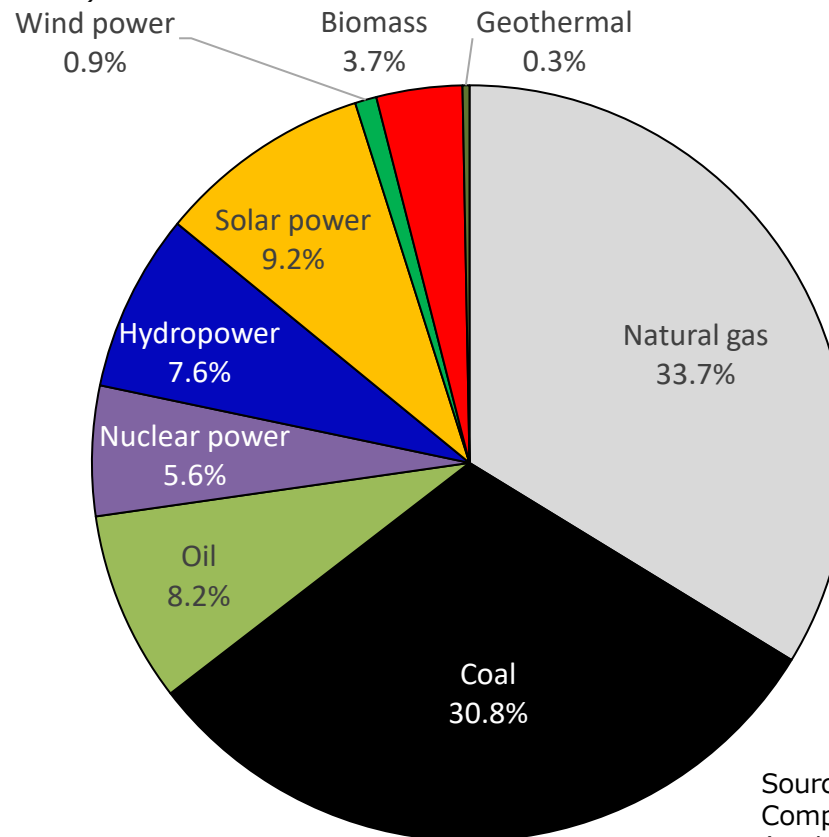
- Strong promotion of government-driven adoption of renewable energy toward decarbonization under the 14th Five-Year Plan
 - The concrete renewable energy target for 2030 (total power generation capacity of 1,200 GW for solar and wind power combined) may even be achieved five years ahead of schedule, as early as 2024.
- Relatively small impact of soaring global raw material prices due to the almost complete domestic supply-chain for solar panels and wind power generation facilities
 - Production costs that are less than half of that in the West not only for solar power generation, but also for wind power generation facilities are realized.
- 30% to 40% fall in solar panel prices compared to 2022 due to increased solar panel production within China
 - As production capacity for solar panels within China was boosted by almost double the level between 2022 to 2023, there is almost an oversupply of solar panels, resulting in a 30% to 40% fall in solar panel prices.
- Greater cost advantage of solar power generation within China due to a 30% to 40% fall in solar panel prices
 - Solar power generation can be achieved at a lower cost than existing coal-fired power generation in many areas, and large-scale solar power projects aimed at satisfying the growing power demand are expected to start operating successively.
- In contrast to rising interest rates worldwide, domestic interest rates in China have remained low due to deflationary pressures
 - The capital costs for renewable energy project developers remain relatively low compared to those in the West
- However, while the government is advancing efforts to boost power transmission lines, renewable energy is growing rapidly at a pace that outstrips these efforts. Hence, the wait for connection to the power grid and increase in output power control could pose significant challenges in the future.

Policy challenges and measures accompanying the expanded adoption of renewable energy, shared by countries around the world in 2024

- Rising production and installation costs of renewable energy facilities due to global inflation and rise in interest rates (particularly for wind power)
 - Many projects, particularly for wind power (both onshore and offshore) in the West have failed due to difficulties with installing new facilities under upper limit bidding prices and PPA prices determined before increases in resource prices and interest rates were predicted.
 - In particular, there are many unsuccessful offshore wind power bids in the West, such as undersubscriptions that fall short of the target amount.
 - While short-term measures are necessary, such as raising the upper limit bidding price and making subsequent adjustments for inflation to contract prices such as PPA, there is also a need to pay close attention to society's tolerance for the rise in energy prices.
- Project delays due to the wait for connection to the power grid
 - This is widely recognized as the greatest structural impediment to the expansion of renewable energy that is shared by almost all countries around the world.
 - The primary factor is that long-term investment in the power grid is not keeping pace with the rapid growth of renewable energy.
 - It is essential to formulate and implement long-term power grid improvement plans with a view to expanding renewable energy, as well as provide policy support to promote long-term investment toward achieving that.
- Delays in approval processes by administrative agencies
 - This is seen as an especially serious issue in Europe, which wants to increase the pace of growth of renewable energy.
 - There is a need to streamline administrative procedures, unify the points of contact, clarify the timeline for approval procedures, and increase the number of administrative personnel while building their capacity.
 - Initiatives to enhance social acceptance, such as promoting dialogues with local communities and developing joint ventures and projects.
- Ensuring the flexibility of the power grid accompanying the increase in VRE share
 - It is necessary to maintain demand and supply regulating power sources, provide policy support for the improvement of power storage systems, and establish policies to promote the proactive use of DR.
- The following are medium- to long-term challenges that do not need to be addressed immediately in 2024.
 - Concentration and reliance of renewable energy equipment supply-chain, such as for solar panels, on specific countries.
 - Securing stable supplies of critical minerals.

Share of renewable energy in Japan's power output: Increased to 21.7% in FY2022

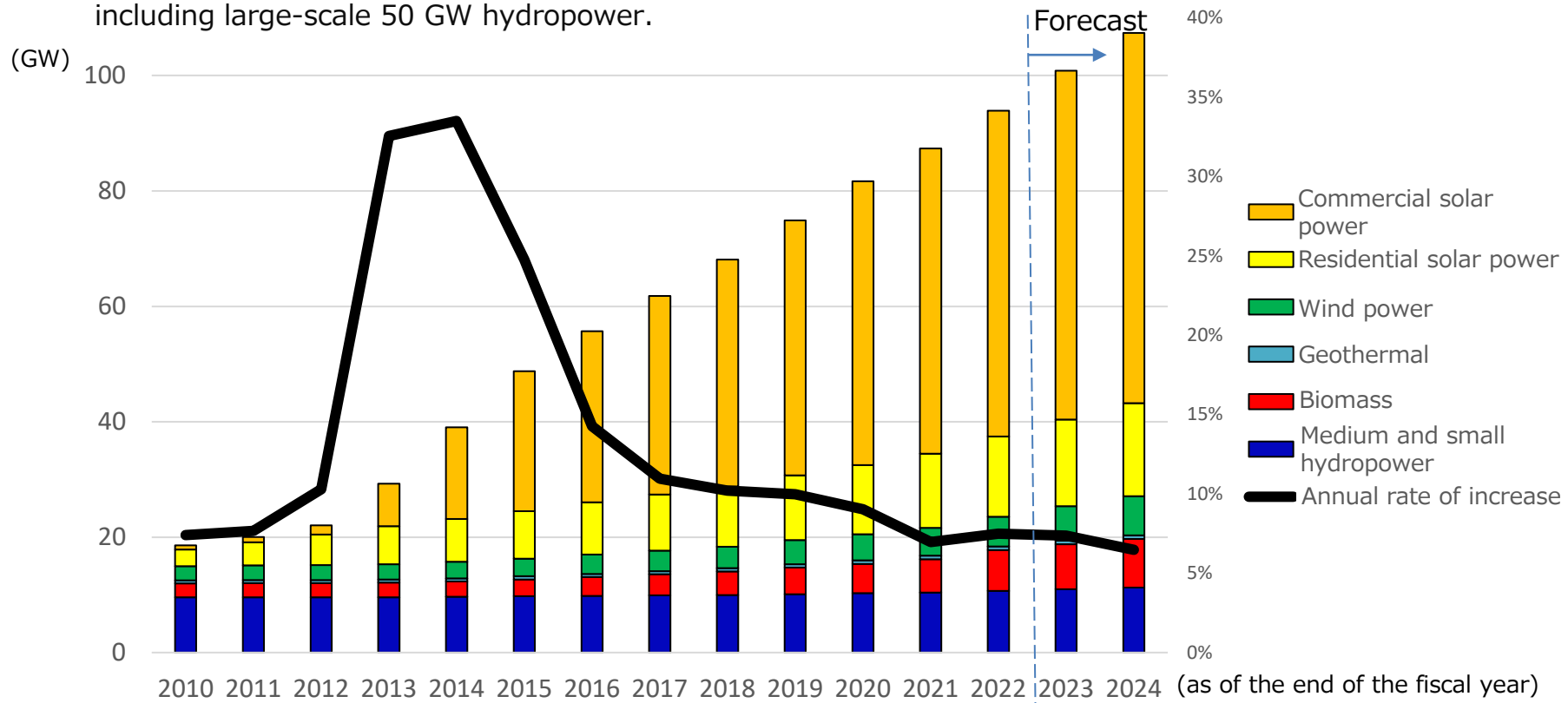
- The share of renewable energy in Japan's power output was 21.7% in FY2022, and Japan will reach the lower limit of its former renewable energy target for FY2030 (22%-24%) under the Fifth Strategic Energy Plan as early as during FY2023.
 - The reversal of the shares of solar power and hydropower has fully stabilized, and solar power has established its position as the greatest renewable energy source in Japan.
 - The share of naturally variable renewable energy (VRE) sources in FY2022 increased to 10.1% (Solar power 9.2% + Wind power 0.9%).



Source: Prepared based on the Comprehensive Energy Statistics of Japan (preliminary values for FY2022)

Cumulative values for Japan's renewable energy generation capacity: To increase to 107 GW by the end of FY2024

- Renewable energy generation capacity (excluding hydropower above 30 MW) will reach 107 GW* by the end of FY2024, and power output will reach 212 TWh**.
- If large-scale hydropower of 30 MW or above is included, the share of renewable energy in FY2024 is expected to be 24.6% (hydropower 7.9%, non-hydropower 16.7%).
- The annual rate of increase peaked in FY2014 and declined to about 6% per year after FY2020, differing from the acceleration of renewable energy worldwide.
- However, if Japan maintains this adoption level at least, it is expected to be on track to reach 187.3 GW of renewable energy capacity, which is necessary for achieving its renewable energy target for 2030 including large-scale 50 GW hydropower.



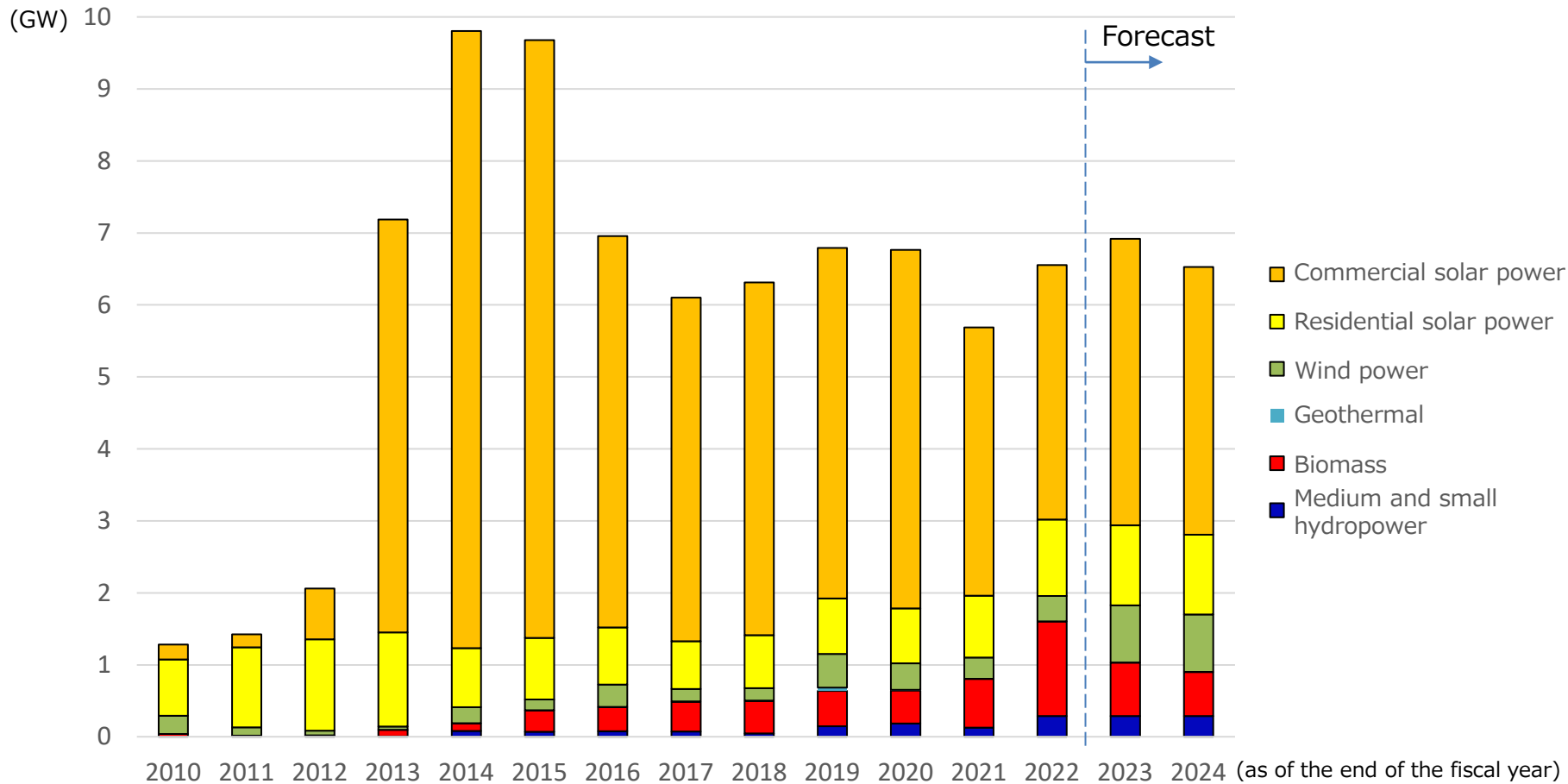
*Figures for solar power are estimated on AC basis.

**Also includes captive consumption such as PPA, etc. for solar power, etc.

Source: Estimated by the Institute of Energy Economics, Japan

Annual increase in Japan's renewable energy generation capacity: Expected to be about 6.5 GW in FY2024

- Expected to increase at about 6.5 GW per year* in FY2024, largely the same level as in the previous fiscal year.
 - In addition to maintaining solar power at about 5 GW per year* with captive consumption such as PPA partially compensating for the drop in FIT/FIP projects, the overall adoption level will be maintained at about 6.5 GW with the gradual start of operation of onshore wind power.
 - Despite progress in bidding for offshore wind power, adoption volume will largely not materialize in FY2024.



*Figures for solar power are estimated on AC basis, and include captive consumption through PPA, etc.

Source: Estimated by the Institute of Energy Economics, Japan

Japan's policy challenges and measures in 2024 accompanying the expanded adoption of renewable energy

- **Decline in the number of locations to install renewable energy generation facilities**
 - Securing space on existing and new buildings for rooftop solar power systems, promoting agricultural solar power generation (solar sharing) and the use of depleted farmland or unused land.
 - Boosting the installation of solar power systems in new buildings or residential homes (for example, the Tokyo government making it obligatory to install solar power generation systems).
- **Wait for connection due to power grid constraints**
 - In the short-term, promote maximum use of existing power grids through "connect and manage" such as non-firm connections.
 - In the long-term, steadily implement push-type development of power grids for the proactive and systematic development of power grids based on the renewable energy potential of each area, as presented in the "Long-term Cross-regional Network Development Policy (Master Plan)" announced in March 2023.
- **Building consensus with the community on renewable energy projects and the approach to coexistence with the local community**
 - Make the shift from conventional unregulated renewable energy project development that was left to the discretion of business operators, to legal positive zoning that officially designates renewable energy promotion zones for the proactive development of projects.
 - Overcome location constraints through support from the government toward the formulation of renewable energy development plans led by local governments (proactive involvement of the national government in addressing location constraints at the local government level).
 - Provide policy support to promote proactive participation by local communities and farming organizations/agricultural corporations in renewable energy generation projects.
- **Establishing new renewable energy business models such as FIP and PPA in a post-FIT environment**
 - Expand renewable energy businesses for non-FIT captive consumption uses, such as PPA that is not reliant on FIT or FIP (change of business model from selling power to the grid → captive consumption)
 - Develop aggregation business and renewable energy generation forecasting as new energy industries.
- **Ensuring the flexibility of the power grid accompanying the increase in VRE share**
 - Address short-term fluctuations through policy initiatives to promote the proactive use of DER as DR resources, such as EVs and heat pumps, through the introduction of storage batteries and electrification of final energy demand (for example, reducing output control through DR, through dynamic pricing that reflects surplus renewable energy).
 - Address long-term fluctuations through policy support to maintain demand and supply regulating power sources (steady operation of capacity markets and long-term decarbonized power supply auctions), and the promotion of the decarbonization of demand and supply regulating power sources (hydropower, biomass, use of hydrogen/ammonia, etc.).

Assuming that the volume of increase in 2024 is maintained, how much is renewable energy generation capacity expected to increase by 2030?

- **Global** **2020: 2,940 GW → 2030: 7,570 GW** **2.6 times**
 - China 2020: 930 GW → 2030: 3,530 GW 3.8 times
 - U.S. 2020: 311 GW → 2030: 670 GW 2.2 times
 - Europe 2020: 635 GW → 2030: 1,280 GW 2.0 times
 - Japan 2020: 131 GW → 2030: 190 GW 1.4 times
 - However, in the case of Japan, if large-scale hydropower of 30 MW or above were excluded, the increase will be 2020: 82 GW → 2030: 146 GW (1.8 times).
- Even if the world were to maintain its adoption rate for 2024, renewable energy generation capacity is expected to increase 2.6 times by 2030 compared to 2020. While "three times the renewable energy generation capacity by 2030" is not an extremely unreasonable level, this can be said to be the result of China driving the overall increase.
- If China's capacity were to increase by 3.8 times, it would achieve "three times the renewable energy generation capacity by 2030" with ease. However, with the increase for other countries staying at the low level of 1.4 to 2.2 times, if we were to look at each individual country, maintaining the current adoption level would not be sufficient for achieving the "three times" increase.
- Looking at each individual country, we can say that it would not be easy to achieve "three times the renewable energy generation capacity by 2030" for many countries if they were to simply maintain the current adoption level.
- However, it is important to note that the value of the multiple changes significantly depending on when we establish the starting point for calculating the "three times" increase, and whether large-scale hydropower is included in the definition of renewable energy, among other factors.