Outlook of Renewable Energy and Hydrogen Market in 2022

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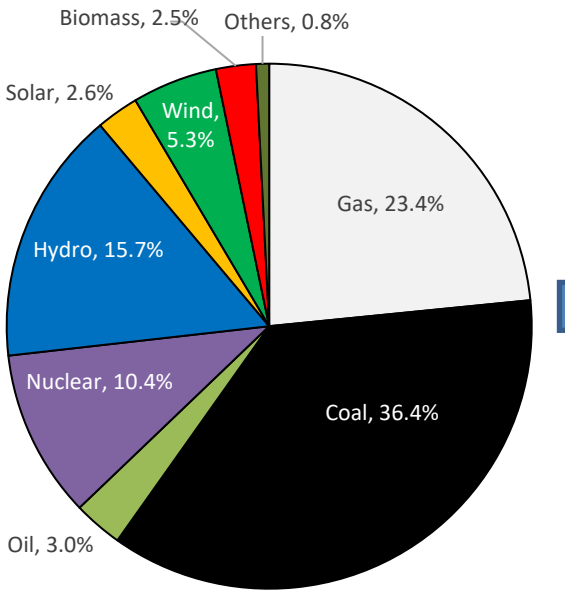
Key Points

- ✓ Global energy output declined by just under 1% in 2020. However, despite similar declines in all other energy sources, renewables increased 6% year over year. Global renewable output for the year was 7,440 TWh, bringing the share of renewables in global electricity generation to 28% from the 2019 level of 26%.
- ✓ Although total electricity demand in 2021 is expected to grow by around 6%, renewable output will also rise 6% to bring annual output close to 8,000 TWh. A similar or even more increase is expected for 2022. The share of renewables in global electricity generation is thus likely to approach 30% in 2022.
- ✓ 2020 was a record year for global renewables deployment. At 260 GW, 2020 far outpaced 2019's 180 GW, which itself was a new high. 2021–2022 is expected to see renewable power generation capacity deployed at a level that exceeds 2020.
- ✓ 2020 saw China's share of annual growth in renewable generation capacity exceed 50% for the first time. 2021–2022 is set to see this single country account for nearly 50% of global growth in renewable generation capacity.
- ✓ During 2021–2022, solar PV will come to account for 60% of global growth in renewable generation capacity. In the 2010s, the growth of renewables saw the market gradually shift away from wind and toward solar PV. The 2020s will now be a time of even greater growth for solar PV.
- ✓ In FY 2020 in Japan, close to 6 GW of renewables capacity was deployed. This dropped to 5 GW in FY 2021, however, with a decline in FIT certifications for solar PV. 2022 is expected to remain at a similar level due in part to uncertainty surrounding the transition to a FIP scheme. Meanwhile, onshore wind deployment could increase significantly in 2021 and beyond as operations gradually commence for FIT certified non-operational projects.
- ✓ For Japan, renewable generation capacity, excluding >30 MW large hydro, will grow to 95 GW by the end of FY 2022, producing 183 TWh of electricity during FY 2021. Adding >30MW large hydropower into this, the share of renewables in total in electricity generation would reach 22.4% in FY 2022.
- ✓ The Japanese 6th Strategic Energy Plan establishes 36% to 38% as the new FY 2030 target for renewables as a share of the energy mix. The 125 GW of renewable generation capacity, including large hydro, in 2020 needs to be increased to around 200 GW by FY 2030. This will require continuing renewables deployment at a pace of 7.5 GW annually, which exceeds the annual 7.1 GW average for the last five years. Target achievement will significantly depend on the effectiveness of policies going forward.
- ✓ FIP scheme will be implemented starting in FY 2022 for selected new renewables projects in Japan. This will be a major turning point for renewable integration into the market.
- ✓ While predicting clean hydrogen production volume is difficult to do for the short-term (through 2022), in light of projects currently being planned, hydrogen production could reach 17 Mt-H_2 a year (green hydrogen 8 Mt-H_2, blue hydrogen 9 Mt-H_2) by 2030.
- ✓ 13 nations had formulated national hydrogen strategies as of the end of 2021, a number that is expected to hit 20 over the next several years. The world's nations are increasingly realizing the importance of the role that hydrogen will play in achieving carbon neutrality.

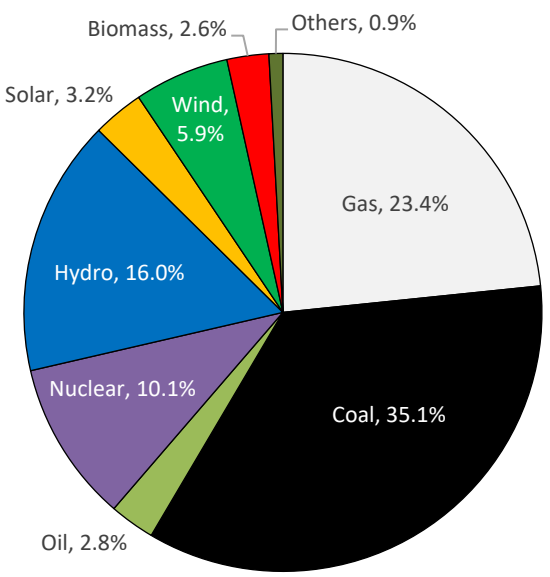
Share of renewables in the total global power output to reach 28% in 2021 and close to 30% in 2022

- Global power output, after dropping by 1% in 2020, would rise around 6% in 2021 from the 2020 level
  - Solar PV, wind, and other renewables totaled 7,440 kWh in 2020, up 6% from 2019
  - Renewables would rise around 500 kWh/year, close to 8,000 kWh in 2021
  - The share of renewables in global power output is expected to continue growing to reach 28% in 2021 and close to 30% in 2022
  - However, an unexpected rise in electricity demand for 2021–2022 could stunt renewables share growth as power output from non-renewables will also increase

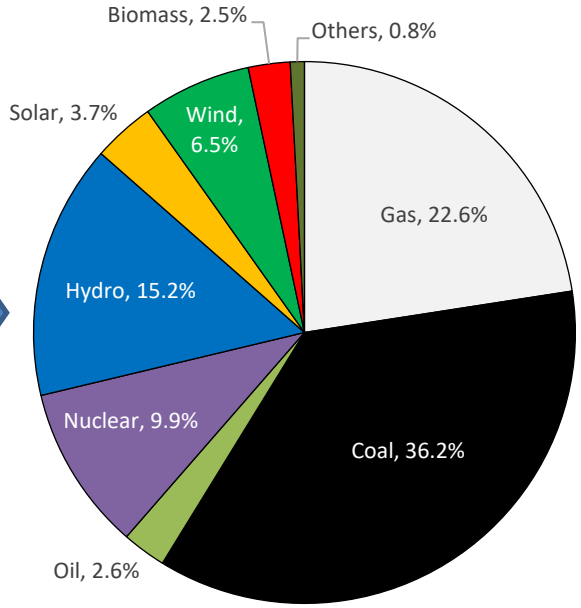
2019 global power output (27,001 TWh)
(Renewables share 26%)



2020 global power output (26,823 TWh)
(Renewables share 28%)



2021 global power output (about 28,300 TWh)
(Renewables share 28%)

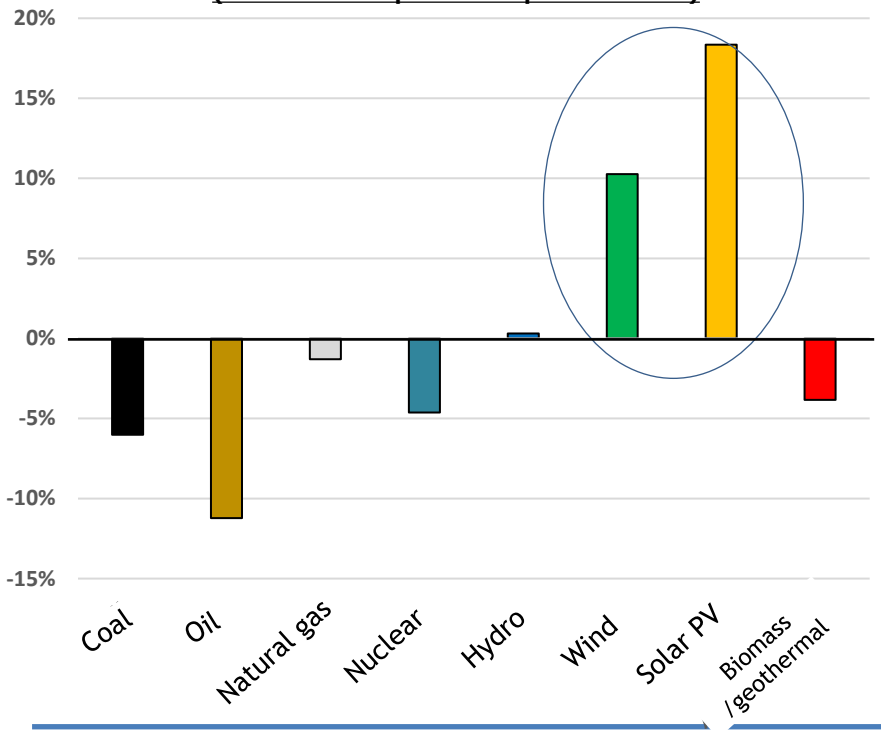


Source: Prepared based on sources including "BP Statistical Review of World Energy July 2021," "IEA Electricity Market Report July 2021," "IEA Renewable Market Update 2021," and "IEA Renewables 2021"

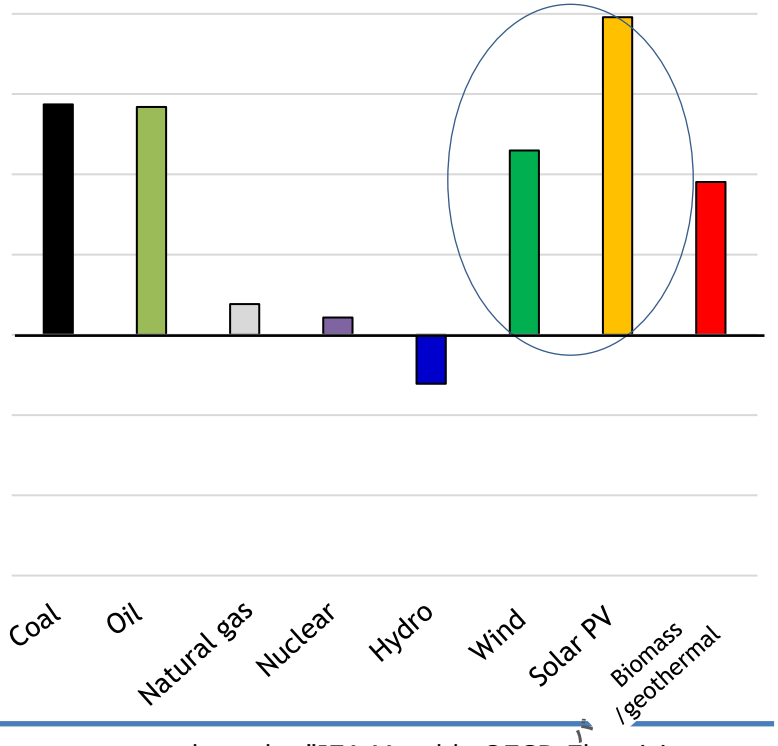
1H 2021: Coal power output to increase alongside solar PV and wind

- Regarding power output in OECD countries + China, India, and Brazil, the following data points exist when comparing the change from 1H 2019 to 1H 2020 (figure at left) and from 1H 2020 to 1H 2021 (figure at right):
  - Though thermal power plummeted in 2020, coal-fired power rose significantly in 2021, especially in Asia, while gas rose slightly
  - Solar PV and wind, which were the only energy sources that increased in 2020, will slightly outpace 2020 in 2021
  - A structural change that has seen solar PV and wind power output continue to rise, regardless of electricity demand decreases or increases in 2020–2021, will continue --> This trend will also continue into 2022

Power output change from January– August, 2019 to January–August, 2020 (6.3% overall power output decrease)



Power output change from January–July, 2020 to January–July, 2021 (7.5% overall power output increase)

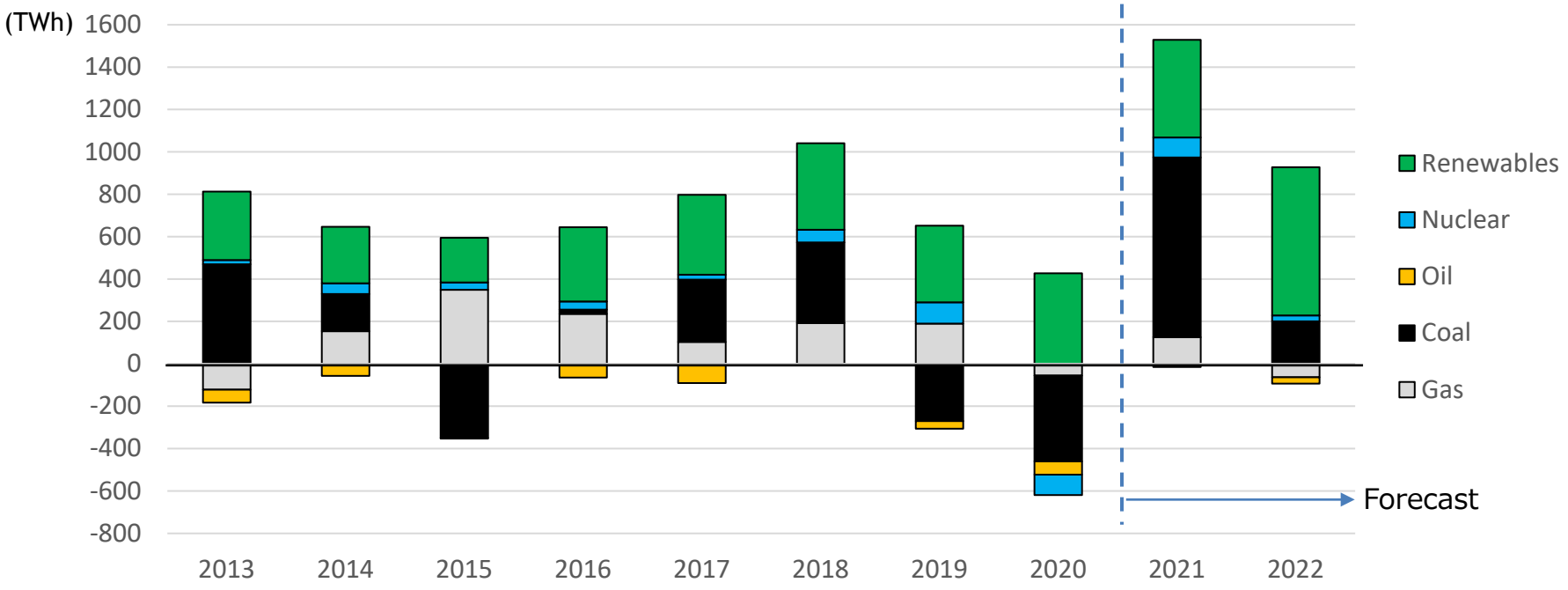


Source: Prepared based on sources such as the "IEA Monthly OECD Electricity Statistics": Data up to July 2021

Constant increase in renewables while coal fluctuates significantly corresponding to demand ups and downs

- Global renewable output increased in 2020 to 430 TWh, a new high; 460 TWh increase is expected for 2021
  - As electricity demand dropped in 2020, the amount of renewable output increase was offset by a drop in coal and other power output. However, as electricity demand substantially increased, over 1,500 TWh, in 2021, only around 30% of the demand increase is met with renewables alone. Most of the rest is being covered by increasing coal power.
  - Although the continued increase of more than 600 TWh for renewable output led by solar PV and wind is expected for 2022, this would be not sufficient enough to cover the increase in overall electricity demand, making a continued increase in coal power likely
  - Whilst renewables output rises constantly, non-renewable sources, particularly coal, fluctuate significantly up and down corresponding to overall electricity demand ups and downs

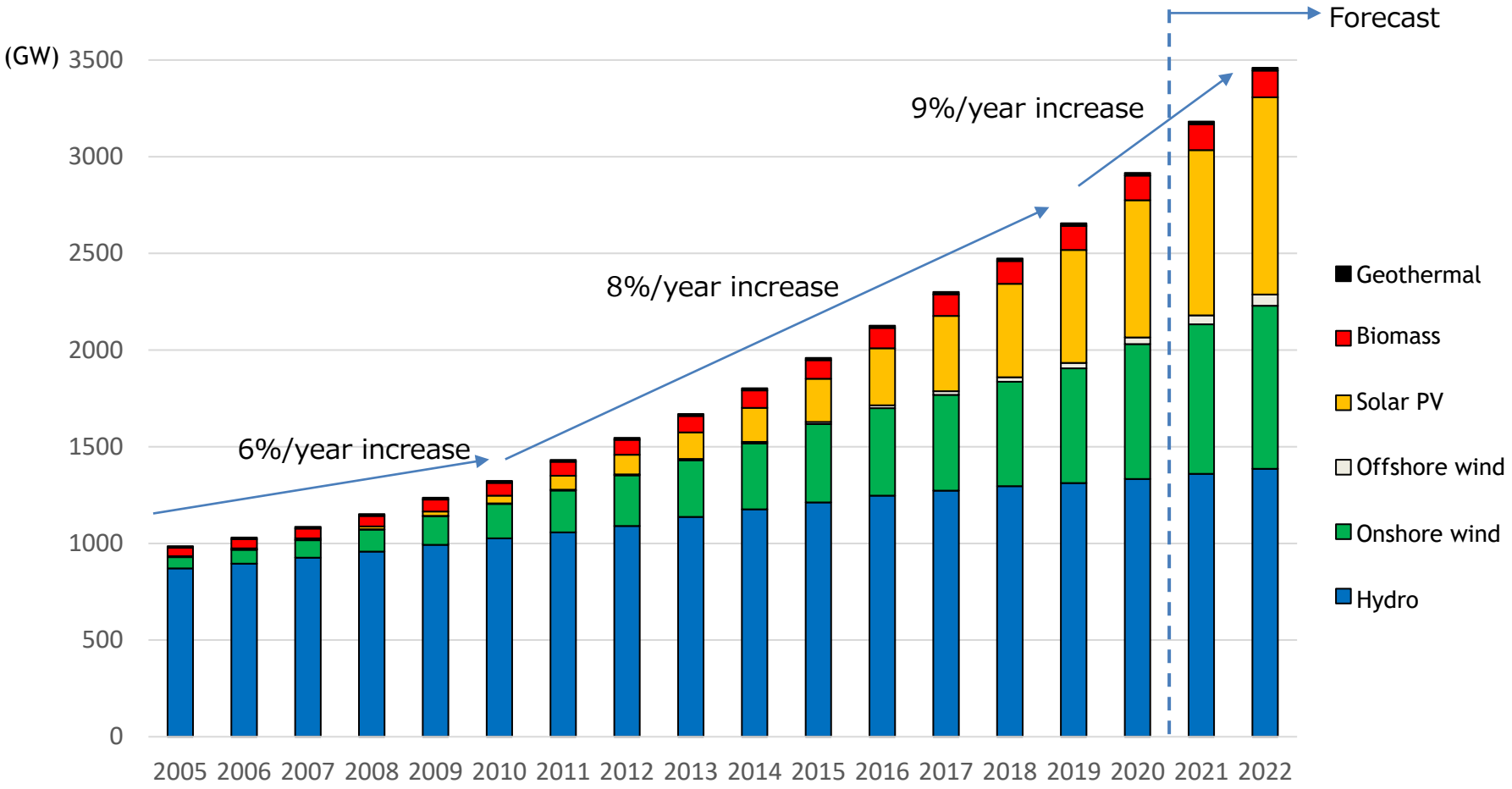
Year-over-year changes in global power output



Source: Prepared based on sources including "BP Statistical Review of World Energy July 2021," "IEA Electricity Market Report July 2021," "IEA Renewable Market Update 2021," and "IEA Renewables 2021"

Global renewable power generation capacity (2005–2022)

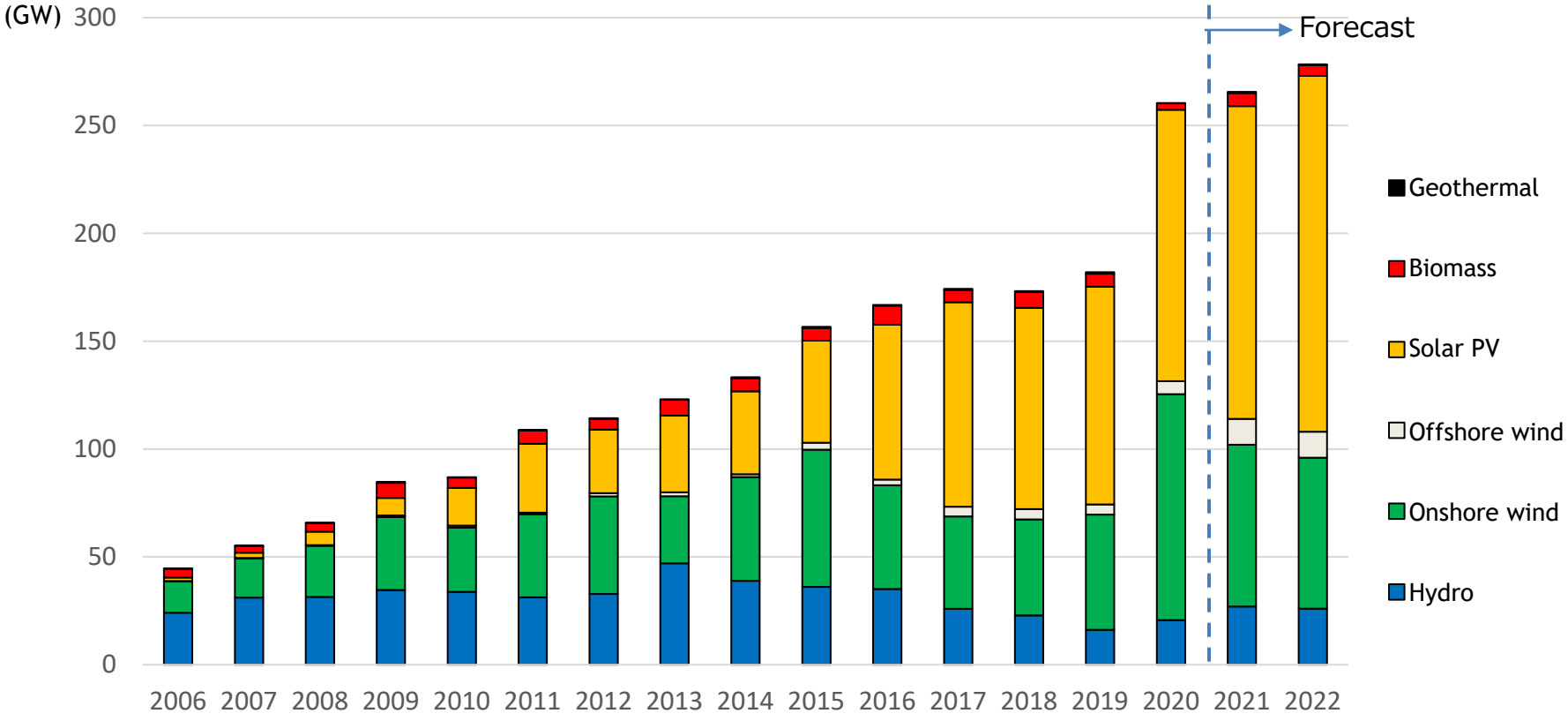
- Renewable generation capacity continues to grow in 2020 and beyond, on track to reach 3,200 GW by the end of 2021 and 3,500 GW by the end of 2022
  - The rate of increase, 6%/year on average between 2005–2010, is expected to increase to 8% for 2011–2019 and 9% for 2020–22



Source: Prepared based on data from sources including "IRENA Renewable Electricity Capacity and Generation Statistics," "IEA Electricity Market Report July 2021," "IEA Renewable Market Update 2021," and "IEA Renewables 2021"

Global annual addition of renewable generation capacity (2006–2022)

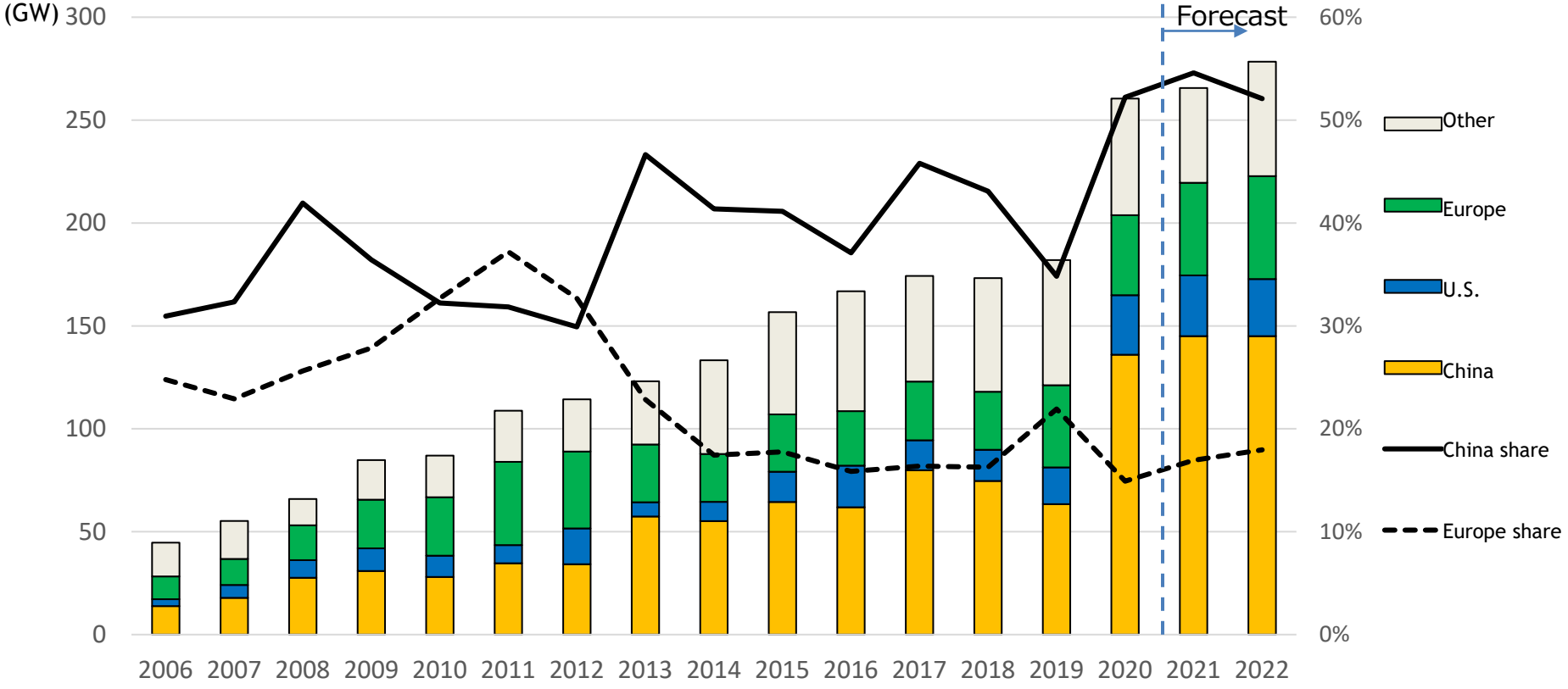
- Despite the ongoing effects of the COVID-19 pandemic worldwide, 2020 was a record year for global renewables deployment. At 260 GW, 2020 far outpaced 2019's 180 GW, which itself was a new high.
- 2021–2022 is expected to see renewable power generation capacity deployed at a level that exceeds 2020
  - Fueling this acceleration is rising investor interest in renewables on account of the declaration of carbon neutrality target, policies to promote renewables by major countries, as well as a market environment that supports the deployment of renewables, one aspect of which is private enterprises' procurement of renewable electricity through means such as PPA



Source: Prepared based on data from sources including "IRENA Renewable Electricity Capacity and Generation Statistics," "IEA Electricity Market Report July 2021," "IEA Renewable Market Update 2021," and "IEA Renewables 2021"

Global annual addition of renewable generation capacity (2006–2022)

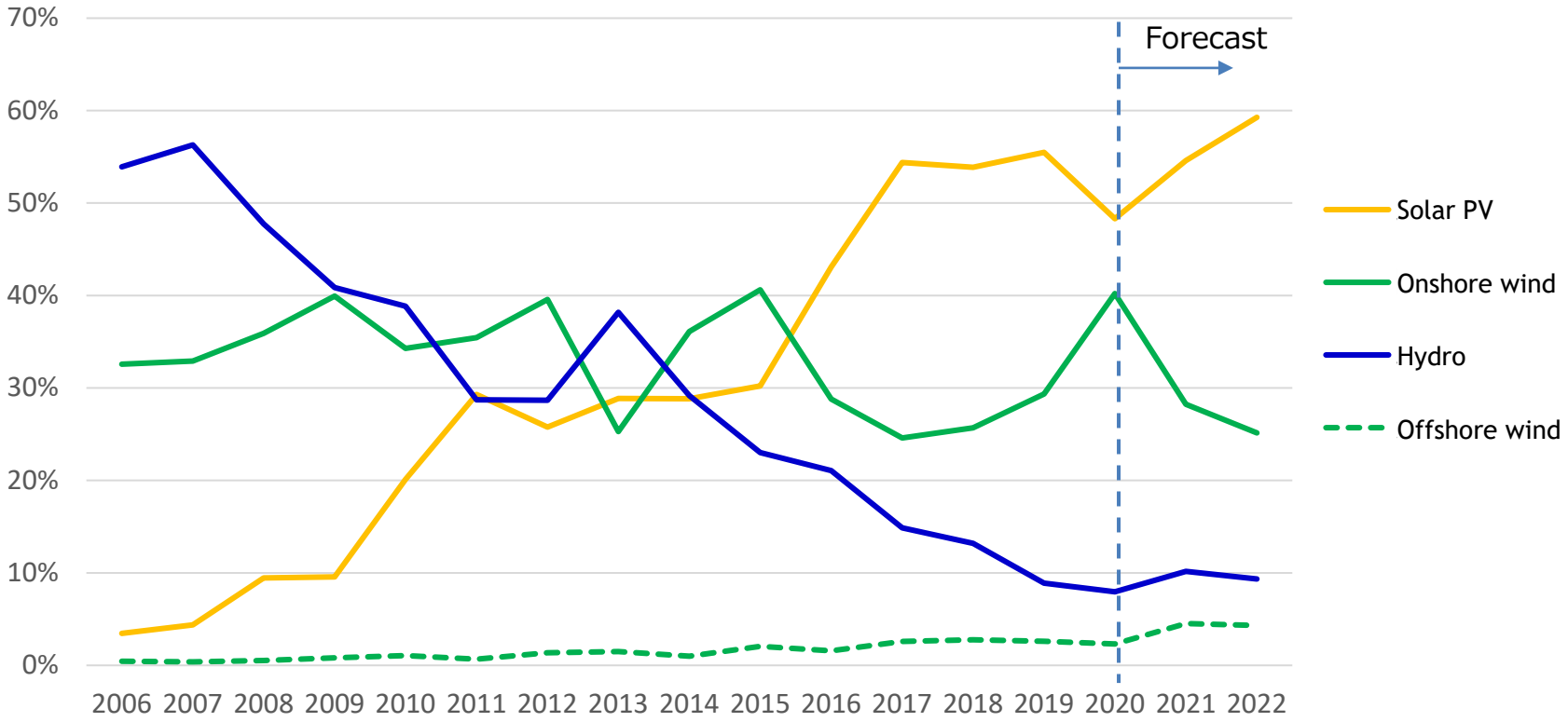
- 2020 saw China's share of annual growth in renewable generation capacity exceed 50% for the first time
  - With China stepping up its renewables deployment seeking to achieve carbon neutrality by 2060, 2021–2022 is set to see this single country account for around 50% of global growth in renewable generation capacity



Source: Prepared based on data from sources including "IRENA Renewable Electricity Capacity and Generation Statistics," "IEA Electricity Market Report July 2021," "IEA Renewable Market Update 2021," and "IEA Renewables 2021"

Global annual increases in renewable power generation capacity, by energy source (2006–2022)

- During 2021–2022, solar PV will come to account for 60% of annual growth in renewable capacity
- In the 2010s, the growth of renewables saw the market gradually shift away from wind and toward solar PV. The 2020s will now be a time of even greater growth for solar PV.
  - Solar power's edge is growing because of a generation cost that has come down to a global average of ¥6.4/kWh, versatility that allows for generation whenever there is sunlight, and ease of installation and maintenance.
  - The significant increase in onshore wind power that began in 2020 is thought to be a temporary phenomenon due to a rush to deploy prompted by policy changes in the U.S. and China.
  - An upward trend for offshore wind has become even more clear despite absolute volume still being low.

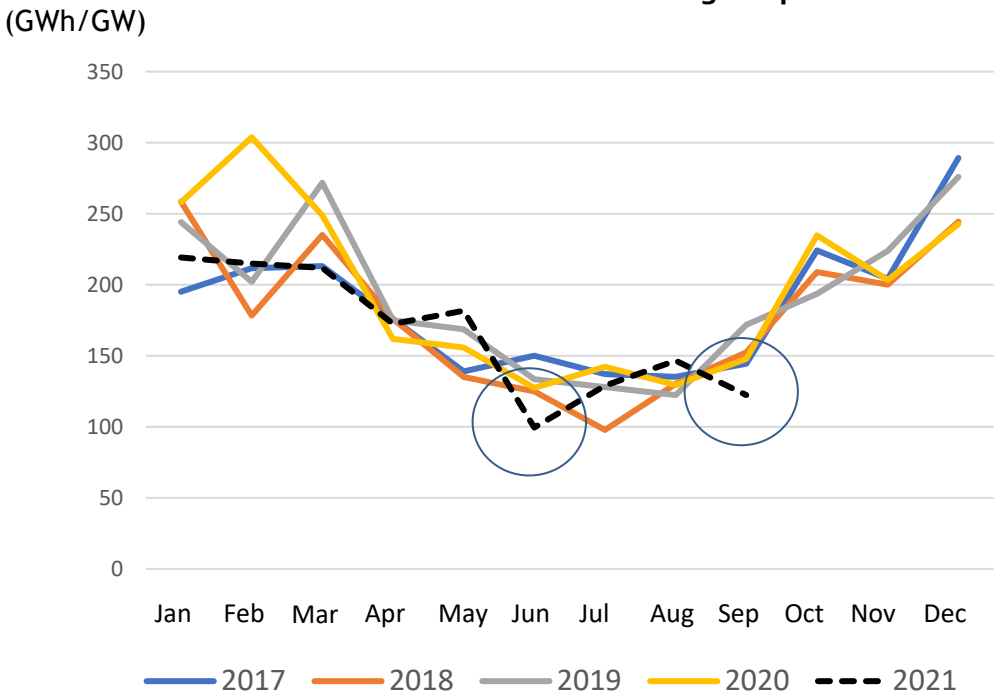


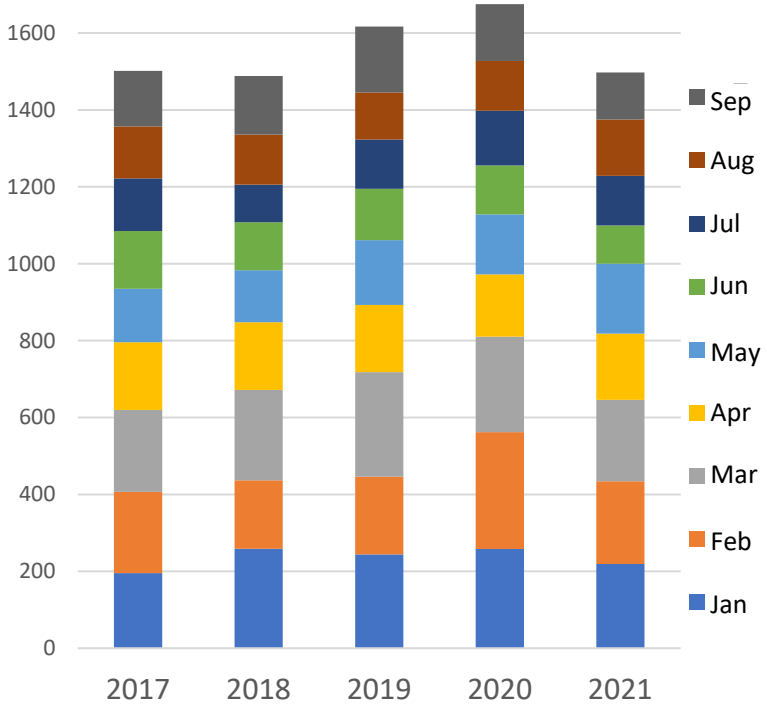
Source: Prepared based on data from sources including "IRENA Renewable Electricity Capacity and Generation Statistics," "IEA Electricity Market Report July 2021," "IEA Renewable Market Update 2021," and "IEA Renewables 2021"

European wind power generation: Declined 20% in June and September, 2021; should not be much worse for the year

- A look at monthly wind power generation in Europe between 2017 and 2021 presented at the left figure, adjusted wind power generation capacity, indicates a roughly 20% average decline over the last 5 years for June and September, 2021, suggesting the wind power picture has clearly worsened in these 2 months
  - On the other hand, May and August saw roughly 10–15% increases; including September in the total gives a level in line with 2017–2018 provided in the right figure, showing that there is no continued severe decline in wind power generation overall throughout the year
  - As the share of variable renewable energy rises, power grids will need to have the flexibility to accommodate this amount of fluctuation as it could happen at any time

EU27 yearly wind power generation (GWh) / wind power generation capacity at previous year end (GW) (figure at left), and totals through September for each year (figure at right)

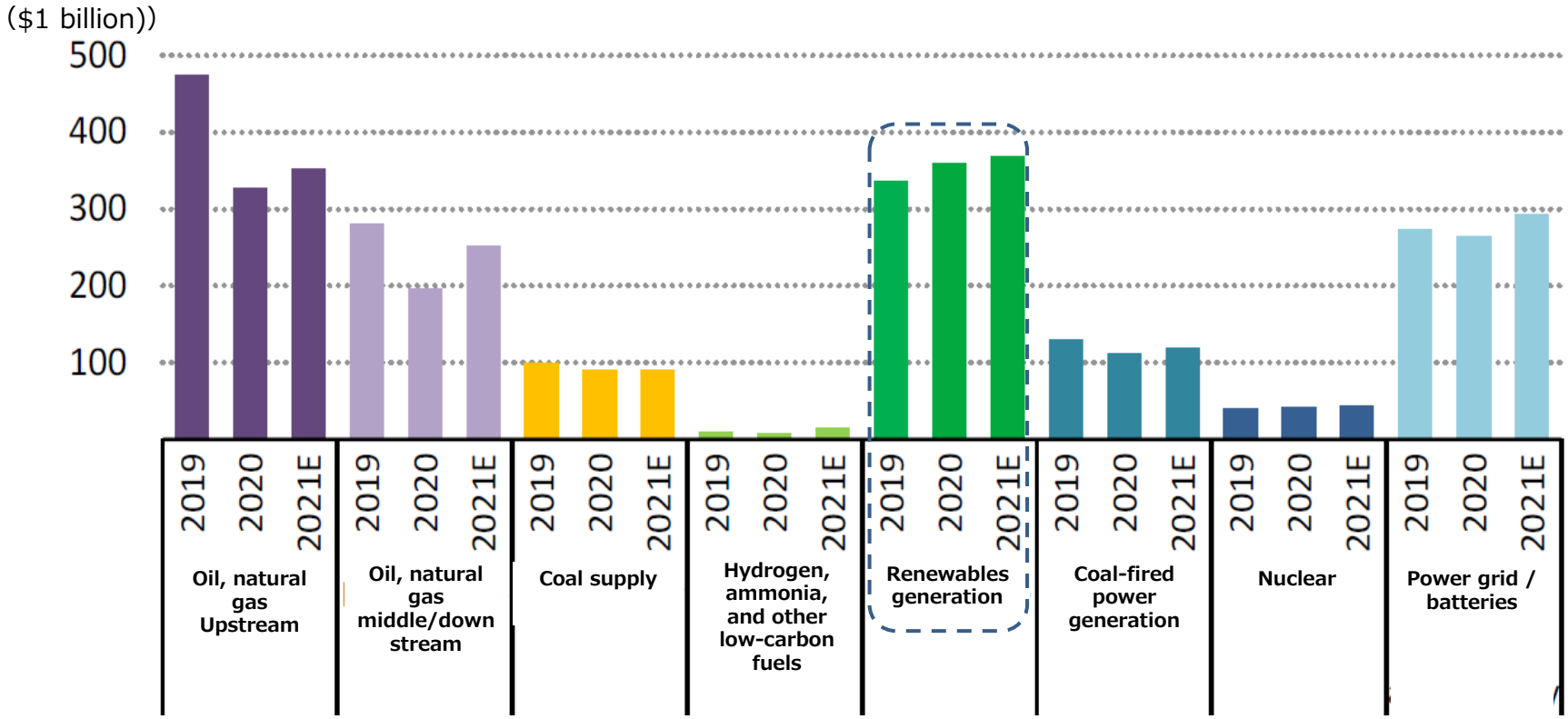




Source: Prepared based on sources including "Eurostat Net electricity generation by type of fuel - monthly data," and "IRENA Renewable Electricity Capacity and Generation Statistics"

Renewables to continue as the largest energy investment sector from 2020 through 2021

- Renewables generation increased in 2020 despite a large downturn in overall energy investment, and renewables will remain the biggest investment target in 2021
  - Renewables will account for 70% of the $530 billion in new power generation investment in 2021
  - 2021 has seen big investment in power grids and energy storage, which will become necessary as renewables grow, exceeding the 2019 levels
  - Investment in renewables generation, power grids, and batteries is expected to continue its ascent in 2022

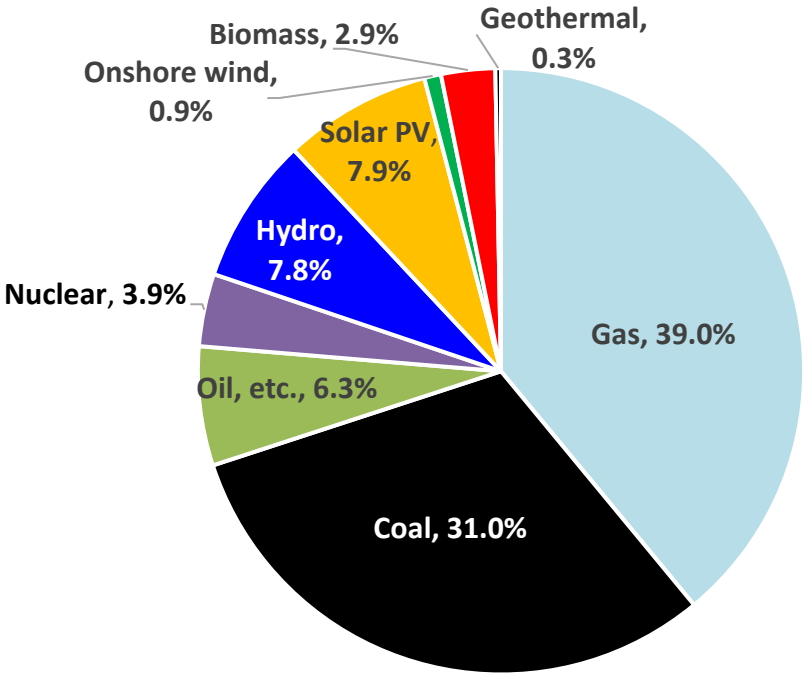


Source: IEA World Energy Investment 2021

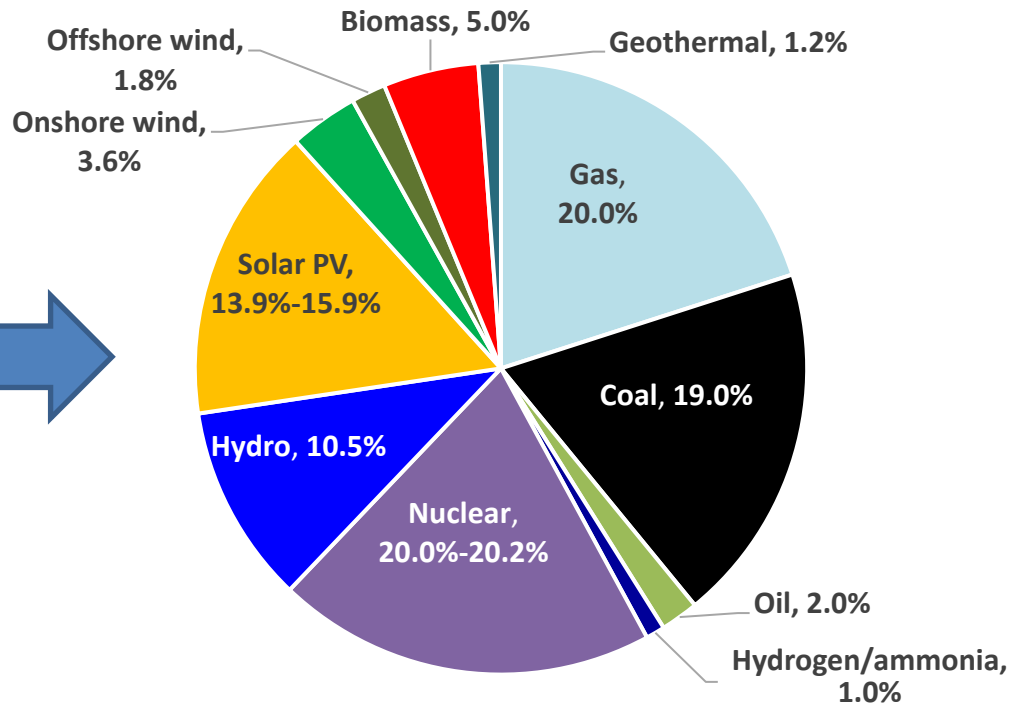
Renewables share in total power generation in Japan: From 19.8% in FY 2020 to targetted 36-38% in FY 2030

- Renewable energy accounted for 19.8% of total power generation of 1,001 TWh in Japan in FY 2020, up 1.8% from the 18.0% of FY 2019 of 1,051 TWh; also a new high on par with FY 2015
  - The 6th Strategic Energy Plan forecasts a total output of 934 TWh for 2030, of which renewables accounts for 336–353 TWh, and establishes 36–38% as a new target for renewables as a share of the energy mix
  - To meet the target, renewables share has to grow by 1.6%/year. Given average annual increase of 1.2% over the last five years, such deployment must accelerate even faster

FY 2020 Japan energy mix (1,001 TWh)
(Renewables share 19.8%)



FY 2030 Japan energy mix (934 TWh forecast)
(Target renewables share 36–38%)

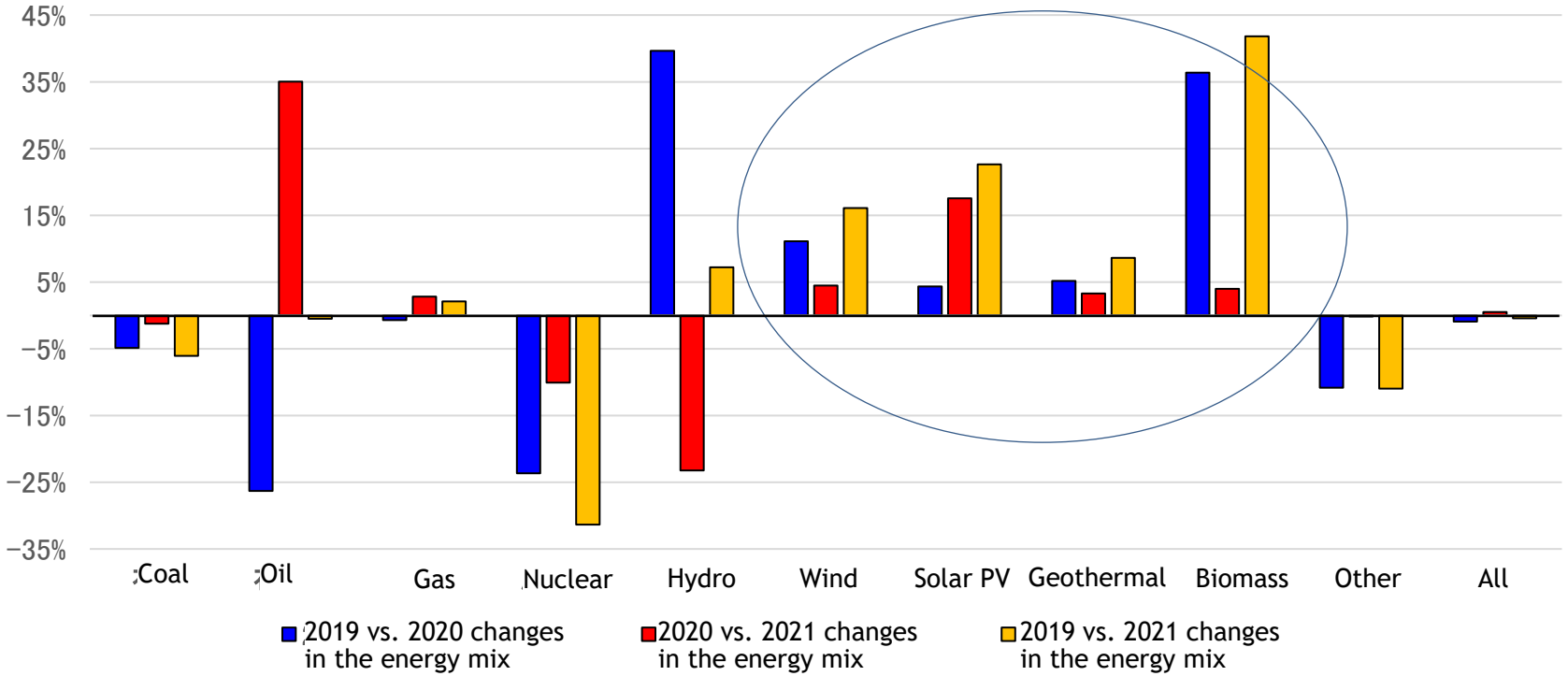


Source: Prepared based on sources such as the "Preliminary Report on the FY2020 Comprehensive Energy Statistics"; Agency for Natural Resources and Energy, "2030 Outlook for Energy Supply and Demand," October 2021

Non-hydro renewables have consistently trended upwards from 2019 through 2021

- Looking at power output change rates from 2019 through 1H 2021 shows a consistent/stable uptrend for wind, solar PV, geothermal, and biomass, which would continue in 2022
  - Market structure has become capable of maintaining stable renewable power, other than large-scale hydro, businesses through FIT; hydro tends to fluctuate considerably due to the instability of rainfall
  - Fossil fuels and nuclear are trending down or seesawing every year
  - Coal power, which has been rising globally since the beginning of 2021, continues to drop in Japan

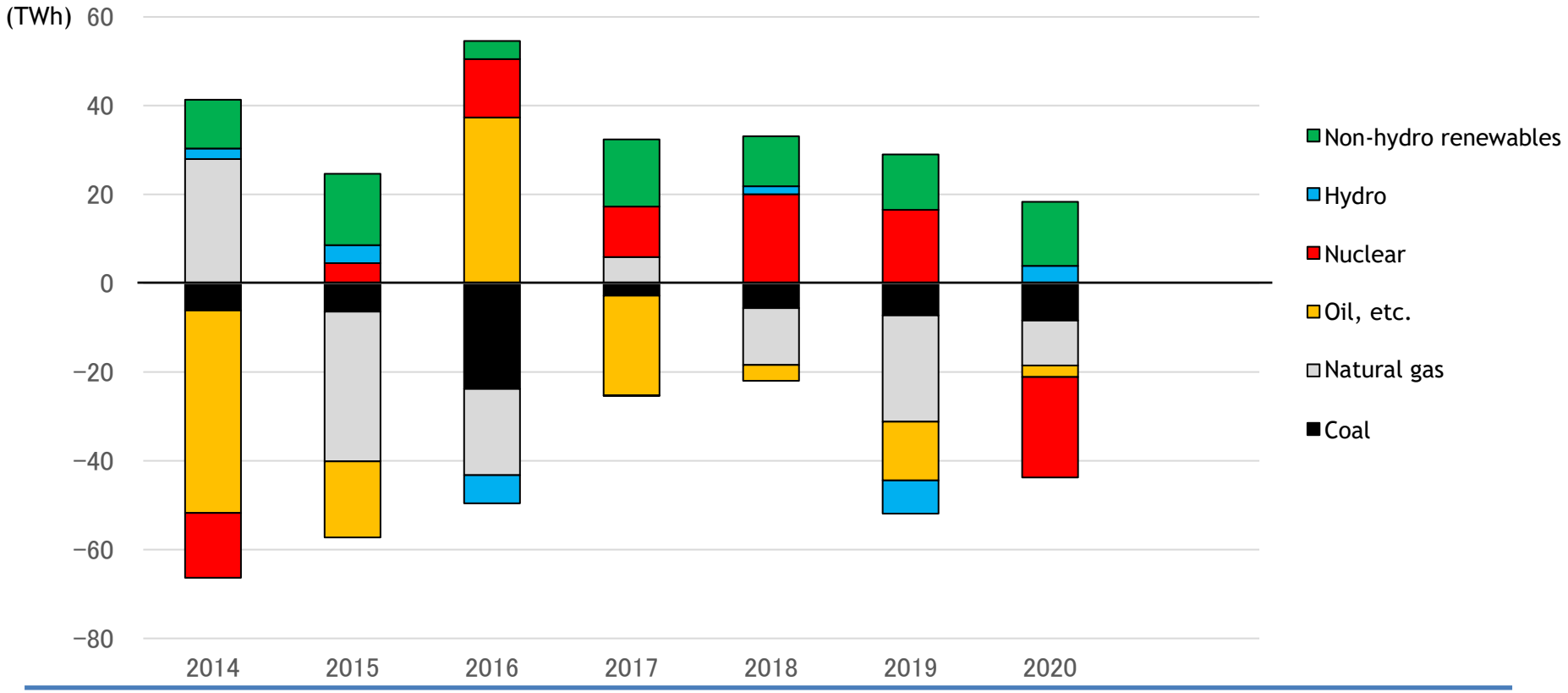
January-July changes in the energy mix: 2019 vs 2020, 2020 vs 2021, and 2019 vs 2021



Source: Prepared based on sources such as the "IEA Monthly OECD Electricity Statistics: Data up to July 2021"

YoY increase/decrease in power output in Japan (2014–2020)

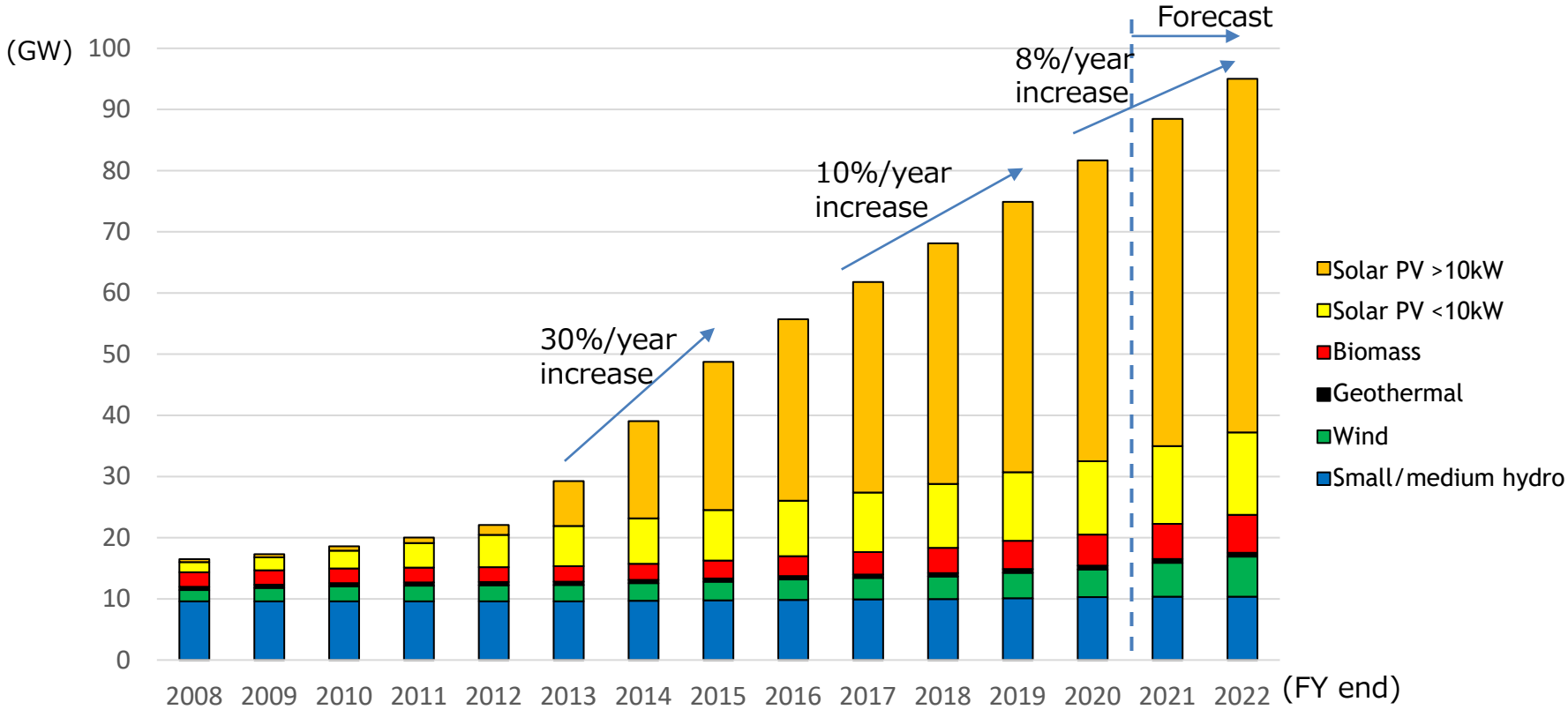
- While overall power output is declining or flatlining, coal has trended down while non-hydro renewables incl. solar PV, wind, biomass and geothermal have consistently trended upward
  - Hydropower fluctuates according to rainfall, and oil swings significantly adjusting to overall demand fluctuation
  - These trends are highly likely to continue in 2022 as long as overall demand does not spike upward
  - As fossil fuel power gets pushed out by the rise of renewables, ensuring power grid flexibility is emerging as a key issue



Source: Prepared based on data from the "BP Statistical Review of World Energy," July 2021

Renewable generation capacity in Japan (FY 2008–2022)
(excl. >30MW large hydro)

- Japan's renewable generation capacity is forecast to increase by 8%/year for 2021–2022, a slightly slower rise than the 9% for the rest of the world
  - Uncertainty surrounds large solar PV market due to the shift from FIT to FIP, which will start in FY 2022. Projects certified but not launched under the current FIT will form the bulk of projects that begin operations in FY 2021–2022. However, new large-scale solar PV developments would stagnant.
  - Renewable capacity excl. > 30MW large hydro would grow to 95 GW by the end of FY 2022, producing 183 TWh* of electricity during FY 2021
  - Adding >30MW large hydropower into this, the share of renewables in total in electricity generation would reach 22.4% in FY 2022

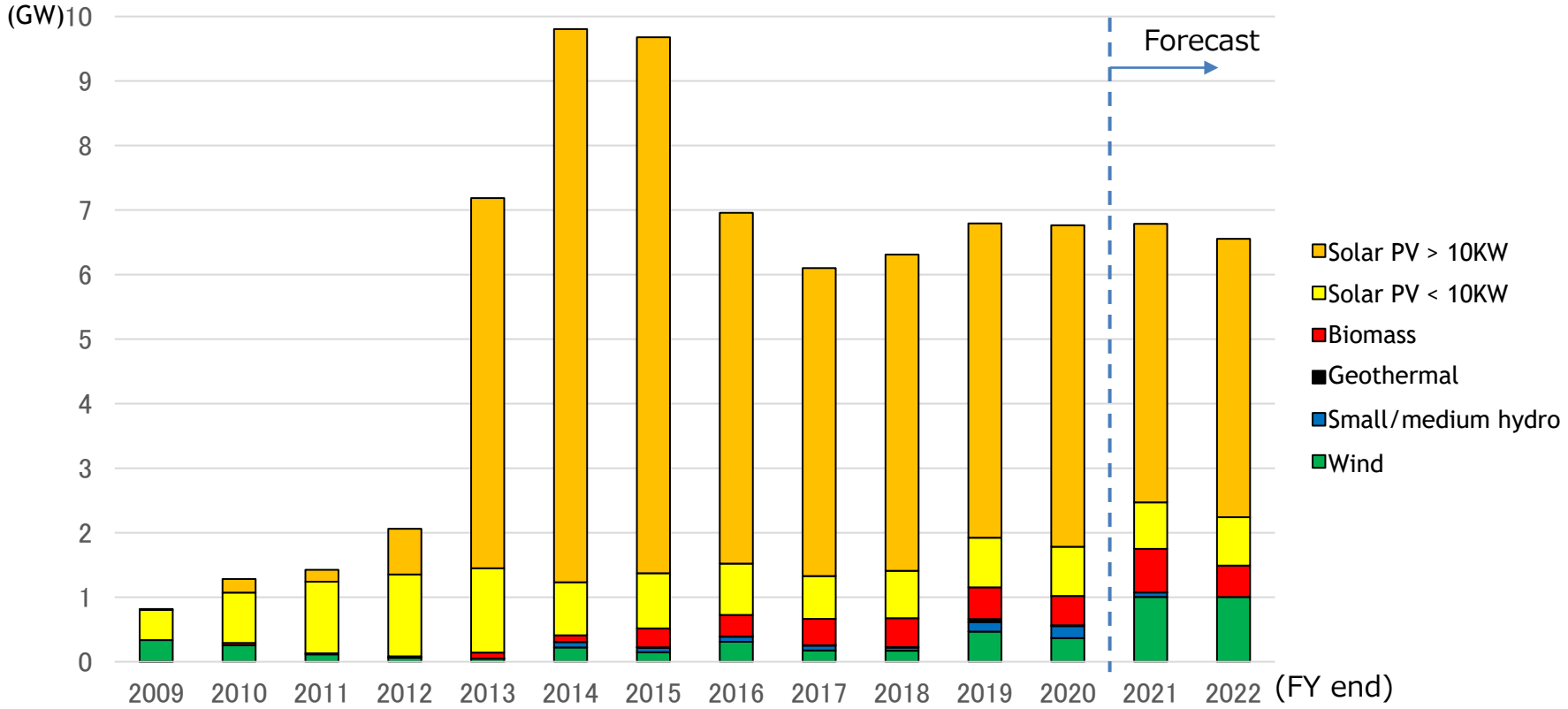


*Incluing own use generation of solar PV

Source: Estimates from the Institute of Energy Economics, Japan

Annual addition of Renewable capacity in Japan (FY 2009–2022)
(excl. >30 MW large hydro)

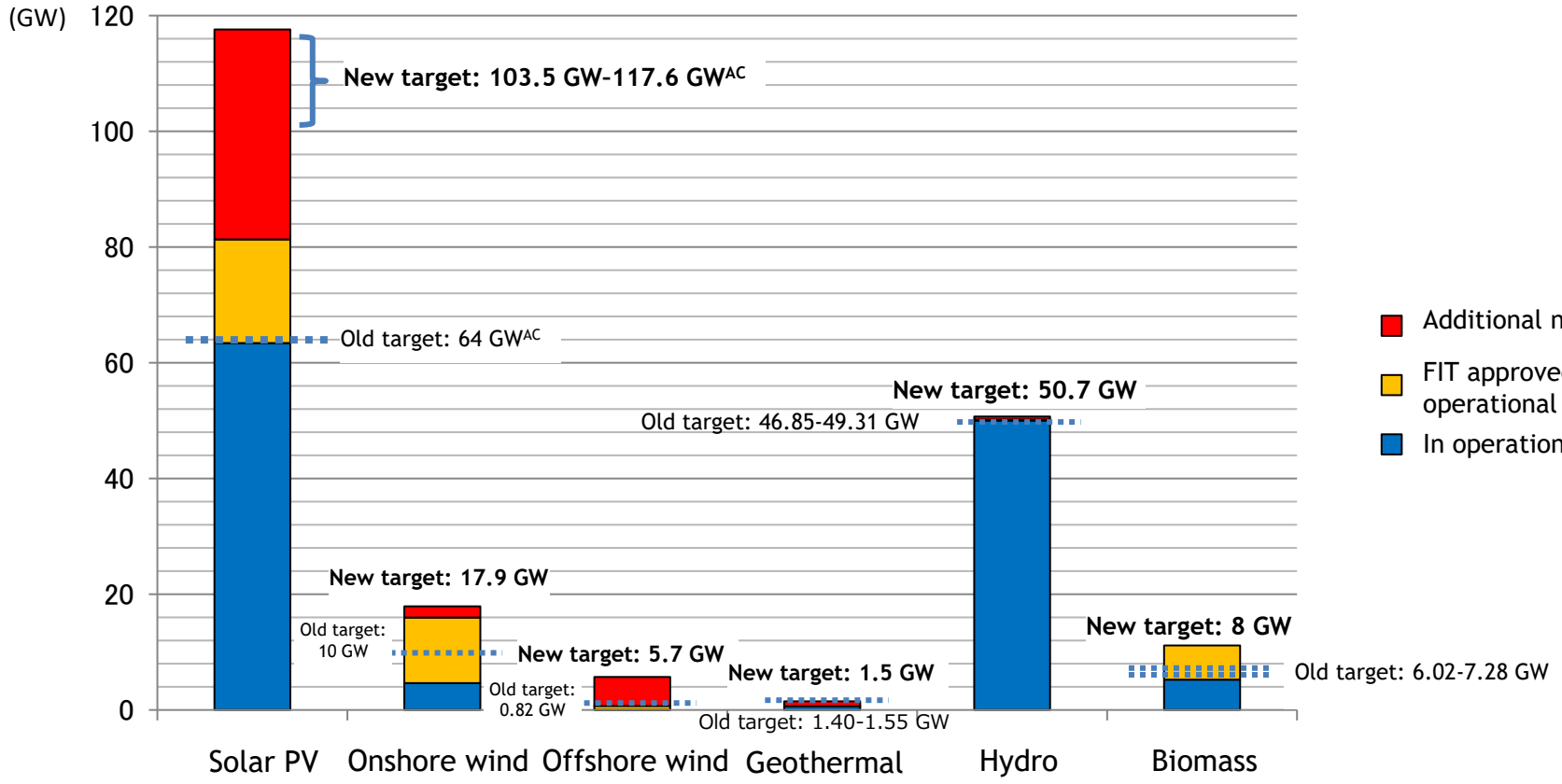
- In FY 2020, close to 6 GW^{AC} of capacity was deployed as large scale solar PVs came online. This dropped to 5 GW^{AC} in FY 2021, however, with a decline in FIT certifications. 2022 is expected to remain at a similar level due in part to uncertainty surrounding the transition to a FIP scheme.
  - Meanwhile, onshore wind has seen new deadlines set for the start of operations and expiration of FIT certification for non-operational projects. Deployment could increase significantly 2021 onwards as operations gradually commence.
  - However, offshore wind will yet not grow appreciably in the short-term market by 2022



Source: Estimates from the Institute of Energy Economics, Japan

Current renewables deployment vs. New/old FY 2030 targets
(as of 30 June 2021, incl. large hydro)

- The 6th Strategic Energy Plan establishes 36% to 38% as the new FY 2030 target for renewables as a share of the energy mix, and target deployment levels for each energy source are shown in the figure below.
  - Solar PV will reach the old target of 64 GW^{AC} within FY 2021, but reaching the new target of 103.5–117.6 GW^{AC} will require operation that about 4–5.5 GW^{AC}/year over the next 10 years. At the current pace, the lower limit could be reached but not the upper limit of 117.6 GW^{AC}.
  - Onshore wind is comfortably within the old target of 10 GW but need to deploy 1.3 GW/year over the next 10 years to meet the new target, which is unlikely at the current pace of 0.4 GW/year. Doing so will require that a considerable number of FIT certified non-operational projects commence operations or begin development.
  - Offshore wind power generation is virtually zero, and target achievement will depend greatly on development of large scale projects after a series of auctions under the offshore wind act.



Source: Prepared based on data from the Agency of Natural Resources and Energy

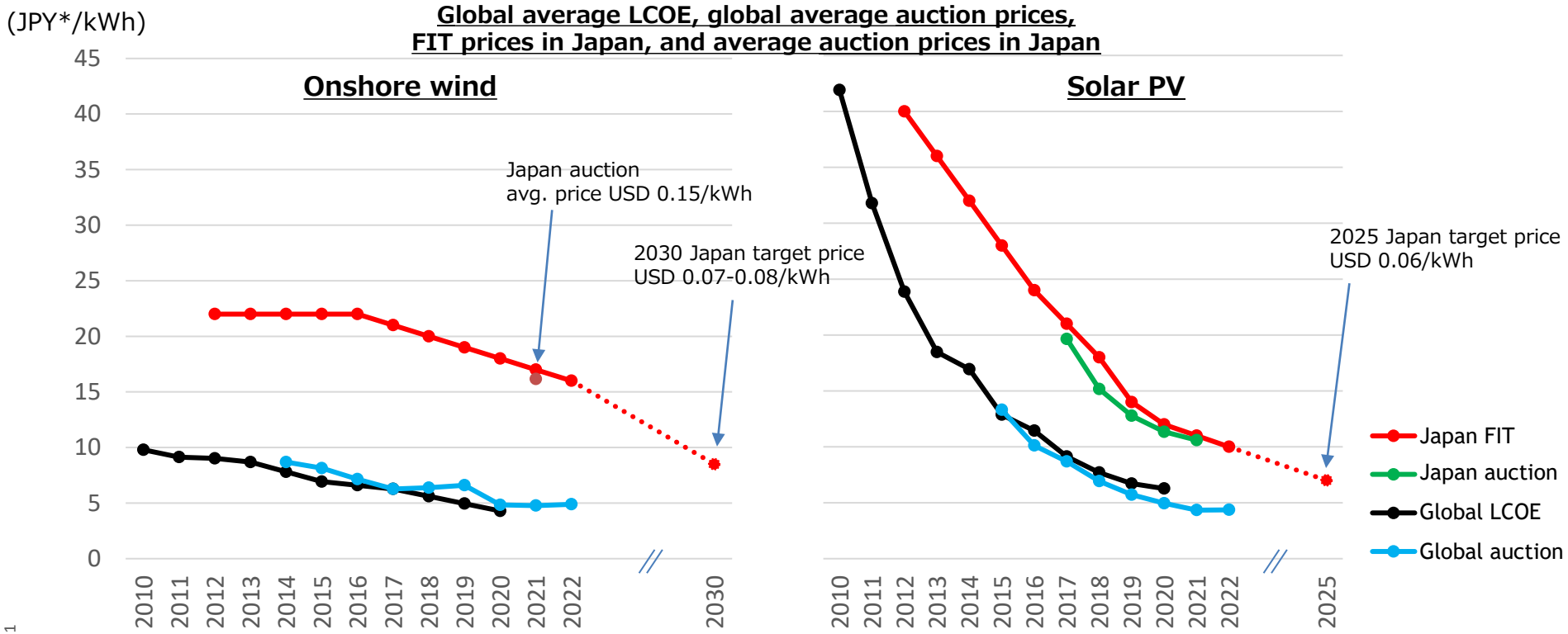
Renewables challenge (1) Deployment: How to deploy renewables to achieve the new 2030 target?

- The 125 GW of renewable capacity, including large-scale hydro, in 2020 needs to be increased to around 200 GW by FY 2030 to meet the target. This will require continuing renewables deployment at a pace of 7.5 GW annually, which exceeds the annual 7.1 GW average over the last five years.
- Target achievement will largely depend on the effectiveness of the following policies set out by the government

- Solar PV (>1 MW projects fully transition from FIT to FIP auction; only <10 kW rooftop and <50 kW projects for regional use will stay under FIT)
  - Commence FIT approved non-operational projects, many of which are large scale projects (18 GW)
  - Promote and commence FIT certified projects under current policies, mainly for rooftop for own use (14 GW)
  - Legal positive zoning that designates regions for development of renewable projects, and local governments' support for formulating renewables development plans (4.1 GW)
  - Mandate the installation of solar panels at newly-built national/local government facilities (6.0 GW)
  - Install solar panels at airports and surrounding unused national and public lands (2.3 GW)
  - Promote PPA and other own use generation through private enterprises (10 GW)
  - Expand solar installations for newly-built homes (3.4 GW)
- Onshore wind (>250 kW projects transition to FIT auction; but not yet FIP at least during FY 2022)
  - Commence FIT approved non-operational projects (4.8 GW)
  - Promote and commence FIT certified projects under the current policies (4.4 GW)
  - Deregulation of requirement for legal environmental assessments (2 GW)
  - Local government support for environmental assesment research/consultation with local community (0.6 GW)
  - Ramp up deployment by strengthening power grid (2.0 GW)
- Offshore wind (transition to FIT auction, but not yet FIP at least in FY 2022)
  - Increased auctions for offshore wind promotion areas under the offshore wind act (1.0 GW)
  - Enhanced governmental support for establishment of offshore wind businesses for selected operators (2 GW)
- Biomass (>10 MW solid biomass transition to FIP auction; only <10 MW projects for regional use will stay under FIT)
  - Commence FIT approved non-operational projects (2.3 GW)
  - Continue current policy efforts (0.5 GW)
  - Support the effective use of waste biomass (0.7 GW)

Renewables challenge (2) Costs: Solar PV FIT price is currently about USD 0.09/kWh, will drop further to the global average?

- The solar PV FIT purchase price was around USD 0.09/kWh in 2021, a sharp drop from when auction began in 2017; this is still about double the global average
  - Solar PV in Japan has been dropping on the back of a four year lag behind international levels, and would be able to reach the 2025 target price of USD 0.06/kWh
  - Onshore wind prices, however, differ greatly from international levels, and it is uncertain if the 2030 target price of USD 0.07-0.08/kWh is reachable
  - The taxpayer burden should trend downwards for the long-term due to falling FIT prices, a transition from FIT to FIP, an increase in own use generation via PPA and other private enterprises, FIT purchase period expiration, and the establishment of deadlines for non-operational FIT projects



*Exchange rate of JPY 110/USD applied

Source: Prepared based on data from "IRENA Renewable Power Generation Costs in 2020"

Renewables challenge (3) Overcoming power grid restrictions: Upgrading power grid would lead to improvements?

- The strengthening of the power grid and re-evaluations of good usage rules so as to accommodate large-scale renewables deployment is proceeding at a quick pace, with grid restriction mitigation expected over the long-term
  - However, the only improvements in the short- to medium-term will be from effective utilisation the existing power grid

- Strengthening the power grid going forward in the long-run
  - Legislate the formulation of plans for building inter-regional interconnections and intra-regional bulk power systems according to renewable resource potential
    - Formulate a push-type master plan based on cost benefit analysis that factor in renewable resource potential for each area, which is scheduled in 2022, and subsequent development of transmission networks
  - Discussion on how to bear the cost of reinforcement of transmission network e.g. inclusion into FIT surcharge
  - Deployment of a long-distance undersea HVDC cable from the Northern area with abundant wind potential to Tokyo

- Effective utilisation of the existing power grid
  - Progress being made on a so-called "Japanese Connect & Manage" for getting the most out of existing transmission grids
    - Expansion of available capacity calculations by rationalising estimated power flow: Operations already begun, expand to about 5.9 GW available capacity
    - Implementation of N-1 contingency criterion: Expand to about 40.4 GW available connection capacity, operations to begin in 2022
    - Non-firm connection: For bulk grid deployed in advance first in Tokyo area, then nationwide in FY 2021; local grids to also start in FY 2022; coverage for distribution grid to also be considered
  - Review of rules for operating transmission grid
    - Regarding inter-regional connections, an indirect auction was implemented in October 2018 that enables power transmission on the merit order changed from on a first-come first-served basis
    - Bulk power transmission lines have also transitioned to rules based on a merit order that prioritises efficient renewables from on a traditional first-come first-served basis
  - Measures to mitigate curtailment of renewables
    - Further Lowered minimum load of thermal power plants, promoted the public disclosure of grid data, increase in automated curtailment system in lieu of manual curtailment process.

Renewables issue (4) Increase share of VRE: Need to ensure power system flexibility

- Many countries, particularly in Europe where the shares of VRE (variable renewable energy) are rapidly rising, are developing and implementing measures to ensure power system flexibility
- Power system flexibility can be increase by suitable combinations of the following four options; No single solution to achieve a favorable balance between decarbonization and costs

1. **Dispatchable power plants**: Hydropower, pumped storage power, thermal power, biomass power, etc.
2. **Power grid strengthening, connection expansion, and operation improvement**: Effective utilisation of DERs (distributed energy resources) through smart grids, Connect & Manage, HVDC systems, DLR, VPL, and stronger power distribution system functions
3. **DSM (demand-side management)**: DR (demand response), aggregators/VPP, renewables own use generation and local production for local consumption, electricity P2P trading, EMS, IoT/AI/big data analysis, EV smart charging, DERs market participation, Energy-as-a-Service (EaaS), dynamic pricing
4. **Energy storage**: pumped storage power, batteries, and other storage technologies, EV, P2G (surplus renewable hydrogen conversion and storage), P2H (surplus renewable heat conversion and storage) and others

FIP to be implemented in FY 2022 in Japan: A major turning point toward renewable integration

- Amended FIT law goes into effect in April 2022 which leads to…
  - Implementation of FIP for selected renewables, non-operational project certification nullification system, allocation of surcharges to defray grid enhancement costs, system to guarantee compensation for solar PV system waste disposal costs

- Implementation of FIP, in place of FIT, for >1MW solar PV, >10MW solid biomass, >1MW geothermal and small/medium-scale hydro after April 2022
  - For >1MW solar PV and >10MW solid biomass, FIP prices will be determined by auction
  - For geothermal and small/medium scale hydro, FIP prices will be fixed by the government for the time being

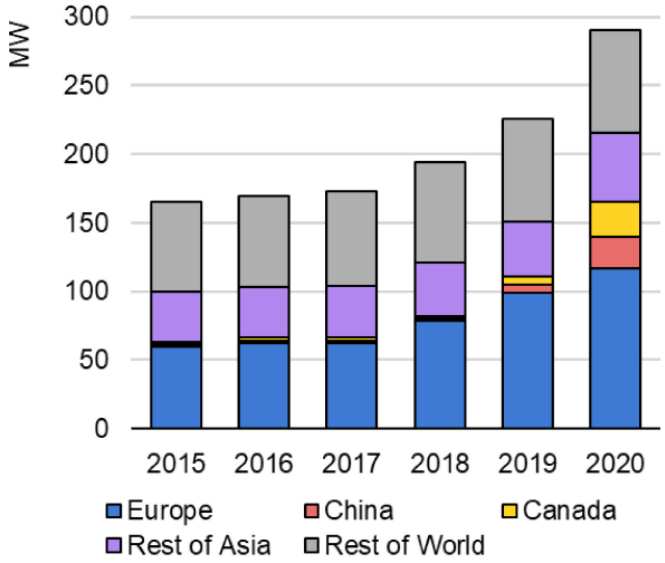
- Renewables have enjoyed guaranteed long-term fixed prices under FIT, but what happens under FIP?
  - Renewable power producers have to sell their generated output to the wholesale electricity market directly
  - The difference between the FIP benchmark price, which is equivalent to previous FIT fixed purchase prices, and the monthly average wholesale power market price, which is called “reference price”, is paid to the renewable producers
  - To maximize this profit margin, the renewable produders need to generate as much as possible when wholesale power prices are high
  - Renewable producers must have balancing responsibility avoiding imbalances, which were exempted from under FIT
  - Renewable producers will have to engage in a dialogue with markets under FIP, whereas under FIT all they had to do was simply generating power --> Major turning point towards renewables market integration

- Under FIP, aggregators and climate data services for power output forecasting are necessary
  - Small/medium-sized renewable power producers will need to work with aggregators to minimise imbalance burden and maximize earnings
  - Climate data provision service improvements are needed to conduct detailed renewable output forecasts
  - Currently, both aggregators and climate data provision services are immature in Japan, and much would be uncertain for the time being at least during FY 2022 until new renewable power business model is established under FIP

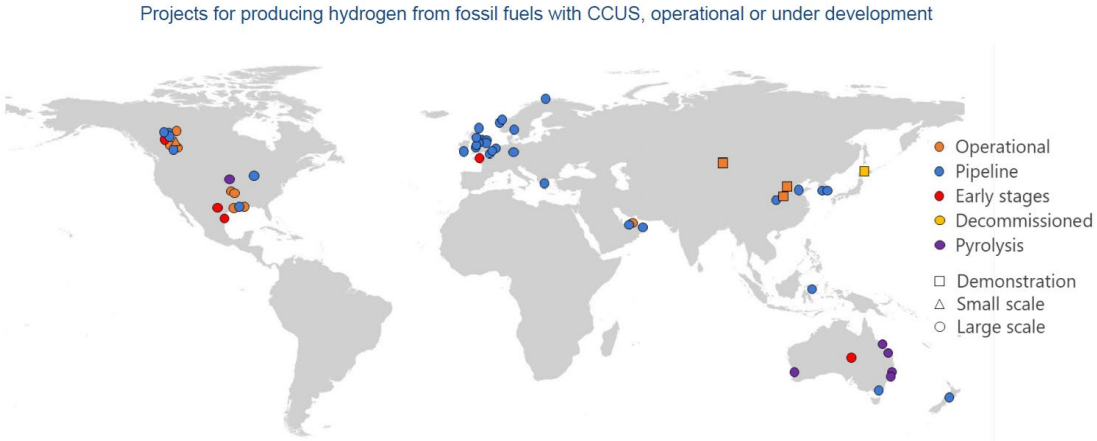
Outlook for clean hydrogen projects

- While predicting clean hydrogen production volume is difficult to do for the short-term (through 2022), in light of all projects currently being planned, hydrogen production could reach 17 Mt-H_2 a year (green hydrogen 8 Mt-H_2, blue hydrogen 9 Mt-H_2) by 2030
  - Current global green hydrogen production volume is 290 MW (an estimated 0.03 Mt-H_2/year), production will reach 5–8 Mt-H_2 if all 350 projects currently being planned commence operations
  - 16 blue hydrogen (fossil fuels + CCUS) are currently in operation around the world (0.7 Mt-H_2/year); production will reach 9 Mt-H_2/year if all 47 projects being developed or planned commence operation

Global green hydrogen production (MW)



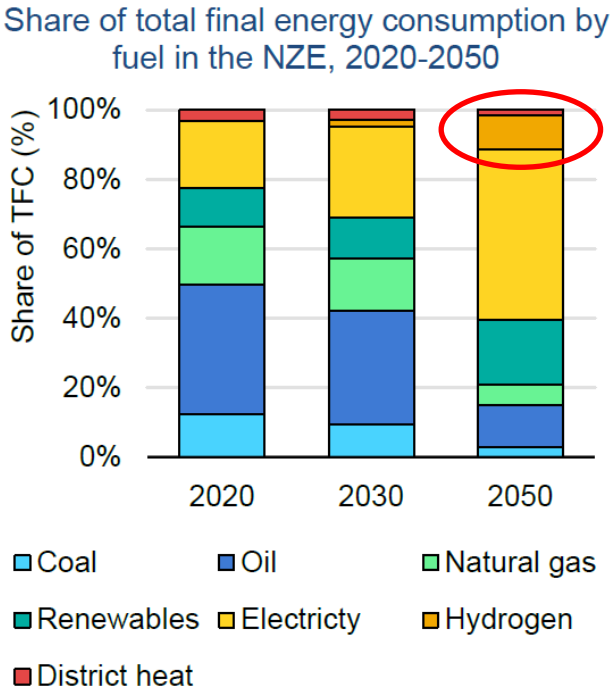
Global blue hydrogen (fossil fuels + CCUS) projects



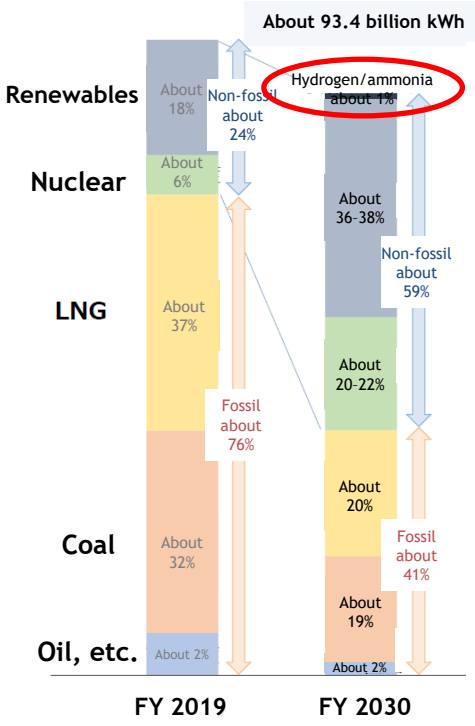
Source: IEA Global Hydrogen Review 2021

Establishing national hydrogen strategies: Hydrogen as a necessary means for decarbonisation

- Countries with national hydrogen strategies: 3 countries in 2019 incl. Japan, Korea, France, 13 more countries as of 2021 incl. Australia, Chile, France, Germany, the Netherlands, Norway, the UK, EC and others; 20 or more countries expected to establish their own over the next few years
  - The world's nations are increasingly realizing the importance of the role that hydrogen will play in achieving carbon neutrality (especially as a strategy for the Hard-to-Abate sector)
  - Hydrogen also shows promise for use in the industrial and transport sectors, in addition to the electricity generation sector



- <-- World: Hydrogen's share in the 2050 decarbonization scenario is predicted to be around 10% (hydrogen's share of final energy consumption)
- --> Japan: To meet the 6th Strategic Energy Plan targets of achieving up to 3 million tons by 2030, up to 20 million tons by 2050, and making hydrogen/ammonia power generation roughly 1% of the energy mix, will continually work to build an international hydrogen/ammonia supply chain (ammonia is in addition to the existing liquefied hydrogen and methylcyclohexane)



Source: IEA Global Hydrogen Review 2021

Source: Agency for Natural Resources and Energy," 2030 Outlook for Energy Supply and Demand," October 2021