



Asia: The Next Frontier for the Offshore Wind Industry





Introduction



The Asia Wind Energy Association was established in December 2016 to become the leading trade association for the wind energy sector in Asia Pacific.

The association acts as the regional platform for all wind power industry stakeholders to collectively promote the best interests of the wind power sector.

The Asia Wind Energy Association is supported by a wide variety of stakeholders from the offshore and onshore wind industry.

Corporate Partners



Corporate Members





www.asiawind.org



[@asiawindenergy](https://twitter.com/asiawindenergy)



Asia Wind Energy Association



CapitaGreen – Level 24
138 Market Street, Singapore 048946



(65) 6679 6071



membership@asiawind.org



Offshore Wind: Can the Asia-Pacific Region Catch up with Europe?

The question is not If.... but When

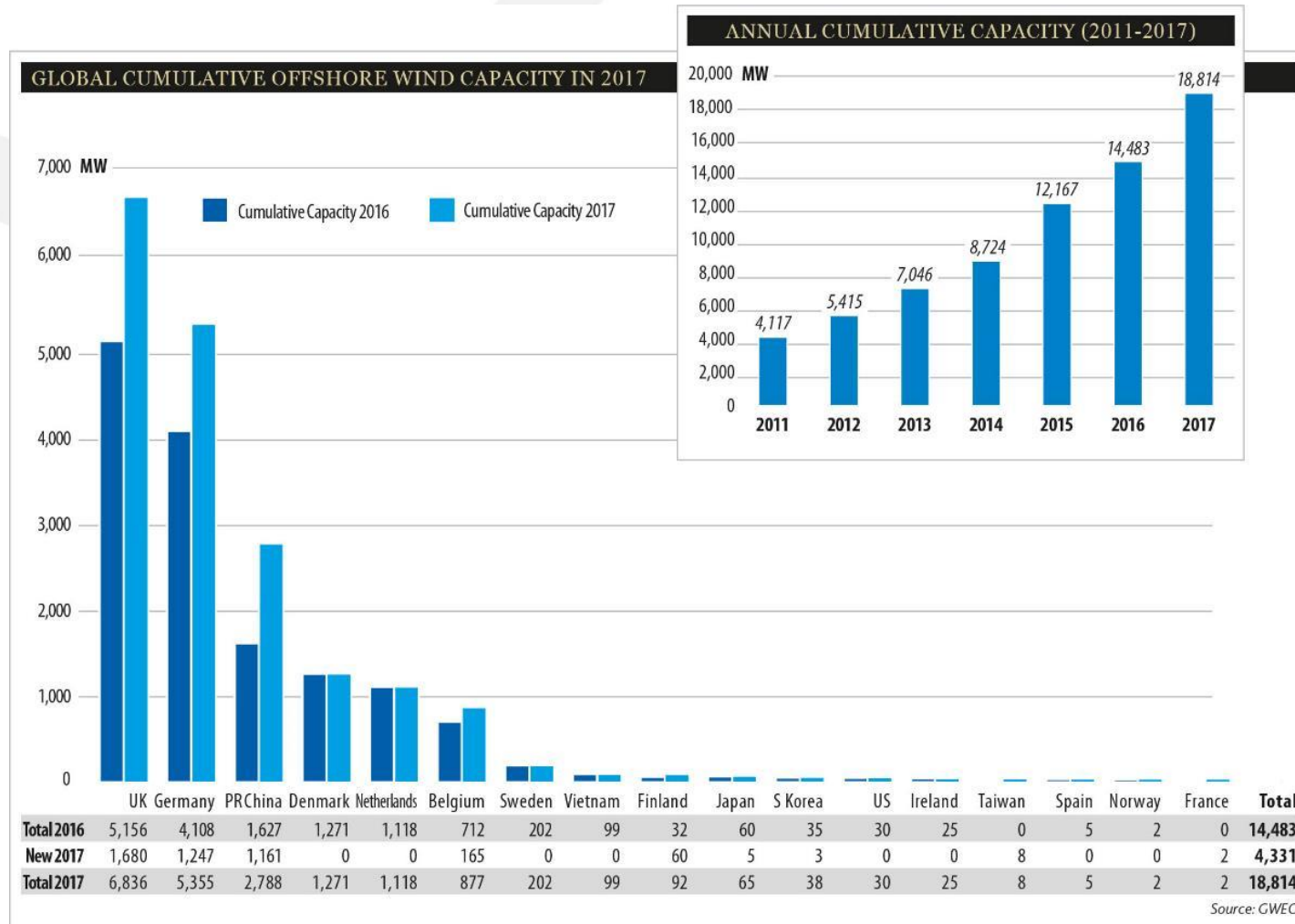


Regional Overview of the Asia Offshore Wind Industry



Global – Overview

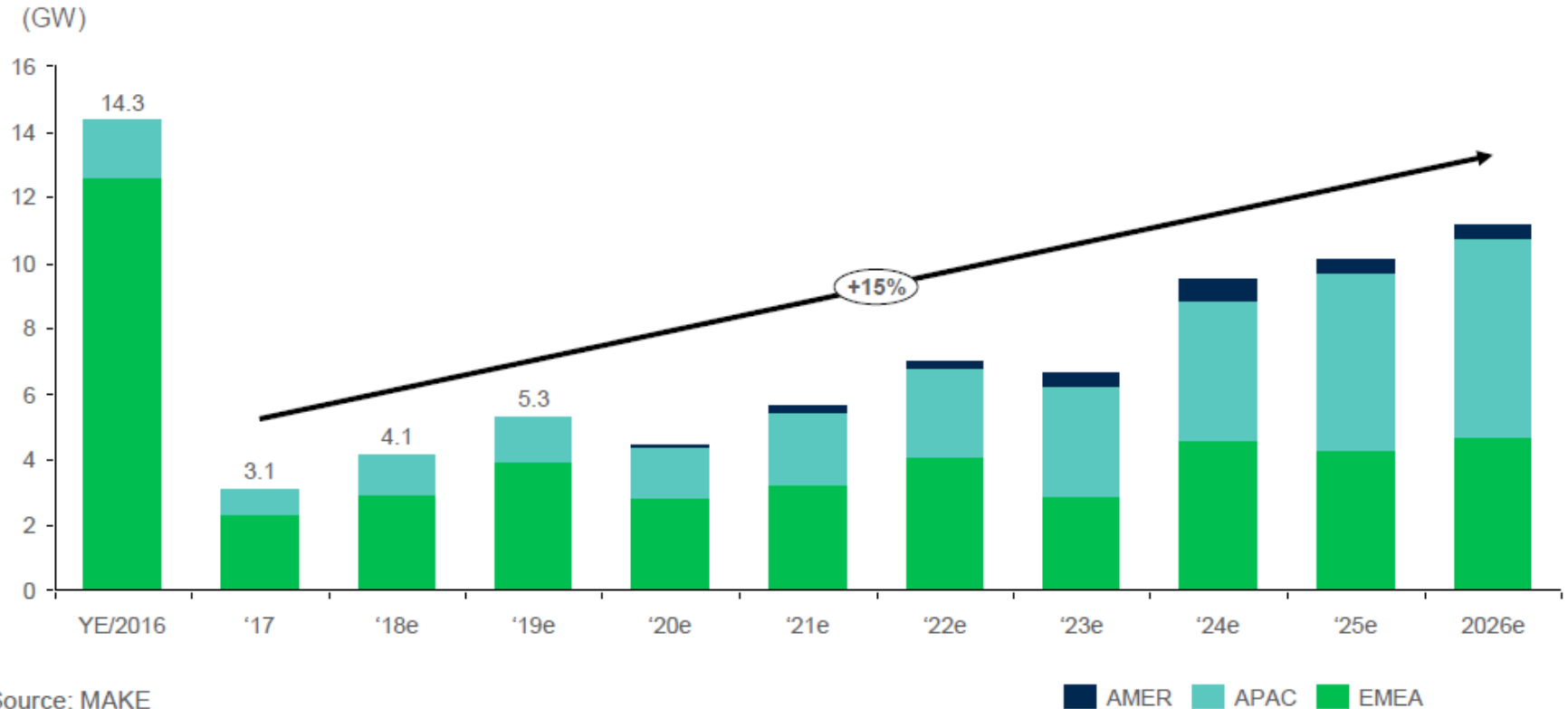
| Overall installed offshore wind capacity was close to 19 GW by the end of 2017.



Global – Outlook

| Significant capacity will be added; driven by Europe and Asia

Global offshore wind market outlook, 2017 to 2026e



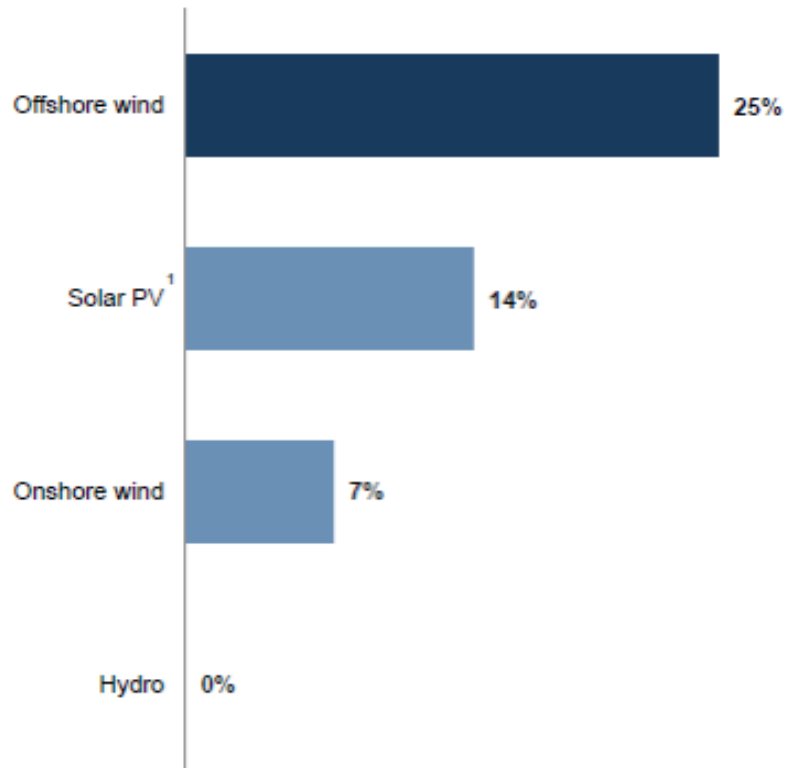
| The European region will grow at CAGR of 8%, significantly superseded by the APAC region, which will grow at a CAGR of 26%.

Global – Key Drivers

| Offshore wind will lead other renewable technologies in the coming year.

Fastest growing renewable technology in OECD

Installed capacity CAGR, 2014-2020
%



Offshore wind power offers multiple advantages

Utility size power generation

659 MW Walney Extension will power more than 460,000 UK homes

Offers +45% capacity factors²

Significantly higher than onshore wind and solar PV

Industry of significant scale

Industry maturity, volume and technological development offer attractive business opportunities and steep learning curves

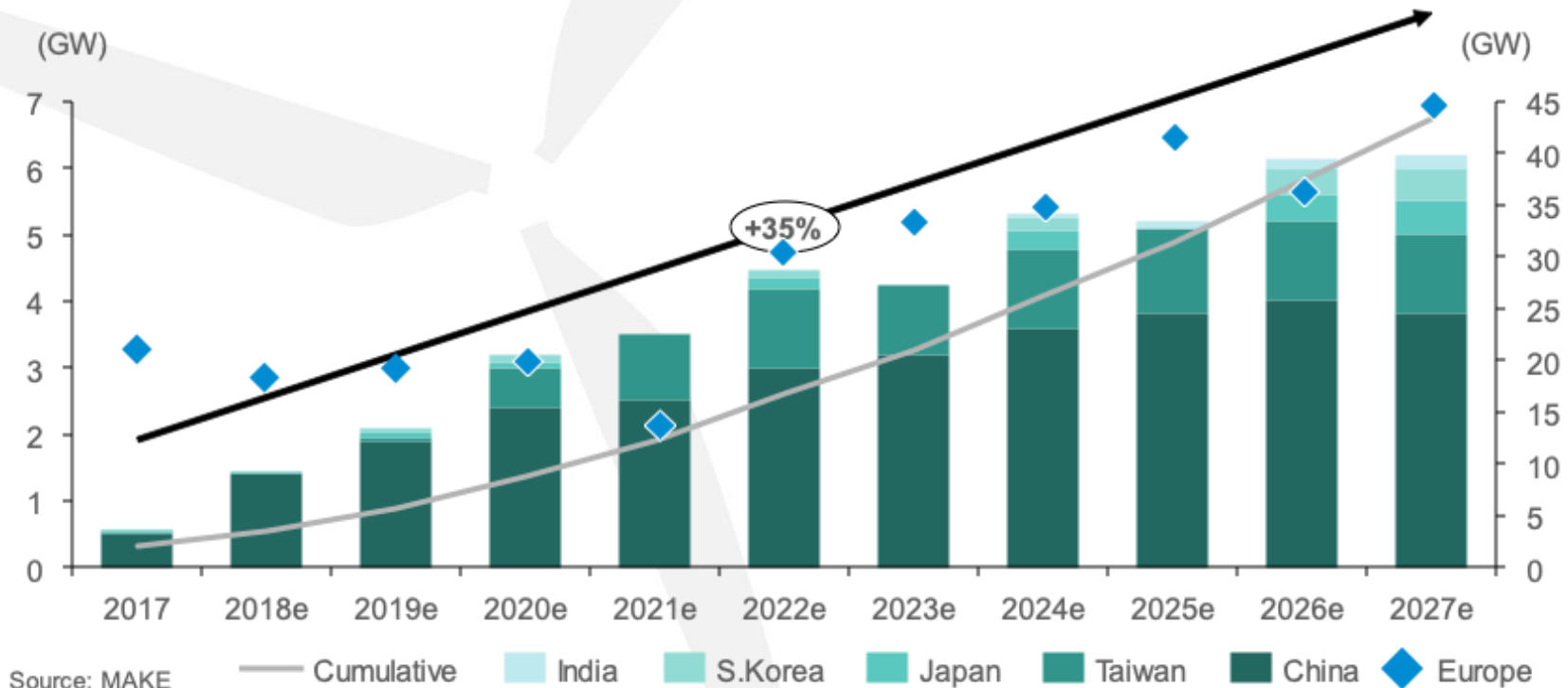
Limited visual impact on landscape

Wind farms are built far from shore

Asia-Pacific – Outlook

| Cumulative offshore capacity to reach 43 GW by 2027.

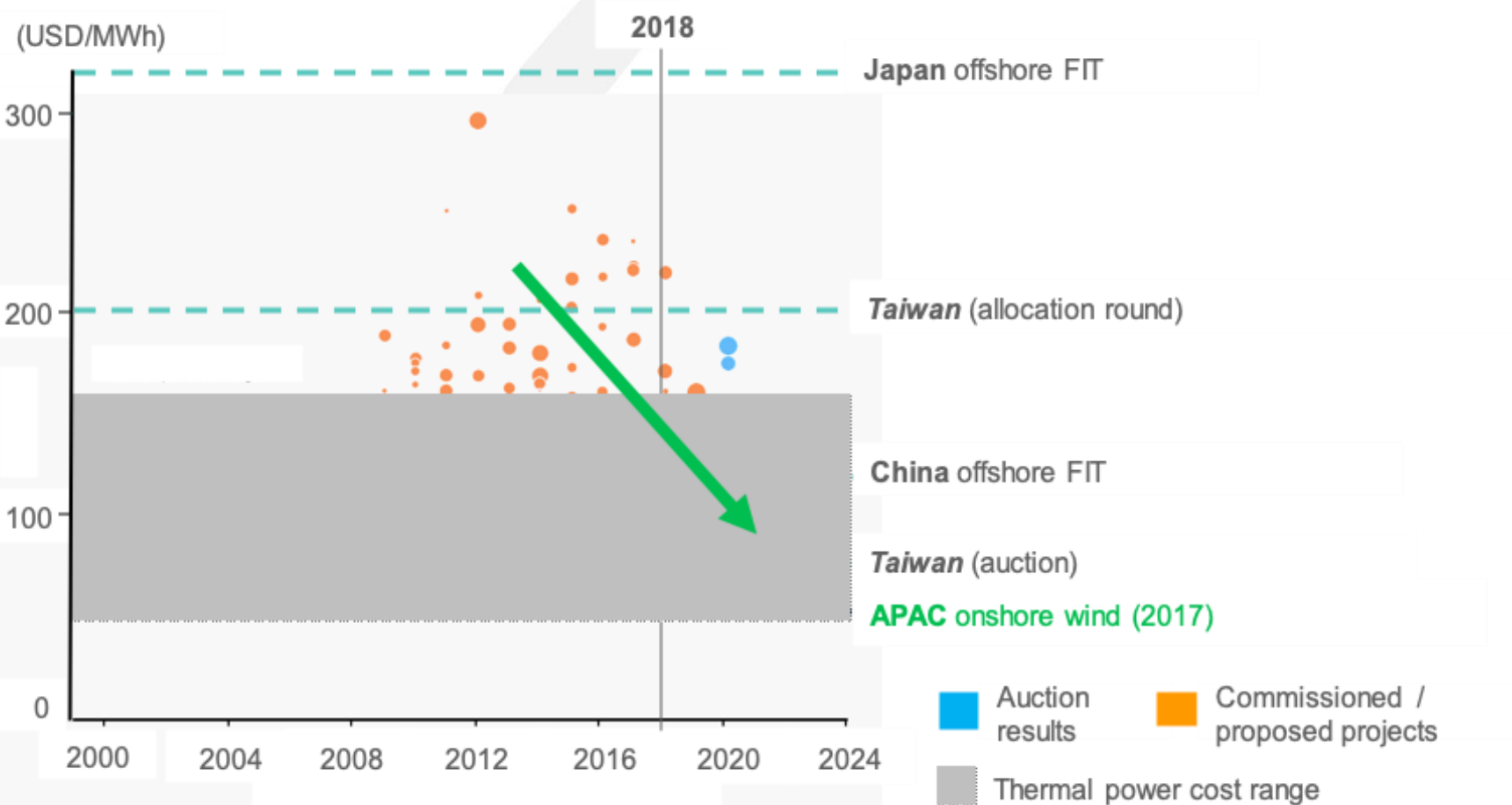
Asia Pacific offshore outlook 2017-2027e



| The Chinese market will account for 85% of capacity additions between 2017 and 2026 in the APAC region. New added offshore wind capacity will average 4 GW per year.

Asia-Pacific – Outlook

| Global offshore wind LCOE and Asia Pacific offshore wind prices



| Offshore wind prices will drop below thermal prices

Asia-Pacific – Outlook

| Only a few select markets have real potential for offshore wind.

Screening of Asia Pacific excluding China (APeC) markets

● = Yes ● = Limited ● = No

Markets	Active offshore development	Subsidy support for offshore	National offshore plans	Coastlines suitable for offshore	Developers interest in offshore	Domestic wind power supply chain
Australia	●	●	●	●	●	●
India	●	●	●	●	●	●
Indonesia	●	●	●	●	●	●
Japan	●	●	●	●	●	●
Kazakhstan	●	●	●	●	●	●
Mongolia	●	●	●	●	●	●
New Zealand	●	●	●	●	●	●
Pakistan	●	●	●	●	●	●
Philippines	●	●	●	●	●	●
South Korea	●	●	●	●	●	●
Sri Lanka	●	●	●	●	●	●
Taiwan	●	●	●	●	●	●
Thailand	●	●	●	●	●	●
Vietnam	●	●	●	●	●	●

Note: Markets shown are those with track record in wind power or active wind power markets
Source: MAKE

Yellow = Potential long-term market
Green = Short/Medium-term market



Offshore Wind Market in China



China - History

2008

First offshore wind project, Donghai Bridge 100MW
- Developers: Datang, CGN, SPIC, Shanghai Green Energy

2009

Policy support started
→ Development plans and targets for 2010, 2015, 2020

2010

First offshore concession projects (2 inter-tidal & 2 near-shore), all in Yancheng, Jiangsu, totaling 1GW

2013

December:
389 MW installed

2014

H2 2014 - H2 2015: 10 projects started construction, 6 completed partial installation

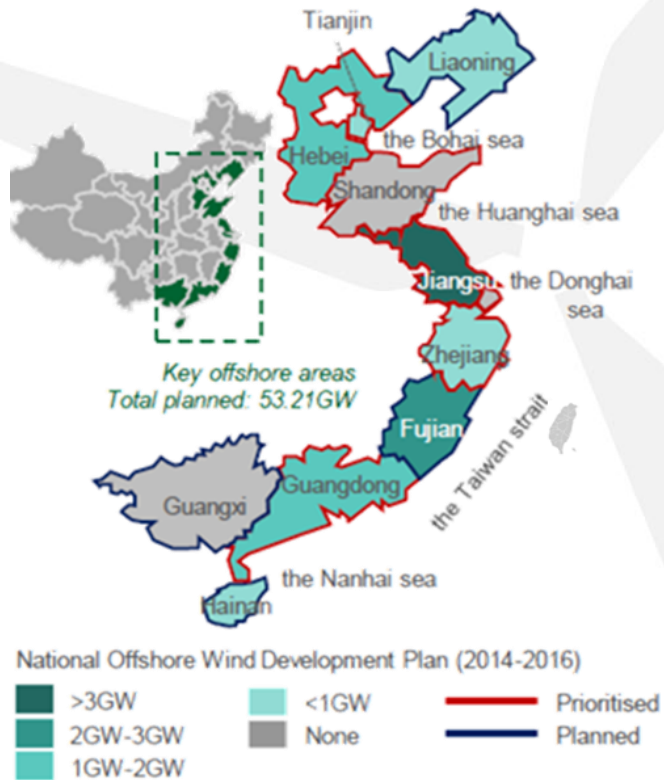
2015

September: first offshore substation installed in Asia (110kV offshore substation)
December: cum. installed capacity 919MW, grid-connected 793MW

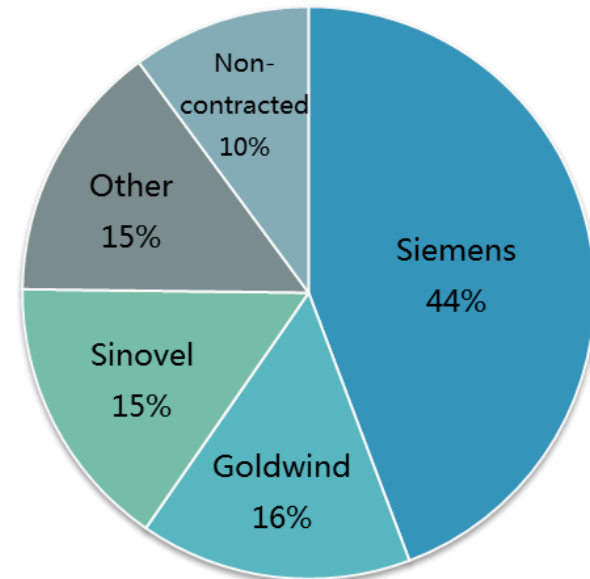
2016

Q1 – Q3: 4 projects commissioned (1 inter-tidal, 3 nearshore, total 382MW)
9 projects under construction (4 partially installed and grid-connected)
September: First nearshore project, CGN's Rudong
October: largest nearshore project in China: Three Gorges' Jiangsu Xiangshui (200MW)

China - Overview

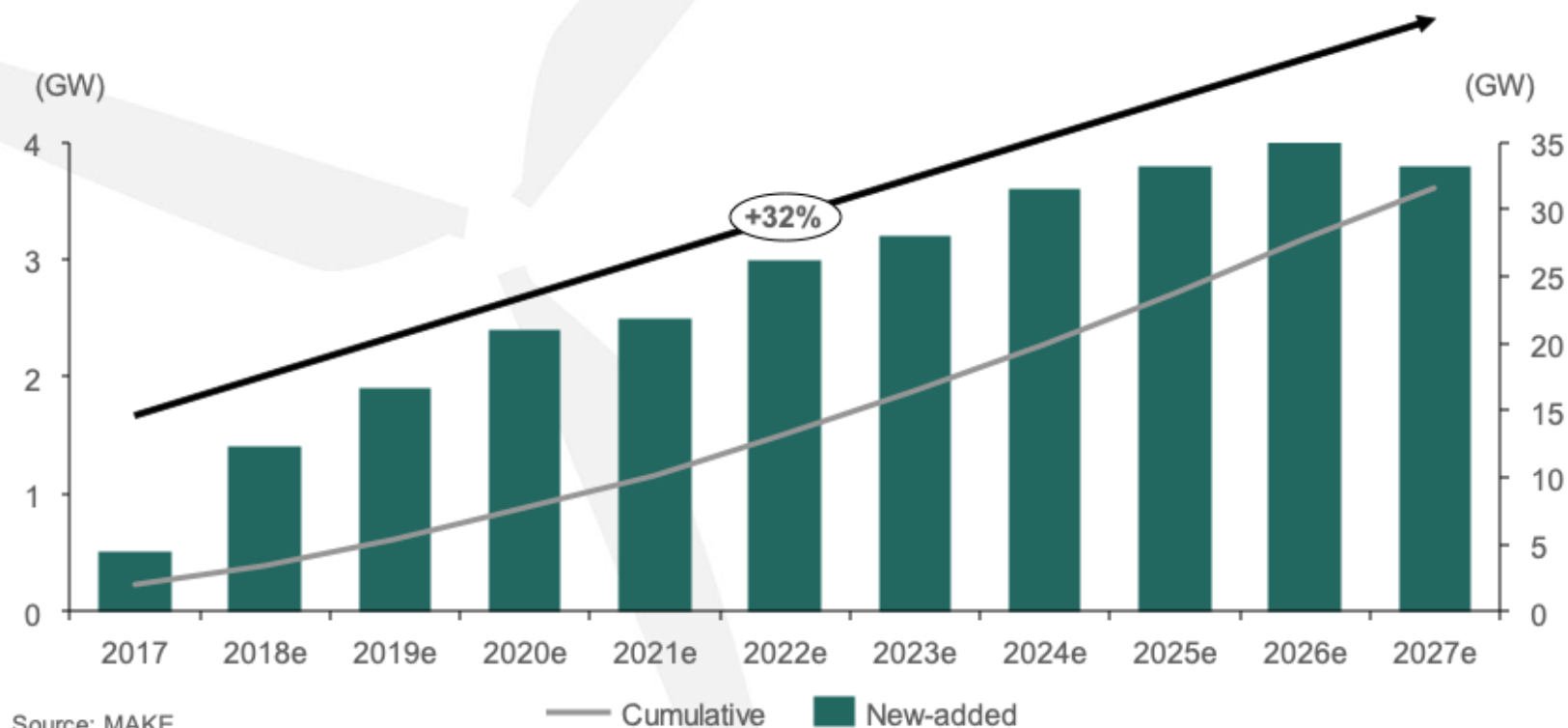


Offshore installations market share in China 2016



China - Overview

| Growth driven by regional policy incentives.

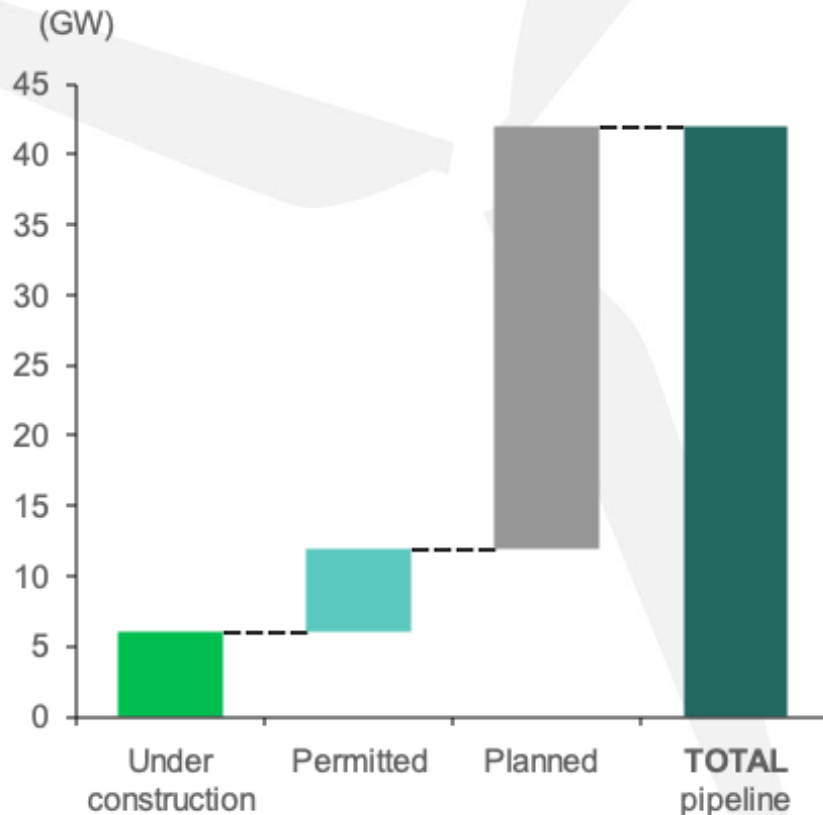


| Offshore wind growth will continue to expand even with the introduction of auction scheme in 2019 as it is part of key energy strategy plans by central and local governments.

China – Regional Overview

| >12 GW of firm pipeline will exceed 2020 offshore target

Offshore development pipeline



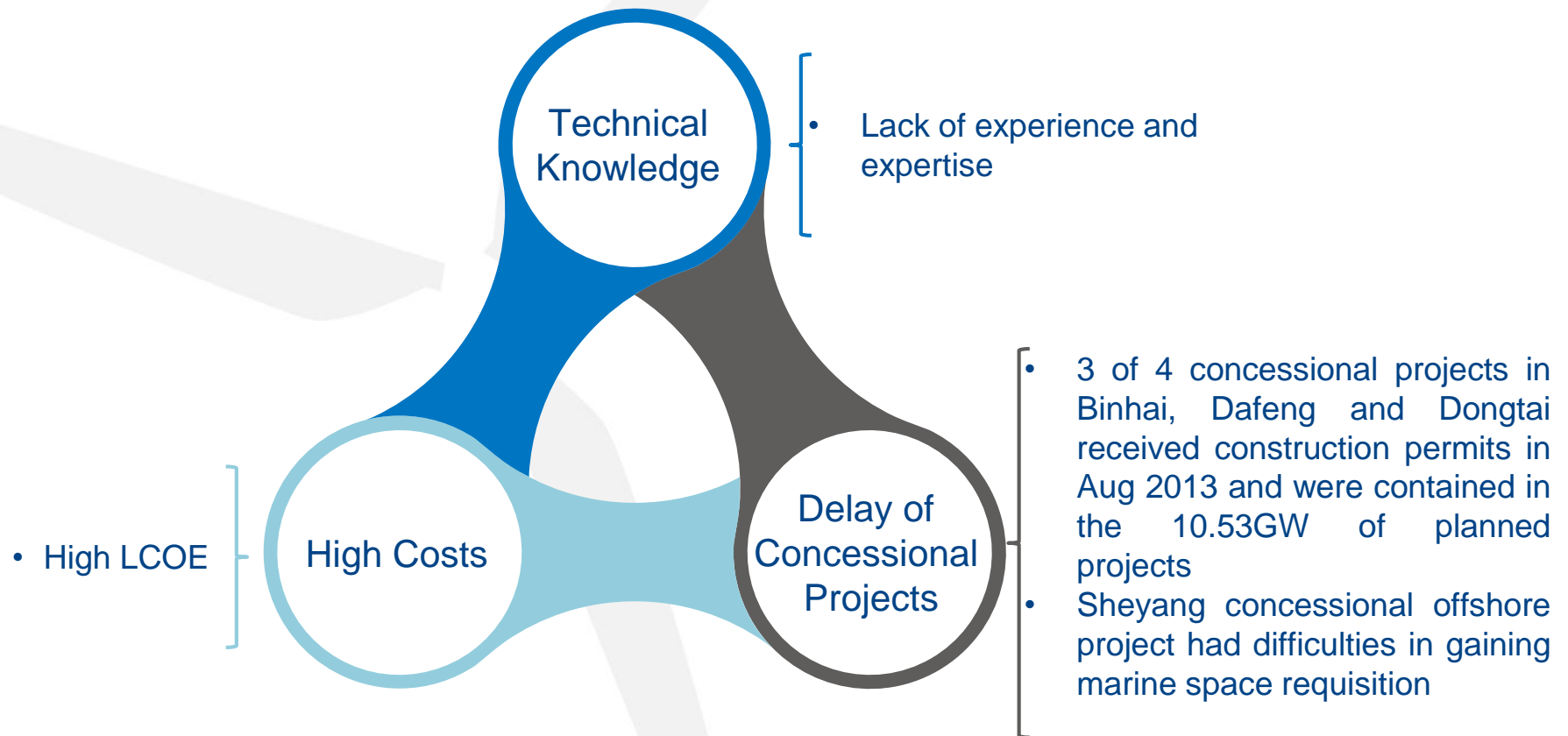
Key drivers

- Provincial support policies
- New business opportunities
- Established wind power supply chain
- National and provincial energy targets
- Close to heavy power demand areas

Key barriers

- Catching up on offshore technology across supply chain
- Low offshore wind FIT
- Introduction of auction regime in 2019 adding more price pressure
- Extreme weather conditions

China - Challenges





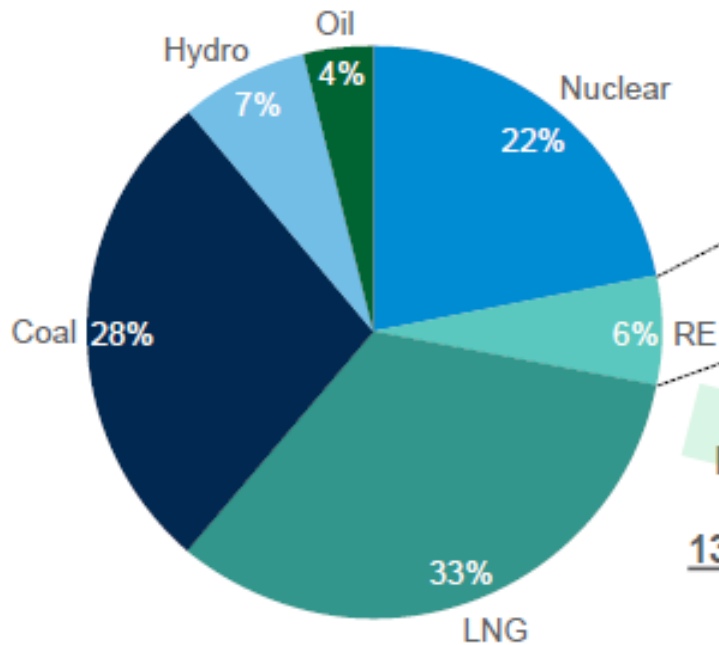
Offshore Wind Market in South Korea



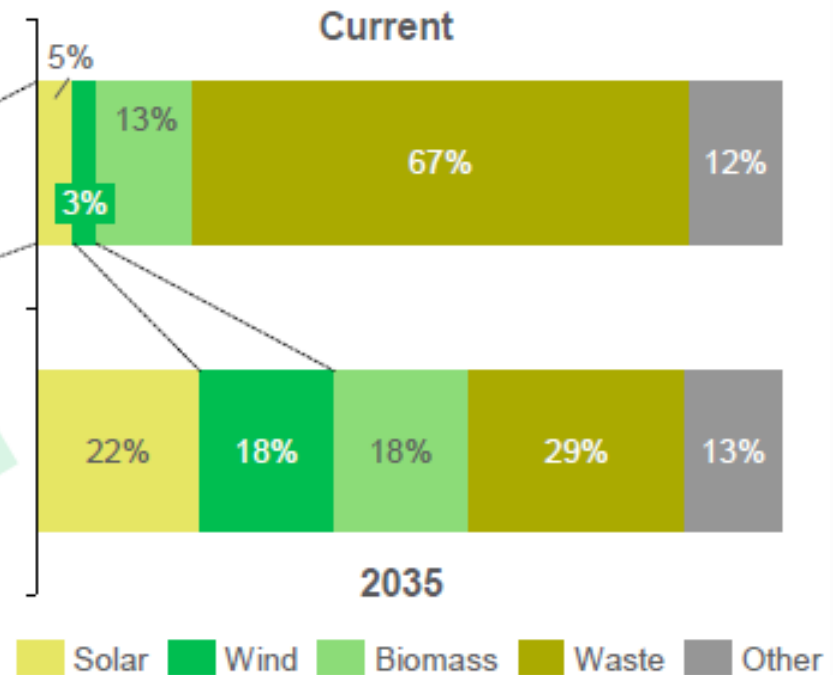
South Korea - Overview

| Wind power's share of renewable energy is set to increase

South Korea 2016 energy mix



South Korea's RE mix: 2016 and 2035



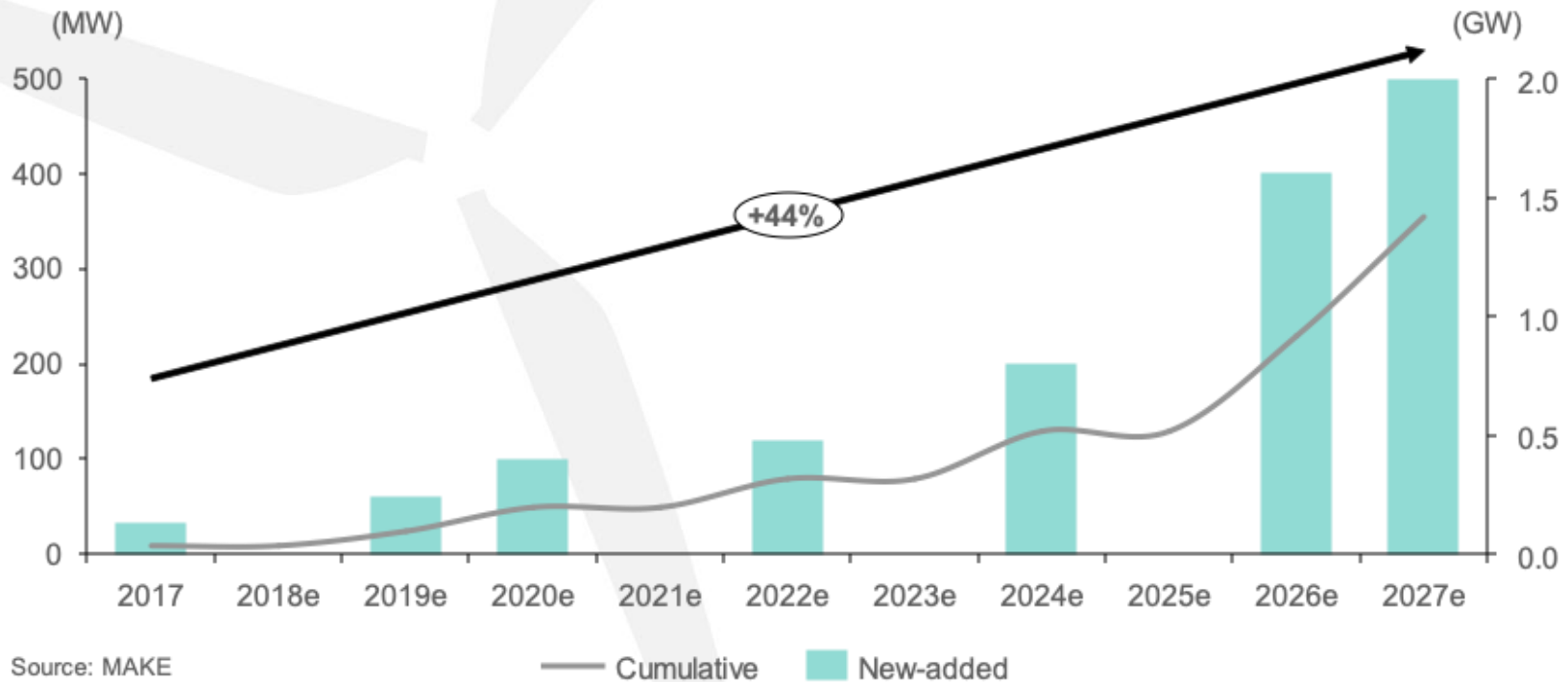
Note: Renewable Energy (RE),
Source: MAKE, Ministry of Trade, Industry and Energy (MOTIE)

| South Korea's future energy plan is based on expanding renewable energy, especially solar and wind, to counter reduction in future share of fossil fuel energy sources.

South Korea - Overview

| Ambitious RE targets require large-scale offshore wind.

South Korea offshore wind power outlook, 2017-2027e

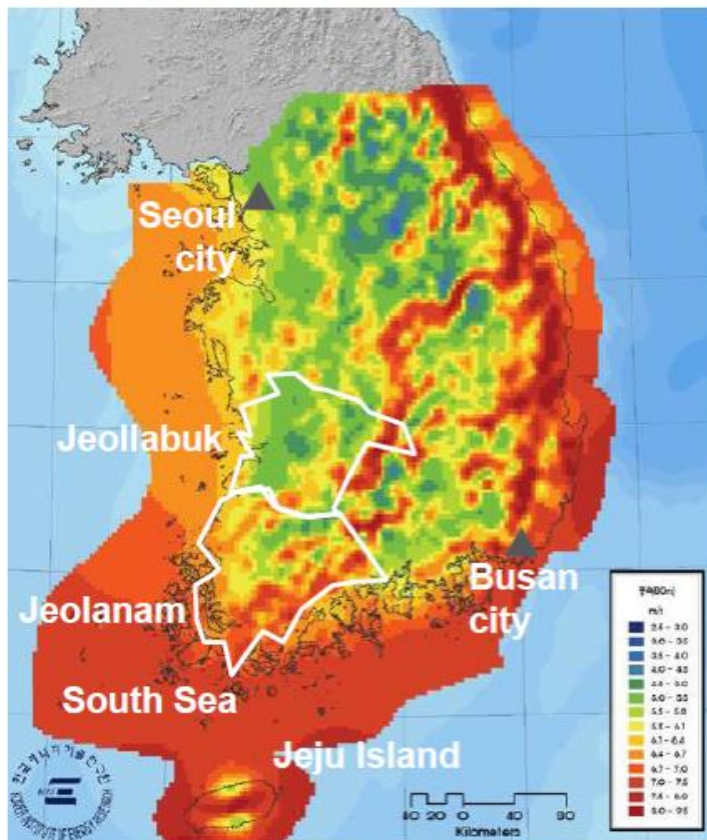


| Scaling up existing capacity and building up local capabilities to sustain growth. New policy support measures are expected to further drive growth in mid-long term.

South Korea – Potential

| Rich offshore wind resources particularly in South Sea area.

South Korea theoretical offshore wind map



Source: MAKE, KIER

	<6.49m/s		6.5-7.9m/s
	8.0+ m/s		

DRIVERS

- Offshore wind is identified as a potential high technology manufacturing sector: Enables sector to receive national R&D support of which the government believes local companies can become world class companies
- Parts of local supply chain are already integrated with global offshore wind supply chain: Local cables, towers, forgings suppliers are already global offshore suppliers and testing facilities are already available

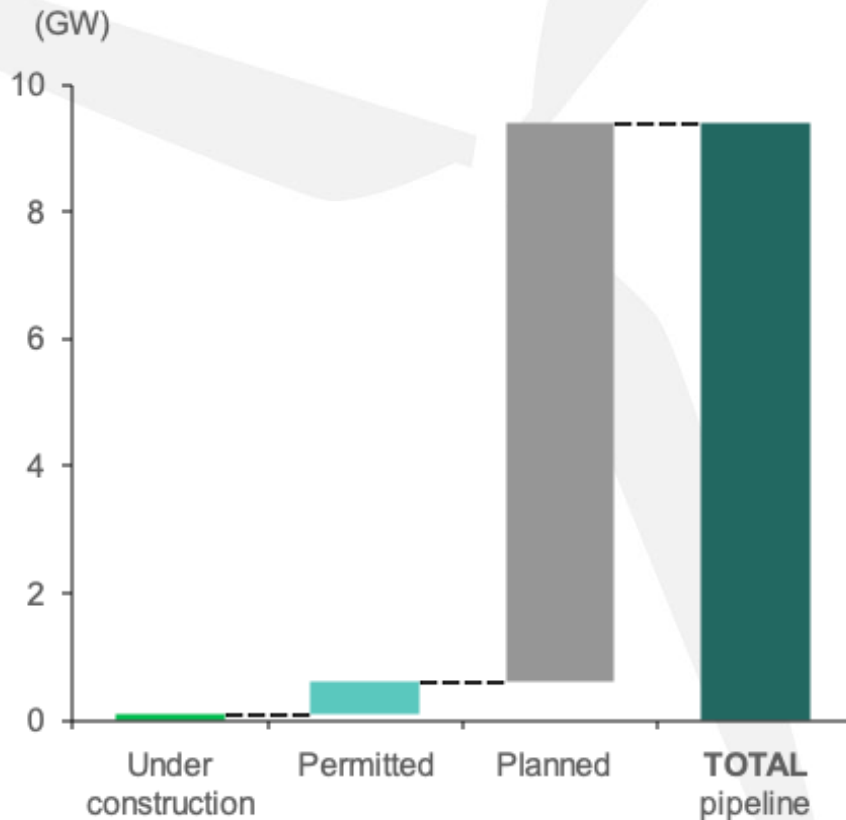
BARRIERS

- No installation vessels in South Korea: There is no plans to import expensive vessels from Europe and companies are actively looking for a local solution – due to soft muddy seabed, it is difficult to utilize jack-up vessels
- Difficult negotiations with local population: Particularly difficult with fishermen over high compensation and has already delayed even projects by local companies leading to higher than expected projects costs

South Korea – Outlook

| 2.5GW Southwest project will remain a key focus

Offshore development pipeline



Key drivers

- Established maritime engineering and construction sector
- Ambitious national offshore plans
- Domestic local wind supply chain including turbine OEMs
- Environmental concerns over air pollution and nuclear future

Key barriers

- Weak offshore policy and incentive measures
- Limited vessel availability
- Fisheries negotiation
- Technology catch up for local turbine suppliers



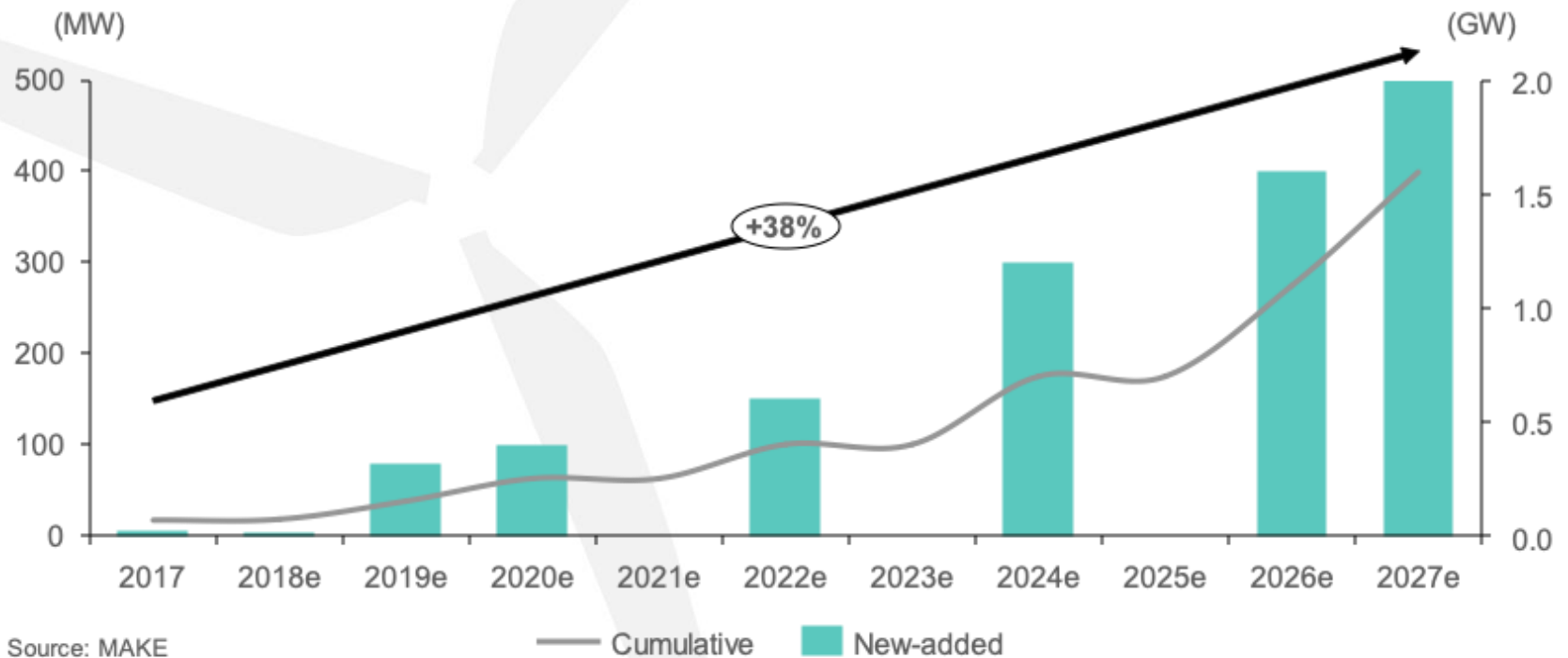
Offshore Wind Market in Japan



Japan - Overview

| Slow to start but will start to accelerate post-2020

Japan offshore wind power outlook, 2017-2027e

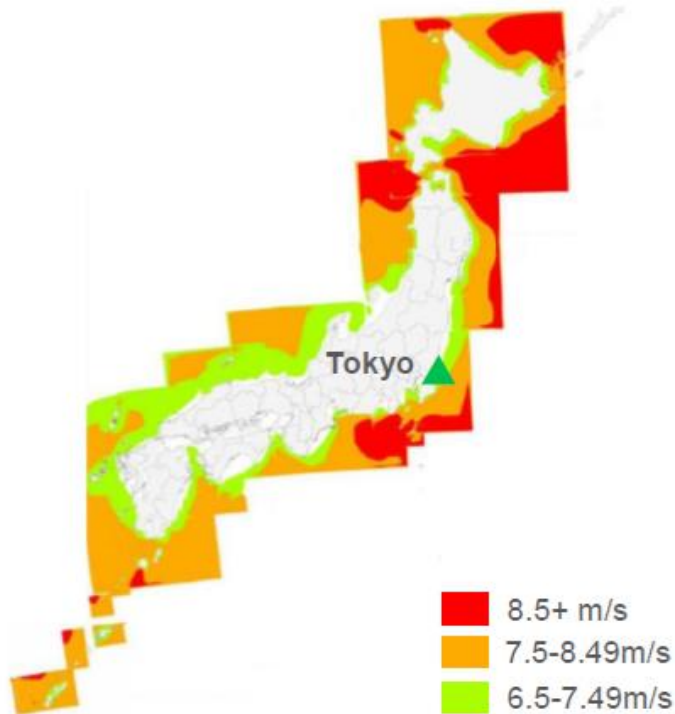


| Lack of regulations pertaining to general sea areas, long EIA period, and deep sea conditions means large scale development will take a longer time to materialize

Japan - Potential

| Strong offshore wind resources, particularly in Northern Japan.

Japan theoretical offshore wind map



DRIVERS

- **Large offshore zones and wide port network:** Japan has the eighth largest Exclusive Economic Zone (4.5 million km²) in the world and has a long established maritime industry
- **Pioneering offshore floating foundation:** Offshore wind provides an opportunity for local companies to become leaders in floating offshore foundations – already the govt. is supporting floating demonstrations as a potential export industry in the future

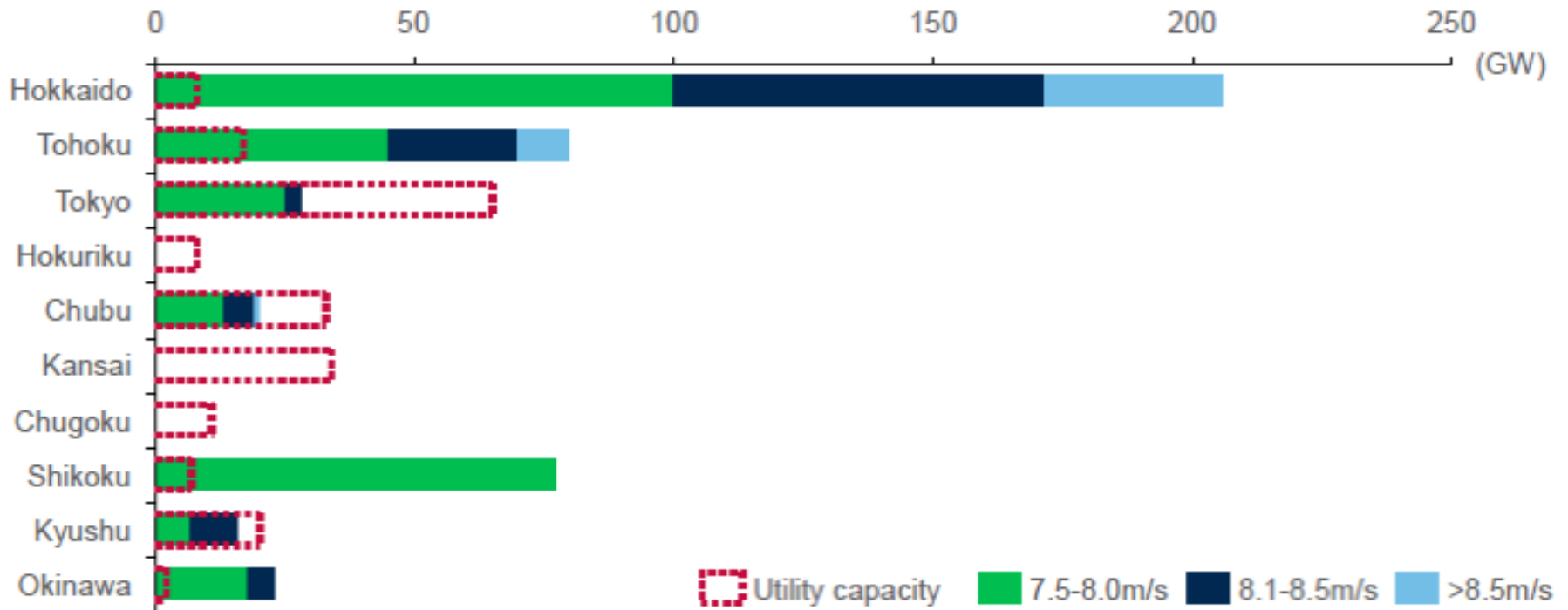
BARRIERS

- **Best offshore zones suffer from curtailment:** Despite rich offshore wind resources in Hokkaido, Tohoku and Kyushu region, they suffer from curtailment by regional utilities who are more supportive of conventional power sources
- **Offshore rich zones have low power demand:** Power demand in Hokkaido and Tohoku region combined is only half of Tokyo

Japan - Potential

| Offshore potential heavily restricted by regional utilities

Offshore wind potential and utility capacity

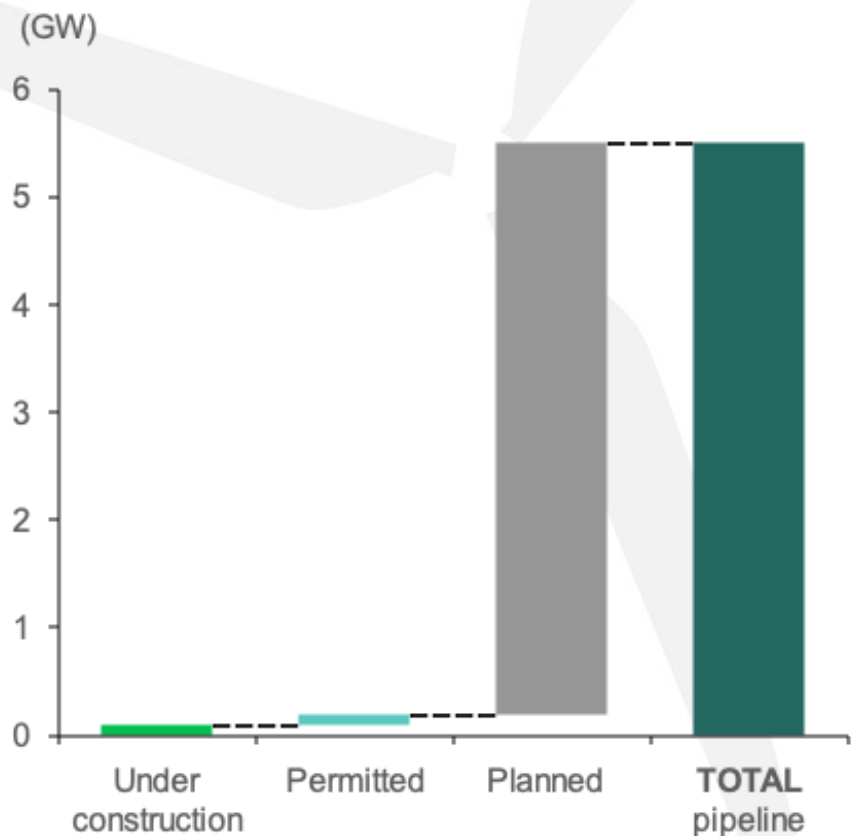


| Supply and demand mismatch as regions with the best wind resource also have the least utility grid capacity and heavy demand areas have limited wind resources.

Japan - Outlook

| Limited regulations and long EIA limits short term growth

Offshore development pipeline



Key drivers

- Established maritime engineering and construction sector
- High offshore wind FIT
- Domestic local wind supply chain including turbine OEMs
- Growing interest by local IPPs and regional utilities

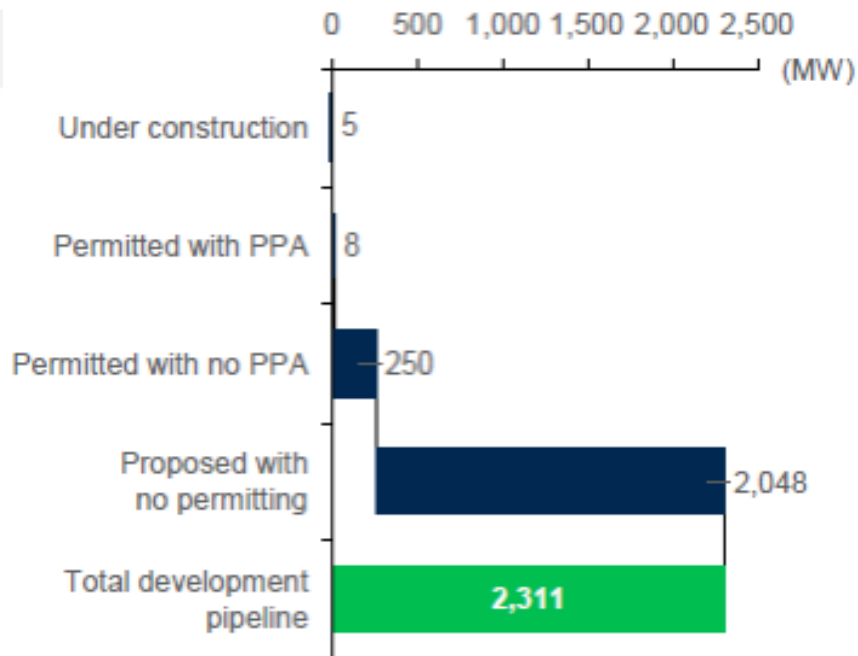
Key barriers

- Lack of offshore regulations
- Limited vessel availability
- Extreme weather conditions
- Deep water depths
- High cost of offshore wind development
- Long EIA period

Japan – Project Pipeline

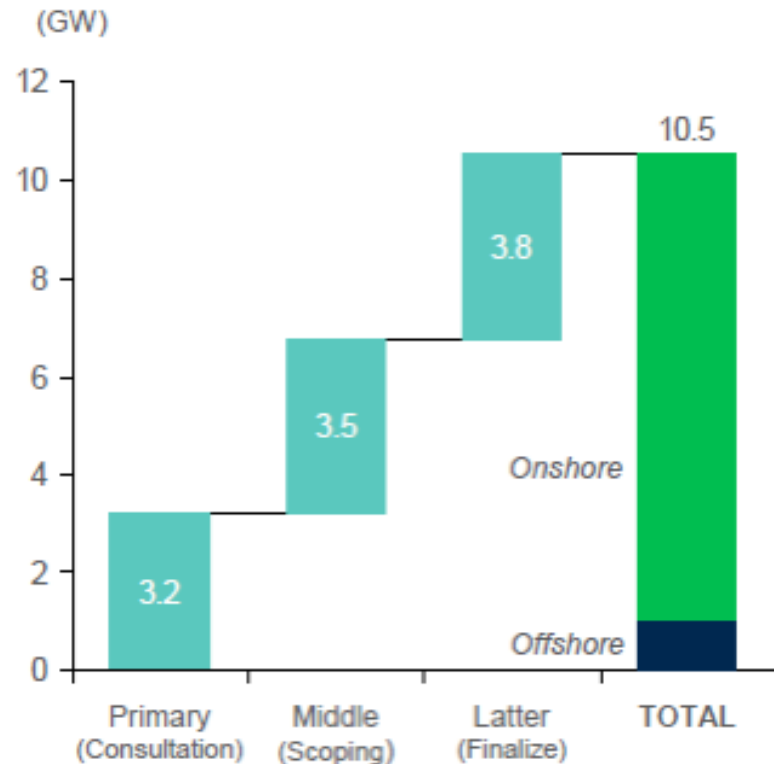
| Japan's large potential project pipeline.

Japan offshore wind project pipeline



Note: Development pipeline only includes projects which have been publicly announced
Source: MAKE

Japan total EIA wind project pipeline



| Despite its large potential pipeline, the majority of offshore projects are in early planning stages subject to lengthy EIA process which takes upwards of 4 years to complete.

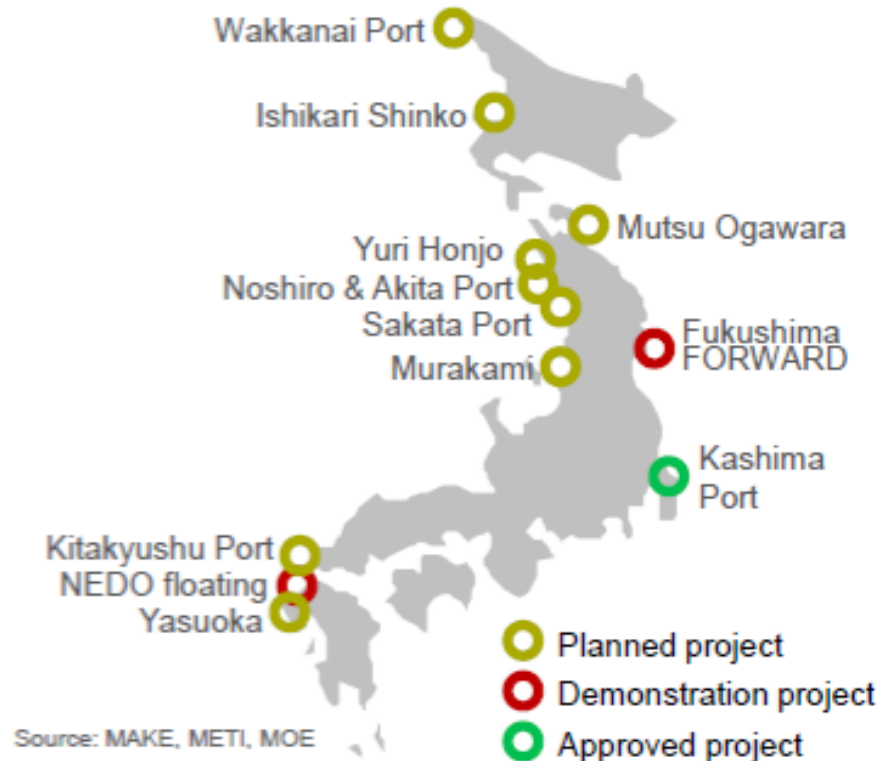
Japan – Project Pipeline

| Planned offshore projects are spread across the country

Majority of pipeline are in planning stages

- Projects in central and northern region will continue to face opposition from local grid utility who are able to prevent grid connection as they operate as monopolies in their own region citing reasons:
 - Already too much solar intake
 - Reserving grid space for potential nuclear restart,
 - Not wanting to upgrade grid
- Southern regions more likely to face “Not-in-my-backyard” opposition from anti-wind groups who interrupt and interfere with EIA process

Selected announced projects in pipeline

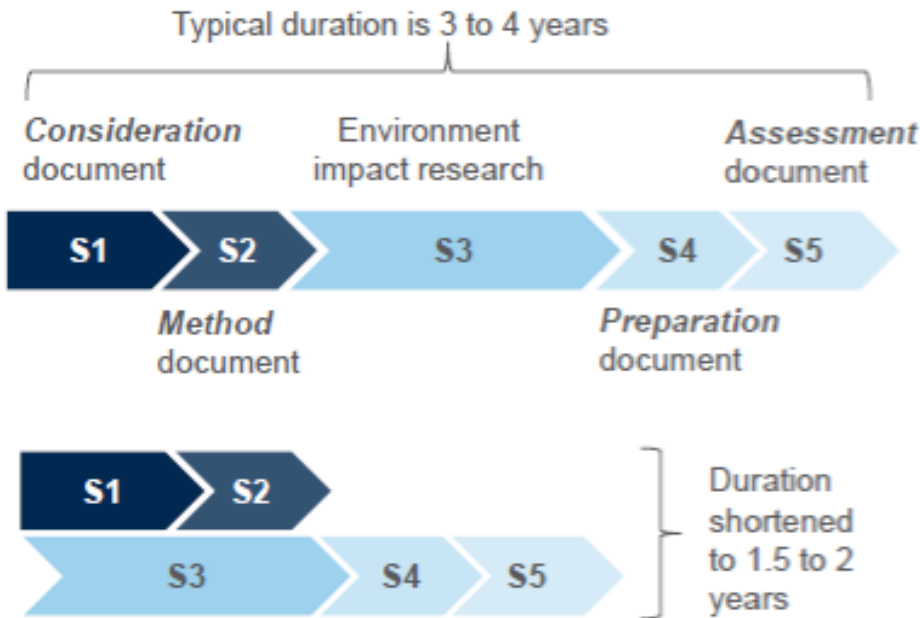


| Most of the planned projects are clustered around along the western coastline, especially in the central region due to lower water depth that can use grounded foundations.

Japan – Challenges

| EIA seen as major hurdle to offshore wind despite high FIT

EIA process: current and suggested



Note: Wind condition research, land negotiations, etc. are conducted prior to EIA

Source: MAKE, Ministry of Environment

Full EIA process is relatively new in Japan

- Japan's Environmental Impact Assessment (EIA) of which wind power projects was included in 2011 (for projects >10MW) came into effect in 2012 and has remained a substantial regulatory barrier to large scale uptake of wind power
- Duration of EIA can take upwards of 4 years with offshore projects so far requiring at the minimum 3 years to pass
- Cost of EIA can run into EUR millions so wind developers are unlikely to engage in EIA unless they are confident that their projects can pass despite the long duration required

| EIA remains costly and time-consuming process but reform remains slow, bogged down by bureaucratic processes as multiple government agencies are involved.



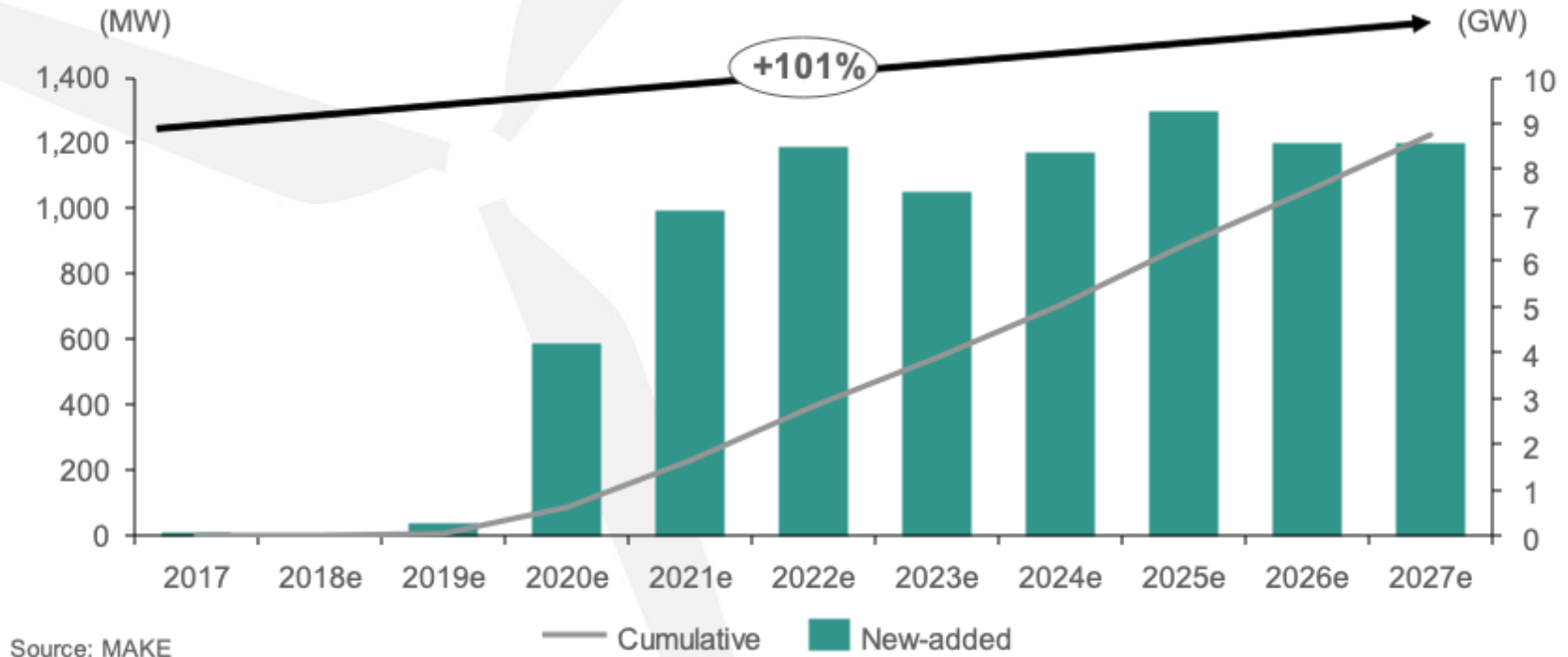
Offshore Wind Market in Taiwan



Taiwan – Overview

| On track to be second largest offshore market in APAC.

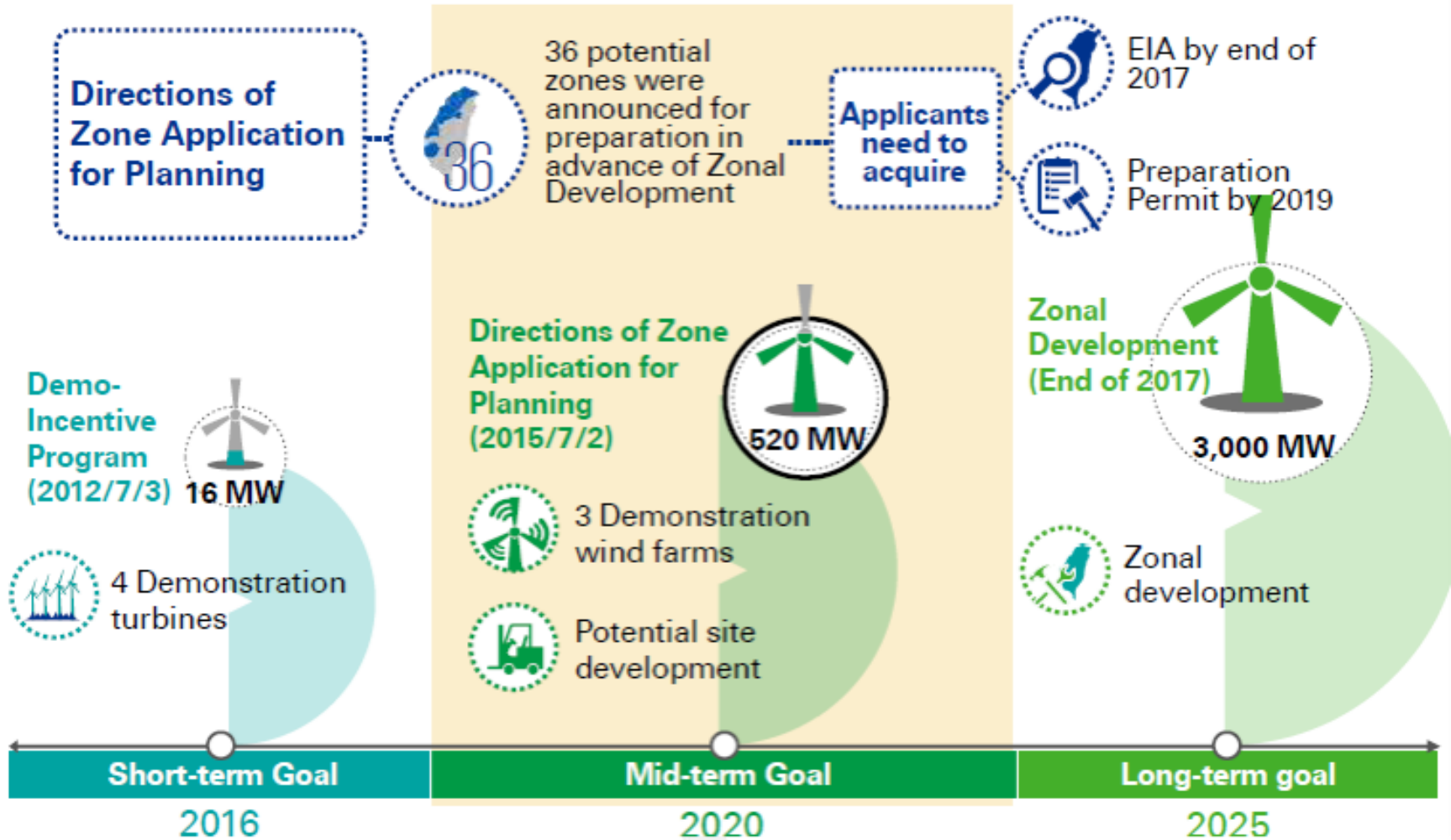
Taiwan offshore wind power outlook, 2017-2027e



| Over 5.5GW of projects have been awarded to date with potential to reach over 10GW by the end of 2030 with future auctions

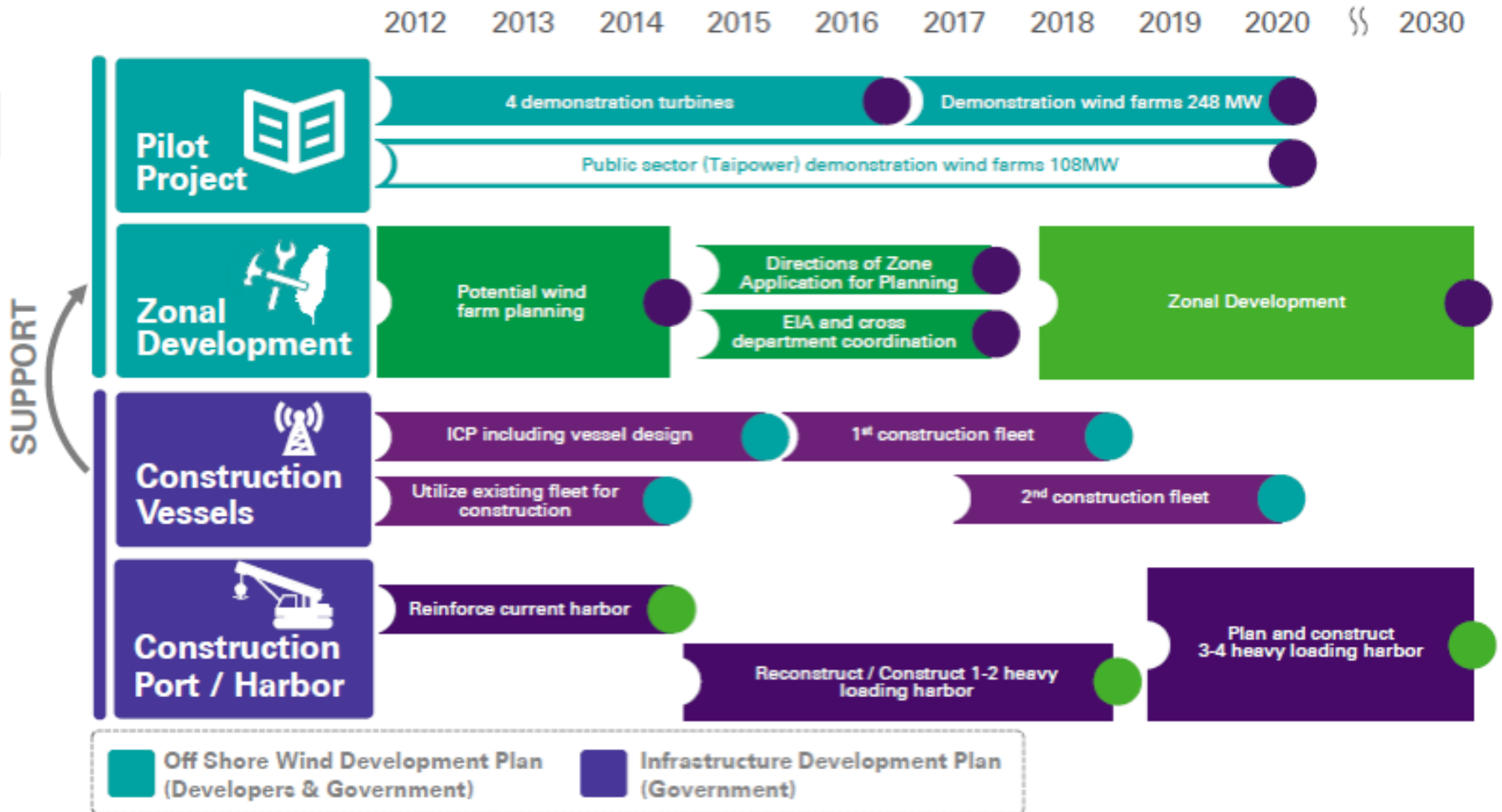
Taiwan – Overview

The Taiwanese government has a clear development plan



Taiwan – Policy

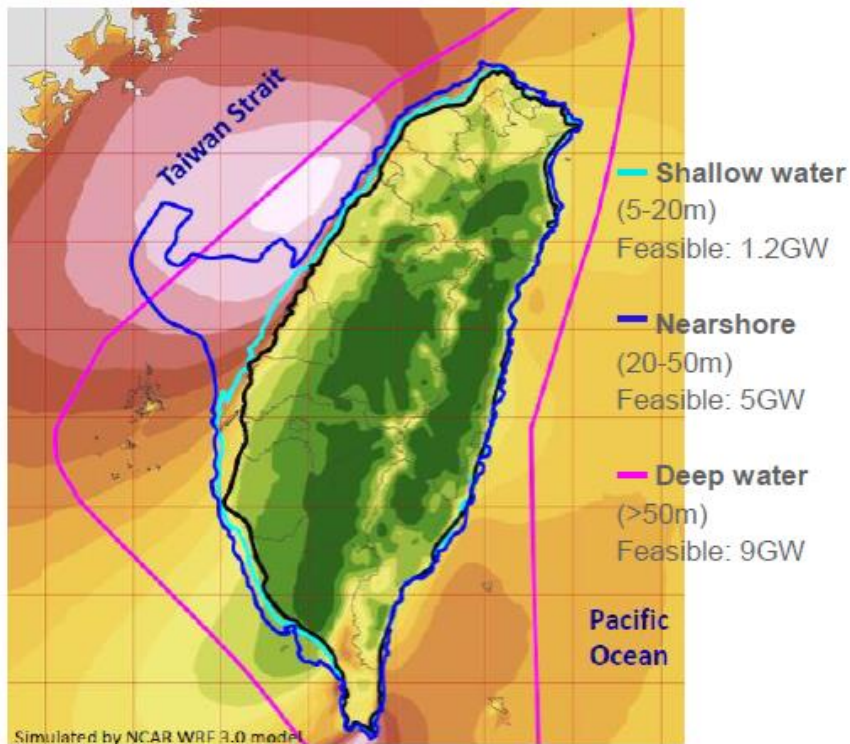
Strong government support to develop offshore wind with appropriate infrastructure



Taiwan – Potential

| Offshore wind conditions along the Taiwan Strait are the best in APAC.

Taiwan theoretical offshore wind map



DRIVERS

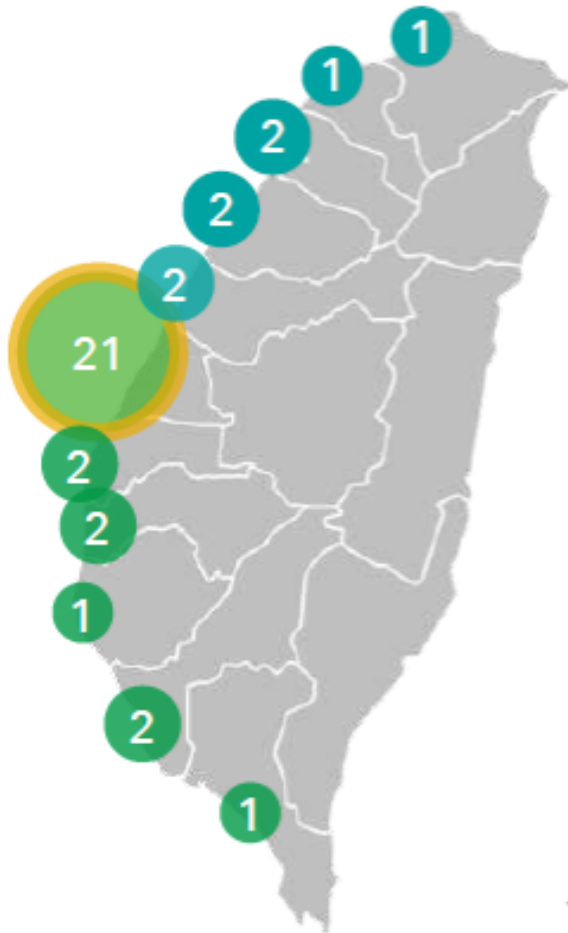
- **World class offshore wind resources:** Capitalize on some of the best offshore wind resources in the world along the Taiwan Straits
- **Public opposition to thermal and nuclear power:** Makes offshore wind power more attractive and offshore wind unlikely to face NIMBY opposition that has slowed onshore wind power development

BARRIERS


- **Persistent delays and cost overruns:** Despite strong policy support and interest by private sector, in practice, all demonstration projects have met with delays (e.g. demonstration units were supposed to be completed by 2015) and cost overruns
- **Cannot rely on sourcing from China to lower costs:** Geopolitical reasons prohibit involvement of companies from China from getting involved in Taiwan offshore due to national security reasons


Taiwan – Potential

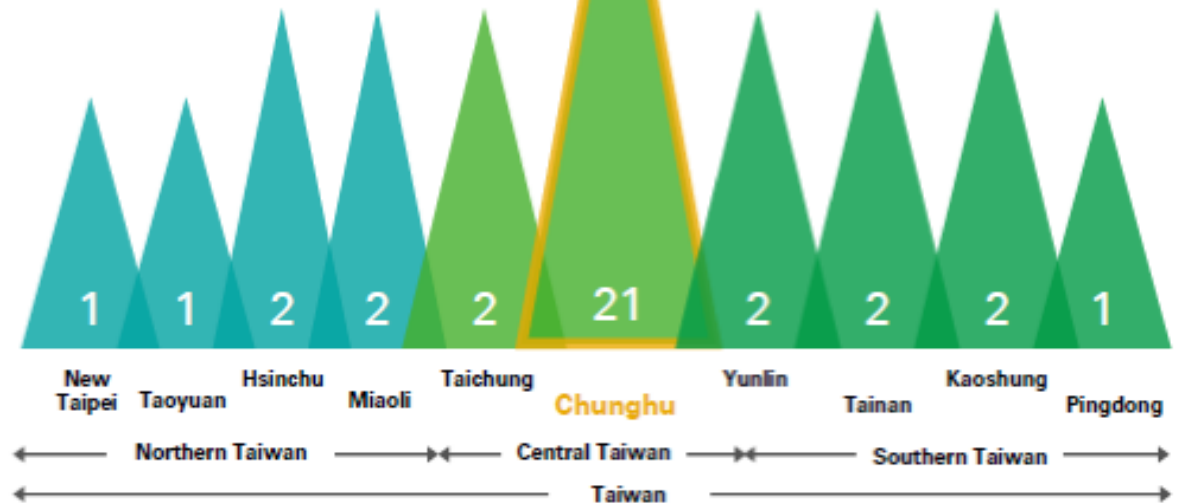
| Taiwan has a significant potential with 36 potential identified sites.



 36 Potential Sites

 21 EIAs on going

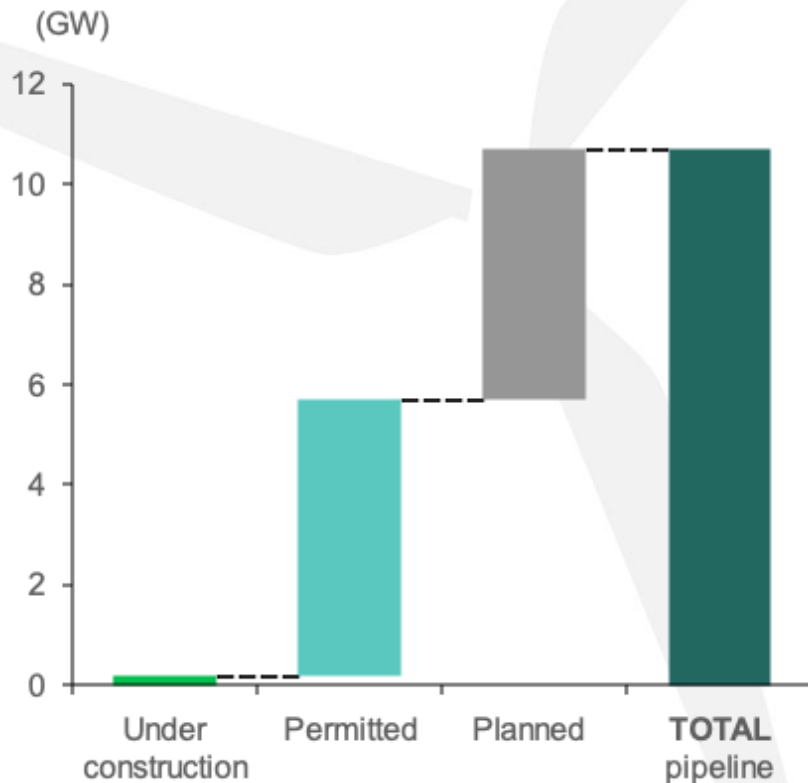
 8 MWs installed



Taiwan – Pipeline

| More than 10GW of projects have applied for EIA.

Offshore development pipeline



Key drivers

- Supportive policy environment
- Hub for regional offshore growth and potential exports
- High technology growth sector
- Denuclearisation
- Urgent power capacity demand

Key barriers

- Pace of substation build by Taipower
- Pace of local supply chain development and training of offshore workforce
- Limited vessel availability
- Extreme weather conditions
- Auction prices setting new expectations for future offshore prices

Note: Planned projects include pipeline projects which were not awarded in round 1 and 2 but could still reapply in future auctions

Source: MAKE

Taiwan – Challenges

| Infrastructure development will be critical for scaling the offshore wind development.



Lack of proper
harbor infrastructure



Heavy loading harbor
needs to be
constructed



Harbor facilities
needs to support
future O&M



Grid needs to
be upgraded



Chunghwa
Concentrated
potential wind
farms in the
Chunghwa region
will require a grid
capacity upgrade
to handle the
potential
installed capacity



Rigorous permitting
process



**The permitting
process**
needs to be simplified
for a more facilitate
more efficient
development



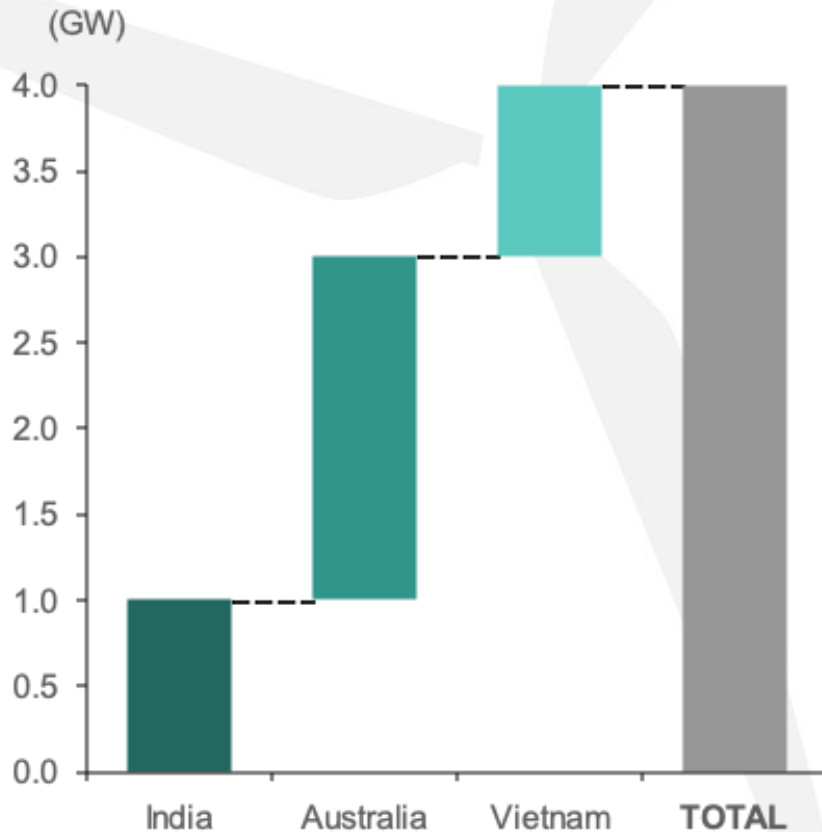
Emerging Markets in Asia



Emerging Markets

| Early planning is already underway in potential markets

Planned pipeline of offshore projects



Ambitious plans in India/Australia

- **India** – 1GW demonstration auction and potential future auctions
- **Australia** – up to 2GW to offset thermal assets to be decommissioned
- **Vietnam** – up to 1GW for intertidal and nearshore projects



Conclusion



Conclusion

- The current offshore wind market is led by Europe, but Asia-Pacific is the market of tomorrow.
- China is leading the way with South Korea, Japan and Taiwan following.
- In China alone, >30GW of offshore wind is expected to come online through 2027. In total, we expect these four countries to install 43 GW by 2027; our old estimate in 2017 was 11.2 GW by 2027.
- Government support is required to provide enabling policies and to support required infrastructure (e.g. port and grid).
- New markets such as Australia, India, Thailand and Vietnam will start within 5 years.

Closing





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