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AWEA Taipei 2018

Asia-Pacific Offshore Wind Power Outlook

18 September 2018

Robert Liew

robert.liew@woodmac.com

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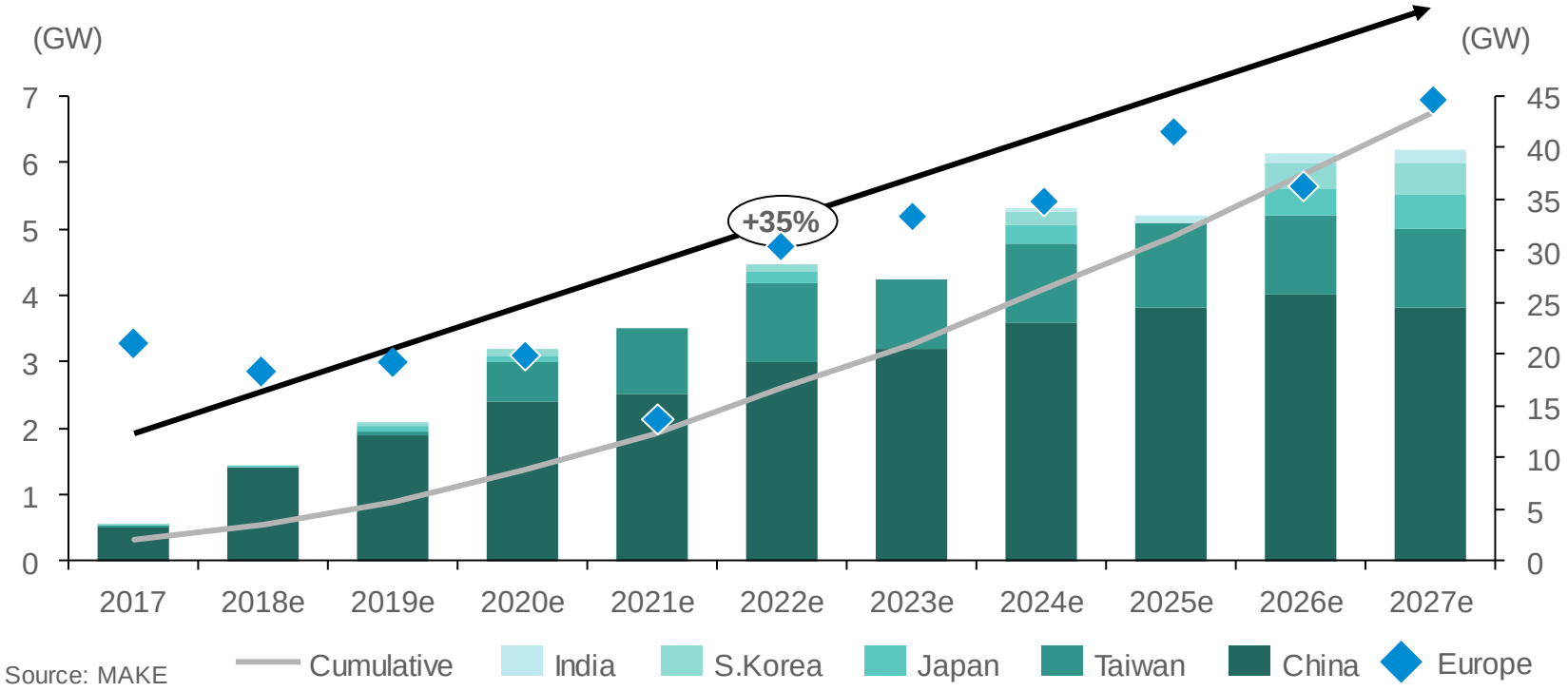
Cumulative offshore capacity to reach 43GW by 2027

Asia Pacific offshore outlook 2017-2027e

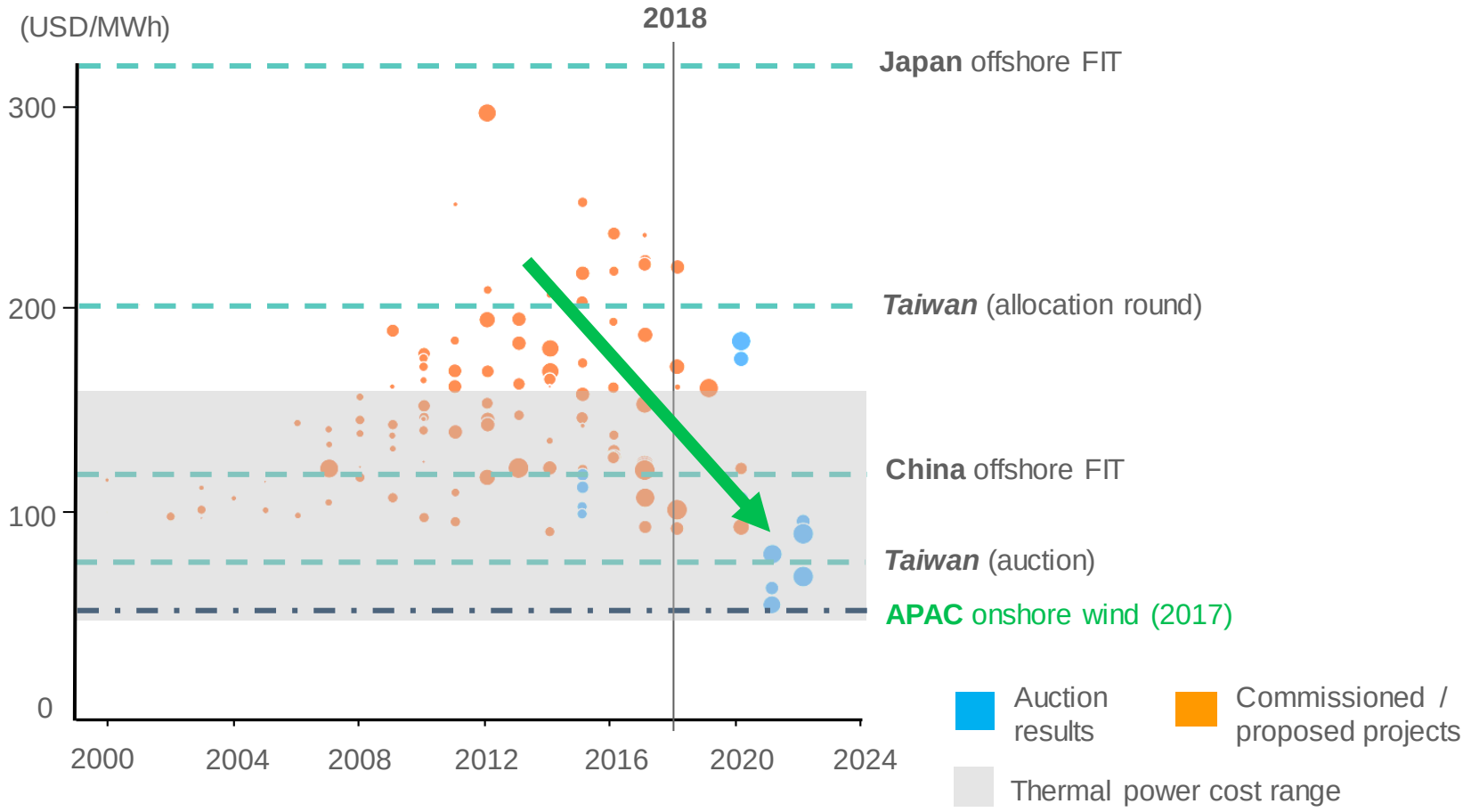


Source: MAKE

New added offshore wind capacity will average 4GW per year driven mainly by China and Taiwan with increasing development in Japan and South Korea post-2020

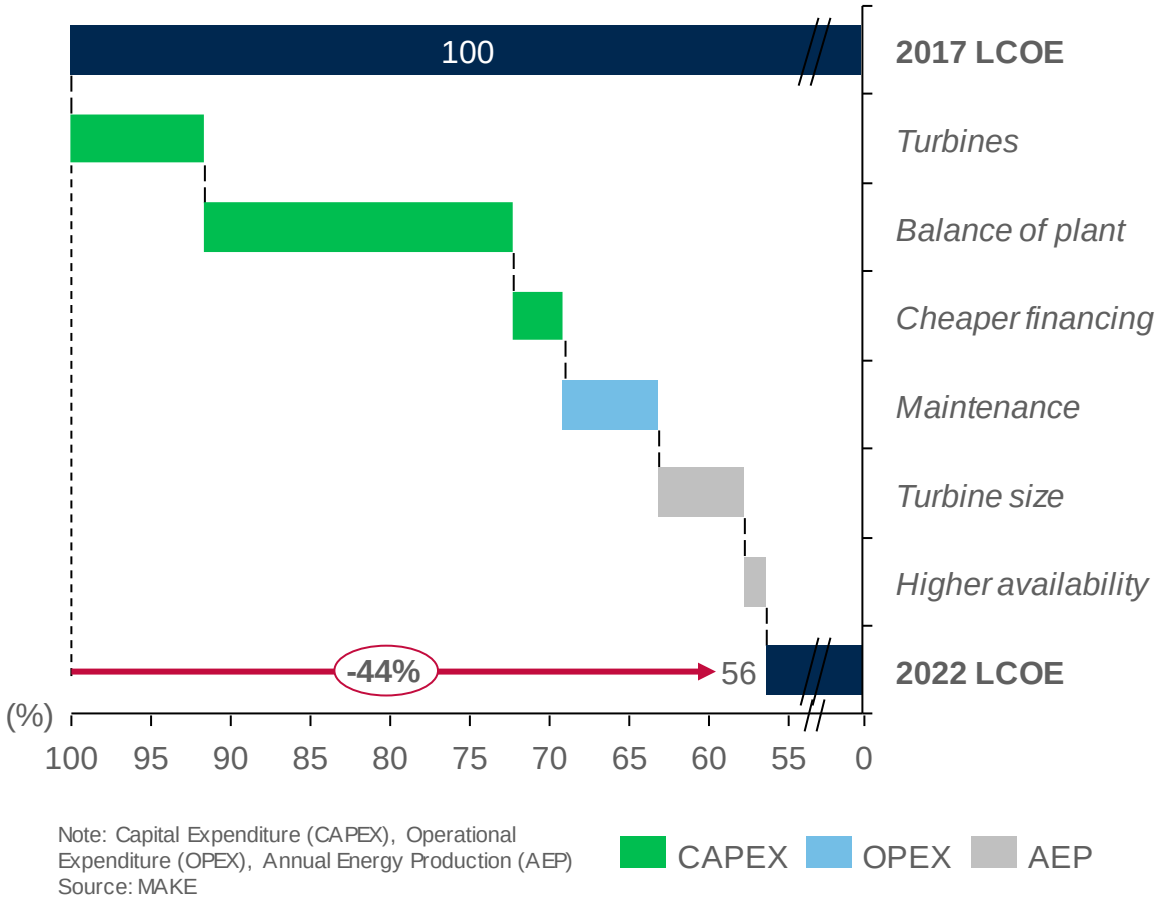
Offshore wind prices will drop below thermal prices

Global offshore wind LCOE and Asia Pacific offshore wind prices



Cost reductions driven largely by CAPEX reductions

LCOE reduction expectations through 2022



Note: Capital Expenditure (CAPEX), Operational Expenditure (OPEX), Annual Energy Production (AEP)
Source: MAKE

Key factors

- Economies of scale
- Project sizes (expected to double)
- Local production / supply chain / financing
- Support for transmission CAPEX
- Developer experience and track record
- Increased competition
- Turbine rating (>10MW by 2025)
- Turbine technology improvements

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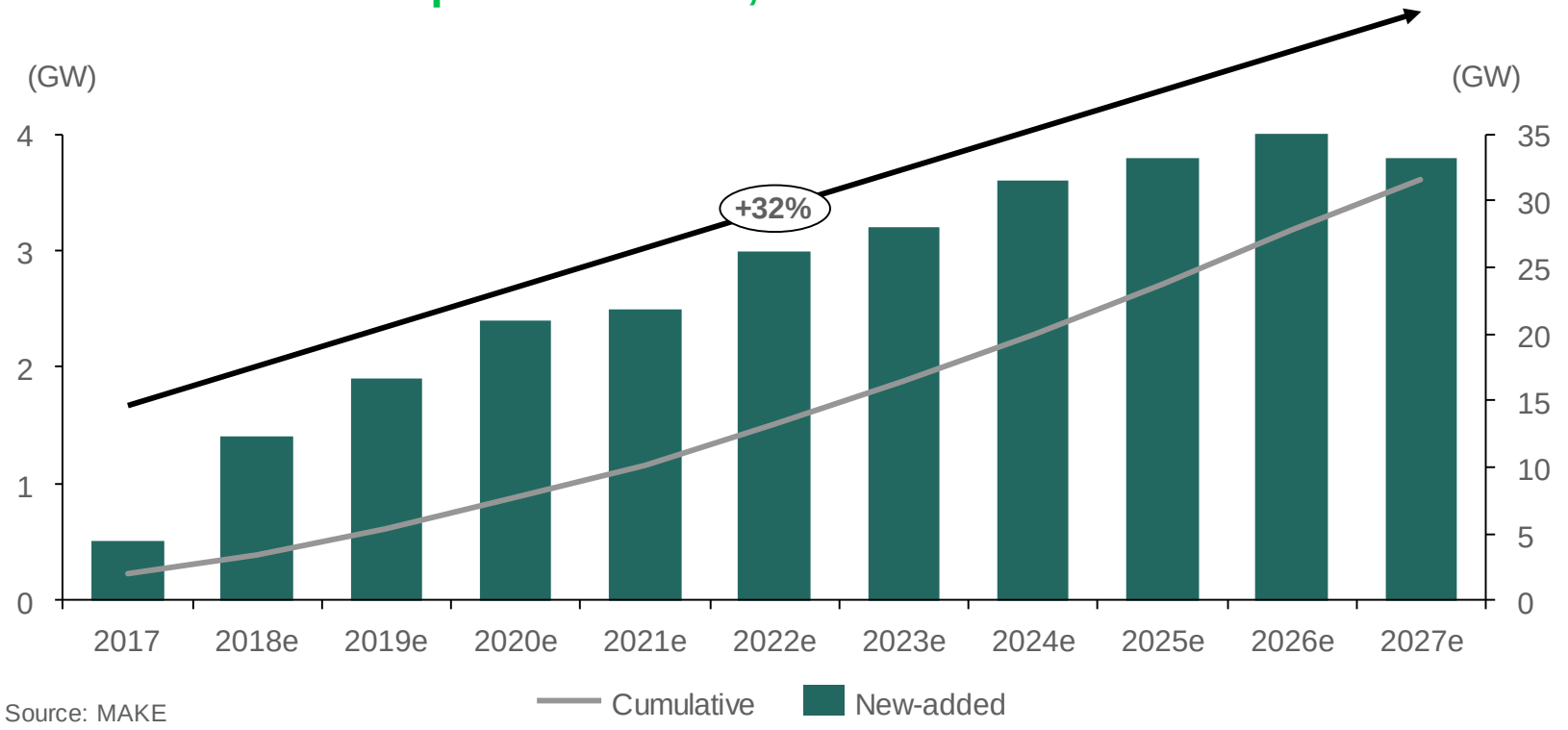
China 中国

Longyuan Rudong offshore wind farm

China offshore outlook

Growth driven by regional policy incentives

China offshore wind power outlook, 2017-2027e



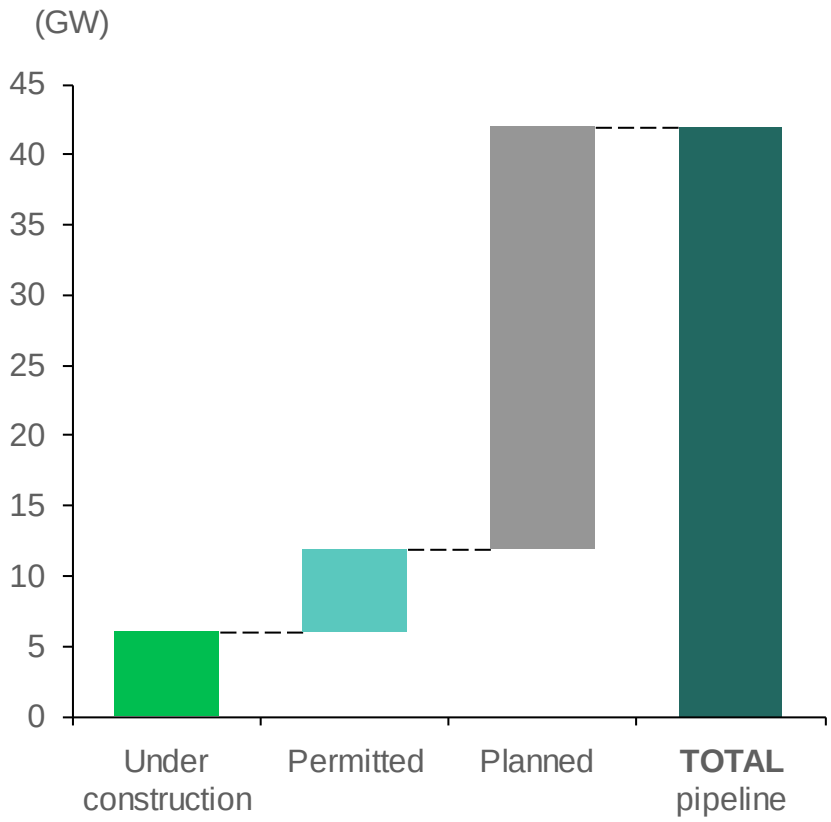
Source: MAKE

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 offshore outlook

>12GW of firm pipeline will exceed 2020 offshore target

Offshore development pipeline



Source: MAKE

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

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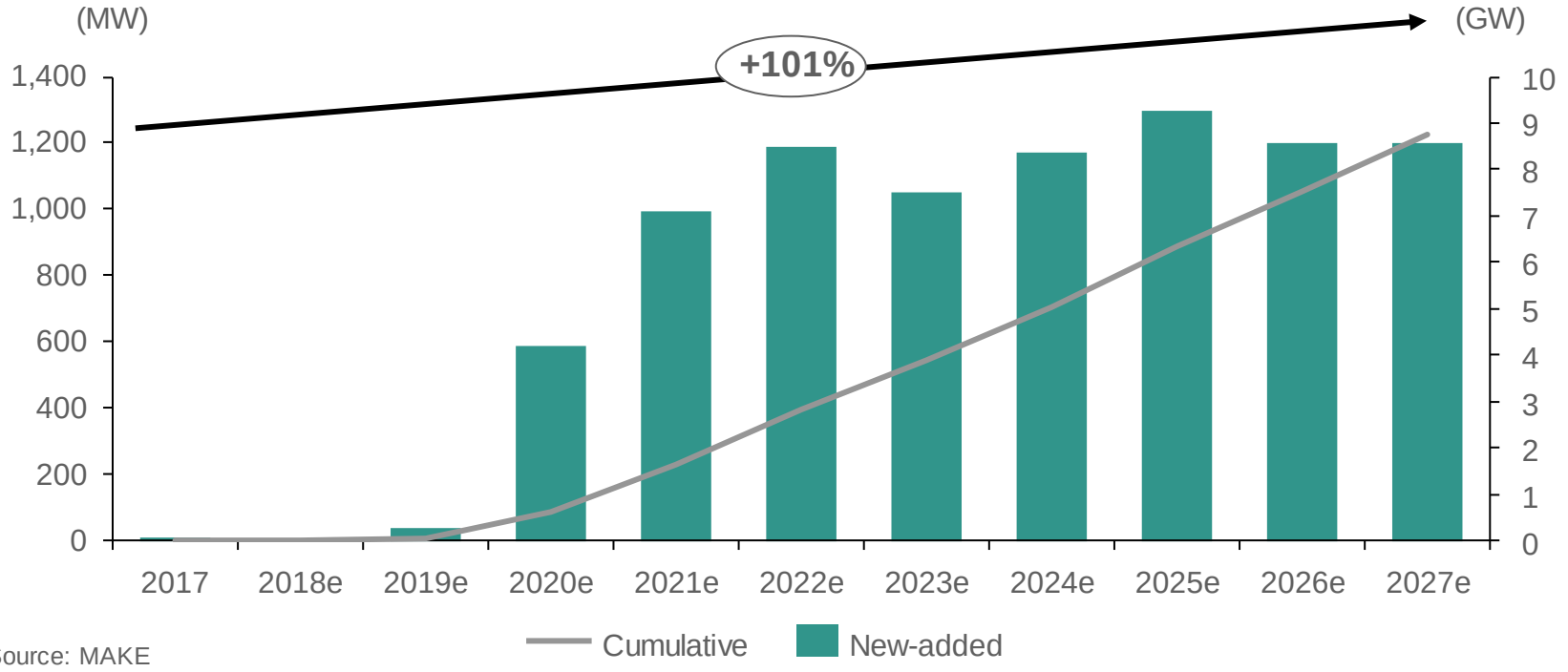
Taiwan

台灣

Formosa phase 1 demonstration

On track to be second largest offshore market in APAC

Taiwan offshore wind power outlook, 2017-2027e

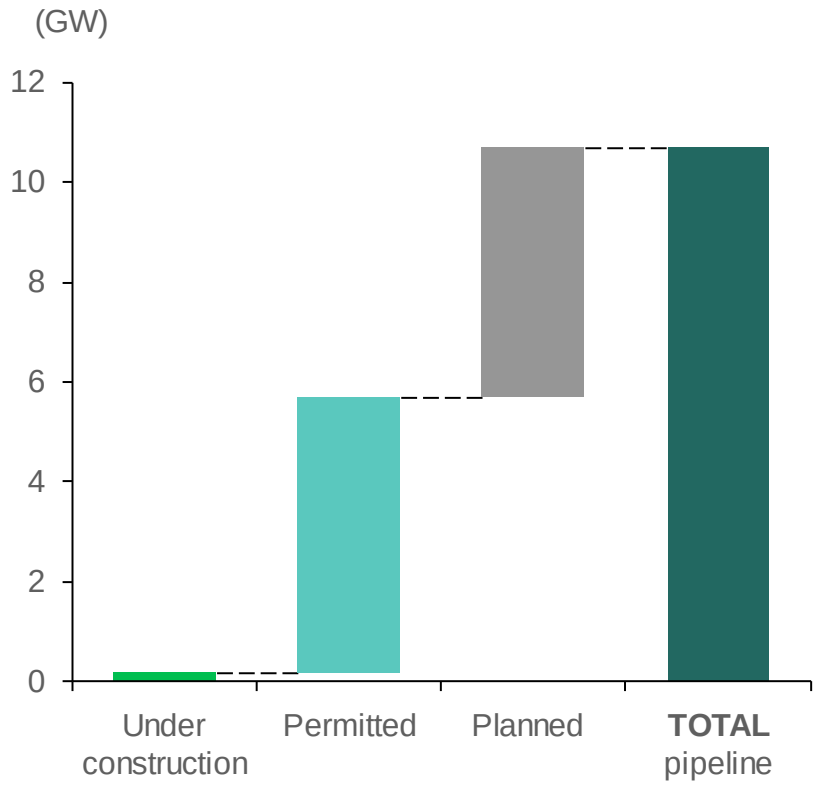


Source: MAKE

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

Large pipeline with >5GW of permitted projects

Offshore development pipeline



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

Source: MAKE

Key drivers

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

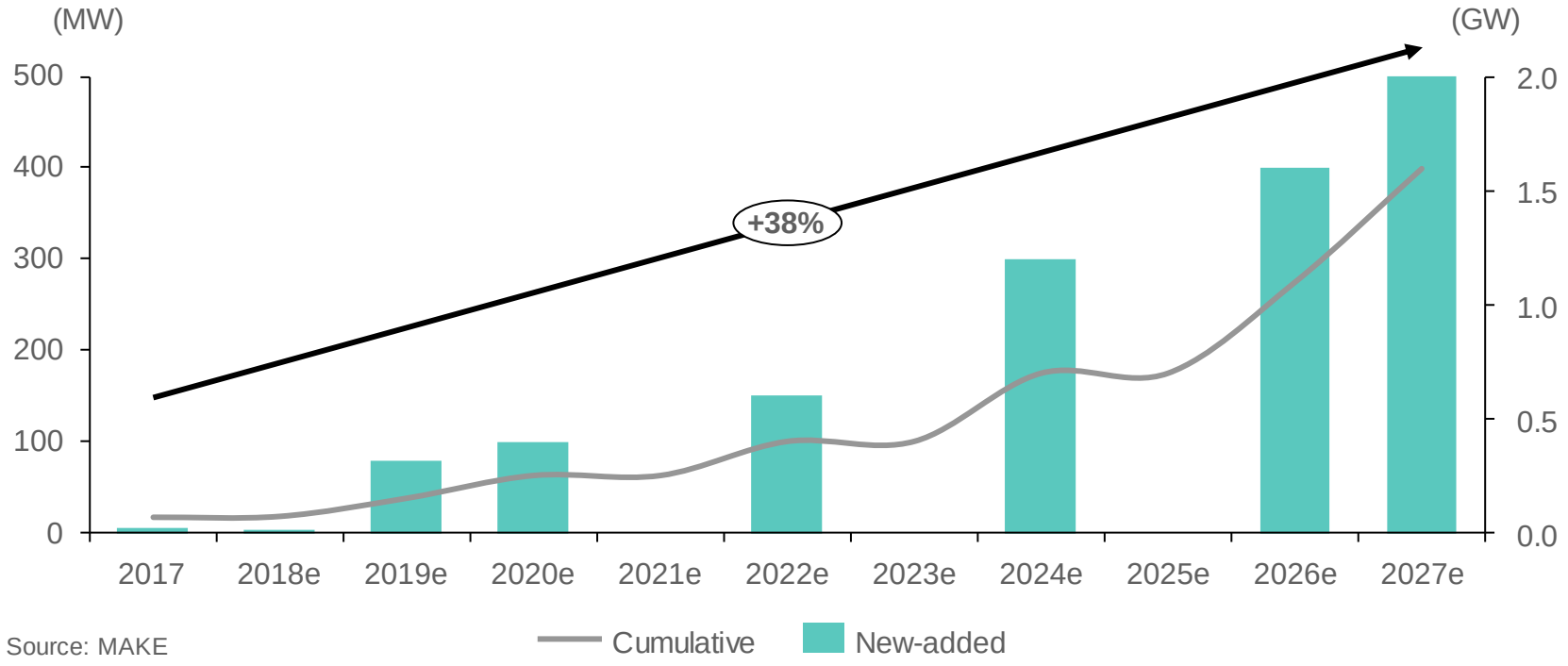
Key barriers

- 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

Fukushima floating demonstration

Slow to start but will start to accelerate post-2020

Japan offshore wind power outlook, 2017-2027e



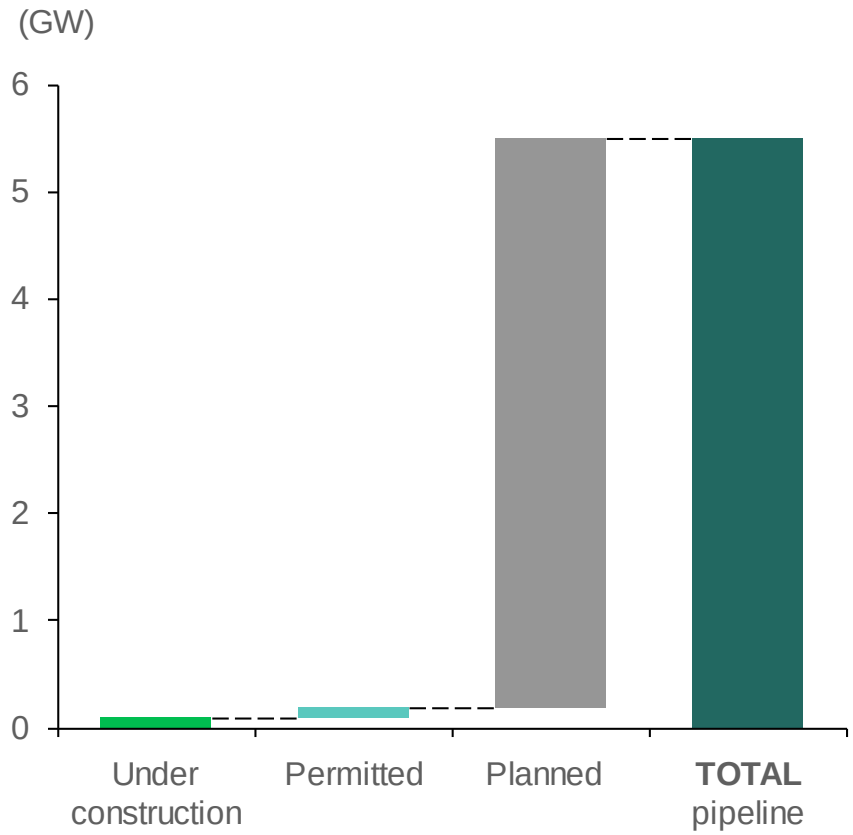
Source: MAKE

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 offshore outlook

Limited regulations and long EIA limits short term growth

Offshore development pipeline



Source: MAKE

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

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South Korea

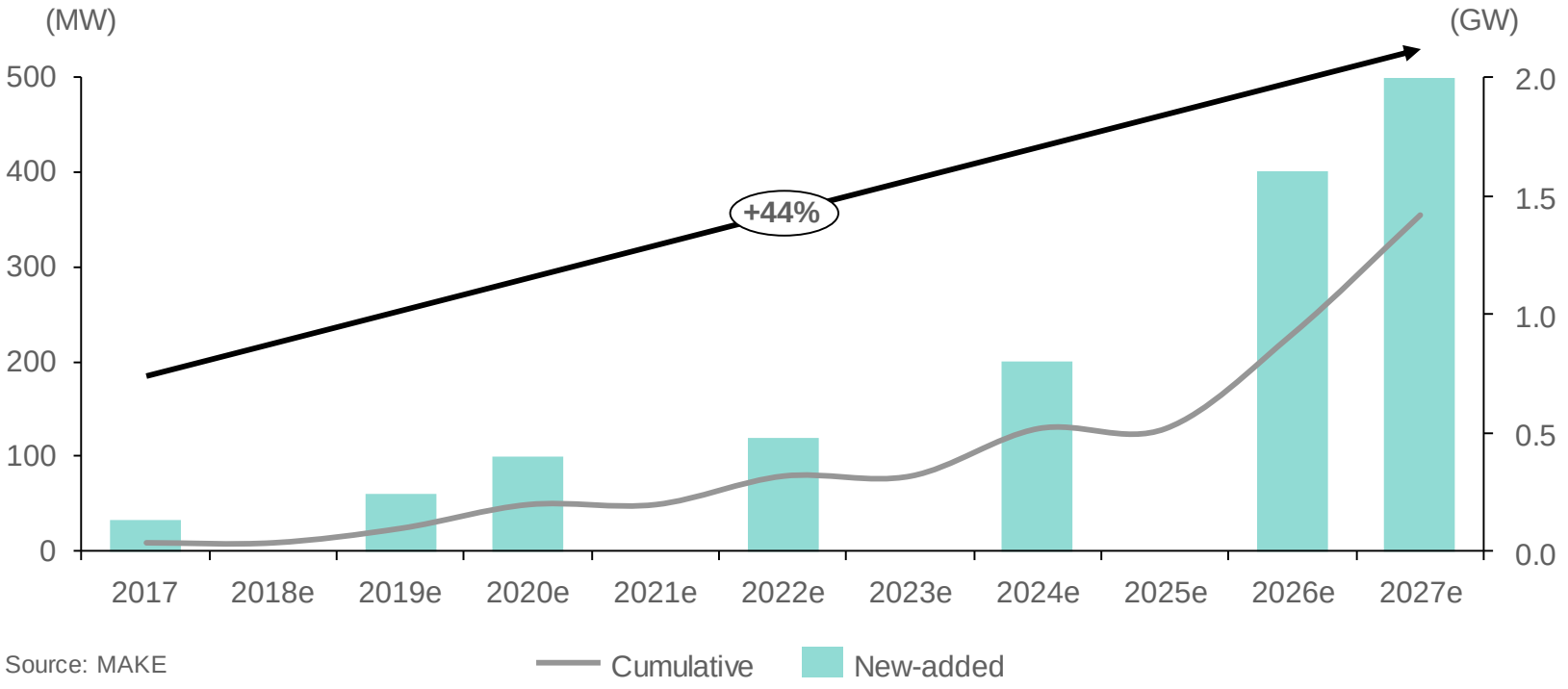
대한민국

Tamra offshore wind farm

South Korea offshore outlook

Ambitious RE targets require large-scale offshore wind

South Korea offshore wind power outlook, 2017-2027e



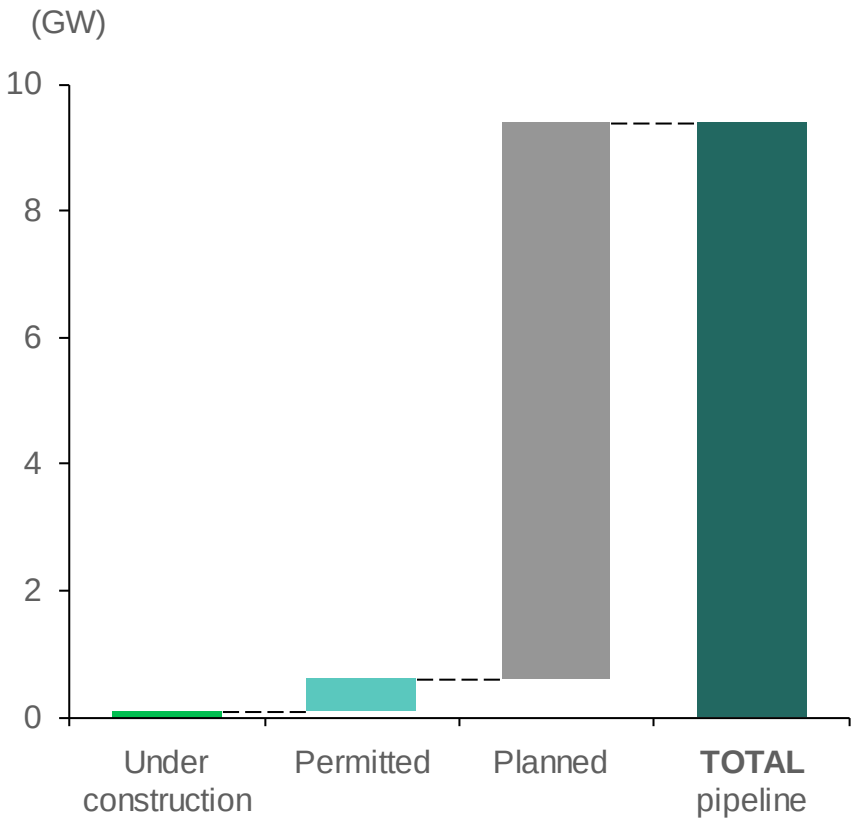
Source: MAKE

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 offshore outlook

2.5GW Southwest project will remain a key focus

Offshore development pipeline



Source: MAKE

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

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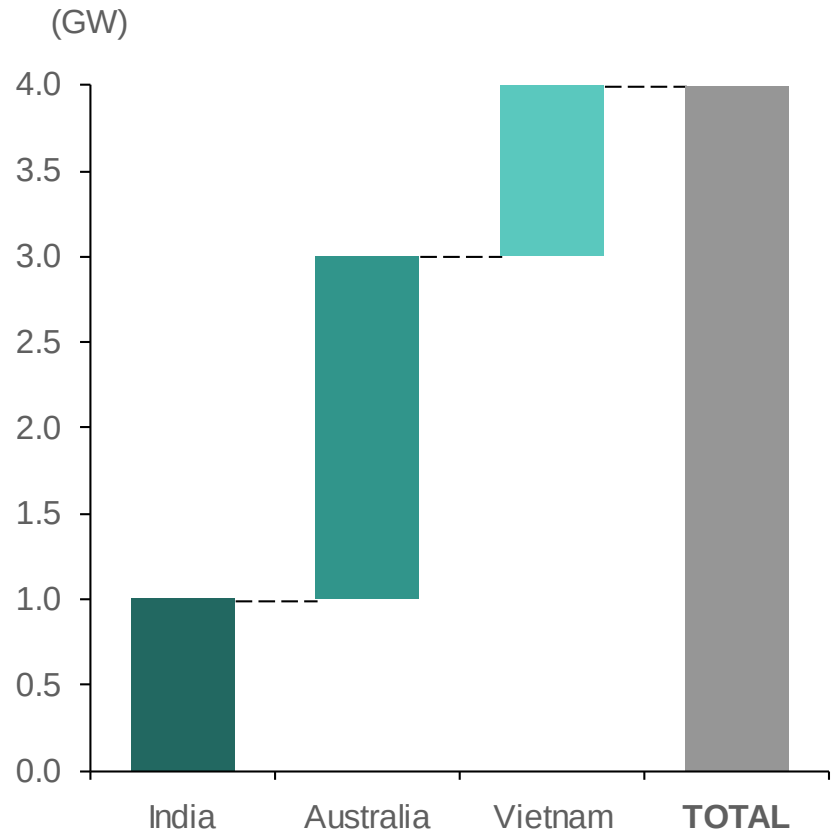
Emerging markets

Bac Lieu wind farm, Vietnam

Early planning is already underway in potential markets

Planned pipeline of offshore projects



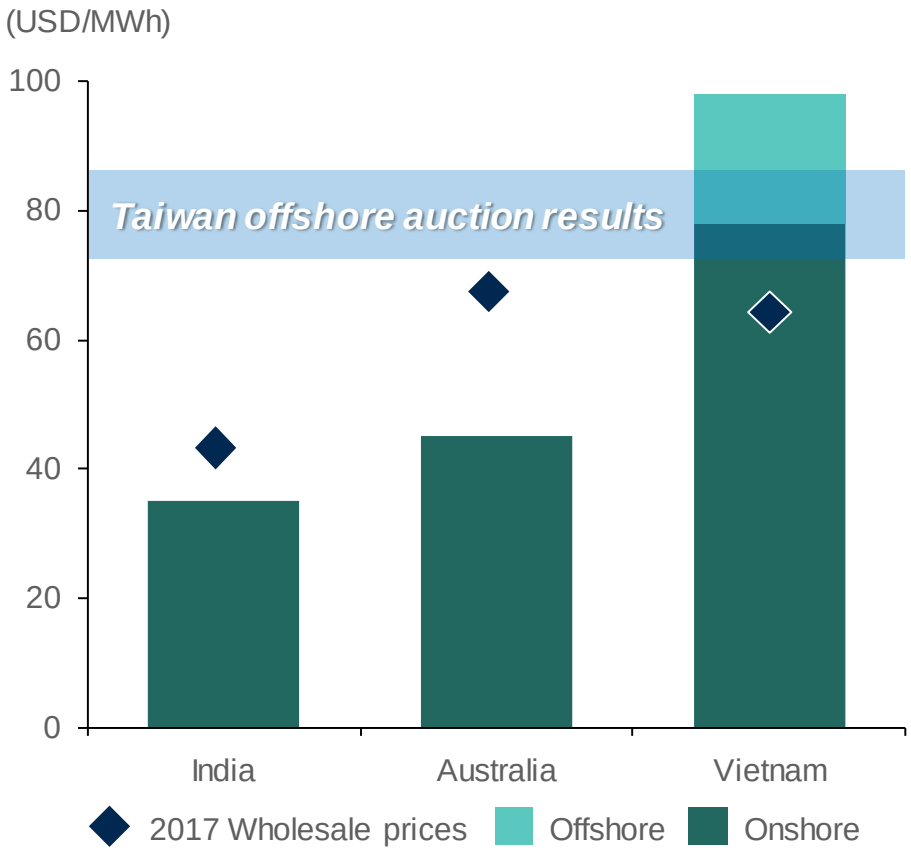
Source: MAKE

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

Low price expectations for offshore in emerging markets

Comparison of wind prices against Taiwan offshore benchmark



Source: MAKE, Wood Mackenzie

- Taiwan offshore auction results likely set a benchmark for other APAC governments' offshore wind price expectations
- **Vietnam**: Govt will increase tariff for offshore wind power
- **India**: Will require financial government support as offshore wind is unlikely to match onshore wind prices of around mid-30s USD/MWh
- **Australia**: Open market will put pressure on offshore wind prices to be around 40-50 USD/MWh to be competitive against onshore wind prices

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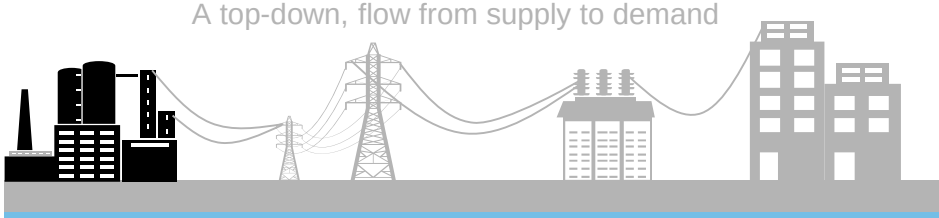
Market evolutions and technology revolutions have disrupted legacy business models, creating a new energy landscape

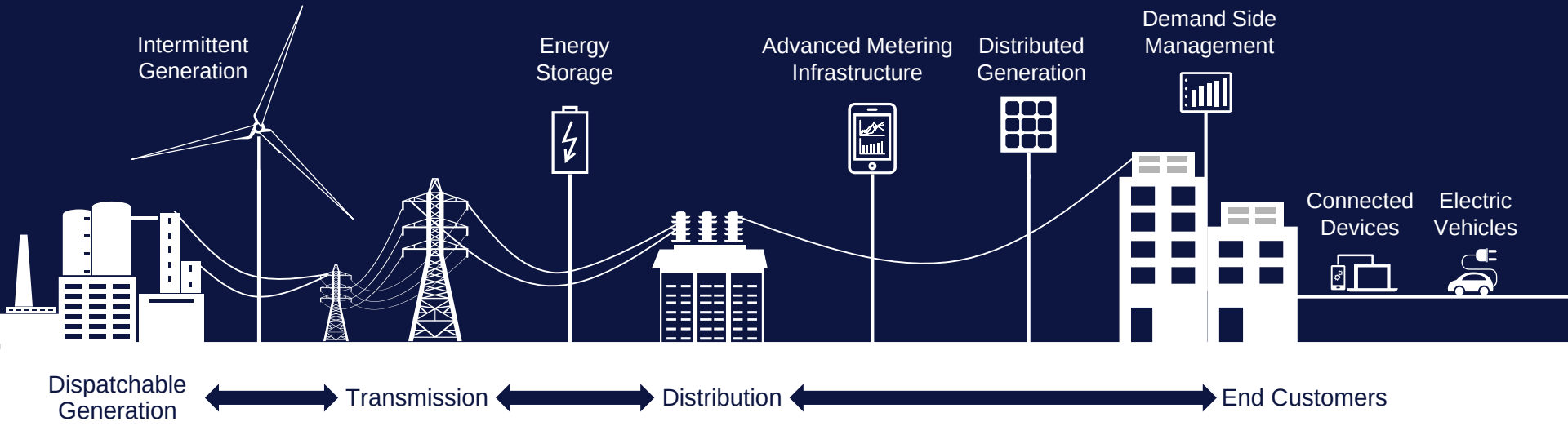
The Power Market of the Past

A top-down, flow from supply to demand



Tomorrow's Decarbonized and Decentralized Power Market

A bi-directional energy network with outside market responses and actors at every node reshaping power market planning and operations



Contact

Robert Liew

robert.liew@woodmac.com

consultmake.com

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Denmark
Sønder Allé 9
DK-8000
Aarhus
T +45 7026 6628

U.S.
117 N. Jefferson Street
Suite 400
Chicago, IL 60661
T +1 312 441 9590

U.S.
2 Liberty Square,
Boston
MA 02109
T +1 617 500 4257

China
No. 19, 470 Shaanxi Bei
Road, Jing'an District
Shanghai 200041
T +86 21 5286 0152

Germany
Neuer Wall 10
20354
Hamburg
T +49 40 822 15 3111