Improving policy, partnerships with foreign developers, and floating technology to drive offshore wind development in South Korea

2019

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Executive summary

South Korea is home to global industrial conglomerates across various industries including the maritime industry. A number of these conglomerates attempted to embrace the offshore wind industry. The general strategy was to acquire expertise abroad and then cater to both the South Korean as well as foreign offshore wind markets. However, these ambitions where put on hold largely by the global financial and economic crisis of 2009. Competition in foreign markets intensified as wind energy state subsidies dropped. Meanwhile, policy development in the South Korean market was still nascent. In addition, the market was not as open to experienced offshore wind players from Europe. The landscape is shifting in a positive direction for offshore wind development thanks to political will. Nothetheless, the local offshore wind supply chain is way behind the European and Chinese supply chains.

Private image by Thomas Poulsen

This *Improving policy, partnerships with foreign developers, and floating technology to drive offshore wind development in South Korea* (the Report) is part of a series of reports on the global emerging offshore wind markets. The reports have been crafted by the Panticon team during the months of July through February, 2019 to mark the new name of the management consulting company. Panticon is particularly strong in the Offshore Wind and Logistics sectors within the three core disciplines of Strategic Management Advisory, Mergers & Acquisitions, and Market Research & Analysis.

The Report has been created using an extensive library of data sources (see Reference section). The main data sources used as the basis for the Report were made up of 500+ pages and mainly consisted of various publications by government related organisations, academic journal articles, offshore wind industry articles, and press releases by firms across the offshore wind market supply side as well as demand side.

The Report contains forward-looking statements, which by their very nature, address matters that are, to different degrees, uncertain as they pertain to the future. These, or any other uncertainties, may cause the actual future results to be materially different than those expressed in the forward-looking statements as contained within this Report. At Panticon, we do not undertake to update our forward-looking statements, nor do we assume any liability for actions or dispositions made by firms, organisations, and/or individuals based on information contained in this Report.

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Image: Satellite map from Google Maps/cropped

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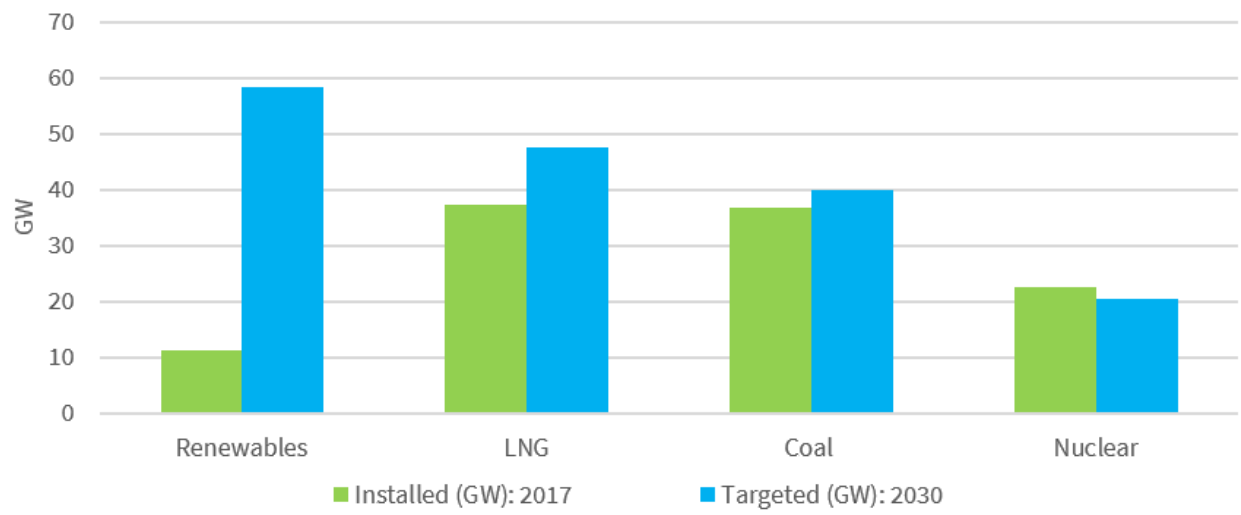
List of abbreviations

AMSC	American Superconductor
CAPEX	capital expenditure
CIP	Copenhagen Infrastructure Partners
DSME	Daewoo Shipbuilding and Marine Engineering
DSW	Daeshin Wind Power
EPC	engineering, procurement and construction
EWP	Korea East-West Power
GW	gigawatts
KEPCO	Korea Electric Power Corporation
KHNP	Korea Hydro and Nuclear Power
KOEN (formerly KOSEP)	Korea South-East Power
KOMIPO	Korea Midland Power
KOSPO	Korea Southern Power
KOWP	Korea Wind Energy Company
kWh	kilowatt hour
kV	kilovolt
HVDC	high-voltage direct current
m/s	metres per second
MOTIE	Ministry of Trade, Industry and Energy
MoU	Memorandum of understanding
MW	megawatt
MWh	megawatt hours
MWS	marine warranty surveying
O&M	operations and maintenance
OPEX	operating expenditure
REC	renewable energy certificate
RPS	renewable portfolio standard
UK	United Kingdom
WP	Korea Western Power

1. Introduction

From as early as 2012, South Korea had unveiled offshore wind targets of up to 2.GW by 2019. However, by the end of 2018, South Korea's cumulative installed offshore wind capacity stood at 38 megawatts (MW), having added 30 MW in 2017. According to South Korea's **Ministry of Trade, Industry and Energy**'s (**MOTIE**) December 2017 Eighth Basic Plan for Electricity Supply and Demand draft, the share of renewables in the country's installed capacity mix should increase from nearly 10% or 11.3 gigawatts

Figure 1: Distribution of South Korea's exisitng & targeted installed capacity



Source: Panticon, September 2018; based on multiple sources

(GW) in 2017 to 35% or 58.5GW in 2030 (see Figure 1).

The draft did not outline the renewables break-down but new offshore wind capacity is estimated to range from 11GW to 12 GW by 2030.

At the June 2018 Strategic *Forum for the Industrialisation of Offshore Wind Power Generation*, **MOTIE** revealed that South Korea plans to raise renewable energy power generation's share from seven per cent in 2018 to 20% in 2030, an increase of 48.7GW, in line with the final part of the *Renewable Energy 3020 Implementation Plan*. Offshore wind makes up 24.6% or 12GW of this increase.

1.1. Factors favouring offshore wind development

A key factor driving South Korea's offshore wind development is the desire to diversify away from the shipping industry.

Limited land: Most of South Korea's terrain is mountainous and hence not suitable for onshore wind development. In addition, the country has a high population density.

Limited onshore wind resources: South Korea has low average wind speeds on land.

Abundant offshore wind resources: Up to 7 metres per second (m/s), especially in the south west region and around Jeju Island (up to 7.5m/s). Jeju island has set a target of 100% clean energy by 2030.

Energy independence: South Korea seeks to reduce its dependence on coal and nuclear power generation

High potential for a local supply chain: South Korea has strong maritime and manufacturing capabilities which provide synergies with the offshore wind industry.

Political will: The government of President Moon Jae-in sees offshore wind development as part of the solution to combatting South Korea's youth unemployment.

1.2. Factors hindering offshore wind development

Offshore wind development in South Korea has so far been mainly hindered by lack of policy that aligns with targets as well as a desire to rely on local players, whose offshore wind track is limited, serve the local market.

Deep waters: South Korea has a limited continental shelf and hence suitable for the relatively more expensive floating technology.

Prevalence of typhoons: South Korea's offshore wind resources are located in a typhoon-prone zone.

Unsuitable seabed: Soft and muddy seabed in the wind-resource rich southwest coast complicates jacking up.

Air force radar issues: South Korea's Ministry of National Defence has expressed fears that offshore wind turbines might interfere with radar.

Limited offshore wind experience: South Korea has a limited local offshore supply chain including offshore wind turbine manufacturing and lacks of experienced local expertise.

Policy uncertainty: Coal and nuclear will still account for 60% of South Korea's power generation by 2030 under MOTIE's December 2017 Eighth Basic Plan for Electricity Supply and Demand draft despite an earlier pledge by the current president to phase out coal.

Slowing economy: The trade tension between China and the US, South Korea's two largest trade partners, has negatively impacted South Korea's economy.

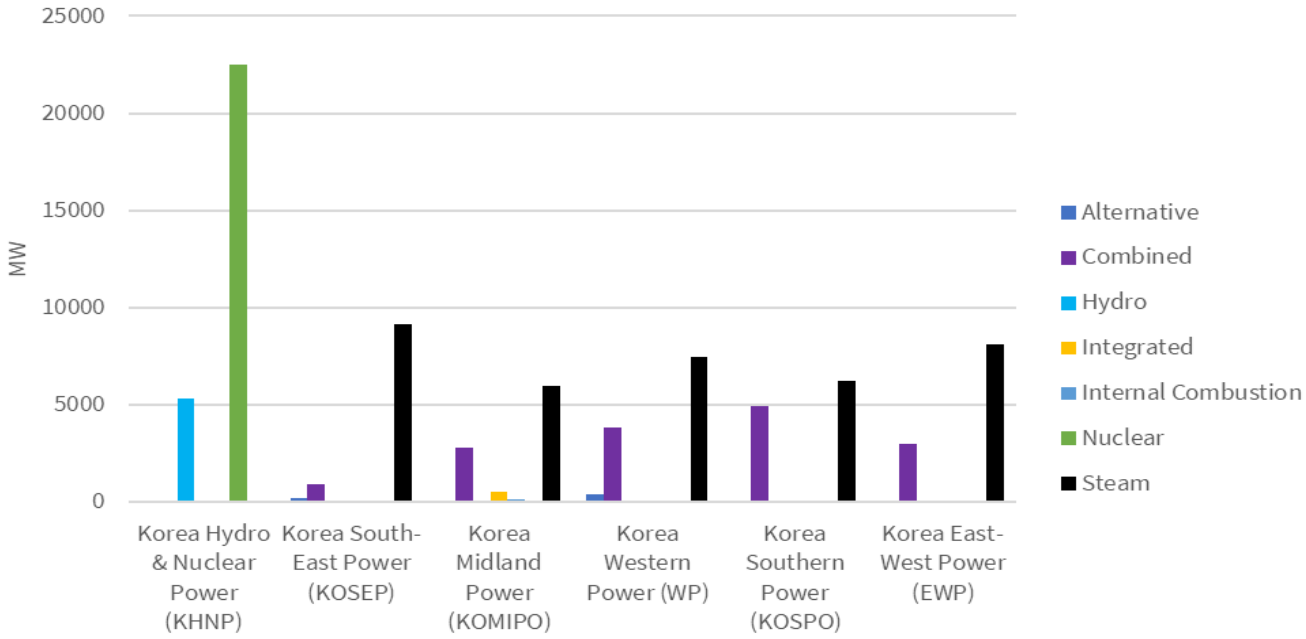
Complex permitting processes: Involve various state ministries and local governments.

Limited transmission infrastructure: As well as unclear regulation on grid access.

2. Offshore wind farm developers and owners

State-owned companies dominate, notably **Korea Electric Power Corporation** (**KEPCO**) which is 51% government-owned. **KEPCO**, via its 100% shares in six power generation companies, controls about 93% of South Korea's power generation. The six power generation companies' technology portfolio is mostly thermal and nuclear (Figure 2).

Figure 2: KEPCO's subsidiaries' power generation as at end of 2017



Source: KEPCO

South Korea's ambitions to transition from nuclear power generation has put pressure on KEPCO's revenue. This has in turn increased pressure on KEPCO to diversify as well as to internationalise. For example, KEPCO's six power generating companies jointly own phases 1 (90MW) and 2 (400MW) of South Korea's 2.5GW "flagship" Southwestern offshore wind project. The developer for both phases is **Korea Wind Energy Company** (**KOWP**), which is also a **KEPCO** subsidiary. At the same time, **KOEN** (formerly KOSEP) co-owns (with South Korea's **NongHyup Bank**) the 30MW Tamra offshore wind farm, which **KOEN** co-developed with **Doosan Heavy Industries & Construction Co**. (**Doosan**).

In June 2018, **EWP** revealed plans to establish a 200 MW floating wind power plant at state-owned **Korea National Oil Corporation**'s gas field platform in the East Sea once the gas field platform's operational life expires.

South Korea's developer / owner space is beginning to open up.

- **April 2018**: Swedish floating wind designer **Hexicon AB** formed a joint venture (JV) - **CoensHexicon Co Ltd** - with South Korean integrated service provider Coens Co Ltd to transfer **Hexicon**'s platform technology to the JV and enable serial production in South Korea and other agreed markets. In June 2018, **Hexicon** signed a memorandum of understanding) MoU with South Korea's **Busan Techno Park and Renewable Energy Centre** to development offshore wind farms in South Korea.

- **June 2018**: Australia's **Macquarie Group** signed a MoU with South Korea's **Gyeongbuk Floating Offshore Wind Power** to jointly develop a 1GW floating wind project 50km off the coast of Pohang and Ulsan in South Korea.
- **August 2018**: Denmark's **Copenhagen Infrastructure Partners (CIP)** revealed that it had set up an office in Seoul.
- **November 2018:** Canada's **Northland Power** signed an MOU with **KEPCO E&C** to jointly develop offshore wind projects, including floating offshore wind projects, in South Korea and abroad.
- **January 2019:** The industrial port City of Ulsan signed an MoU with consortia (South Korean gas and power company **SK E&S** (part of **SK Group**) and **CIP**; British-Dutch oil and gas company **Shell** and **CoensHexicon**; the **Green Investment Group** (**Macquarie Group**); and **Wind Power Korea** and **Principle Power** (USA)) to build out and maintain a combined 1GW of floating offshore capacity off South Korea as well as create a local supply chain.

3. Local offshore wind farm supply chain

A small domestic offshore market has stood in the way of South Korea realizing its potential to become an export powerhouse in foundations, vessels and cabling, as well as operations and maintenance (O&M) services. The limited existing offshore capacity in the country has mostly been served by a local supply chain.

3.1. Development and consent life-cycle phase

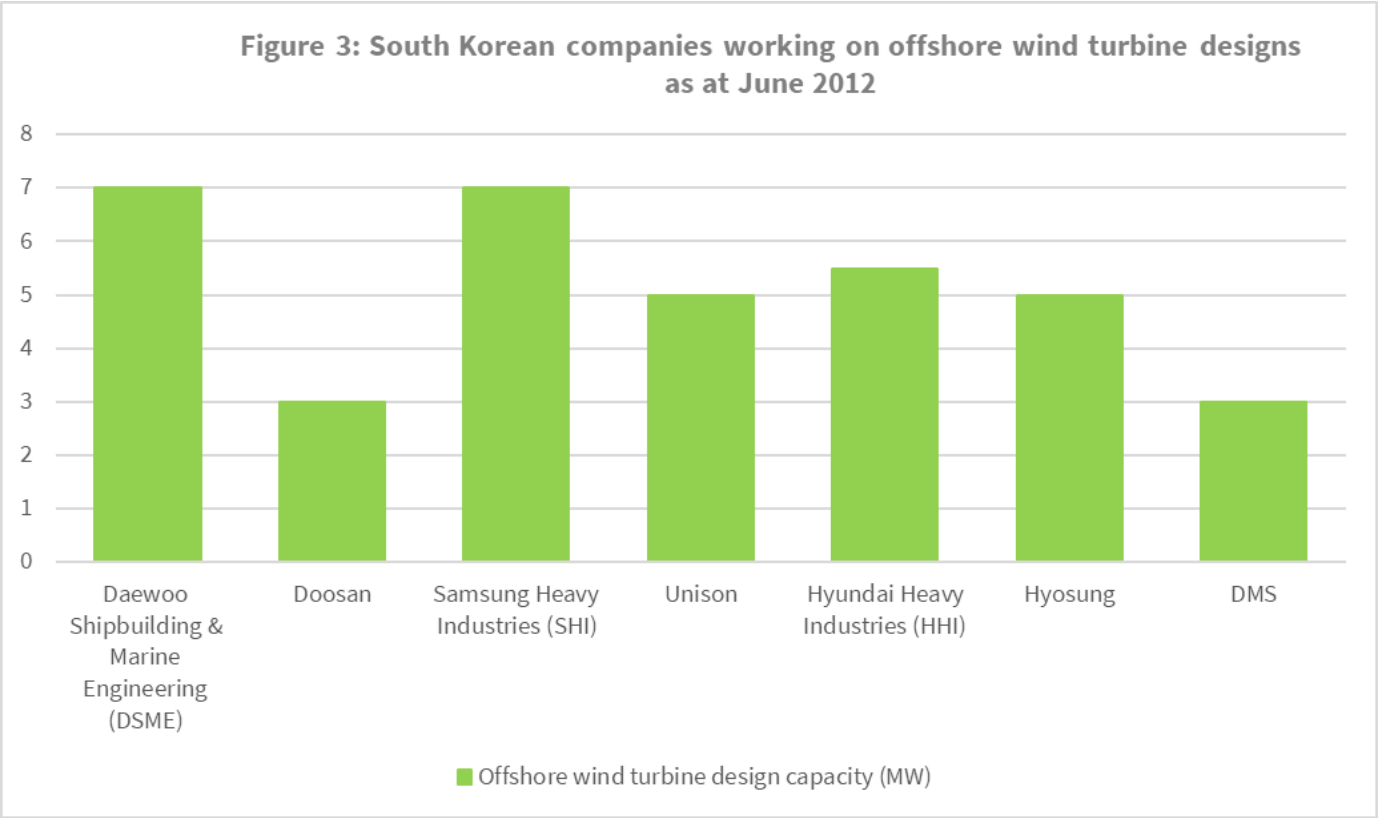
The development and consent lifecycle phase has seen South Korea reach out most to western players.

- In May 2014, Scotland's renewable energy engineering consultancy **SgurrEnergy** deployed one of its Galion lidars (the G4000 unit) for a 12-month measurement campaign in support of a proposed OWF in South Korea for engineering, procurement, construction and maintenance services company **SK E&C** (part of **SK Group**) as part of wind flow modelling and preconstruction development work.
- In July 2014, **GS Yeongyang Windpower** chose Denmark's **K2 Management** as engineering, procurement and construction (EPC) contractor for a 59.4MW wind farm in South Korea. In December 2016, **K2 Management** was awarded a contract by an unnamed South Korean company for a feasibility study for a planned OWF in South Korea. The scope included review of foundation jacket design, onshore substation and grid connection, and offshore cable route engineering. In addition, **K2 Management** will work on an O&M strategy and estimate capital expenditure (CAPEX) and operating expenditure (OPEX).
- In September 2016, re-insurers **Swiss Re** and **Korean Re** jointly appointed the United Kingdom's (UK) **London Offshore Consultants** (LOC) as the marine warranty surveying (MWS) service provider for the Tamra demonstration OWF (first phase of part 1 of the planned Southwestern OWF) (owned by **KOEN**, and offshore wind turbine manufacturer **Doosan**). In May 2017, **LOC** was retained by **KOWP** and **Swiss Re** to carry out MWS services (from Q2 2017 to Q1 2019) on the 60MW test phase of Korea's Southwest Offshore windfarm project.
- In June 2017, Dutch contractor **SPT Offshore** signed a MoU with **KOWP** for a joint viability assessment of an OWF planned for construction near Anma Island in South Korea.

3.2. Installation and commissioning lifecycle phase

3.2.1. Offshore wind turbines

By June 2012, several South Korean companies were working on at least one offshore turbine design (Figure 3).



Source: Panticon, September 2018; based on multiple sources

All except one have withdrawn. Reasons include bankruptcy and heavy parent-company losses stemming from the slowdown of the global shipbuilding industry. One prominent withdrawal from the market was **SHI**'s divestiture of its 7 MW test machine in the UK to ORE Catapult in December 2015.

- As at end of 2018, **Doosan** is the only South Korean manufacturer offering offshore turbines. It is supplying turbines for the 60MW demonstration OWF (second phase of part 1 of the planned Southwestern OWF). **Doosan** will use 3MW turbines and in April 2017 ordered Exceed 3MW gearboxes from Finland's **Moventas** with delivery scheduled by end of Q2 2018. In August 2018, Doosan signed a 15-year maintenance service contract with the project developer KOWP.
- In November 2017, Doosan entered into an agreement with US company **AMSC** (**American Superconductor**) for a 5.5 MW offshore wind turbine design that had previously been under joint development by **Hyundai** and **AMSC**. The typhoon-customised turbine has been operating in Gimnyeong Pilot Complex on South Korea's Jeju Island since 2014. Hyundai will continue to supply related turbine parts for the 5.5MW wind turbine and participate in mutual collaboration.
- **Doosan** is eyeing the typhoon-prone Asia Pacific market. In March 2018, it signed an MoU with Vietnam's state-run utility **Vietnam Electricity** to jointly develop a pilot offshore wind project off Vietnam.
- In June 2018, Doosan announced it will lead a four-year project to develop an 8MW offshore wind turbine to meet local demand and compete globally. The project is backed by the state-owned **Korea Institute of Energy Technology Evaluation and Planning** (**KETEP**).

3.2.2. Balance of plant

3.2.2.1. Sub-sea cables

South Korean **Taihan Electric Wire** has succeeded in developing 33 kilovolt (kV) subsea cable for power distribution and a high-voltage direct current (HVDC) 250 kV subsea cable for power transmission. It is supplying subsea array cables for the 60MW demonstration OWF (second phase of part 1 of the planned Southwestern OWF).

South Korean cable manufacturer **LS Cable & System** is increasingly becoming more active in the global offshore wind market. In January 2019, it won a contract to supply 170km subsea cables for the 640MW Yunlin OWF off Taiwan. Earlier, in October 2018, **LS Cable & System** won a contract to supply 350km high voltage onshore cables for the 1.4GW Hornsea 2 OWF off the UK.

3.2.2.2. Foundations

South Korean companies have limited local and foreign experience in offshore wind turbine foundation manufacture with significant potential to scale up.

- **June 2014: DSME** announced it was moving into jacket foundation fabrication for export to the European offshore wind market. But after missing out on a possible supplier-contract for the Inch Cape project in Scotland, it put its plans on hold.
- **August 2015:** South Korean company **CS Wind** was contracted to supply offshore foundations to the Nobelwind NV project in Belgium.
- **October 2016:** South Korean steelmaker **POSCO** announced plans to mass-produce jacket foundations and develop projects in the Asia Pacific region. Earlier, it supplied jacket foundations for the 30MW Tamra OWF in South Korea.

3.2.2.3. Offshore substations

For offshore sub-stations South Korean companies' experience is limited but the potential is high. **KOWP**, a subsidiary of state utility **KEPCO**, has built an offshore high voltage substation for the 60MW demonstration OWF currently under construction.

3.2.2.4. Installation vessels

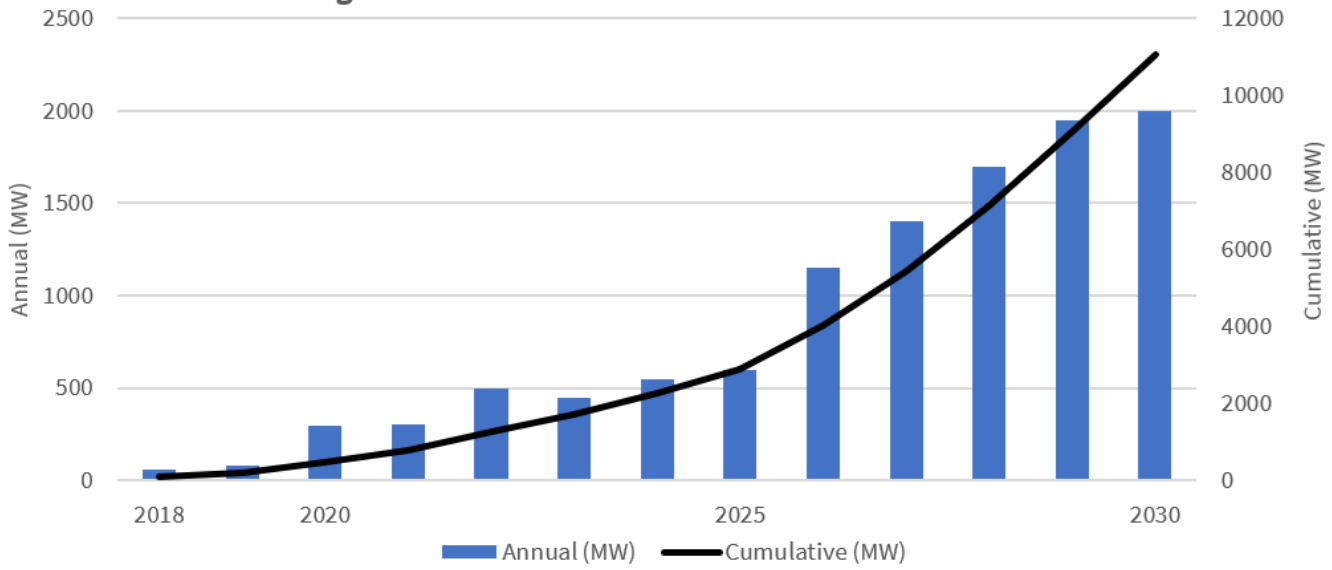
South Korea lacks the whole logistics supply chain such as jack-up vessels. However, the country has significant potential, thanks to a shipbuilding and offshore oil and gas platform industry.

- **June 2016:** Korean contractor **Daeshin Wind Power** (DSW) handled jacket foundations installation at the 30MW OWF off Jeju island.
- **November 2017: Korea Ocean Engineering & Consultants Company** contracted **G8 Subsea** (Singapore) to carry out array cable burial at the 60MW test phase of Korea's Southwest OWF project.

4. Offshore wind installation forecast

Based on **MOTIE**'s December 2017 Eighth Basic Plan for Electricity Supply and Demand draft , South Korea could install over 10GW offshore wind capacity by 2030. However, the focus to rely on local turbine suppliers, when 8MW-plus machines are becoming the norm in mature and emerging offshore wind markets, is likely to lead to delays. **Doosan**'s planned 8 MW offshore wind turbine is expected to be ready in 2022 at the earliest.

Figure 4: Offshore wind installation forecast - 2030



Source: Panticon, December 2018

5. Conclusion

The nascent South Korean offshore wind supply chain has from the start been targeting foreign offshore wind markets, including the emerging markets of Asia-Pacific. This focus on exports has contributed to limiting experienced foreign players in the South Korean offshore wind market. Meanwhile, a small local offshore market has prevented South Korean companies from accumulating offshore wind construction track record needed to conquer foreign markets. In addition, positive developments in neighbouringmarkets like Taiwan mean that the South Korean supply chain may be out-competed in the rest of Asia-Pacific by western and Chinese players. To catch up, the positive developments in the regional offshore wind markets are likely to encourage more coherent pro-offshore wind policies in South Korea.

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How we create value

- Tailor-made strategies
- Support M&A endeavours
- Share knowledge
- Analyse markets
- Advise our clients in every aspect of our three core disciplines

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