FRANCE-KOREA JOINT WORKSHOP ADEME-KEA

30 June 2021



"OFFSHORE WIND POWER IN FRANCE AND KOREA: FEEDBACK FROM COMPANIES, INNOVATION & PERSPECTIVES"





어서오십시오 Bienvenue

Welcome





Program

Introduction/ OPENING REMARKS (8:30AM - 8:45AM CET)

 2 speakers: ADEME: Mr. Arnaud LEROY, CEO KEA: Mr. KIM Chang-seob, President

Session 1/ INTRODUCTION TO "OFFSHORE WIND POWER" POLICIES AND R&D STATUS (8:45AM - 9:30AM CET)

- 4 speakers
- 1 discussion time

Session 2-Part A/ Information exchange on "OFFSHORE WIND POWER" projects and technologies (9:30AM - 10:20AM CET)

- 4 speakers presenting case studies
- 1 discussion time

- 1 coffee break (15 mn) -

Session 2-Part B/ Information exchange on "OFFSHORE WIND POWER" projects and technologies (10:35AM - 11:50AM CET)

- 4 speakers presenting case studies
- 1 discussion time

Conclusion/ CLOSING REMARKS (11:50AM - 12:00PM CET)

• 2 speakers :

ADEME: Mr. Philippe MASSET, Europe and International Director KEA: Mr. Sung-moon JUNG, Director, Global Project Division





Moderators



Ms. SHIN Jiye, Master of Ceremony for Introduction and Session 1



Mr. Philippe TIEFFRY, Master of Ceremony for Session 2 and Conclusion





Workshop organization

The timekeeper : Ludovic BAROU, Senior consultant, JITEX, France

Language

- Presentation materials in English
- Korean-French simultaneous translation available

Zoom application

- Please download the latest version of zoom to follow this webinar in the best conditions
- This will notably allow you to use translation channels





Workshop organization

Questions

- You can ask your questions via the channel provided for this purpose
- At the end of sessions 1 and 2, there will be Q&As and we will answer after the meeting to the unanswered questions

Web link to the event

• On the landing page, you will find: presentation of the speakers, workshop documents, etc.

Video: The workshop will be recorded

Social networks: You can use the # below



KEY FIGURES OF KEA-ADEME WORKSHOP ON OFFSHORE WIND POWER (30th JUNE 2021)





years of bilateral partnership

More than **LO** feedbacks from companies















INTRODUCTION **OPENING REMARKS**





OPENING REMARKS

ADEME: Mr. Arnaud LEROY, CEO

KEA: Mr. KIM Chang-Seob, President





ADEME

Mr. Arnaud LEROY, CEO









KEA

Mr. KIM Chang-Seob, President





SESSION 1

INTRODUCTION TO "OFFSHORE WIND POWER" POLICIES AND R&D STATUS





INTRODUCTION TO "OFFSHORE WIND POWER" POLICIES AND R&D STATUS

Offshore wind power policy in France

Mr. Matthieu LAURENT, Offshore Wind Project Manager DGEC, Ministry for Ecological Transition

Offshore wind power policy in Korea

Mr. KIM Sang-joon, Director, Wind Division KEA

Offshore wind power R&D & Innovation in France

Mr. Régis LE BARS, Investments for the Future Programme ADEME

Offshore wind power R&D & Innovation in Korea

Mr. KWEON Ki-Yeoung, Wind Program Director KETEP

DISCUSSION





Offshore wind power policy in France

Mr. Matthieu LAURENT

Offshore Wind Project Manager DGEC, Ministry for Ecological Transition







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OFFSHORE WIND POWER POLICY IN FRANCE



France's assets for the development of offshore wind energy

- **11 million km²** of maritime zones under France's jurisdiction.
- France has the second largest wind resource for offshore wind power in Europe, after the UK.
- A potential for offshore wind energy by 2050 between 49 and 57 GW for floating and bottom-fixed.
- A committed administration favoring the development of offshore wind power at lower cost, with a strong focus on floating wind

Offshore wind is key to reduce greenhouse gas emissions and diversify the French energy mix





French strategy: part of a global and European dynamic

Paris Agreement (2015)

- Containing global warming under 2°C
- European Green Deal
 - Carbon neutrality by 2050

• UE Key targets for 2030:

- At least 40% cuts in greenhouse gas emissions (from 1990 levels)
- At least 32% share for renewable energy
- At least 32.5% improvement in energy efficiency

• UE recognises that offshore wind is key to meet these targets:

EU Strategy to harness the potential of offshore renewable energy for a climate neutral *future (2020)* proposes to increase EU's offshore wind capacity from its current level of 12 GW to at least **60 GW** by 2030 and to **300 GW by 2050**.



The French energy policy: reaching carbon neutrality and increasing the share of renewable energy

Energy transition for Green growth Act (2015) & Energy-climate Law (2019)

■ National Low-carbon Strategy → Outlines the French roadmap for reducing greenhouse gas emissions by 2050.

Offshore wind is key to achieve the objectives set by this strategy. Therefore, an ambitious offshore wind program was defined in the

■ Multi-Annual Energy Plan (2019-2028) → Establishes the priorities for government action regarding energy policy in the next decade, shared in two 5-year periods.



Sources : Programmations pluriannuelles de l'énergie (PPE), Loi transition énergétique pour la croissance verte (LTECV), Loi énergie-climat (LEC). MINISTÈRE

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Multi-Annual Energy Plan – Agenda for offshore wind energy

- Multiannual Energy Plan Agenda of future commercial tenders for offshore wind (attribution date)
- Despite some delays, all these volumes will be attributed. These ambitions may be exceeded when this Plan is revised for the 2024-2033 period

Grant date for the call for tenders	2019	2020	2021	2022	2023	>2024	
Floating wind turbine			250 MW South Bretagne (€120/MWh)	2 x 250 MW Mediterranean Sea (€110/MWh)		1000 MW per year, fixed or floating, depending on	
Fixed wind	600 MW Dunkirk (€45/MWh)	1000 MW Eastern English Channel North Sea (E60/MWh)	500 – 10 Sud-Atl (€60/1	000 MW antique* MWh)	1000MW (€50/MWh)	prices and resources, with target prices converging towards the market price for fixed wind	

<u>Table 7</u>: Calls for tender for offshore wind (the dates indicated are the dates on which a winner will be selected, following a pitch procedure; prices indicated are the target prices for the calls for tender on the basis of which the maximum prices will be fixed). **The projects assigned starting in 2024 will primarily focus on the expansion of existing floating offshore wind farms using a shared connection.** * In this context, an offshore wind installation off Oléron may be assigned MINISTÈRE DE LA TRANSITION ÉCOLOGIQUE Liberti Égalité Fraternité

7 wind farms and 4 pilot floating projects have already been awarded



Offshore wind policy framework



A modernized legislative framework for offshore wind

Reforms implemented since 2016 :

- New procedure called 'competitive dialogue' (dialogue concurrentiel)
- Reduction of timeframe for dealing with objections (suppression of 1st instance court)

• « ESSOC » law (2018) :

- > Organisation of a public debate by the government before the call for tender in order to determine the project's geographical area;
- Reform of the permitting regime so that the permits remain valid if some modifications to the projects occur because of technological progress, e.g. use of a larger wind turbine;
- Preliminary studies, including environmental site assessment and geotechnical studies, undertaken by the State before the call for tender, are delivered to candidates in order to reduce risks and thus the cost of production of electricity (LCOE).

•« ASAP » law (2020) :

- Launch of competitive dialogue before the public debate's end ;
- > Public debates can cover several offshore wind farms at the same time;
- > Reduction of timeframe for dealing with objections (directly at Conseil d'Etat, suppression of a 2nd instance court),

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Offshore wind farm lifespan today



MINISTÈRE DE LA TRANSITION

ÉCOLOGIQUE Liberté Égalité Fraternité

Support scheme for offshore wind

- The cost of fixed wind has dropped significantly in recent years but prices for floating wind are still high. To be sure that the revenues from the sale of electricity will offset the costs of construction and operation,
- French government has decided to support wind energy by implementing a remuneration scheme ensuring a fixed remuneration per MWh.
- The last tender, for a farm at Dunkerque (600 MW), was awarded at 44€/MWh (without grid connection).
- This support scheme has to be accepted by the EU, as it is considered a State aid



"Complément de remunération" scheme when market prices are

below the target price

idéfini par l'appel d'offres

€/MWh Tarif cible

"Complément de remunération" scheme when market prices are **higher** than the target price.



25

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France supports offshore wind at various stages of development

Support for Innovation :

- Financing for research projects, demonstration of core technologies and deployment of pre-commercial prototypes
- Since 2009, several calls for interest have been launched for off-shore renewable energy technologies.
- Funding is piloted by the ADEME (the French sustainable energy agency) and provided by the State in the context of a national Innovation Investment Program (« Programme des Investissements d'Avenir »)
- 4 floating farms between 25 and 30 MW each awarded under this scheme

Accompanying floating projects towards commercial deployment :

• Launch of 2 call for tenders for 3 floating wind farms of 250 MW each before 2022



The economic benefits of offshore wind development

Strong commitment of industry and territorial authorities :

• Several offshore facilities in France :

- General Electric plant (wind turbines) in Saint-Nazaire,
- LM Wind plant (blades) in Cherbourg
- STX plant (offshore substations) in Saint Nazaire,
- Siemens-Gamesa plant (wind turbines and blades) in Le Havre.
- Territorial authorities' strong investment to support those projects :
 - Investment in regional infrastructures (Brest and Port La Nouvelle's port facilities, especially for floating wind)
 - Co-investment with the State for plant construction (Cherbourg, Le Havre)

The industry of marine renewable energies, especially offshore wind, already generates local employment (close to 4900 jobs in 2020, +59% in 1 year). The constitution of a French industry will generate approximately 15 000 direct and indirect jobs in France,



Distribution of jobs related to marine renewable energies

Biodiversity conservation and cohabitation of activities

Conservation of the environment ...

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- According to the biodiversity protection policy and the UE policy, the French government works to protect and to reduce risks for the biodiversity.
- France has 9 marine natural parks. In a logic of cohabitation of activities, the development of offshore renewelable energies is possible.
- EU Natura 2000 legislation allows to implant offshore wind farms if an environmental evaluation is undertaken. Offshore wind farms have to respect the local biodiversity.
- Offshore wind farms are submitted to the « Avoid, reduce and offset » sequence.

...and cohabitation of activities are key components of the offshore wind program

- France strongly supports the cohabitation of all activities at sea with offshore wind
- Whenever it is possible and secure, fishing is allowed inside windfarms



Photo 2 : Grands dauphins (Virginie Wyss - Cohabys)

MINISTÈRE DE LA TRANSITION ÉCOLOGIQUE Liberti Feature

Thank you for your attention





Offshore wind power policy in Korea

Mr. KIM Sang-joon

Director, Wind Division KEA











KOREA ENERGY AGENCY New & Renewable Energy Center



Background

2010

Results

- Announced 'Offshore wind road map'('10.11)
 - Phase1(demonstration) 100MW by 2013
 * Test Bed, Track Record, R&D
 - Phase2(Pilot) 900MW by 2016

 Operation Technology, Commercialization

 Phase3(Large Scale) 1,500MW by 2019

 Commercial large scale wind farm
- Announced 'National Roadmap for Southwest sea 2.5GW Offshore wind Power'('11.11)
 - Phase1(demonstration) 100MW by 2014
 - ☑ Phase2(Pilot) 400MW by 2016
 - ☑ Phase3(Large Scale) 2,000MW by 2019



- Phase1(60MW) has been constructed by 2020
- Phase2 has been permitted(2021), Phase3 is under going







II Obstacles of Offshore wind power

• Marine Spatial Planning in Korea(9 marine use zones)

- Ocean Uses : Multiple
- ☑ Conflict of interests : Energy development zone ↔ other uses(fisheries etc.)
 - Resident Acceptance becomes more important







III Plans for Offshore Wind Power Development






Site Identification(Local Gov.)

- 'Site information map'
 - Wind resource, regulatory, fishing info, etc
- 'Consideration zones'
 - Economical efficiency, less affecting fishing, etc
- 'Basic feasibility survey'
 - Budget supporting



Evaluation(MOTIE)

Evaluation

- Plans for permitting, power grid connecting, etc
- Resident acceptance, environmental affect
- Plans for profit sharing
- Discussion
- Authorization of related agencies
- Procedure for public participation



Organizing Public-private joint conferences

Discussion with stake holders(residents, fishermen, etc)

Public-private joint conferences

- Discussion for resident acceptance
- Site candidates
- Profit sharing(REC)
- Marine environment, etc

Members

- Representative(resident, fishermen, etc)
- Expert
- Local government
- Participate in integrated farm planning
- Local governments have to consider whether reflect members' opinion or not

Gathering residents' opinion

- Hold a public hearing(local gov.)
- The plans for integrated farm
- Consider the residents' opinion(local gov.)
- Revise the plans(local gov.)
 - Reflect the resident's opinion



Incentives for integrated farm

- Give a REC(max 0.1) to local government
 - * Apply a sprint rec by lead time in construction(REC can be changed by the lead time)
- Reflect as energy development zone to MSP
- Support quick permitting procedure

Preparing guide lines

- ☑ Organization, procedure, etc
- Public-private joint conference guide line
- Resident acceptance guide line
- Profit(REC) sharing guide line

Others

- Pre-establish public connection network
 - * Support a grid connection on time
- Pre-notice service for REC weight
 - * Support a FID





1 Jeonbuk Southwest(2.4GW)	Public-private joint conference accept the plans(MOU, '20.7)
2 Jeonnam Sinan(8.2GW)	Phase1(4.1GW, '21~), Phase2·3(4.1GW, '26~) Phase2·3 are on progressing site identification and feasibility study
Ulsan(1.4GW) + Southeast(4.6GW) Floating offshore wind	Ulsan(200MW), 6 Individual developers(MOU, '19) '23~
4 Jeju(0.6GW)+Incheon(0.6GW) +others	Jeju ′21~, Incheon ′23~







Thank you!





Offshore wind power R&D & Innovation in France

Mr. Régis LE BARS

Investments for the Future Programme **ADEME**



#ADEME-KEA2021





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Accelerate the ecological transition with ADEME

KEA / ADEME Event – offshore wind turbine



ACT MORE and FASTER

State operator among :

- The Ministry for an Ecological Transition;
- The Ministry for Higher Education, Research and Innovation

Field of activities:

- Low-carbon pathways, adaptation to climate change;
- Renewable energy;
- Building ;
- Enterprise-Industry
- Sustainable Bioeconomy;
- Mobility-transports ;
- Air quality ;
- Behavioural change and mobilisation ;
- Circular economy ;
- Contaminated soils and sites

Budgets:

- 757 M€ in 2021 ;
- 2 billions€ in the frame of France Relance (2021-2022).
- 2,4 Billions€ in the frame of the PIA since 2010 to promote innovation for ecological transition

Our missions :

- Broaden the deployment of ecological transition ;
- Contribute in collective expertise;
- Innovate and prepare future.

How many, where ?

- 904 agents (393 in regional divisions);
- 3 central sites (Angers, Valbonne-Sophia Antipolis, Montrouge)
- 17 regional divisions.







Longue vie aux objets



1 ²⁵⁵ # **** #	2 	3 ETHERATE		5 LALIETARE	6 LAUPROPERT JSSAMIELEENT
7 INTELLIGENER ELECTRICOLI MATERIALE	8 TRAVAL DECINT TERMISSIANCE ECINIMIUE	9 BOLGERE BNODELTOP FT BFRASTRICTION			12 CONSIDERATION REPORTABLES
13 ALLUITEDATE LESCAREZATIONE CIMINES	14 ve Appendix TO	15 ******* ****	16 Mar Jactice Constitutions UPFOACES	17 MATERAARAUS POOR LABEAUSAIRAN MISTORACTINS	OBJECTIFS DURABLE





ADEME actions for RDI & Innovation

A continuum of involvement: from research to implementation





ADEME strategy for Research, Development and Innovation







Key figures for PIA 1, 2 and 3 (achievements 2010-2020)

More than **110** RFP/CEI Including IPME, CI, IRVE

1979 partners Including 1001 Micro/SMEs

943 projects funded including 398 under the SME Initiative and the CI and 89 for EV charging infrastructure

€2,4 billion ADEME financing amounting to total projects funding of €7,4 billion = 2 leverage effect



€4 million Average funding Per project (excluding IPME/IRVE/CI)

€0.32 million Average funding Per SME Initiative project or CI



Focus on the floating offshore wind market



Flottantes Gravitaires Jackets 50 100 150 200 Bathymétrie en m \leftarrow 40 - 60m \rightarrow

- Floating offshore wind adresses water depth greater than 50-60 m
 - Targeted zones far from coastlines (20-50 km)
 - Floating offshore wind less sensitive to geotechnical conditions thant bottom-fixed
 - Important wind resource (winds stronger farshore)
 - Improved social acceptance(less conflicts with stakeholders)
- Potential optimisation of the electricity production costs (LCOE)
 - Harnessing stronger winds farshore (> 9 m/s)
 - Reducing installation costs (smaller vessels, wider meteo windows)
 - Supporting larger wind turbines (> 15 MW)

COUNTRY / REGION SHARE OF OFFSHORE WIND RESOURCE IN +60m DEPTH

USA

Japan

Source : MOFA (JP), Carbon Trust (UK), WindEurope (EU)



60%

80%

Location of bottom-fixed (red) and floating (green) offshore wind zones in France.

Expected offshore wind capacity estimated by RTE at 2050 horizon between 20 and 65 GW including 2/3 of floating wind (*RTE - Futurs énergétiques 2050*)

Différentes technologies de fondations de l'éolien en mer



PIA program allows to create the floating wind industry and positions France in floating wind leading countries

- **By supporting R&D** projects of floater designs : TrussFloat (DIETSWELL), Hexafloat (SAIPEM), Efficace (EOLINK)
- By supporting the first offshore wind turbine connected to the french grid : FloatGen (IDEOL)
- By supporting 4 pilot floating wind farms located in the two main seaboards: 3 in the Mediterranean Sea, 1 in the Atlantic Ocean





Floating offshore projects



Eoliennes Flottantes de Grois-Belle île

- **EFGBI –** Groix-Belle île Capacity: 28,5 MW
- Developper/shareholders: Eolfi Offshore France (CGN/Eolfi), Eolfi-Shelle, Eolien en Mer Participation

ADEME

AGENCE DE LA TRANSITION ÉCOLOGIQUE

- Wind Turbine supplier : Vestas 3x9,5 MW
- Floater supplier: Naval Energies

Floatgen

- BW Ideol , ECN, Bouygues TP
- Le Croisic (Sem-Rev) 2 MW since 2018

Eolmed Gruissan : Gruissan (Port La Nouvelle) - Capacity: 30 MW

- Developper/shareholders : Qair Marine; AREC; CALEN; LGN; SEMPER: AMIDEOLE, TOTAL
- Wind Turbine supplier : Vestas 3 x10 MW
- Floater supplier : BW IDEOL (Damping Pool®).



Provence Grand Large

- PGL : FOS Faraman Capacity: 25,2 MW
- Developper/shareholders : EDF Renouvelables France,
- Wind Turbine supplier : Siemens Gamesa 3 x 8,4 MW
- Floater supplier: : SBM Offshore

Eoliennes flottantes du Golfe du Lion

- EFGL: Leucate Capacity: 30 MW
- Developper/shareholders : Ocean Winds Offshore, Eolien en Mer Participation
- Wind Turbine supplier : Vestas 3 x10 MW
- Floater supplier : Eiffage Metal/PPI





others wind projects funded by PIA ADEME

EFFIWIND Pessac (33) Adera Aide: 3.6 M€ • Fin: 2020 Coordinateur : Adera

MATÉRIAUX THERMOPLASTIQUES POUR PALES ET CAPOTS DE NACELLE.

Objectifs : Le projet EFFIWIND vise à mettre en œuvre des composites à base de polymères thermoplastiques acryliques pour la fabrication de pièces de grandes dimensions. Ces innovations devraient permettre une diminution de poids et de coûts de fabrication, et des possibilités de recyclage. Durant le projet, un jeu de pales à base de matériaux thermoplastiques sera fabriqué et testé sur une éolienne en exploitation. FICHE PROJET en ligne



Installation de la pale EFFIWIND en composite acrylique 100 % recyclable sur le site de CANOE Laca

HALIADE-X Nantes et Saint Nazaire (44) Aide : 10.3 M€ • Fin : 2021

Coordinateur : GE Renewable Energy PROTOTYPE d'ÉOLIENNE EN MER DE FORTE PUISSANCE - HALIADE-X 12MW

Objectifs : Concevoir et fabriquer une turbine d'éolienne en mer de puissance de plus de 10 MW. Les innovations technologiques envisagées concernent notamment la puissance nominale. le type de générateur. le diamètre du rotor, les matériaux de la pale, les travaux d'optimisation du mât avec la sousstructure et les solutions digitales à introduire pour améliorer la fiabilité et la disponibilité de la turbine. FICHE PROJET EN LIGNE



Inauguration de la nacelle prototype Haliade-X produite à l'usine de GE Renewable Enerav à Saint-Nazaire.

More projects are described accross the review concerning EnR on the ADEME website:

https://librairie.ademe.fr/recherche-et-innovation/4700-bilan-dela-thematique-energies-nouvelles-et-renouvelables-duprogramme-d-investissements-d-avenir-pia-opere-par-l-ademeedition-2021-9791029717505.html#/43-type_de_produitformat imprime

Pale d'éolienne équipée de penons électroniques

FICHE PROJET en ligne WIDEO PROJET en ligne

encore en efficacité.

INITIATIVE PME

Aide : 205 k€ • Fin : 2018 Coordinateur : Mer Agitée

D'UNE PALE D'ÉOLIENNE.

ePENON La Forêt-Fouesnant (29) merQ

CAPTEUR AÉRODYNAMIQUE POUR QUALIFIER L'ÉCOULEMENT

Objectifs : Le ePenon apporte un diagnostic en temps réel du réglage

quer le profil aérodynamique des pales, puis optimiser le rendement

aérodynamique. En vérifiant en permanence que l'angle d'incidence des pales est bien réglé et en le corrigeant le cas échéant, on maximise la portance et on augmente la performance. A terme, un contrôle

actif en temps réel de l'angle d'attaque est envisageable pour gagner

des pales d'une éolienne pour, dans un premier temps, diagnosti-

DETI/Pôle IASV – DEBR/SRER

51 06/07/2021







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Direction des Entreprises et Transitions Industrielles Régis LE BARS – regis.lebars@ademe.Fr

Offshore wind power R&D & Innovation in Korea

Mr. KWEON Ki-Yeoung

Wind program Director **KETEP**





#ADEME-KEA2021

Webinar Series: France-Korea joint workshop ADEME-KEA

30 June 2021

Ki-Yeoung KWEON Program Director for Wind Power





KETEP?

KETEP is an energy R&D funding agency in the Republic of Korea which undertakes roles in planning, evaluating, and managing national energy R&D Projects

Main Function

Energy Technology Policy Planning Project Planning, Evaluation and Management

International cooperation

Higher Education and Training

KETEP

In 2021, KETEP supports innovative R&D projects with budget of 1 billion USD

Energy Supply Innovation

Renewable energy, Hydrogen, Clean thermal power, Nuclear, etc

Energy Demand Innovation

Energy storage, Smartgrid, Energy efficiency, ESS, etc

Enhancement of energy technology infrastructure and policy planning

R&D Programs





Korea's Energy Policy Direction



Eco-friendly	Significant expansion of renewable energy : increasing the share of renewable energy in power generation mix up to 20% by 2030
Smart	Distributed generation system + the 4 th industrial revolution new technology → Fostering IoE-based New Energy Industry

• IoE(Internet of Energy) : Integrated energy systems with electricity generation-transmission, distribution and consumption by utilizing ICT



National Target of Renewable Energy 3020





Key Statistics(Wind Energy) 2020, Korea



Cumulative Installation Capacity 2019



Table 1. Key Statistics 2019, Republic of Korea			
Total (net) installed wind power capacity	1490 MW		
Total offshore capacity	72 MW		
New wind power capacity installed	191 MW		
Decommissioned capacity (in 2018)	0 MW		
Total electrical energy output from wind	2.76TWh		
Wind-generated electricity as percent of national electricity demand	0.5%		
Average national capacity factor	23.0%		

- ** Cumulative Installation Capacity 2020
 - 1,641 MW installed (Offshore 3 site 124.5 MW),
 - Total 106 Wind farms , 739 WTGs

National Offshore Wind Pipeline





Source: Korea Wind Energy Industry Association

GWEC | Global Offshore Wind Report 2020

Wind Industry in Korea



A few turbine OEMs and Mid/Small-size component suppliers

□ (WTG) 4 Turbine OEMs: Doosan, Unison, Hyosung, Hanjin Ind., focusing on 2~3MW WTGs

* Main Product : (Doosan)3MW / 5.5MW, 8MW(Developing), (Unison)2.3MW / 4.2MW, 10MW(Developing) (Hanjin) 2MW WTG, 4.XMW(Developing)

□ (Component) Multiple suppliers, mainly tower and forging components But Lack of production base for key and bespoke components(blade, gearbox etc.) on each turbines.

* Only 1 ~ 2 Blade, Gearbox, Generator, and PCS suppliers are existed in Korea.

Wind Resource

potentials(Onshore)

- Theoretical: 499GW
- Technical: 352GW
- Market-wise: 17GW



Drivetrain: High-speed geared IEC Class: I Korean firm Doosan accuired the rights to manufacture this 5.5MV offshore turbine in 2017, following in the footsteps of Dongfang and Hyundai Heavy Industries, which both signed licence agrements with his designer, US-based ASMC Windtec. Solutions. The turbine has been around for some time now. Dongfang installed the first prototops at on onshore site in China back in 2012, and the second at the Revision interticial wind farm in eastern China the following year.

7. Doosan WindS500

Power rating: 5.5MW Rotor diameter: 140m

On/Offshore wind resource map: <u>https://kredc.kier.re.kr/kierflex/#</u>

8MW 대용량 해상풍력모델 개발 목표 사양





1) 이용률 계산은 단지효율 90%, 가동율(Availability) 95% 가정

Unison 4.2MW

R&D Vision & Goal



Vision	To secure the competitive prowess of Korea's wind energy, enhance competitiveness of the industry ecosystem				
Goal	 Reinforce competitiveness by core-parts development and technology advancement for wind power Establish competitiveness in mega-scale wind energy through Korea's proprietary technology in large-scale offshore and floating wind energy as well as technologies related to the wind energy market 				
	Overview				
	Reinforce the competitiveness of wind energy core parts	Develop and demonstrate mega- scale offshore wind power technology	Develop and demonstrate floating offshore wind power technology	Build and deploy eco-friendly wind farms	
Strategic	Market entry strategy				
tasks	 Manufacture and advance competitiveness of core parts of large-scale wind turbine made in Korea Establish demonstration testbeds and parks to build track-records for large-scale land and offshore wind turbine and its core parts Develop large-scale offshore wind energy system with innovative LCOE reduction and wind power platform with technology convergence Develop large-scale floating wind power platform, integrated control, and operation technologies 				
	 for demonstration ✓ Develop the wind energy related market technologies in the areas of wind park maintenance, wind farm design, and farm acceptance improvement model 				



WTG development

Development of 8MW High-Capacity Offshore Wind Turbine ('18~'22) Development and Field Test of 4.2MW Onshore Modular Drive Train ('15~'19)

Offshore Application

Development of floating offshore wind turbine pilot plant (MW class) in finite water depth ('20~'24) Development of a 13,000-ton wind turbine installation ship ('18~'21) Development on Installation System of XL Monopile for Offshore Wind Turbines in Korea ('18~'21)



Deployment

Anma-do 220WW Offshore Wind Farm Design and Development of Resource Evaluation Technology ('18~'20) Design of Ulsan 200MW Floating Offshore Wind Demonstration Farm and Development of Offshore Wind Resource Evaluation Technologies ('18~'20) Development of Repowering Total Technology to Improve Availability of Old Wind Farm ('18~'21)

0&M

Technology Development of Long-Term Environmental Monitoring System and Safety Standards of Marine activities to solve environmental and safety issues due to the offshore wind farm ('16~'19)

Target of R&D Activities





Wind Power Roadmap



\diamond Short \cdot Mid–Term R&D roadmap \rightarrow Demonstration

 \rightarrow System improvement and Expansion \rightarrow Export industrialization

Establish R&D roadmap

Technology	Cost Reduction	Next-Gen	→ Secure floating offshore
Catch-up R&D	R&D	Technology R&D	wind technology
* 6MW or larger extra large off- shore WTG	 * Localize core components * System cost reduction 	* Develop 5MW floa	ating offshore WTG

Create initial market through strategic pilot and demonstration project

→ 4 Phases implementation in consideration of current domestic technology and core components level

Phase 1(`17-`19)	Phase 2(`20-`22)	Phase 3(`22-`24)	Phase 4(`25-`27)	
3MW	5MW	6-8MW	Floating	
Offshore WTG	Offshore WTG	Offshore WTG	Offshore WTG	

Build renewable energy Innovation growth cluster;

→ Accumulate industry-academy-research and infrastructure(harbor, industrial complex, etc.)

Large scale offshore wind farm Large scale WTG demonstration and deployment * Build supporting base harbor and production/ assembly complex * Link to wind farm planning system * Build professional engineer training center and R&D demonstration center > Demonstrate and deploy domestic technology such as large scale offshore WTG and float-type offshore WTG

 \rightarrow Attract related companies



감사합니다

KOREA INSTITUTE OF ENERGY TECHNOLOGY E V A L U A T I O N A N D P L A N N I N G

Thank you

0

Renewable energy \bigcirc

Ki-Yeoung Kweon (kweon_wind@ketep.re.kr) KETEP, Seoul, Korea

Discussion

>>You can use the questions & responses channel





SESSION 2.A

Information exchange on "FIXED OFFSHORE WIND POWER" projects and technologies





Information exchange on "FIXED OFFSHORE WIND POWER" projects and technologies

Shilla Corporation

Mr. CHOI Dongwan, Executive Director in Strategy Department and Domestic & Overseas, Sales Department

General Electric (GE) *Mr. Stéven CURET, Offshore wind funding and advocacy Leader*

SeAH Steel Corporation *Mr. KIM Juan, Part Leader in Offshore Windfarm*

SAIPEN

Mr. Benjamin MAURIES, Offshore Plant & Renewable Systems Development Department Manager

DISCUSSION





Shilla Corporation

Mr. CHOI Dongwan

Executive Director in Strategy Department and Domestic & Overseas, Sales Department







SHILLA CORPORATION




CONTENTS

1. Company Introduction

2. Design and Validation cycle

- 2-1. FEA Capability
- 2-2. Application of AI & Big data (Induction Hardening)
- 2-3. Test bed for Offshore Application
- 2-4. CMS (Conditioning Monitoring System)



1. COMPANY INTRODUCTION



History

- 1986 Incorporated
- **1989** Started the slewing bearing production
- **2001** Started to supply the wind turbine bearings.
- 2021 Achieved 50,000 bearings for Pitch & Yaw bearing delivered (to GE, Goldwind, Enercon etc)

<u>Reference</u>

Year	Туре	WTG Capacity
2001	Pitch & Yaw Bearing	250KW
2006	Pitch & Yaw Bearing	1.5MW
2010	Pitch & Yaw Bearing	1.7MW
2011	Pitch & Yaw Bearing	2.5MW
2011	Pitch & Yaw Bearing	2.75MW
2011	Pitch & Yaw Bearing	4.1MW Trial
2016	Pitch & Yaw Bearing	3.2MW
2017	Pitch & Yaw Bearing	3.8MW
2019	Pitch & Yaw Bearing	4.8/5.8MW
2022/2023	Pitch & Yaw Bearing	8/10/12MW Trials

MSHILLA

1. COMPANY INTRODUCTION

Pitch Bearing



Yaw Bearing



► Specification

- Type : Double Row Ball Bearing / Triple Row Roller Bearing Double Row Angular Contact Ball Bearing
- v Size Capacity : O.D 2,000mm ~ O.D 6,500mm
- Quantity Capacity : 700pcs per month (Korea factory)
 250pcs per month (China & Brazil factory)

► Specification

- v Type : Single Row Ball Bearing / Double Row Ball Bearing
- v Size Capacity : O.D 2,000mm ~ O.D 6,500mm
- Quantity Capacity : 600pcs per month (Korea factory)
 200pcs per month (China & Brazil factory)



2. Design and Validation cycle

SHILLA intends to validate bearing reliability through FEA and Reliability test through Test bed





2-1. FEA Capability

SHILLA has been developing FEA models for various bearing type and applied to our design verification



>Large pitch and yaw bearings for offshore wind require designs that take into account deformation of surrounding structures. This is because the sensitivity of deformation increases as the size of bearings and surrounding structures increase.

2-2. Application of AI & Big data (Induction Hardening)

SHILLA is developing Induction Hardening AI which is contribute to defect prediction and quality improvement.





2-3. TEST BED FOR OFFSHORE APPLICATION

SHILLA is planning to build a test bed for offshore wind pitch & yaw bearing.

SHILLA has continued to build test beds to ensure the reliability of bearing design in the development process of wind bearings.





▷ SHILLA has always aimed to secure reliability through design of bearing and its verification, and to establish plans to build a test bed for offshore wind pitch and yaw bearing.



2-4. CMS (Conditioning Monitoring System)

Based on the validation results, SHILLA plan to develop and supply pitch and yaw bearings for offshore wind turbines by establishing a bearing conditioning monitoring system through AI learning from reliability test.



THANK YOU.

SHILLA CORPORATION http://www.shillacorp.co.kr

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General Electric (GE)

Mr. Stéven CURET

Offshore wind funding and advocacy Leader



#ADEME-KEA2021





Offshore Wind GE Renewable Energy



\$15B

REVENUE

80+ 40,000+

COUNTRIES GLOBAL EMPLOYEES

40,000+

WIND TURBINES INSTALLED GLOBALLY

25%+

OF WORLD'S HYDRO INSTALLED BASE

90%

OF UTILITIES WORLD-WIDE USE GRID SOLUTIONS TECHNOLOGY

400+GW

INSTALLED BASE

THE WORLD'S LARGEST

CLEAN ENERGY

FOOTPRINT

>10%

OF GLOBAL RENEWABLE ENERGY CAPACITY IS PROVIDED BY GE TURBINES



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Our Projects

USA

CHINA

* Order backlog
Haliade-X wind turbine

Merkur (396 MW) Block Island (30 MW) Dogger Bank (3.6 GW)* 5 x Haliade 150-6MW (2016) 66 x Haliade 6MW (2018) (starting 2023) Skipjack (120 MW)* (2023)Ocean Wind (1.1 GW)* (2024)Vineyard Wind 1 (800 MW)* Ostend (6 MW) (2023)1 x Haliade 150-6MW (2016) Osterild (6 MW) 🕂 Haliade 150-6MW (2014 Le Carnet (6 MW) 1 x Haliade 150-6MW (2013) Rotterdam (12/13 MW) 1 x Haliade-X (2019) St. Nazaire (480 MW)* 80 x Haliade 150-6MW (2021) Xinghua Gulf (18 MW) 3 x Haliade 150-6MW (2018)



Installed capacity: 474 MW | Backlog: 5.6 GW (Haliade-X) + 480 MW (Haliade 150-6MW)

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Our Offshore Wind Footprint





GE's Offshore Wind Global HQ

Location: Nantes (FR) – established in 2013 Employees: 200+ Functions: Engineering, Global Supply Chain, Project Management, O&M, support functions.

Saint-Nazaire (manufacturing facilities)



- Components: Generators and nacelles
- Products: Haliade 150-6MW & Haliade-X (12 & 13 MW)
- Area: 13 hectares
- Constructed area: 19,000 sqm.
- Opened: December 2014
- Employees: +400
- Quality processes designed by manufacturing experts from the automotive and aircraft industries
- First European factory HEQ certified

Saint Nazaire Offshore wind plant

By the numbers

- +400 employees as of today
- ~200 more employees expected for the ramp up of the Haliade-X starting in 2022
- Extension works ongoing





Upcoming milestone: completion of assembly of 50 nacelles of the Haliade 150-6MW for the first offshore wind farm in France

Saint-Nazaire (manufacturing facilities)





Cherbourg LM Wind Power Plant

By the numbers

- 450 employees as of today, hiring 300 more in 2021
 ... we expect to employ 750 people by the end of the year.
- Set up to provide sets of blades for the world's largest offshore wind farm located in the UK ... Dogger Bank (3.6 GW)



AND A REAL AND A SHELL AND A REAL PROPERTY.



30,000 m² of industrial floor dedicated to the production of the 107 m blade for the Haliade-X

Haliade-X Prototype, Netherlands

The world's most powerful wind turbine in operations

Developer: Future Wind (JV - Pondera and SiF Holding) Demo Project: 1 Haliade-X 12 MW Location: Maasvlakte-Rotterdam (NL) Site: on-shore for easy access during test activities Scope: 5-years testing & 15-years full service O&M Type Certificates 12 MW and 13 MW obtained in 2020



1st Haliade-X rolling-out of the factory



One Haliade-X 13 MW ...



... can generate enough clean power to supply **17,000** households.*



... one spin could power a UK household for more than two days.



... can save up to **52,000 metric tons of CO₂**, the equivalent of emissions generated by **11,000** vehicles in one year.

Installing at the **world's** largest wind farm in UK.

Powering **6 million** UK households.

Record amount of power output in 24 hrs ... **312 MWh in November 2020**. Height: **248 m** Blade: **107 m** Rotor: **220 m** Swept area: **38,000 m**²

Leading capacity factor (63%)

5.6 GW backlog of orders





Haliade-X blade comparison





Haliade-X, selected as the preferred wind turbine for5.6 GW of projects



THE RIGHT TURBINE

Haliade-X 13 MW-220 Backlog

120 MW 3,600 MW 800 MW 1,100 MW SKIP JACK (2023) DOGGER BANK (starting 2023) VINEYARD WIND (2023) OCAN WIND (2024)



Haliade-X: An international recognition



• NOV '19: Generated its 1st MW

0

- JAN '20: First wind turbine to ever generate
 288 MWh in one day!
- JUN '20: Provisional type certificate 12 MW-220 (DNV-GL)
- NOV '20: Broke its own record!
 Generated 312 MWh in 24h
- NOV '20: Full type certificate 12 MW-220 (DNV GL)
 - DEC'20: Full type certificate 13 MW-220 (DNV GL)

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Best Sustainable Invention of the Year TIME magazine – (DEC 2019)

Best Wind Turbine of the Year Wind Power Monthly magazine – (JAN 2020)





SeAH Steel Corporation

Mr. KIM Juan

Part Leader in Offshore Windfarm











Contents

SeAH Steel Overview

SeAH Steel OWF Business

SeAH Overview

Snapshots

Founding Date	October 19, 1960	S pro
Affiliates	65 (29 Domestic and 36 Overseas Affiliates)	
Listed firms	5 (SeAH Holdings, SeAH Steel Holdings, SeAH Steel, SeAH Besteel, S	SeAH Special Steel)
Sales	7.6 Billion Euro (Dept ratio 82%) in 2020	

SĕAH

Business Sectors





Pusan Pipe (SeAH Steel Holdings) founded

Acquired KS Mark

The first steel pipe exporter in Korea

Carried out IPO

USD 100 Million Export Award / Gold-Tower Industrial Award

Establishment of R&D Center

- Started Stainless Steel Pipe business
- Pusan Pipe and all subsidiaries renamed as 'SeAH'

- Establishment of SeAH Steel U.A.E. LLC.
- Establishment of Suncheon Plant
- Establishment of JCOE Plant
- 2014 INOX TECH, an Italian stainless steel pipe manufacturer, acquired
- SeAH Steel Holdings launched, DOSCO acquired, Subsidiary (SeAH Global (Thailand)) established

SĕAH

SeAH Steel **BUSINESS FIELD IN KOREA**



Total 1.52 million metric ton Capacity

Pohang Plant

Products : Steel pipes for oil suppliers, oil wells, plumbing, and structure, material pipes Markets : Energy, Construction, Shipbuilding, Offshore Plants, Automobile Capacity : 1.05 million tons

SěAH

Products : Steel pipes for plumbing, material and structure Markets : Construction, Automobile Capacity : Rolling 250,000 tons, Galvanizing 150,000 tons

Products : Large diameter steel pipes, Capacity: 180,000 tons

Stainless large-diameter steel pipes, Spiral steel pipe Markets : Construction, Shipbuilding, Offshore Plants

Changwon Plant

Gunsan

Plant

Suncheon Plant

> Products : Stainless steel pipes, Titanium tubes Markets : Construction, Shipbuilding, Offshore Plants Capacity : 40,000 tons

Global Network

Italy Inox Tech (Lendinara) United Kingdom (2023)

England Humble

USA

SeAH Steel America (LA, Houston) State Pipe & Supply (LA) SeAH Steel USA (Houston)

Japan

SeAH Japan (Tokyo, Osaka)

Vietnam

SeAH Steel Vina (Ding Nai) Vietnam Steel Pipe (Haipong)

Indonesia

SeAH Steel Indonesia (Jakarta)

China

Landmark Steel (Beijing) SeAH Steel Bejing Office (Beijing) Inox Tech China Plant (Shangdong)

14 Operating Sites in 8 Countries

SeAH Steel UAE (Ras Al Khaimah) SeAH Steel Middle East Office (Dubai)

UAE

SĕAH

Jacket Business

Single Can Stub Node P2P Leg Pin pile Semi fabricated Jacket Fully fabricated Jacket



SĕAH

Manufacturing Capacity of Team SeAH in Korea

SeAH Steel		O.D.	W.T.	Length	Capacity
HFW (ERW)		¹ /2" ~ 24"	1.2~22MM	Max 24M	1,200,000MT
	SAWH	16" ~ 160"	6~25.4MM	Max 70M	165,000MT
EFW (SAW)	SAWL (ROLL BENDER)	1,000mm ~ 6,500mm	Max 150MM	4.2M	150,000MT
	SAWL (JCOE)	457mm ~ 1,625mm 406.4mm ~ 1,830mm	Max 50MM Max 120MM	18.3M 13.2M	300,000MT 120,000MT

Team SEAH

SAWL Roll Bender (5R/B) 150,000MT per year SAWL Press bender (5P/B) 420,000MT per year 3 Saddle Cut Machines (OEM)

ERW 1,200,000 MT + SAW 735,000 MT = Total 1,935,000 MT per year

Pin Pile fabrication 4pcs per week Transition Piece 1pc per week Fully fabricated Jacket (OEM) 1 Jacket per week Monopile 2pcs per week (From 2023~)

Suncheon Plant Layout



SĕAH

SEAH OF Plant



Top The

Suncheon

Products	P2P (Circumferential Welding)
OD	355mm – 6500mm
WT	150mm
Lengths	100 meters Circ Welded
End Use	Jacket Legs and Braces, Pin Pile

Jacket Legs and Braces, Pin Piles, Point to Point Welding, Fabrication of Pin Piles
Pohang Plant Layout









SĕAH

Tongyoung



Products

Capacity

JACKET(Fixed & Floating) / TP

1 FULL JACKET/ WEEK, 48 FULL JACKET/ YEAR

Product Photo P2P Leg



SeAH

Product Photo Node & Stub & Cone





SEAH (





Product Photo Pin pile



Edgen Murray, in collaboration with South Korea's SeAH, has completed the manufacturing of 84 pin piles for the Changhua Phase 1 offshore wind project in Taiwan.







Product Photo FULL SET JACKET





Product Photo Fabrication of Floater









Project Reference - Details

Year	Project	Foundation	Product Range	OD mm	WT mm	Grade	Ton	Qty
2017	UK	Jacket	Braces	600-850	30-50	S355ML	21,000	x 32 Jackets
"	Ш	11	Legs	1000-1700	50-90	S355ML		O WAR
"	UK	Floating	Braces	800-1200	25-50	S355ML	3,000	x 1 Floater
2019	UK	Pin Piles	Pile Sections	2046	50-60	S355ML	14,000	x 150 Piles
"	UK	OSS Jacket	Braces	600-850	30-50	S355ML	200	x 1 OSS
"	Taiwan	Pin Piles	Piles	3099	50-75	S355ML/S420ML	24,000	x 80 Piles
2020	Taiwan	OSS Jacket	Braces	600-900	30-60	S355ML	5,200	x 1 OSS
"	11	и	Legs	900-2000	50-100	S355ML		
"	UK	Jacket	Braces	600-850	30-50	S355ML	19,500	x 18 Jackets
"	11	и	Legs	1000-1800	50-100	S355ML/S420ML		
"	France	Jacket	Braces	600-800	30-50	S355ML	40,000	x 62 Jackets
"	11	и	Legs	1000-1700	50-90	S355ML		
	Taiwan	Jacket	Braces*	600-900	30-60	S355ML	8 000	x 8 Jackets
"	"	и	Legs*	900-2000	50-100	S355ML	8,000	
2 " 0	Taiwan	Jacket	Braces	600-900	30-60	S355ML	2,300	J-Tube



UK Monopile Plant Summary







SeAH Proposed Specification for Monopile Facility





SAIPEM

Mr. Benjamin MAURIES

Offshore Plant & Renewable Systems Development Department Manager





#ADEME-KEA2021

Webinar ADEME - Korean Energy Agency Saipem Floating Wind

Benjamin MAURIES



SAIPEM AT A GLANCE

We are a Global Solution Provider.

A company with distinctive competences and high-tech assets, capable of identifying and developing multiple solutions to satisfy clients' needs.

71 COUNTRIES WHERE WE OPERATE ~32,500 EMPLOYEES FROM 122 DIFFERENT NATIONALITIES

8 FABRICATION YARDS

€9.1 BLN **REVENUES 2019**



"One Company" in five divisions:

XSIGHT Conceptual Design

E&C OFFSHORE Engineering & Construction

E&C ONSHORE Engineering & Construction

- OFFSHORE DRILLING
- ONSHORE DRILLING

A GLOBAL FOOTPRINT FOR A GLOBAL OFFSHORE WIND INDUSTRY



WITH A DIVERSE PORTFOLIO OF OFFSHORE WIND PROJECTS

Project Name	Country	Client	Saipem Scope
HYWIND SCOTLAND	UK	EQUINOR	5 Floating WTG Installation
HORNSEA 1	UK	ORSTED	4 OSS T&I (Jacket and Topside)
NNG	UK	EDF, ESB	54 Jackets EPCI
FECAMP	FR	EDF, WPD & ENBRIDGE	71 GBS EPCI
COURSEULLES	FR	EDF, WPD & ENBRIDGE	64 Monopiles EPCI
ST BRIEUC	FR	IBERDROLA	1 OSS T&I (Jacket and Topside)
DOGGER BANK	UK	EQUINOR, SSE	2 OSS T&I
DOGGER BANK	UK	Aibel	2 OSS Jackets EPC (Arbatax)
SEAGREEN	UK	Seaway 7	114 Jackets Installation
FORMOSA II	Taiwan	Jan de Nul	32 Jackets Fabrication (Karimun)









SAIPEM FLOATING WIND SOLUTIONS



HEXAFLOAT Saipem Solutions Benchmark

Lest provides stability Heavy steel weight



HEXAFLOAT

A pendulum floater

AIPEN

SAIPEM developed a pendulum <u>lightweight</u> structure made of:

- a semi-submersible floater with tubular elements
- a counterweight connected to the floater with tendons
- simple mooring lines





HEXAFLOAT Key characteristics

• Good dynamic stability

• Simple serial construction

• Low steel mass







• Compatible with large wind turbines (above 10MW)



No major change on floater when turbine size increases



HEXAFLOAT

Haxafloat development status and roadmap

On going to Technical Readiness Level (TRL*) 7

- Basic design developed & Concept Validated
 - Stability, Seakeeping & Transportation & Mooring analysis
 - Fabrication sequence developed & Installation outline procedure
- Scale testing (TRL 4)
 - Model test performed for 8MW & 12MW.
- > Approval in Principle by BV in Jan. 2019
- Detailed design of a 6MW floater
- A prototype with Italian CNR at reduced scale to be installed in 2021 to achieve a TRL 5
- Full scale demonstrator in design phase with ADEME support (TRL 7) 2023

* Maturity of technology (normalized in EU)







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HEXAFLOAT DEMONSTRATOR

Project description

Site: MISTRAL Test site (Mediterranean sea / Golfe de Fos)

Distance to coast: 5 km. Water Depth: 63m.

EPCI of one (1) Floating Offshore Wind Turbine (FOWT)

Partners: VALECO/EnBW AG / Ecole Centrale de Nantes

Turbine size: 3MW

Start of Operation: Q4 2023







For Any Question: benjamin.mauries@saipem.com



Discussion

>>You can use the questions & responses channel





SESSION 2.B

Information exchange on "FLOATING WIND TURBINE" projects and technologies





Information exchange on "FLOATING WIND TURBINE" projects and technologies

Doosan Heavy Industries

Mr. YUH Dongjoon, Wind Power Sales & Marketing Team / Senior Manager

BW IDEOL *Mr. Paul DE LA GUERIVIERE, CEO*

Hyundai Heavy Industries *Mr. Jin-wook HONG, Senior Researcher*

Dolfines *Mr. Mathieu AUPERIN, Head of Renewables Business Unit*

SBM Offshore *Mr. Laurent VERDIER, Renewable Product Line Director*

DISCUSSION





Doosan Heavy Industries

Mr. YUH Dongjoon

Wind Power Sales & Marketing Team / Senior Manager



#ADEME-KEA2021





Doosan Heavy Industries & Construction

DOOSAN Wind Power Business

'21. 6. 30



- Company Profile
- DHI Wind Biz. Status
- DHI Competitiveness



DOOSAN GROUP (Oldest Company but Fastest Company in Korea)



One of top 10 conglomerates in Korea,

active in engineering and manufacturing of power plants, construction equipment, industrial facilities, engines, construction.

Doosan is the oldest conglomerate with **125 years of history** : The recent transformation has set up bases for globalization.

Strong aspiration for accelerated global-scale growth, with focus on *Infrastructure Support Businesses (ISB)*



Profile of Doosan Heavy Industries and Construction

Doosan Heavy Industries & Construction which was established in 1962 with over 50 years history has grown as a global power and water company.

Vision

Global Leader in Power & Water

- Global Leader : Becoming a global top-tier player in all businesses
- Power & Water : Representing main businesses

History

Doosan Heavy Industries & Construction was established in 1962

- Establishment Period (1962 ~ 1979) : Erected national power industries
- State-owned Period (1980 ~ 2000) : Technical development and Growth
- After Privatization (2001 ~ now) : Going global

General Information

Employees

- 14,615 (6,958 Koreans, 7,657 global staff) *Head Office*
- Changwon, South Korea







- Company Profile
- DHI Wind Biz. Status
- DHI Competitiveness



DHI Wind Power Solution - Highlight



- Focusing on Offshore Wind Power
- [2011] Asian First Offshore WTG (3MW)
- [2019] Completion of WinDS5500 Development
- [2022] Commercialization of DS205-8MW



Pioneer of Korean Offshore Wind Market - Jeju Tamra Offshore Wind Farm (30MW) - Jeonbuk Southwestern Demonstration Site(60MW)

Shared Growth with Domestic Supply Chain - 70% of Local Contents rate (30% at initial stage)

Cultivating Key Components
- World Class Blade Length (100m) for 8MW



Model Line-up

DHI has been responding to market demand by diversifying model line-up through own technologies and developing new products







National R&D PJT					
Title	Development of 8MW Floating Offshore Wind Turbine System				
Period	2021. ~ 2025.				
Consortium	 Kyungsangnam-do Kyungnam TP, KOEN Doosan Samgang M&T Institute for Advanced Engineering 				



Track Record

DHI has a Track Record of 340MW




Offshore Wind Farm in Korea

DHI is only one company who has capabilities and experiences about offshore wind farm in Korea





Shared Growth_Components

DHI is promoting shared growth continuously with Korean supply chain



Mout 70% of parts of Doosan WTG are supplied from Korean Supply Chain

Doosan has a plan to improve local contents rate in line with domestic market expansion



Shared Growth_Infrastructure

DHI is cultivating relevant infrastructure also











- Company Profile
- DHI Wind Biz. Status
- DHI Competitiveness



DHI Competitiveness #1_Product Competitiveness

DS205-8MW has differentiated competitiveness for law wind area like Korea by maximizing rotor diameter

Catagoty	Korean Condition (Mean W.S: 7m/s)		EU Condition (Mean W.S: 10m/s)	
Categoty	Hours/year	Days/year	Hours/year	Days/year
Non-Production (Wind Speed 0~3 m/s & 25 m/s+)	1,533 hrs	64 days (17.5%)	835 hrs	35 days (9.5%)
Production (Wind Speed 3~25 m/s)	7,204 hrs	300 days (82.2%)	7,908 hrs	329 days (90.3%)
Production below Rated Power (Wind Speed 3~10 m/s)	5,713 hrs	238 days (65.2%)	4,230 hrs	176 days (48.3%)
Production with Rated Power (Wind Speed 11~25 m/s)	1,491 hrs	62 days (17.0%)	3,677 hrs	153 days (42.0%)
Gyeonggi: 6.5m/s Jeonbuk: 6.9m/s Jeonnam: 7.2m/s Jeju: 7.5m/s	Ozos Shuk			



DHI Competitiveness #2_Comprehensive O&M Service

DHI provides optimum PJT availability (99%+)





DHI Competitiveness #3_Total Solution Provider







DOOSAN

Thank you for your attention.



BW IDEOL

Mr. Paul DE LA GUERIVIERE

CEO







BW IDEOL Company Presentation

ADEME / Korean Energy Agency webinar 30 June 2021



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A leader in floating wind developments and long-term assets owner





BW ideol

BW Ideol is far more than just a technology supplier





...with the advantage of being an early mover

- One of the few current players with over 10 years of engineering, execution and maintenance experience in floating wind
- Two full-scale demonstrators in operation in two of the most promising floating wind markets – France and Japan
- Fully proven technology with more than two years of operational experience
- Integrated team of 60 experts in France and Japan
- Sizeable project pipeline as co-developer in Japan, Europe and the US
- 30 MW EolMed project in France with FID expected in Q4 2021







And supported by an industrial owner with a global maritime track record







Transferable experience from mooring technologies ~250 km of mooring lines deployed







Early mover with fully proven technology...

- Fully patented technology
- Suitable for any environment –
 >30 meter water depth, any wave conditions, seabed conditions, and wind turbine
- Proven and excellent seakeeping performance even in typhoon areas like Japan
- Designed to be the most competitive solution in the market – compactness and simplicity with floater built in concrete
- Proven serial production methods
- Easy maintenance and installation shallow draught compatible with several ports and quayside assembly of wind turbine



1) Issued technology patens (families): I) installation and method for exploiting wind energy (filed: 2010/2011) in Europe (validated in France, Germany, Denmark, the United Kingdom and the Netherlands), Japan and US; II) the damping pool (filed: 2011/2012) in Europe (validated in France, Germany, Denmark, the United Kingdom, Ireland, Hungary, Belgium, Luxembourg, Sweden, Norway, Denmark, Spain, the Netherlands, Greece, Italy, Malta, North Macedonia, Monaco, Poland, Portugal, Switzerland/Liechtenstein, Turkey), Japan, US, Brazil, China, Korea and Singapore; III) anchor chain (filed: 2013/2014) in France, US, Japan, CS, Brazil, China, Korea and Singapore; IV) float-out methods (filed: 2017/2018) in France (Europe, US, Japan, Korea and Singapore pending). Pending technology patens: I) mooring lines published for France (filed: 2018) and international patent filed 2019 (including Japan and the United States). The maximum term of a European patent in the sector is 20 years from its filing date



...solving several of the drawbacks with other technologies



- Unsuited for deployment in waterdepths less than 100 meters vs. a large coming market in water-depths of 50 to 100 meters led by Scotland, France, Japan, Korea and Taiwan
- Offshore wind turbine integration
- Not possible to tow back to port for heavy turbine maintenance

- Large dimensions and steel weight
- Design makes it more difficult to industrialise production
- Need for ballasting in operations and less stable during towing

- No demonstrators in operation
- Less compatible for active seismic areas such as Japan and California
- More complex installation procedures and risk of tendons failure
- Not applicable at greater than ~80-meter water depth



A unique and valuable experience from real floating assets



Le Croisic, France



- Floatgen demonstration project 2 MW¹) installed at 33m depth 20 km of the coast of France (constructed 2016-17)²⁾
- Average 6.4 GWh produced and >90% availability in 2019-2020 compared to 4.1 GWh on competing technology with the same wind turbine³⁾
- Hibiki demonstration project 3 MW⁴) installed at 55m depth 15 km of the coast of Japan (constructed 2016-18)
- Successfully weathered three category 5 typhoons



Representative of the harshest environments

Documented ability of safeguarding the guaranteed turbine power curve

1) Turbine: 1 x Vestas V80 80m 2.0 MW; 2) Demonstration phase on Sem-Rev site on-going until Sep-2023; 3) Average 2012-2015; 4) Turbine: 1 x AERODYN SCD 3.0 MW



With a clear mission and long-term ambitions





A floating offshore wind champion

Proven floating wind technology with a strong competitive edge and ready to scale

Strong pipeline of projects in partnerships with leading local utilities

Early mover position in the most attractive markets for floating wind

Extensive track-record of complex industrial offshore projects and unique in-house competences







Thank you







Hyundai Heavy Industries

Mr. Jin-wook HONG

Senior Researcher







Global Leader

Strategy for Korean companies to enter the Floating Offshore Wind

Turbine business and fields of cooperation with France

Hyundai Heavy Industries JinWuk Hong



30 Jun. 2021



Equipment

Center



Introduction

- Floating Offshore Wind Turbine Market
 - 10.7GW of floating wind is feasible by 2030 and 70GW by 2040.
 - The market growth across Asia, Europe and North America is expected.
 - From 2030, the build out rate is expected to increase to over 3GW/year.



Market strategy for Korean companies



- ✤ Using an experience with oil and gas
 - Korean companies have a long experience with the oil and gas field.
 - Many shipyards have related infra and well trained engineers.
- ✤ Mega project
 - The project cost of FOWT is more expensive than that of a fixed project. The project needs to be a mega project.
 - Each wind turbine capacity needs to be enlarged.
- Localization
 - License fee might be occurred.
 - Local supply chain is necessary.
- Cooperation with other country
 - Korea company and France company such as Total, BV, Doris, etc. have a good relationship in the oil and gas field.



HHI Experience

- ✤ Major Floater Projects
 - Since 1998, HHI has successfully delivered 28 world class floater facilities to clients.





FOWT Development Plan for HHI



Cooperation fields with France



- Engineering
 - France has companies with a lot of engineering experience.
 - Field development, Concept Design, etc.
- Substation system
 - Korea company has a limited HVDC record yet.
 - Cooperation for engineering and supply of equipment is needed.
- Subsea cable
 - Cooperation for engineering and supply of HV subsea static & dynamic cable is need
- ✤ T&I
 - There are limited installation vessels in Korea.



Conclusion

- Strategy for Korean companies to enter the Floating Offshore Wind Turbine business
 - Using an experience with oil and gas
 - Mega project
 - Localization
 - Cooperation with other country
- Cooperation fields with France
 - Engineering
 - Substation system
 - Subsea cable
 - T&I

Thank you!



Dolfines

Mr. Mathieu AUPERIN

Head of Renewables Business Unit









The EolFloat Project

Webinar ADEME - KEA (Korean Energy Agency) 30th June 2021

Dolfines

French Company founded in 2000 (Ex-Dietswell)



EolFloat Project

Supported by ADEME and INVESTISSEMENTS D'AVENIR

Duration :	2 years
Budget :	4,5 M€







- ➤ Multiple goals for the TrussFloatTM semi-submersible :
 - 1. Perform bassin tests & confirm floater motions
 - 2. Perform floater detailed design (incl mooring & export cable)
 - 3. Optimize floater construction
 - 4. Study floater installation
- Project completed in June 2019





Dolfines

Bassin Tests

- > Performed by Oceanide at their Test Facility
- ➢ Model scale : 1/36
- Measure all floater motions
- > Confirm acceptability of tilt and acceleration at RNA
- > Check mooring loads & Dynamic cable motions
- Perform numerical model calibration
- Towing analysis







Detailed design

- > 2 fully coupled hydro/aero models
 - One with OrcaFlex (Orcina)
 - One with DeepLines Wind[™] (Principia)

3 turbines studied

- 6MW Haliade 150 by GE
- 6MW 2B6 by 2BEnergy (2 blades Downwind)
- 6MW Generic model (3 blades Upwind)

2 sites

- Mediterranean French coast
- Atlantic French coast

Main Design codes

- DNVGL-ST-0119 (ex DNV-OS-J103)
- BV NI 572

Both ULS & FLS studies performed



Dolfines
Construction engineering



- Performed by Matiere
- Based on a modular construction philosophy
- Assembly at Quay Side



Installation engineering

- Performed by Dolfines
- > Towing analysis
- > Installation of the mooring lines
- Connection of the mooring lines
- Connection of the electric cable







Thank you.

The EolFloat Project

Webinar ADEME - KEA (Korean Energy Agency) 30th June 2021



www.dolfines.com

www.oceanide.net

www.matiere-tp.fr



SBM Offshore

Mr. Laurent VERDIER

Renewable Product Line Director











SBM Offshore Introduction



"SBM Offshore believes the oceans will provide the world with safe, sustainable and affordable energy for generations to come. We share our experience to make it happen."



SBM Floating Wind Business Outlook





Pilot farm - EPCI floater and anchoring system - Provence Grand Large





South of France 3 x 8.3 MW WD 100m EPCI of floater & mooring system





Provence Grand Large Project Key Stakeholders



* Engineering, Procurement, Construction and Installation contract





Project location





Floating Offshore Wind Turbine (FOWT) & *Floating Sub-structure (FSS)*



3 Floating units

Supply & fabrication across the world





FSS Structural fabrication scope





Assembly, Integration and Storage Hubs and Port logistics

<u>1- Quay for the FSS Assembly</u>

- FSS assembly
- FSS transfer on barge

2- <u>Darse</u> FSS float-off

- 3- <u>Quay for Storage</u> FSS & FOWT storage
- 4- Quay for the FSS Assembly WTG integration
- 5- Quay for the Storage FSS & FOWT storage

6- <u>Offshore site</u> FOWT tow & hook-up



Tensioned Leg Platform, a breakthrough technology for Floating Wind







Discussion

>>You can use the questions & responses channel











CLOSING REMARKS

ADEME: Mr. Philippe MASSET, Europe and International Director

KEA: Mr. Sung-moon JUNG, Director, Global Project Division





ADEME

Mr. Philippe MASSET, Europe and International Director



#ADEME-KEA2021





KEA

Mr. Sung-moon JUNG, Director, Global Project Division







감사합니다

Merci!

Thank you for attending!

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