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*Comment Received From: Cierco Corporation*
*Submitted On: 7/12/2019*
*Docket Number: 19-ERDD-01*

# Cierco Corporation comment on the CECâ€™s Draft Renewable Generation Research Roadmap and its view on cost for offshore wind

*Additional submitted attachment is included below.*

Date: July 12, 2019

Mr. David Hochschild, Chair and Members
California Energy Commission
Dockets Office
1516 Ninth Street,
Sacramento, CA  95814

Submitted digitally over the CEC Electronic Commenting System

Subject:

Research Idea Exchange, CEC Docket No. 19-ERDD-01 - Comments by Cierco Corporation on the CEC's Draft Renewable Generation Research Roadmap and its view on cost for offshore wind.

To California Energy Commission and its Research Idea Exchange Project.

Dear Chair Hochschild and Members,

Cierco Corporation hereby wishes to comment on the following documents:

- CEC's Preliminary Draft Utility-Scale Renewable Energy Generation Research Roadmap (*Draft Roadmap*),[1] docketed on June 27, 2019, and;
- Presentation of the above roadmap via webinar on July 1, 2019 (*Roadmap Presentation*).[2]

First, we recognize and appreciate the CEC's consideration of offshore wind as an integral component in the Draft Roadmap. Being involved in offshore wind since the very first wind

[1] Energetics, *Preliminary Draft Utility-Scale Renewable Energy Generation Research Roadmap* (June 2019), CEC Docket No. 19-ERDD-01, TN 228863. The *Draft Roadmap* draws upon a longer study document. Energetics, *Technical Assessment of Grid Connected Renewable Energy and Storage Technologies and Strategies* (Jan. 2019) (*Technical Assessment*), CEC Docket No. 19-ERDD-01,TN No. 228811. The CEC Docket with links to individual documents is available at https://efiling.energy.ca.gov/Lists/DocketLog.aspx?docketnumber=19-ERDD-01).

[2] Silvia Palma-Rojas, PhD., California Energy Commission, *Presentation Webinar for Public Comments on the Preliminary Draft*, CEC Docket No. 19-ERDD-01, TN 228811 (July 1, 2019).

turbine offshore in the late 1980's, we have cooperated closely with offshore energy from demonstration project through commercial developments. Hence, we possess a bottom up understanding of the technologies and the commercial drivers that have brought this power source to its current position.

We would like to offer our comments in respect to the assessment and numbers used for the cost of energy level of offshore wind, described in the Draft Roadmap and in its relation to the other renewable energy sources. The Draft Roadmap takes its basis from the March 2018 Department of Energy (DOE) estimates of cost and projections for offshore.[3]

During the last three years, Cierco has been leading a cost of energy analysis under the DEMOWIND 2 funding program called "ForthWind Offshore Demonstration *Project"*.[4] DEMOWIND 2 is a co-funded program with The Department for Business, Energy and Industrial Strategy (BEIS), forming a part of the UK Government.[5] The Project has included a detailed analysis of the most recent cost basis for floating wind energy, using real data and real designs. Accordingly, designs has been based on a real 12 MW wind turbine with actual load data, resulting in a design basis, thereafter implemented in to LCOE modeling undertaken by BVG and Associates ("BVG" a leading consultant for LCOE assessment for the UK Government). Other cost elements of the assessment has been provided by leading Supply chain companies and Contractors. Hence, the cost assessment undertaken in the Project, being on a "bottom up" model provides realistic and results, using cutting edge technologies and the most recent wind turbine generation launched for 12 MW class. Results of the Analysis has subsequently led to revision of official cost projections by BVG. The key results from the Project was launched and presented at the 2019 US Offshore Wind Conference in Boston on June 10, 2019. The presentation is attached to this letter as Annex 1.

Although there are several components in the LCOE assessment, which influence results and values. From Annual Average Wind speed to how for example grid connectivity is treated in the assessment.

It is our view and as evidenced by our results, the LCOE numbers for floating wind will descend below $50/MWh as the next generation turbine and rotor platform undergoes optimization. In this regard we offer a well-documented example from the offshore wind market where most recent the MHI Vestas wind turbine with 7 MW installed capacity and a rotor platform of 538

[3] U.S. Department of Energy, *Department of Energy FY 2019 Congressional Budget Request* at 23 (March 2018) (*DOE Budget Request*) (presenting FY 2017 to FY 2019 LCOE estimates based on "capacity weighted average installed CAPEX and OpEx values from European installations in 2016"), available at http://www.energy.gov/sites/prod/files/2018/03/f49/FY-2019-Volume-3-Part-2.pdf.

[4] DEMOWIND 2 website with project Description available at http://www.demowind.eu/pages/funded-projects-8.html

[5] UK Government, department of Department for Business, Energy and Industrial Strategy description of Program available https://www.gov.uk/guidance/funding-for-innovation-in-renewable-energy

feet, after stepwise optimization and cost reduction would reach an installed capacity of 10 MW with same rotor configuration. Although all platforms are different and driven by various factors, it is realistic to expect similar optimization for the new 12 MW turbine with 722 feet rotor diameter. Hence, using same scaling factors, the 12 MW turbine would on the same basis reach close to 18 MW capacity.

As the driver of floating foundation designs are the rotor loads, we can conclude from the evidence that the next generation larger wind turbine is leaping the cost reduction for floating foundation compared to earlier smaller turbines, depicted in earlier reports. Furthermore, the optimization, conceptually described above, normal for the industry, will drive the cost even lower.

In conclusion, we recommend CEC and CPUC's work ahead to include closer dialogue to establish a robust basis for the cost assumptions of offshore floating wind. Current indicational numbers included in the *Draft Roadmap* we fear are based on an aged basis, where recent acceleration of cost reduction and our improved outlook for the technology results in a misleading depiction of the technology and its capabilities. In this regard, Cierco offer to engage in dialogue to support the CEC's efforts in this work and contribute creatively toward establishing as representative value as possible. Cierco will continue more detailed LCOE assessment based on the DEMOWIND modeling to specifically assess the LCOE for California site options. We would invite CEC to take part in the results and engage in inputs for deeper assessment.

We would like to thank CEC for offering the opportunity to provide comment on the *Draft Roadmap,* which we value to come through as a tool in several ways. Needless to say, Cierco look forward to engaging with the CEC to contribute input and value to the generation of a final version.

Sincerely yours

Mikael Jakobsson
CEO

CIERCO Corporation
810 N. Farrell Drive
Palm Springs CA, 92262

Annex 1:
Presentation from Boston Offshore Wind event, June 10th, 2019:
"*DEMOWIND – LCOE ANALYSIS, PERSPECTIVES ON COST OF ENERGY FOR OFFSORE WIND*"

ANNEX 1

# US Offshore Wind Conference - Boston 2019

## DEMOWIND – LCOE ANALYSIS

- PERSPECTIVES ON COST OF ENERGY FOR OFFSORE WIND

A report by:

C I E R C O

Mikael Jakobsson

June 10th , 2019





C I E R C O









# … a short background on CIERCO

- CIERCO Corporation (US) formed 2001
- Offices in in Aberdour (Scotland) and Palm Springs (California)
- Technology independent project developer with technical background
- Focused on large scale offshore floating wind project with next generation wind turbines
- Owner of the Forthwind test and demo project, Scotland
- Activity focus mainly in UK and in the USA

# ABOUT – The DEMOWIND study

- The report is to be delivered under contract with UK Government (BEIS)

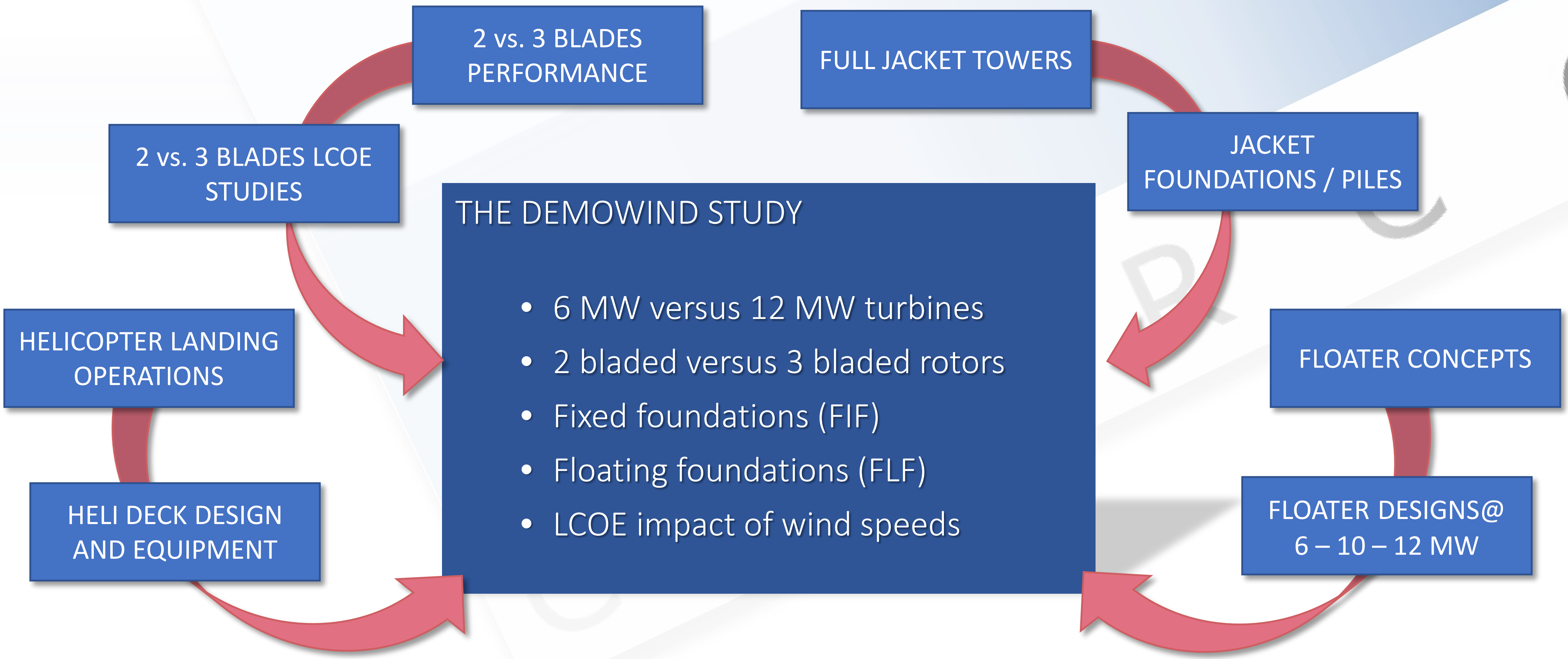
Department for Business, Energy & Industrial Strategy

- Project has been in partnership with DEME Offshore and SAITEC

DEME OFFSHORE saitec offshore technologies

- Input based on bottoms-up approach with actual loads and designs as basis
- All LCOE calculations and modelling has been done by BVG & Associates (UK), a third party with extensive leading experience in the field
- Other Resources and Contracted parties for the studies has been:
  - 2B Energy
  - ARUP
  - FUGRO
  - C-Wind
  - Ramboll
  - Wider network of tier 1 supply chain companies
- The DEMOWIND study assumes experience, maturity and processes optimized as for offshore fixed foundation projects of today, also assuming infrastructure for floater builds is in place

# The DEMOWIND study and the main pre-studies and analysis that has provided input to the project



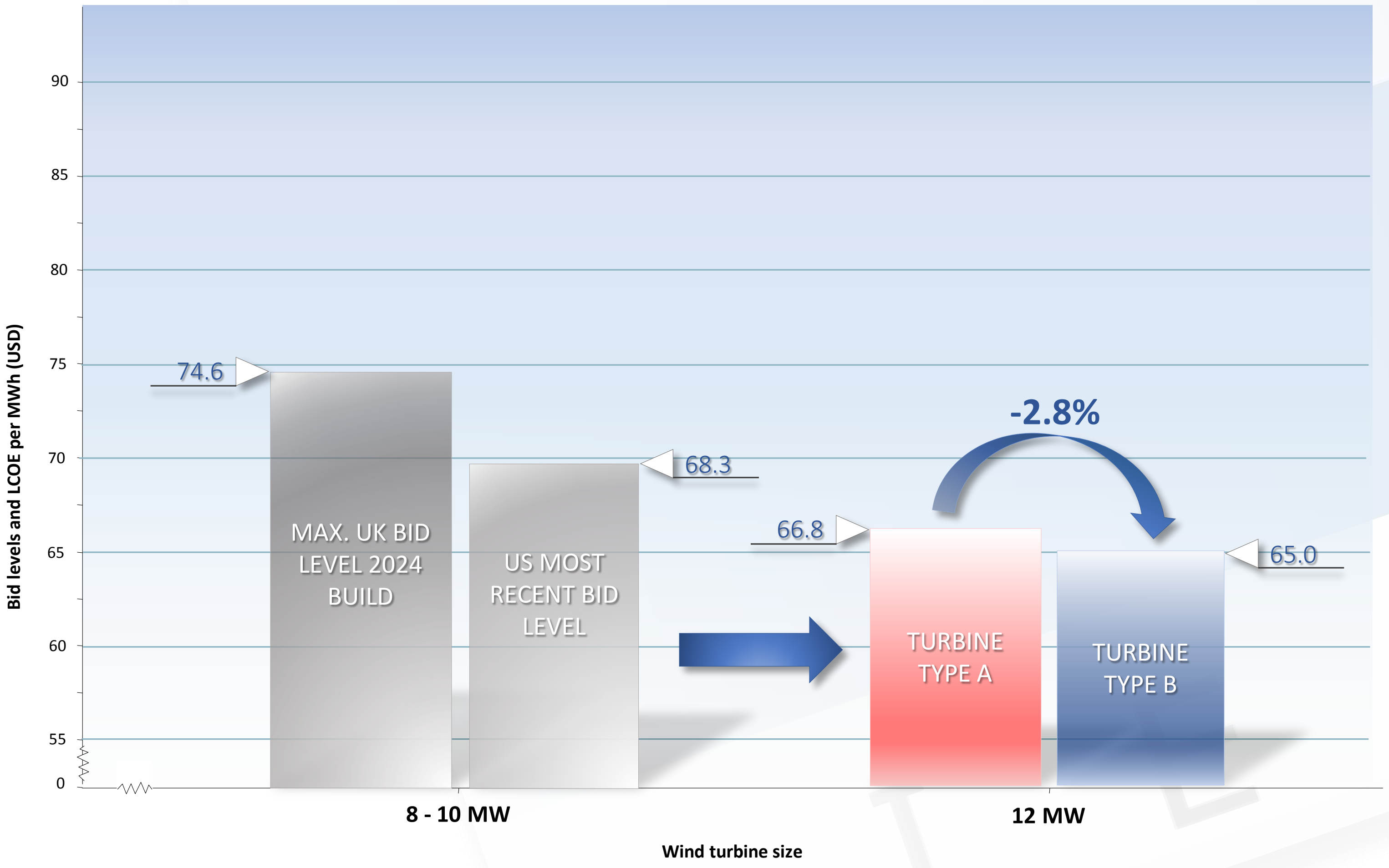
# Main assumptions and conditions to the report

- Side by side comparison on technical and commercial level
- Bid 2019, FID 2021 and build in 2024
- Project size of 500 MW
- Water depth for fixed foundation (FIF) of 35 m and floating foundations (FLF) of 50 m
- Floater project sites some 40 km from shore
- Fixed foundation (jackets) installation and logistics based in FID data and real quotations
- Grid connection fees as per OFTO principles

- Standard annual average windspeed used by BVG at 9.4 m/s at 100m
- Additional wind speeds (@100 m amsl) used for AEP impact are:
    - 7.56 m/s (low case) and 11.00 m/s (high case)
- Correction for Annual Energy Production using wind shear factor of 1.2 for change in hub height
- Bid/Strike prices and references has all been aligned to 2019 bidding or 2024 build – US index of 2.5% and UK index of 2.0%
- Exchange rate conversion @ 1.27 USD/GBP

DEMOWIND REPORT

# Fixed Offshore wind – Recent tenders vs. new 12 MW (2 and 3 blades)




*Keys:*

TURBINE TYPE A (3 bladed upwind):

*12 MW, 220m rotor diameter, 138 m hub height, tubular/jacket*

TURBINE TYPE B (2 bladed downwind):

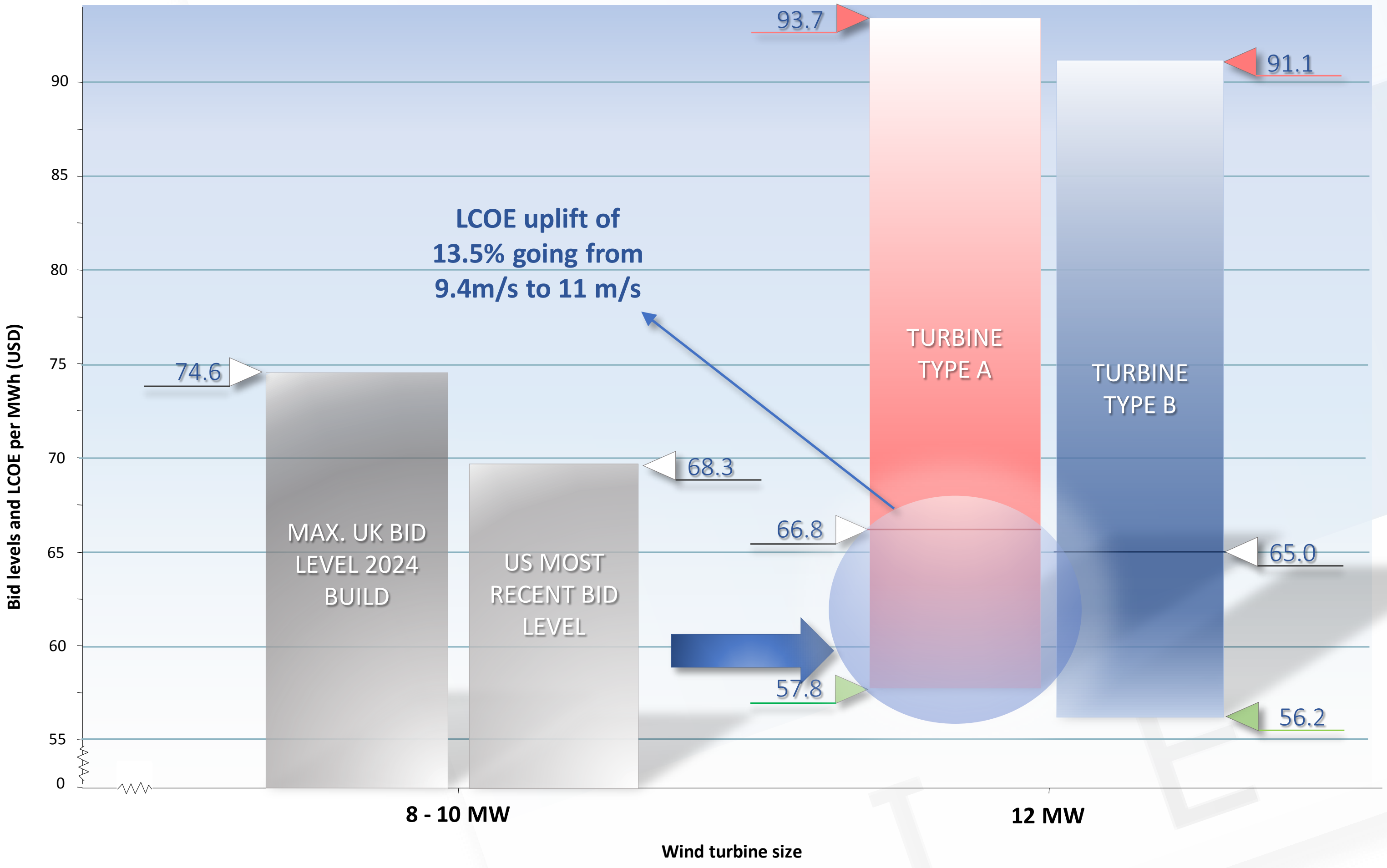
*12 MW, 220 m rotor diameter, 138 m hub height, tubular/jacket*

*Comments:*

1. *Annual Average Wind Speed = 9.40 m/s*
2. *Wind speeds based on air density of 1.225 kg/m3 and temperature of 15 dgr C.*
3. *All windspeeds are described at 100 m amsl, with correction for hub height with wind shear factor 1.2*

DEMOWIND REPORT

# Fixed Offshore wind –12 MW (2 and 3 blades) – Impact of Windspeed




*Keys:*

TURBINE TYPE A (3 bladed upwind):

*12 MW, 220m rotor diameter, 138 m hub height, tubular/jacket*

TURBINE TYPE B (2 bladed downwind):

*12 MW, 220 m rotor diameter, 138 m hub height, tubular/jacket*

*Comments:*

1. *Annual Average Wind Speed = 9.40 m/s*
2. *Wind speeds based on air density of 1.225 kg/m3 and temperature of 15 dgr C.*
3. *All windspeeds are described at 100 m amsl, with correction for hub height with wind shear factor 1.2*
4. *Wind speed range in analysis:*

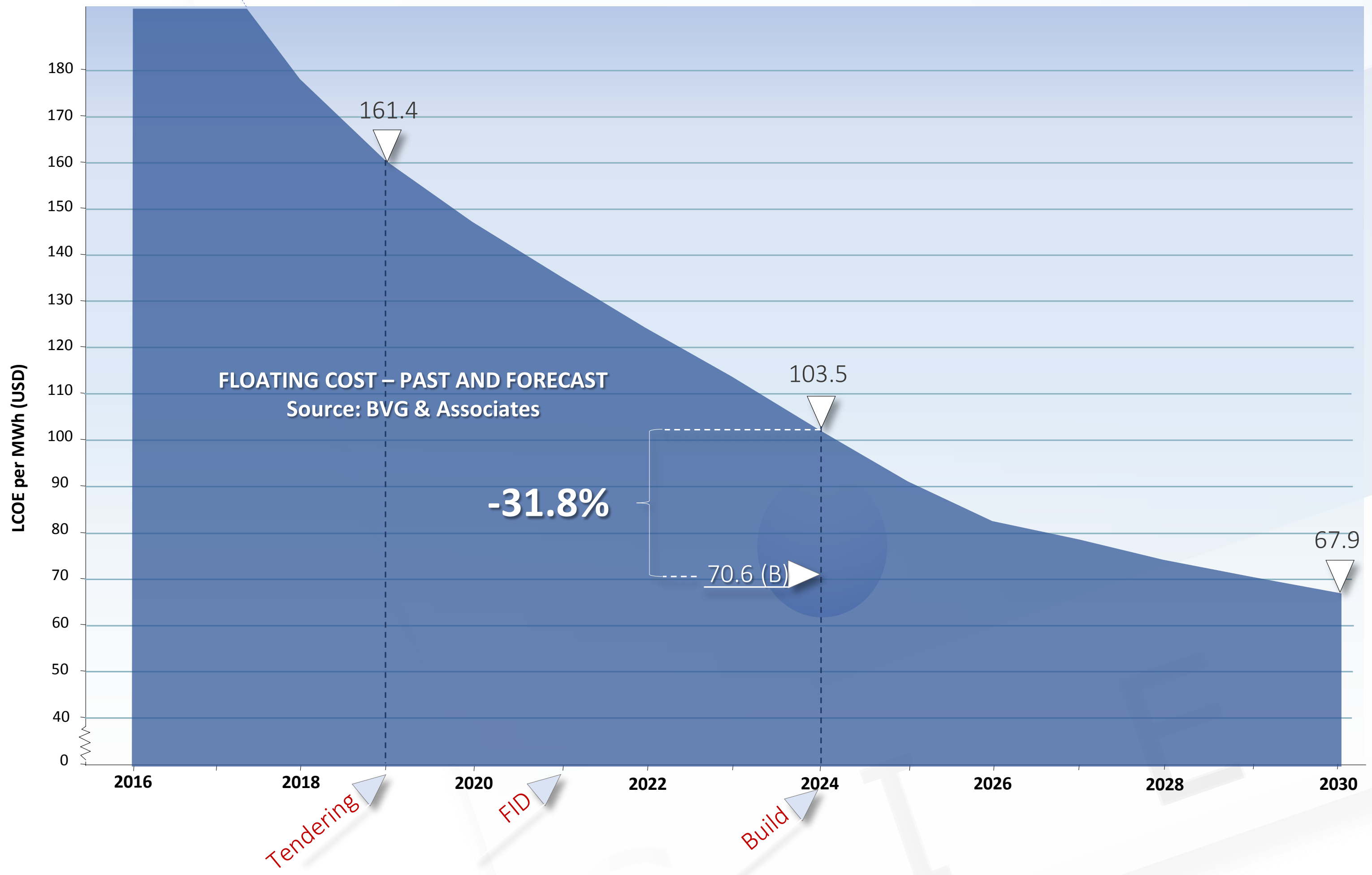
*A - Low = 7.56 m/s*

*B - Medium = 9.40 m/s (lines)*

*C - High = 11.00 m/s*

DEMOWIND REPORT

# Floating Offshore wind cost – Next generation 12 MW on floater




*Keys:*

TURBINE TYPE A (3 bladed upwind):

*12 MW, 220m rotor diameter, 138 m hub height, tubular/SATH*

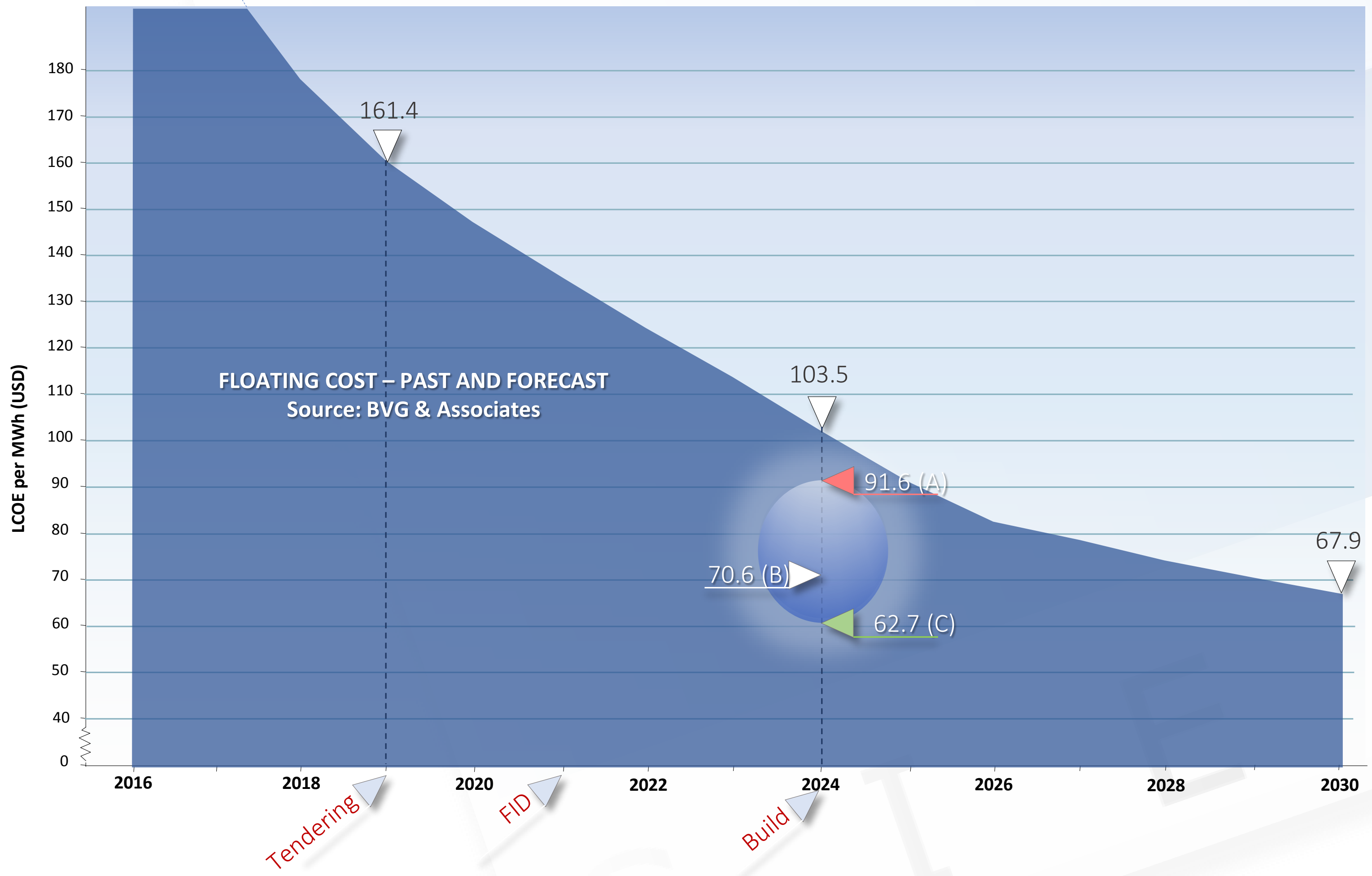
*LCOE range at different windspeeds*

*Comments:*

1. *Annual Average Wind Speed = **9.40 m/s (B)***
2. *Wind speeds based on air density of 1.225 kg/m3 and temperature of 15 dgr C.*
3. *All windspeeds are described at 100 m amsl, with correction for hub height with wind shear factor 1.2*
4. *Site conditions:*
   *Distance to shore: 40 km*
   *Water depth: 50 m*
5. *Floater used for assessment : Saitec SATH design*
6. *Wind speed range in analysis:*
   *A - Low = 7.56 m/s*
   *B - Medium = 9.40 m/s (lines)*
   *C - High = 11.00 m/s*

DEMOWIND REPORT

# Floating Offshore wind cost – Next generation 12 MW - Impact of Windspeed




*Keys:*

TURBINE TYPE A (3 bladed upwind):

*12 MW, 220m rotor diameter, 138 m hub height, tubular/SATH*

*LCOE range at different windspeeds*

*Comments:*

1. *Annual Average Wind Speed = **9.40 m/s (B)***
2. *Wind speeds based on air density of 1.225 kg/m3 and temperature of 15 dgr C.*
3. *All windspeeds are described at 100 m amsl, with correction for hub height with wind shear factor 1.2*
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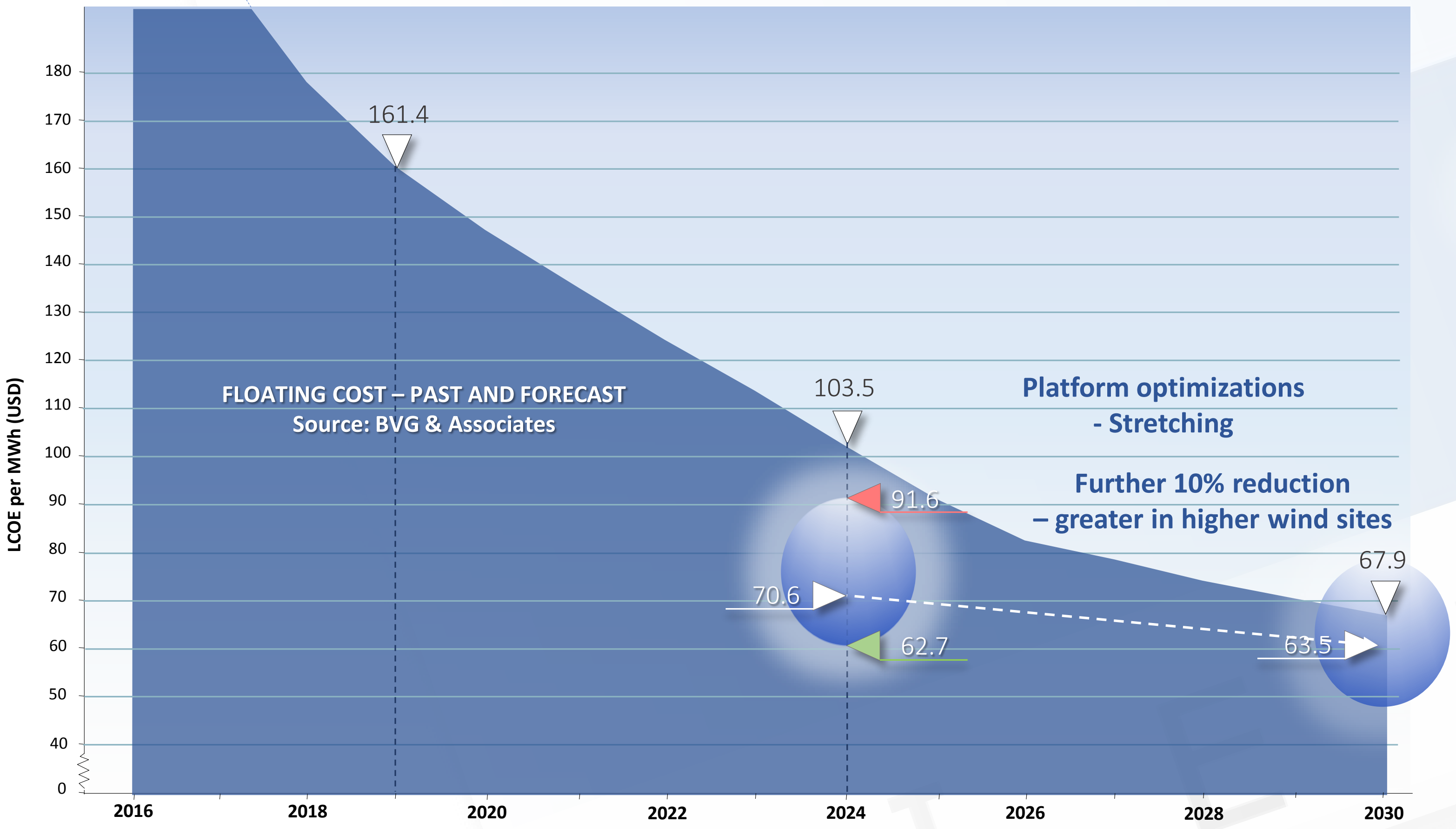
6. *Wind speed range in analysis:*
   *A - Low = 7.56 m/s*
   *B - Medium = 9.40 m/s (lines)*
   *C - High = 11.00 m/s*

# Floating Offshore wind cost – Next generation 12 MW - optimization




*Keys:*

TURBINE TYPE A (3 bladed upwind):

*12 MW, 220m rotor diameter, 138 m hub height, tubular/SATH*

*LCOE range at different wind speeds*

*Comments:*

1. *Annual Average Wind Speed = **9.40 m/s***
2. *Wind speeds based on air density of 1.225 kg/m3 and temperature of 15 dgr C.*
3. *All windspeeds are described at 100 m amsl, with correction for hub height with wind shear factor 1.2*
4. *Site conditions:*
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5. *Floater used for assessment : Saitec SATH design*
6. *Wind speed range in analysis:*
   *A - Low = 7.56 m/s*
   *B - Medium = 9.40 m/s (lines)*
   *C - High = 11.00 m/s*

# Some Conclusions and Findings from the Demowind Analysis

### *General*

- Cost reduction trajectory steeper for FLF - larger turbines experience lower BOP with growing turbine rotor sizes than FIF.
- Stretching of 12 MW flatforms (ex. V164) can reduce LCOE further (10 - 15%).

### *Fixed Foundations (FIF)*

- 2 bladed rotor has a short 3% upside to the 3 bladed rotor.
- 12 MW platform on FIF can reduce current bid levels with 10-20 % depending on wind site.

### *Floating Foundations (FLF)*

- FLF in larger projects can be competitive FIF well before 2030 (Technically as early as 2024).
- Pilot projects and Investments in infrastructure for next gen. wind turbines on FLF can pay off and accelerate timeline as indicated above.

# Thank you.

If you have more questions about the report, please contact us directly on office@ciercoenergy.com

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