Wärtsilä Finland Oy	Energy Solutions

15 June 2018

The SEM Committee

Subject: Consultation response

To whom it may concern,

Please see our response to the SEM Committees consultation on BNE Net CONE.

Yours sincerely,

Bent Iversen

Senior Business Development Manager

Energy Solutions

Postal Address

Wärtsilä Finland Oy
P.O Box 252
FI-65101 VAASA
Finland

Office Address

Puotikuja 1
65380 VAASA
Finland

Phone

+358 (0)10 709 0000

Registered in Finland No. 465.942
Registred Office: Vaasa

Wärtsilä Finland Oy	Energy Solutions

Response: Capacity Remuneration Mechanism (CRM) T-4 Capacity Auction for 2022/23 Best New Entrant Net Cost of New Entrant (BNE Net CONE)

Postal Address

Wärtsilä Finland Oy
P.O Box 252
FI-65101 VAASA
Finland

Office Address

Puotikuja 1
65380 VAASA
Finland

Phone

+358 (0)10 709 0000

Registered in Finland No. 465.942
Registred Office: Vaasa

WÄRTSILÄ

Wärtsilä Finland Oy	Energy Solutions

1 Introduction

Wärtsilä Energy Solutions are pleased to respond to the consultation on Capacity Remuneration Mechanism (CRM) T-4 Capacity Auction for 2022/23 Best New Entrant Net Cost of New Entrant (BNE Net CONE) (SEM-18-025).

2 SEM-18-025 Consultation Question and Response

"The SEM Committee welcomes views and responses on any aspect of this consultation paper and the appended Poyry report. However, the overriding question is: Do respondents agree that the Best New Entrant applicable for the competitive capacity auction process should be the reference technology analysed which results in the lowest Net CONE (based upon the analysis for this consultation the BNE Net CONE is proposed as a CCGT located in Northern Ireland)?"

We do not agree with the conclusion that the BNE of a CCGT in NI is the best reference point for indicating which technology that is least risky and most lucrative to invest in. This is based on the recent and coming impact that the increasing amount of installed renewable energy sources (RES) will have on the need for dispatchable generation.

Ireland is now a global leader in taking variable renewable electricity like wind and solar onto the grid. Currently 65% of renewable can be taken onto the grid, and by 2030 that will rise to 75%. Ireland has set its target to have 40% of electricity consumed from renewable sources by 2020[1].

This change in installed capacity will change the logic of how market works. Installed capacity of wind generation has grown from 145 MW at the end of 2002 to over 2,300 MW in 2016 and is expected to grow to between 3,800 MW and 4,100 MW according to Eirgrids Generation Capacity Statement[2]. The drawbacks from the increase of wind power, however, arise from the intermittent nature of these sources. Because of this intermittency, increasing the relative share of renewables in the power system creates system imbalances for which flexible measures must be introduced.

In other areas/countries where variable renewable electricity has grown rapidly in last years, CCGTs are struggling to keep capacity factors at a required level to be financially viable.

2.1 CCGT technology in modern markets with high level of renewable electricity

In the Pöyry report, the following is stated:

"When it comes to the expected load factor, it is difficult to envisage a set of market conditions (within reason) that would suggest any operating pattern other than mid-merit/baseload for a new entry CCGT in I-SEM. We, therefore, assume an average load factor within the range 65%-75% for the reference CCGT plant over the entire period 2022/23 to 2031/32 (i.e. over the 10-year period of the

[1] http://www.dcenr.gov.ie/energy/en-ie/Energy-Initiatives/Pages/White-Paper-on-Energy-Policy-in-Ireland-.aspx
[2] http://www.eirgridgroup.com/site-files/library/EirGrid/Generation_Capacity_Statement_20162025_FINAL.pdf

Postal Address
Wärtsilä Finland Oy
P.O Box 252
FI-65101 VAASA
Finland

Office Address
Puotikuja 1
65380 VAASA
Finland

Phone
+358 (0)10 709 0000

Registered in Finland No. 465.942
Registred Office: Vaasa

RO contract). We assume a 75% load factor in the first year of operation gradually declining (linearly) to 65% in the tenth year of operation.

During recent years, we have seen several CCGTs failing to reach such load factors. In the past, load factors of 70-75% have been possible but the continuous increase of low priced electricity from solar and wind has significantly lowered those figures. Below are some reference cases where one can see the effect an increase of renewable electricity can have on CCGT power plants designed for base load electricity production.

2.2 CCGTs in trouble

CCGT is a less flexible technology compared with other potential capacity or system service providers. It is no longer acceptable to be relying on baseload energy sales; market flexibility is the most important criteria. CCGT units typically have a minimum load of around 40%. The CCGT plant needs to be deployed at a large scale (400MW+) to be financially cost effective (in particular to carry the high fixed costs).

Working against CCGT as BNE technology is also the slow startup time and ramping time. This with the combination of the high startup costs make the CCGT a lot more expensive than when only providing baseload electricity.

In 2014 Panda Temple Power built a modern and efficient, 758 MW CCGT in Temple, Texas, USA. The plant filed for Chapter 11 bankruptcy only 3 years later. A big reason behind the bankruptcy was the high level of low priced solar and wind power, similar to the situation in Ireland where the amount of wind power is increasing. Between 2014 and 2017 whole-sale prices in ERCOT (Electric Reliability Council of Texas) fell with approx. 40%, substantially lowering the CCGT power plants load factors.

In 2017 ExGen Texas Power LLC filed for Chapter 11 bankruptcy. ExGen's portfolio was totaling 3560 MW of gas-fired power plants and consisted of five power plants. The largest by generating capacity was the five-unit Handley plant in Tarrant County, with 1265 MW and in 2016 Handley had the lowest capacity factor among the operating ExGen Texas Power facilities, at 4.95%. The owner of ExGen is Exelon Corp. Their two newest Texas gas plants, Wolf Hollow and Colorado Bend Energy Center, had the highest capacity factors in 2016 of the five, at 46.23% and 45.29%, respectively.

La Paloma Generating Co LLC, a 1200 MW combined cycle plant about 110 miles northwest of Los Angeles, USA, filed for U.S. Chapter 11 bankruptcy in 2016. Market factors including slower-than-expected growth in electricity demand, oversupply of natural gas and a boom in solar and other renewable energy depressing power prices were the primary reasons behind the bankruptcy[3].

The appended Pöyry report in the SEM-18-025 consultation points at high CAPEX as primary reason for not considering reciprocating engine plant as the choice of a rational investor. Simultaneously, they state that "Some reciprocating engines tend to have enhanced start-up and ramping capabilities. If these characteristics are valuable to the system, and this 'flexibility' can be monetized through participation in the energy markets and from System Services payments, then engines could be a more efficient choice, and the capital cost difference could be offset." [4]

2.3 Peaking plants and flexibility

The rapid increase in intermittent energy dramatically increases the need for competitive flexible generation. Categories for flexible generation include OCGTs (Open cycle gas turbines) as well as high-and medium-speed reciprocating engines. OCGTs and high-speed reciprocating engines are lower in efficiency compared to medium-speed reciprocating engines entailing that the former two ultimately contribute to higher electricity prices.

In Australia, OCGT and reciprocating engines are the technology types mostly used to cover peak demand, it makes up the largest share of the industry's planned capacity additions after wind and solar. Reliability is the attribute that variable wind and solar lack. Insisting that baseload is the only way to provide reliability is not rational. A better approach would be to recognize that other generation technologies are more nimble providers of reliability, and when partnered with renewables can provide a lower-cost solution.

Gas is very well suited for such a future. In the first seconds after wind and solar output falls on a change in the weather, rechargeable batteries might be best placed to provide instant electricity. After that, potentially pumped-storage dams and then flexible gas plants will be able to provide less costly generation for hours until variable renewable generation recovers. CCGT plants tend to be too slow to gear up and down to be suitable for such unpredictable events.

The CCGT was originally designed to achieve high efficiencies with a nearly constant output. The frequent start up and shut down operations required to match the system demand with high wind power share in the network affects the plant's efficiency and increases the wear out of the plants components. The efficiency is also affected by operating the plants below 80% of their rated capacity; a critical limit below which the efficiency drops dramatically[5]. A direct result of this way of operating the CCGT fleet is an increase of the CO_2 emissions for each MWh generated by the gas turbines.

3 https://www.reuters.com/article/us-la-paloma-bankruptcy-idUSKBN13V2PY

4 (COST OF NEW ENTRANT PEAKING PLANT AND COMBINED CYCLE PLANT IN I-SEM, A report to the Utility Regulator and the Commission for Regulation of Utilities, p.10)

5 http://euanmearns.com/co2-emissions-variations-in-ccgts-used-to-balance-wind-in-ireland/

Building new modular flexible power generation technologies are better providers of reliability, and when together with growth of installed renewables can provide a lower-cost solution. Modularity in power plant design enhances flexibility and reliability. Reciprocating engine power plants comprised of multiple generating units complement renewable energy without sacrificing efficiency.

2.4 High-speed vs medium speed reciprocating engines

It is important when classifying reciprocating engines to note that there are significant differences in models based on their revolutions per minute (RPM) at rated power. High-speed (HS) engines run at above 1200 RPM, medium-speed (MS) engines at 400-1200 RPM, and low-speed (LS)at below 400 RPM. For power generation purposes, the prime movers are most often HS or MS (while LS are used in ships). The output of a HS engine is below 5MW, while MS is between 5-20MW.

Typical HS gas engines have a lower efficiency (<40% HHV), making their short-run marginal cost (SRMC) higher as they have a higher marginal cost of fuel and carbon cost. Thereby they find themselves lower in the merit order and are more exposed and have increased market risk compared to medium-speed MS gas engines which have higher efficiency (>40% HHV). In addition, HS maintenance costs are usually on par with MS, so HS do not have a competitive advantage on the O&M cost side either. Finally, the flexibility capabilities of HS and MS will differ depending on what the manufacturer is willing to guarantee (start/stop times, start allowances, start costs etc.), which is also important to take into account.

HS engines tend to have a lower CAPEX than MS which primarily due to them being less massive and thereby being composed of less steel. However, if load factors and margins are modelled as low or to deteriorate, this makes low CAPEX less important. In the business case evaluation comparing HS vs MS, it is important to model future scenarios to calculate how exposed each engine is to market risk. As the increase in wind is causing more volatility on the system, this will also push the need for flexible assets that can start and stop quickly and economically. However, even though the this drives the demand for both HS and MS to 'fight' for demand peaks, MS should always find itself being more competitive on the market because of its lower SRMC. It may well be that HS also does get a contract, but MS will always generate a better margin (on a pay-as-clear market). For ancillary services, it also means that MS is more competitive due to its lower cost for dispatch by the grid, even if it is a pay-as-bid market.

In a nutshell, it may be that lower efficiency, yet lower CAPEX, HS engines will require a higher exit price than higher efficiency and higher CAPEX MS engines in the Capacity Auctions to recover missing money and reduce investor risk premiums (WACC).

Wärtsilä Finland Oy	Energy Solutions

3 Conclusion

We do not agree with the conclusion that the BNE of a CCGT in NI is the best reference point for indicating which technology that is least risky and most lucrative to invest in. This is based on the recent and coming impact that the increasing amount of installed renewable energy sources (RES) will have on the need for dispatchable generation.

Postal Address

Wärtsilä Finland Oy
P.O Box 252
FI-65101 VAASA
Finland

Office Address

Puotikuja 1
65380 VAASA
Finland

Phone

+358 (0)10 709 0000

Registered in Finland No. 465.942
Registred Office: Vaasa