

## Minutes of the combined Thematic Working Group Seminar Technology and Grid / Market and Supply: „Baltic Sea Offshore Wind Energy Grid Development 2035“

Side event at the Wind Europe Conference and Exhibition 2017 in Amsterdam  
Wednesday 29th November 2017 from 13:30 to 16:30  
Amsterdam

Venue: RAI Exhibition and Convention Centre, Europaplein 22  
(Hall: Elicium, Room: D203, 2nd floor), Amsterdam  
Host: Danish Technical University (DTU) in cooperation with Rostock Business  
Materials: Presentations, participant list and the agenda of the meeting

### Speakers:

Julia Sandén, IKEM  
Gert Proba, Rostock Business and Technology Department  
Nicolaos Cutululis, DTU Wind Energy  
Leif Rehfeldt, Deutsche WindGuard GmbH  
Giles Hundleby, BVG Associates Ltd.  
Patrick Paranhos, Kraken Robotik  
Andreas Möser, Lund University  
Kaushik Das, DTU Wind Energy

### 13:30 o'clock: Welcome and introduction

Gert Proba from Rostock Business and Technology Development GmbH and Nicolaos Cutululis from DTU Wind Energy welcomed the participants and described the plan of the Thematic Working Groups (TWG) Market & Supply and Technology & Grid and the objectives of the seminar within this context. They specified the questions to be discussed here as follows:

- Where will the Offshore Wind Energy Grid stand in the Baltic Sea region in 2025 or 2035?
- Which markets and countries are frontrunners for offshore grid infrastructure?
- What technology needs to be provided?
- What are the perspectives of system operations, developers and technology providers?
- Where are the prospects for settlement of Offshore Wind Energy industry and new businesses?

### 13:40 o'clock: Baltic InteGrid – What is this project about?

Julia Sandén from IKEM introduced the project Baltic InteGrid to the TWG seminar participants. The Interreg project Baltic InteGrid (Integrated Baltic Offshore Wind Electricity Grid Development) provides a professional network for expertise exchange and state-of-the-art interdisciplinary research on the optimisation potential of offshore wind energy in the Baltic Sea Region (BSR) by applying the meshed grid approach.

### 13:50 o'clock: Offshore Wind Energy (OWE) markets in the Baltic Sea region – Which capacities will be reached up to 2025 or 2035?

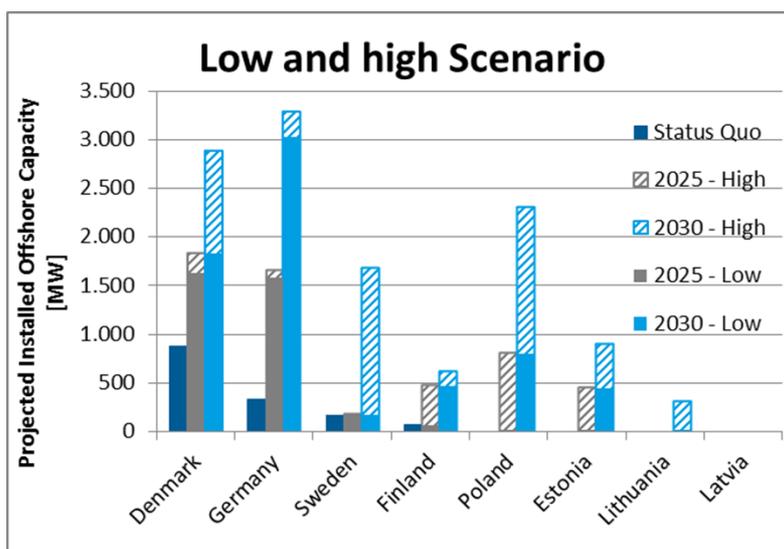
Leif Rehfeldt from Deutsche WindGuard GmbH presented the future Offshore Wind Energy (OWE) market scenarios in the Baltic Sea region. As stated in the presentation, scenario buildings until 2030 as presented here aim to:

- Enable a calculation of market potential (e.g. grid components)
- Develop a vision for a “Baltic Offshore Grid” (BOG) in 2050

The methodology applied here can be characterized as follows:

- Building up on existing data and scenarios of superior actors (provided by WindEurope / ENTSO-E TYNDP 2018-draft)
- Analysis of offshore wind farm data base (compiled by Baltic InteGrid)
- Additional desk top research with regard to other data bases (4C Offshore, Global Data) and specific projects, if necessary
- Development of appropriate assumptions for each country based on the gained information

Afterwards, the status quo of Offshore Wind Energy Development in the Baltic Sea was presented, for the single BSR countries first and as a compilation afterwards. Out of this, final project scenarios up to 2030 were presented.





Nicolaos asked about the equivalency of wind power potentials between presentations by Julia and Leif. Potentials presented by Julia represented the total wind power potential in the Baltic Sea region while the potentials presented by Leif represented more feasible potentials based on market and supply, regulations etc. for the timeline around 2035.

**14:10 o'clock: Assessment of Baltic hubs for offshore wind transmission development**

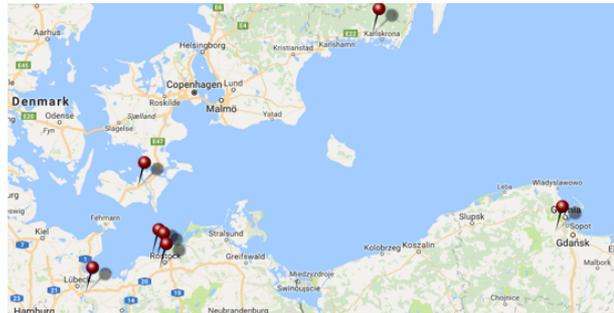
Giles Hundleby, BVG Associates Ltd., presented the preliminary results of the assessment of Baltic port infrastructure with focus on the following aspects:

- Cable supply
- Substation structure supply
- Substation electrical supply
- Cable installation
- Substation structure installation
- Cable maintenance and service
- Substation structure and electrical maintenance and service

**Cable supply**

**Assessment of Baltic port infrastructure**

- Several cable suppliers already operate in the Baltic region including Nexans, NKT, Prysmian and TF Kabel
- Baltic market demand for cable supply is relatively small – ~370km cable for medium-term future Baltic projects
- Cable supply does not require a high specification port, although some dedicated infrastructure required for cable transport
- Ideally (but not critical) port is located close to customers
- Materials for a cable manufacturing facility (copper strand, cladding and extrusion material) can be transported by standard HGVs or by sea-borne containers
- Finished cable is spooled from the manufacturing facility directly onto a cable lay vessel or barge
- Due to bend radius restrictions, many cable facilities use spool tracking on the quayside which can extend via a gantry out into the sea.
- Current port infrastructure for cable supply is likely adequate



Location of cable suppliers in the south Baltic area

Port characteristic	Optimal requirement
Horizontal clearance	28m
Air draft	30m
Vessel draft	6m
Total area	90,000m <sup>2</sup>
Quay length	125m

The assessment of the Baltic hubs for offshore transmission development was the next step determined in his presentation with the following focus:

- Develop detailed coastal infrastructure requirements in transmission system production, installation and service
- Detailed review of existing Baltic infrastructure
- Detailed review of availability of additional Baltic infrastructure

- Identification of priority ports and assessment of suitability for transmission development

Out of this analysis of the current and future situation, the recommendation was given to cover the strengths and weaknesses of supply chain and infrastructure, the demand of new infrastructure and the barriers to development.

A representative of the company 50Hertz asked if the availability of cables could be an issue/bottleneck for future projects, as several developments are happening simultaneously (offshore and onshore, e.g. for Germany). The same concern was expressed by NKT representative, who mentioned that while investing in additional production capacity is possible, this would require a clear outlook and currently there are great uncertainties for future projects (as also has been experienced in North Sea developments).

The TenneT representative said that there is a certain overcapacity in the market and that cable availability should not be a problem and cables are already over-dimensioned in many parts allowing future WPPs to connect to them. In the last auction organized by TenneT, more than 10 cable manufacturers participated (including from outside Europe; the winner is from China). Furthermore, the recommendation to also include Polish ports was given by the audience.

#### 14:30 o'clock: Unmanned Underwater Digitalization - Cloud-based Integration of Next Generation Sensors for Predictive Analytics

Following, the aspect of underwater digitalization was presented by Patrick Paranhos, Kraken Robotik with many interesting videos. Along this presentation the following 3 "A" of Autonomy were presented:

Automated (where we have been – high technology readiness level – (TRL))

- By default with Autonomous underwater vehicles (AUVs)
- Given a detailed mission, the vehicle will run it
- ...and *only* the mission

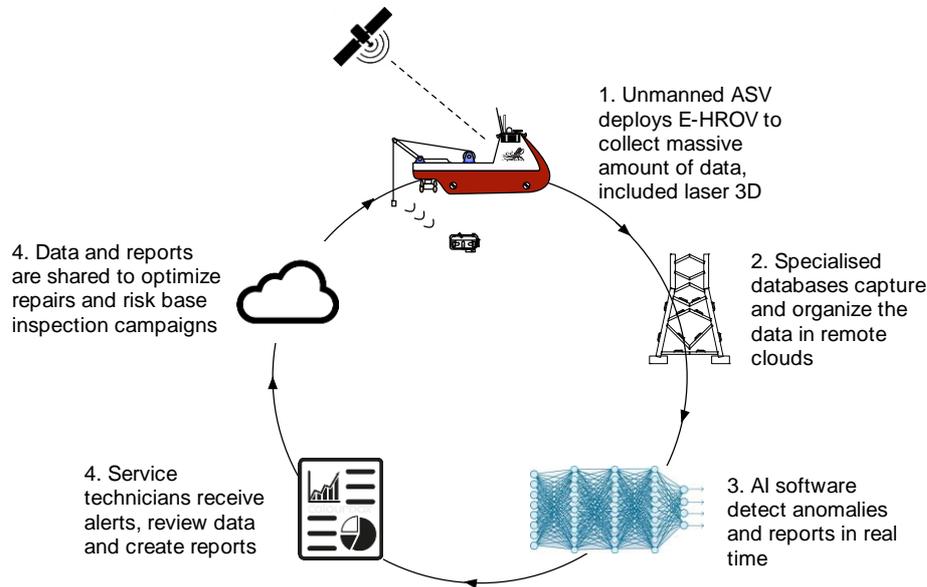
Adaptive (where we are – medium TRL)

- Use in-situ data to optimise a task
- Adaptive track spacing

Autonomous (where we are going – low TRL)

- High-level mission goals
- Using adaptive capabilities as inputs to accomplish that goal
- Ability to evaluate progress and plan tasks accordingly
- Cognitive - learning from success and failure

Related digitization solutions are:



Afterwards, the participants discussed questions of availability of robotic sensors for measuring temperature sensitivities for cables.

### Coffee break with active networking

#### 15:10 o'clock: Technology options and development trends for OWE and grids

Technology options and development trends for OWE and grids were presented by Kaushik Das from DTU Wind Energy. The presentation focused on the following aspects:

- The evolution of the LCOE
- The increasing complexity in siting
- LCOE Minimization by minimizing CAPEX, OPEX and AEP

Different relevant components and structures were considered here, and the current status of development was determined for each of them to show the development potentials per component.

#### 15:30 Today and future technology for offshore wind and grid development

Current and future technology were presented by Nicolaos Cutululis from DTU Wind Energy. First, background information was provided here to present the current technology trends related to the following aspects afterwards:

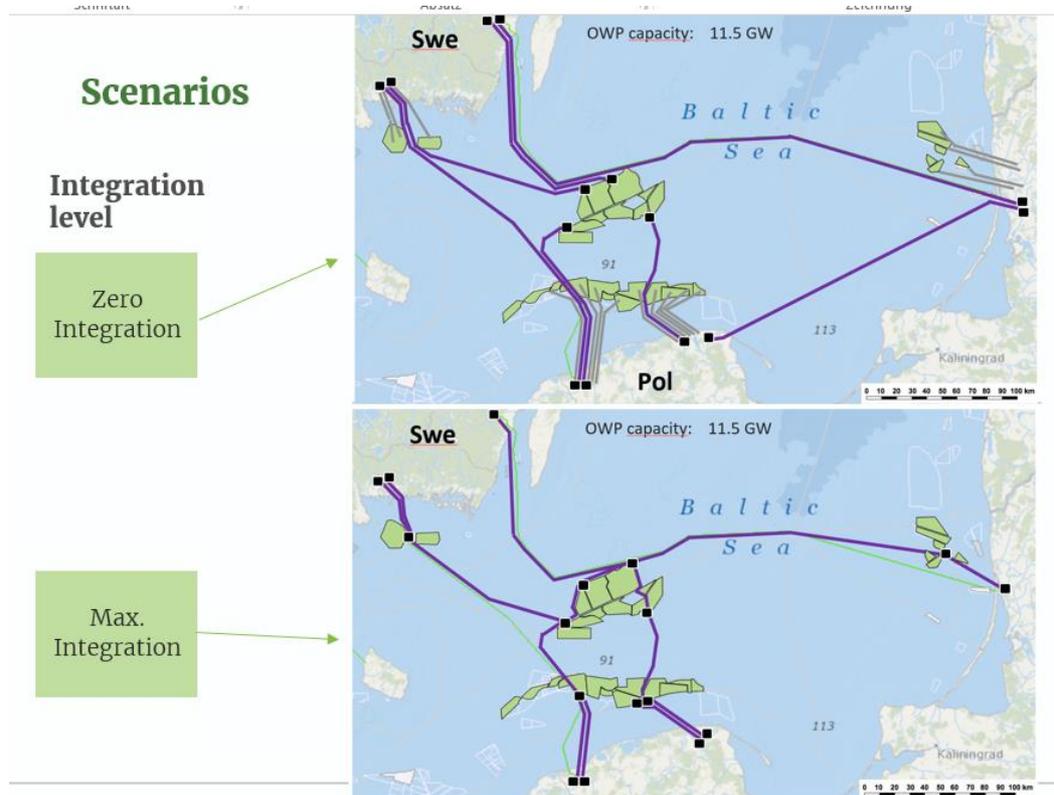
- Offshore wind turbine size
- Inter-array voltage level
- Offshore substations
- HVDC technology
- Overplanting

The conclusion drawn from this was that the principles bigger, higher, smaller (or) larger, (more) efficient and flexible in operation are guiding the coming technology developments.

### 15:50 Swedish-Polish-Lithuanian case study

Andreas Möser from Lund University presented the Swedish – Polish case study with the following details:

- Scenario structure
- High & Low Offshore Wind Power (OWP) development
- Technology assumptions
- Scenario: Maximum vs Zero grid integration
- Scenario: Partial grid integration



The 50 Hertz representative asked if the analysis considers the investments needed in the onshore AC power system to evacuate all the offshore power. This was not considered because the focus is on offshore grids.

Thilo Krupp from the German Offshore Wind Energy Foundation asked if there is any specific technology that is required for the Baltic Sea area that is not used in North Sea. No specific technology was identified.

### 16:10 Wrap up and Networking