Transportens Innovationsnetværk
Medfinansieres af Uddannelses-og Forskningsministeriet

Wind Logistics Group

Continuation of PhD Reference Group

Online web meeting

Altered meeting schedule (COVID-19)

(Replacing 4th face-to-face meeting)

Venue: Online

Wind Logistics Group, Meeting #5, November 24, 2020

Global Wind Energy Shipping and Logistics PhD project Reference Group meeting (#15)

Program of today

11:30 – 12:00 CET	*The online MS Teams platform will be available*
12:00 – 12:45 CET	**Working lunch and introduction of new Wind Logistics Group members**
12:45 – 14:00 CET	**Meeting part I**
14:00 – 14:15 CET	**Break**
14:15 – 15:45 CET	**Meeting part II**
15:45 – 16:00 CET	**Break**
16:00 – 17:30 CET	**Third "gå-hjem" (after work) meeting with public participation**
17:30 – 18:00 CET	Online networking and refreshments

Agenda
Wind Logistics Group meeting 1200-1600 CET

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1	Welcome and opening	1200-1215
2	New members/changed participants	1215-1245
3	Activities since our last meeting	1245-1315
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5	Break	1400-1415
6	“Transport concept for big wind turbines” speed boat	1415-1530
	a) Specifications for existing and future wind ports	
	b) Transport/handling/lifting equipment	
	c) Wind vessels of the future	
7	Wrap-up, summary of decisions/actions, next steps	1530-1545
8	Break (before After Work meeting at 16:00 PM CET)	1545-1600

1. Goals of today

a) Welcome new members of Wind Logistics Group

b) Review activities and updates since last meeting August 19, 2020

c) Go through result of speed boat “sprint” over the past weeks

d) Understand next steps and recommendations from speed boats

e) Make decisions to move speed boats forward

1. Roll call and brief introduction

Name	Company
Attending member organizations:	
Henrik Dalsgaard	DHL Global Forwarding Industrial Projects
Jakob S. Schmidt	DIS/CREADIS
Knut Magne Joannessen	Elevon
Christian Munk Jensen	Energy Cluster Denmark
Jacob Michelsen	FORCE Technology
Feng Zhao	Global Wind Energy Council
Peter Eriksen	Head Energy
Jan Rose Andresen	Head Energy
Per Fenger	Liftra
Hans K. Jepsen	NorSea Group Denmark
Kjartan Ross	Port of Aalborg
Thomas Padfield	Procon
Søren S. Kellenberger	R&D
Thomas Mortensen	Siemens Gamesa
Hans Christian Hansen	Vento Maritime
Carsten Kofoed	Vento Maritime
Morten B. Nielsen	Vestas

Name	Company
Tentative member organizations:	
Thomas Sender Mehl	KK Wind Solutions
Lars Aarestrup Sørensen	MHI Vestas Offshore Wind
Ian La Pointe	Elevon
Attending facilitator:	
Thomas Poulsen	TINV/Panticon

Others attending:

- A
- B
- C

1. Around the room – quick intro

- Company by company
  - Names
  - Background of company
  - Background of persons

Agenda
Wind Logistics Group meeting 1200-1600 CET

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Elevon

- Knut Magne Johannessen

KK Wind Solutions

- Thomas Sender Mehl

FORCE Technology

- Jacob Michelsen

Liftra

- Per E. Fenger

Vento Maritime

- Hans Christian Hansen

New name: Energy Cluster Denmark

- Christian Munk Jensen

  - ➢Used to be Offshoreenergy.DK
  - ➢Then became Energy Innovation Cluster
  - ➢Now Energy Cluster Denmark

    - ✓ www.energycluster.dk

Coming soon: MARLOG

- Thomas Poulsen

  - TINV and MDC will be part of Maritime & Logistics Innovation Denmark
  - www.marlog.dk
  - January 1, 2021



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Wind Logistics Group meeting 1200-1600 CET

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Purpose and scope defined in May 2019 - Why Wind Logistics Group?

- The ”mother vessel” and the ”speed boats”

Summary of key decisions (1/2)

1. **Name:**
   - Wind Logistics Group
2. **Scope:**
   - Wind Logistics Group will focus on onshore wind logistics as well as offshore wind logistics
3. **Purpose:**
   - Primary purpose of the Wind Logistics Group should be to work on relevant and value creating joint projects within wind logistics
   - Secondary purpose is networking (after work meetings 2 times/year about wind logistics)

Summary of key decisions (2/2)

4. **Projects** selected by Wind Logistics Group to focus on will be funded separately
   - Joint learning and logistics synergies to add value
   - Scalability/global projects
5. **Next meeting:**

Incubation of projects

Managed and funded by Wind Logistics Group

- Secretariat, project managers

Or funded separately

- Publicly funded projects
- Other funding

Our charter discussions May, 2019
- Key considerations of ”mother vessel members”

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Summary of key discussions (1/2)

1. **Geographical focus.** The wind industry (including offshore wind) is not just Denmark; the business is rapidly globalizing
   - Norway, Sweden (nearby, short term), Germany, Holland, Belgium, UK (nearby, medium term), and China, Taiwan, Japan, South Korea, India, Australia, USA (further away, long-term)
2. **Members.** More members for the Wind Logistics Group could be considered
   - Denmark: Vattenfall, BMS, Energinet, LM Wind Power, Bladt, DEME Offshore, Swire Blue Ocean
   - Nordic: Equinor, AKER Solutions, Fred Olsen, Norwegian Energy Partners
   - Europe: Van Oord, Boskalis, Jan De Nul, Fugro, Seajacks, E.ON, EEW
3. **Funding and project prioritization.** A “funnel” with selection criteria should be applied and lead to selections of projects to work on and achieve funding support for (private, public, or combination thereof)

Wind Logistics Group - Transportens Innovationsnetværk 2019-2020 5

Time invested

Value derived

Company and industry ”return on investment”

Democratic forum

Voluntary

Cross-supply chain

Summary of key discussions (2/2)

4. **Value creation.** It is critical to create value to the members and the industry from the projects worked on by the Wind Logistics Group
   - Better health/safety/security/quality, revenue increases to member companies, cost reductions, shorter time spent, better processes, greater logistics synergies, standardization, digitalization, automation, and organization
5. **TINV platform** (link) to sponsor the involvement of Thomas Poulsen in the preparation, execution, and follow-up of 4 Wind Logistics Group and after work meetings during 2019 and 2020, every 6 months
   - Relevance to Danish firms
   - Support to TINV

Call on June 18, 2020 - speed boat discussions

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Replaced our face-to-face meeting planned for May 12, 2020

- It was hard for us to find the necessary speed boat information
- Scoping had not been completed
- Work had halted to quite some extent
- Both speed boats need new captains
- Insufficient members available to handle speed boat charter

Speed boat decision: Focus and finalize

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- We decided to focus on the speed boats we already launched
  - Let us finalize what we started!!!

- 2 speed boats launched at November 4, 2019 meeting:
  - Transport concept for big wind turbines
  - Lack of USA infrastructure

- A third speed boat was considered and not launched:
  - Green fuels ***WILL NOT FORM PART OF TODAY'S CALL; IT IS THE FOCUS OF OUR AFTER WORK MEETING TODAY***

Call on August 19, 2020
- planning of our autumn work sessions

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- We still struggled with COVID-19 and checked on company policies
  - ➢We hoped for resuming face-to-face meetings
- We wanted to make our next meeting a speed boat working session
  - ➢Planned for September 22, 2020 at NorSea Group, Esbjerg
- We set out a work schedule for the autumn, 2020

Meeting on September 22, 2020 - work on the speed boats

- The face-to-face meeting was cancelled last minute due to COVID-19

- We instead conducted two separate 90-minute online speed boat meetings
  - Reset work efforts
  - Redefine goals

- One speed boat split into 3x sub-speed boats

- We agreed to have 3x online working meetings before the meeting today

We got busy!
- give yourselves a round of applause for the sprint

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Speed boat/sub-speed boat	Meeting dates
Lack of USA infrastructure	September 22, 2020
	October 27, 2020
	November 10, 2020
	November 17, 2020
Transport equipment for big wind turbines	September 22, 2020 (split in 3x sub-speed boats)
- - - 1. Specifications for existing and future wind ports	October 13, 2020
	October 27, 2020
	November 9, 2020
	November 18, 2020
- - - 2. Transport/handling/lifting equipment	October 7, 2020
	October 27, 2020
	November 11, 2020
- - - 3. Wind vessels of the future	October 12, 2020
	October 28, 2020
	November 2, 2020
	November 10, 2020
	November 17, 2020

Speed boat information now online

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www.windlogisticsgroup.com

Online presentation – September 16, 2020

- MDC online lunch ”TITBITS”

  - Watch here

White paper – September 22, 2020

- In collaboration with BreakBulk

  ➢Download the White Paper here

Today and next up…

- Online conference December 15, 2020

  ➢See the outline of the day here

Agenda
Wind Logistics Group meeting 1200-1600 CET

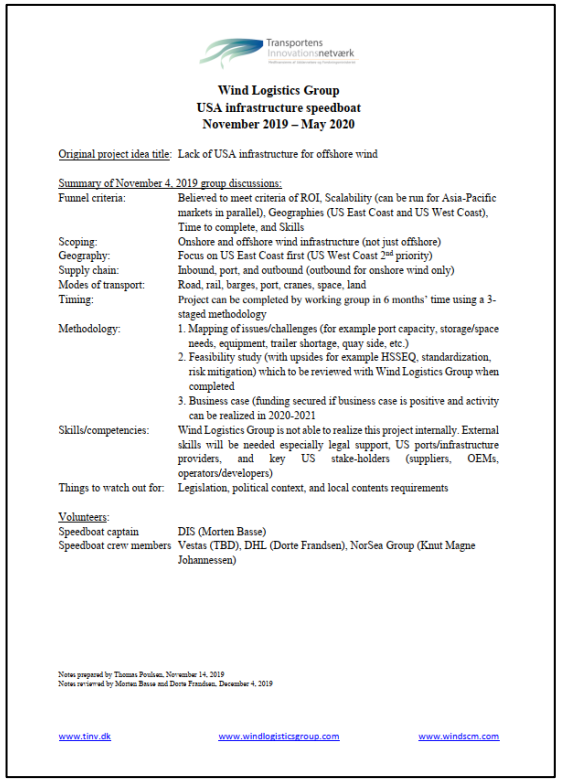
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Lack of USA infrastructure

- Who are the member companies?

  - DIS (formerly captain)
  - Vestas
  - NorSea
  - DHL Global Forwarding
  - KK Wind Solutions
  - Siemens Gamesa Renewable Energy



Wind Logistics Group
USA infrastructure speedboat
November 2019 – May 2020

Original project idea title: Lack of USA infrastructure for offshore wind

Summary of November 4, 2019 group discussions:

Funnel criteria:	Believed to meet criteria of ROI, Scalability (can be run for Asia-Pacific markets in parallel), Geographies (US East Coast and US West Coast), Time to complete, and Skills
Scoping:	Onshore and offshore wind infrastructure (not just offshore)
Geography:	Focus on US East Coast first (US West Coast 2nd priority)
Supply chain:	Inbound, port, and outbound (outbound for onshore wind only)
Modes of transport:	Road, rail, barges, port, cranes, space, land
Timing:	Project can be completed by working group in 6 months' time using a 3-staged methodology
Methodology:	1. Mapping of issues/challenges (for example port capacity, storage/space needs, equipment, trailer shortage, quay side, etc.) 2. Feasibility study (with upsides for example HSSEQ, standardization, risk mitigation) which to be reviewed with Wind Logistics Group when completed 3. Business case (funding secured if business case is positive and activity can be realized in 2020-2021
Skills/competencies:	Wind Logistics Group is not able to realize this project internally. External skills will be needed especially legal support, US ports/infrastructure providers, and key US stake-holders (suppliers, OEMs, operators/developers)
Things to watch out for:	Legislation, political context, and local contents requirements

Volunteers:

Speedboat captain	DIS (Morten Basse)
Speedboat crew members	Vestas (TBD), DHL (Dorte Frandsen), NorSea Group (Knut Magne Johannessen)

Notes prepared by Thomas Poulsen, November 14, 2019
Notes reviewed by Morten Basse and Dorte Frandsen, December 4, 2019

www.tinv.dk www.windlogisticsgroup.com www.windscm.com

NEW (June 18, 2020 meeting)

NEW (June 18, 2020 meeting)

Speed boat update:
Lack of USA infrastructure

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Call on September 22, 2020 concluded that:

- Lack of clarity with industry progress and current challenges
- Limited information available about actual shipping, logistics, supply chain, maritime, and offshore related challenges faced
- Politics and bureaucracy are causing delays
- Presidential election outcome will have an uncertain impact
- Difficult for our expert group to effectively impact US industry because of lack of clarity and uncertainty (described above)
- Idea: Produce a white paper
  - ➢ Identify challenges / pains faced as well as provide insights and suggest means to alleviate using knowledge and track-record from more mature markets

The basic idea:

A ‘White Paper’ that maps out the actual logistical challenges faced in the US for Wind.

(Current, relevant and clear / insightful information in the public domain is limited).

What we know: There are numerous logistical challenges in the US. *(Here are a few)*

- …blades are getting longer onshore, challenging rail
- …manufacturing future for offshore wind is not clear
- …the supply chain in offshore wind is partitioned state by state
- …the Jones Act, tug-and-barge regulations, and other “cabotage” type legislation presents big challenges for maritime requirements
- …US firms are eager to engage and lack track-record, knowledge, and partners

Scoping the White Paper:

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Scope will aim to create the most value:

(Preliminary)

- Emerging offshore wind (onshore?)
- Wind Logistics Group members supplemented by select externals (interviews, surveys, technical resource)
- Insights (not just focused on challenges)
- Readability and clarity (short / moderate length)

Other decisions:

- Audience and distribution?

What needs to be done?

Contact to key stakeholders (developers, OEMs, EPCi's, sub-suppliers, transport companies):

- Interviews / Surveys
- Process and analyze data collected
- Draw conclusions and insights
- Discussions / collaboration with Wind Logistics Group members
- Produce well-designed, professional white paper
- Produce digital download
- Distribute in online networks (accessible for free)

Next steps:

- Scope project (tasks, time and resources)
- Estimate costs
- Quantify / qualify value for Danish and Norwegian companies, institutions and associations
- Apply for funding to Danish and Norwegian sources
- Execute the project on behalf of Wind Logistics Group
- Elevon and Panticon to jointly complete the work (with possible support from Energy Cluster Denmark or MARLOG)
- Execute project Q1 / Q2 2021

Recommendation

We recommend to Wind Logistics Group that we move ahead with the next steps as outlined

- The next steps as outlined can be completed by Elevon, Panticon, Energy Cluster Denmark, and MARLOG in collaboration
- The preparation can be completed this year making us ready to apply for funding on January 2, 2021
- We expect that the white paper can be produced within 90 days after the funding has been obtained

Discussion and decisions

- Discussion items:
  - Identify challenges; come up with useful solutions
  - Focus on developers; EPCi's

- Decisions:
  - 6 YES
  - 0 (zero) NO

  - Recommendation supported

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Wind Logistics Group meeting 1200-1600 CET

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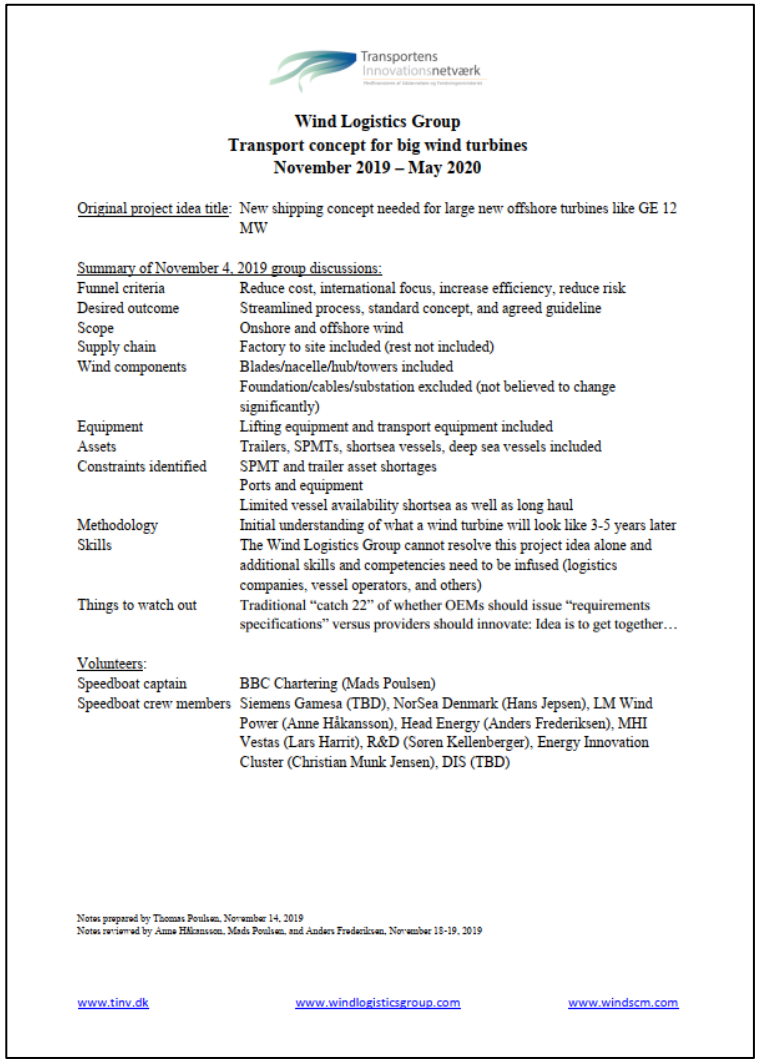
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Transport concept for big wind turbines

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- Who are the member companies?
  - BBC Chartering
  - DIS
  - MHI Vestas
  - LM Wind Power
  - NorSea Group
  - Head Energy
  - Siemens Gamesa Renewable Energy
  - Vestas
  - R&D
  - FORCE Technology



Transportens Innovationsnetværk

Wind Logistics Group
Transport concept for big wind turbines
November 2019 – May 2020

Original project idea title:	New shipping concept needed for large new offshore turbines like GE 12 MW

Summary of November 4, 2019 group discussions:

Funnel criteria	Reduce cost, international focus, increase efficiency, reduce risk
Desired outcome	Streamlined process, standard concept, and agreed guideline
Scope	Onshore and offshore wind
Supply chain	Factory to site included (rest not included)
Wind components	Blades/nacelle/hub/towers included Foundation/cables/substation excluded (not believed to change significantly)
Equipment	Lifting equipment and transport equipment included
Assets	Trailers, SPMTs, shortsea vessels, deep sea vessels included
Constraints identified	SPMT and trailer asset shortages Ports and equipment Limited vessel availability shortsea as well as long haul
Methodology	Initial understanding of what a wind turbine will look like 3-5 years later
Skills	The Wind Logistics Group cannot resolve this project idea alone and additional skills and competencies need to be infused (logistics companies, vessel operators, and others)
Things to watch out	Traditional "catch 22" of whether OEMs should issue "requirements specifications" versus providers should innovate: Idea is to get together…

Volunteers:

Speedboat captain	BBC Chartering (Mads Poulsen)
Speedboat crew members	Siemens Gamesa (TBD), NorSea Denmark (Hans Jepsen), LM Wind Power (Anne Håkansson), Head Energy (Anders Frederiksen), MHI Vestas (Lars Harrit), R&D (Søren Kellenberger), Energy Innovation Cluster (Christian Munk Jensen), DIS (TBD)

Notes prepared by Thomas Poulsen, November 14, 2019
Notes reviewed by Anne Håkansson, Mads Poulsen, and Anders Frederiksen, November 18-19, 2019

www.tinv.dk www.windlogisticsgroup.com www.windscm.com

Speed boat update
- Transport concept for big wind turbines

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September 22, 2020 online call:
- decision to split in 3 sub-speed boats

Specifications for existing and future wind ports

Transport, lifting, and handling equipment

Wind vessels of the future

Speed boat update
- Transport concept for big wind turbines

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Specifications for existing and future wind ports

Transport, lifting, and handling equipment

Wind vessels of the future

Specifications for existing and future wind ports - the basic idea

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- Evaluation of an existing or new port
- Wind energy
- Tool
- Data entry
- Traffic light notification of suitability

Our intention

- Wind turbine yield per WTG is constantly being upscaled
  - Bigger dimensions
  - Heavier weights
- Dillemma: Future proofing

Our tool is work in progress
- examples of output from the tool

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- Graphs to predict the future
  - ➢We would like to show developments over time
    - ✓WTG model ”jumps” cause weight/dimensions to increase significantly; flattened over time as MW is upscaled for each WTG model
    - ✓Blade length/weight
    - ✓Blade length/blade root diameter
    - ✓Nacelle yield/weight/size
    - ✓Etc…
- Tables with data from the past
  - ➢Showing developments

Cheat sheet – weight, volume, and dimensions

AALBORG UNIVERSITY DENMARK

Weight & Dimensions	Full Nacelle Weight (t)	Nacelle dimensions (m)	Hub Weight (t)	Total Hub Mass (t)	Hub Height (m)	Blade Length (m)	Blade Weight (t)	Tower Weight (t)
Siemens 2.3 MW	82			142	80	45		162
Siemens 3.6 MW	140				80	58.5	18	
REpower 6.15 MW	325					61		
Siemens 6 (9) MW	364		96	360	135	75	27	
Samsung 7.5 MW						83		
MHI Vestas 8 (9.5) MW	390	20 x 8 x 8			105-140	80	35	
NREL/DTU 10 MW	446		106-180	700		86-100	42-57	628
GE 12 MW					150	107	65	
NREL/SGRE 15 MW			303	1000		125	100	1000
DTU 20 MW	1061		299			125	118	1985

August 21, 2018 PhD thesis defense - Thomas Poulsen 1

Our goal: Present and future ports

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What turbines can your port handle?

Only edit yellow fields!

				Rating (MW)	10	15	20
				Model	DTU 10-MW	IEA Wind 15 MW	MU turbine
Blades							
	Storage area for blades	m2	17,000		17,421	15,210	16,266
	Maximum lifting height	m	11		11.4	11.2	12.2
	Turning radius (blade)	m	100		86.4	117.0	140.1
Towers							
	Quayside strength	ton/m2	10		13.7	7.8	8.6
	Required lifting height	m	130		121.6	141.0	160.4

Input Used

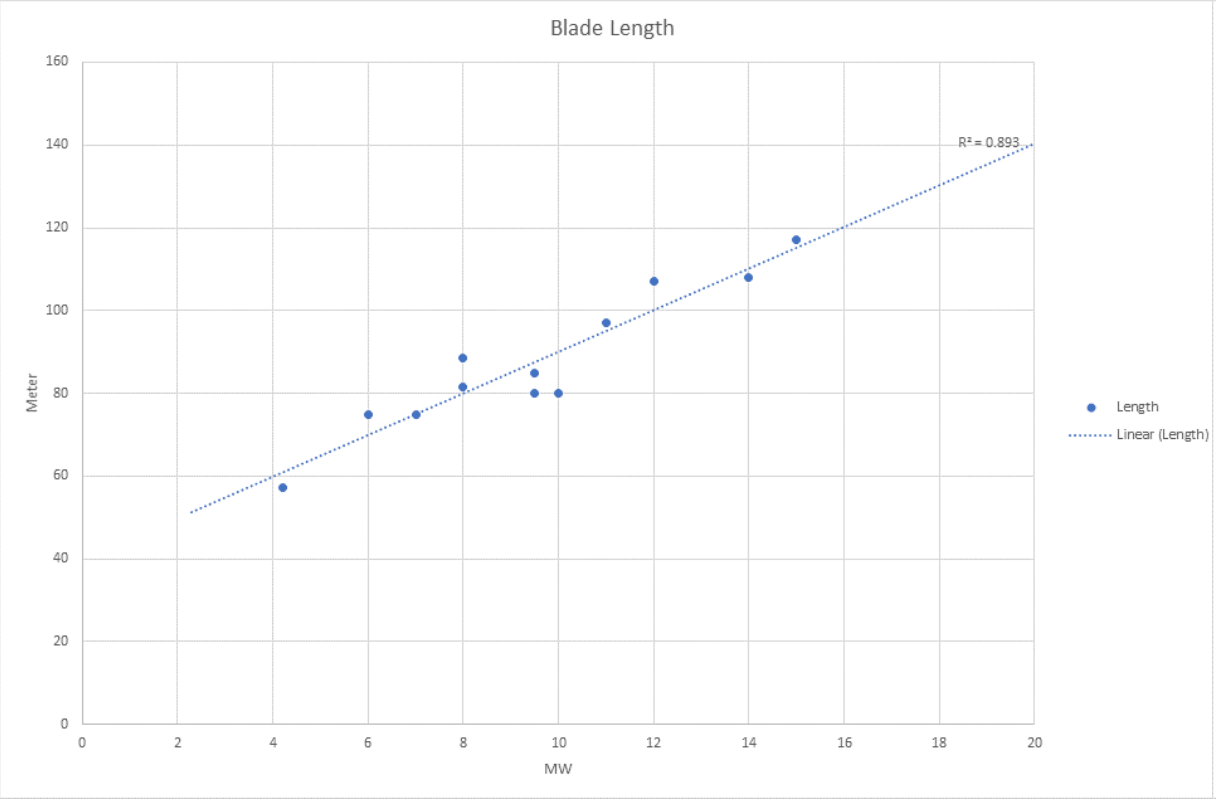
Blades							
	Blade length	m			86.4	117.0	140.1
	Root diameter	m			5.4	5.2	6.2
Towers							
	Weight	t			987.0	860.0	1348.1
	Diameter at base	m			8.0	10.0	12.0
	Height	m			115.6	135.0	154.4

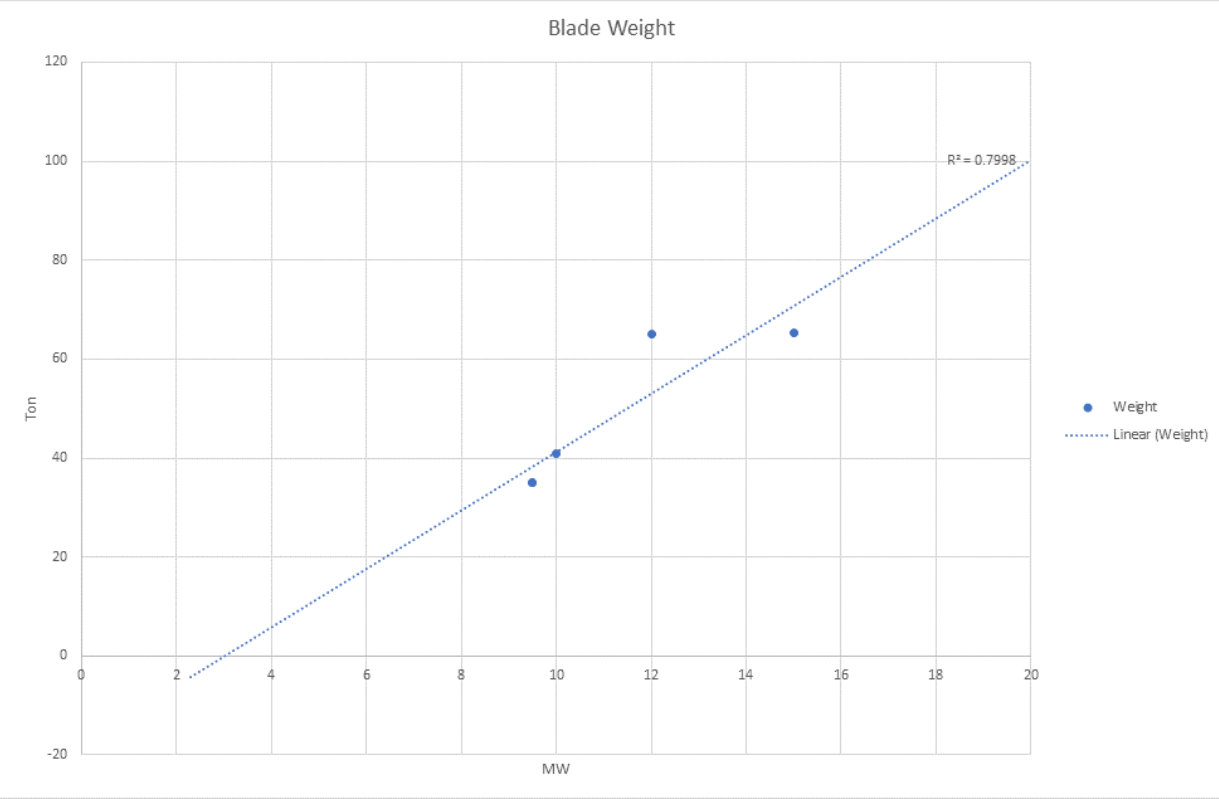
Big input section for desired outcome

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MW Rating			3	3.6	4.2	6	7	8	8	9.5	9.5	10	10		11	12	14	15	
Company		Vestas	SGRE	SGRE	MVOW	SGRE	SGRE	SGRE	Adwen	MVOW	MVOW	MVOW	DTU 10-MW		SGRE	GE	SGRE	NREL/DTU	
Model		V112			V117-4.2 MW™	SWT-6.0-154	SWT-7.0-154	SG 8.0-167 DD	AD 8-180	V164-9.5 MW™	V174-9.5 MW™	V164-10.0 M	DTU 10-MW		SG 11.0-200 DD	Haliade-X 12 MW	SG 14-222 DC	IEA Wind 15 MW	
Serial Production (year)						2014	2017	2019				2021			2022		2024		
Wind Turbine Generator																			
Blade																			
Full component																			
Length	m				57.2	75	75	81.4	88.5	80	85	80			97	107	108	117	
Weight	t									35	35		41			65		65	
Root diameter	m								4.2	4.6	https://www.windpowermonthly.com/article/1435504/mhi-vestas-launc					5.5	Product sheet	5	
Pre-bend	deg												3.332					4	
Storage footprint	m2																	608	
Rotor diameter	m												178.3					240	
Centre of Mass	m																	27	
Nacelle and Hub																			
Bille	**Total weight (nacel**	t				364				390	390		446					820	
	Nacelle weight (exc	t	TP		125 https://en.wind-turbine-models.com/turbines/669-siemens-swt-3.6-120-offshore													630	
	Hub weight	t																190	
	Hub diameter	m											5.6					8	
	Length	m			12.8					20	21	20.7							
	Width	m			4.2					8	9	8.8							
	Height	m			3.4					8	9	9.3							
	Ton/footprint	Ton/m2																	
	Direct Drive									1						1	1		
	Geared				1						1	1							
Towers																			
Full component																			
	Weight	t	TP		210 https://en.wind-turbine-models.com/turbines/669-siemens-swt-3.6-120-offshore								987					860	
	Length	m														150		135	
	Diameter at base	m											8					10	
	Diameter at top	m																7	
	Storage footprint	m2																	
Largets Part components																			
	Weight	t																	
	Length	m																	
	Diameter at base	m											8	5				10	5
	Storage footprint	m2																	
Other																			
Hub Height		TP		80 https://en.wind-turb		135 TP				105	110		119			150 TP		150	
Balance of Plant																			
Transition Piece																			
Full component																			
Weight	t												987					860	
Length	m												10					15	
Diameter at base	m												8					10	
Storage footprint	m2																		
Monopile																			
Full component																			
Weight	t												2044					1,318	
Length	m																	75	
Water depth used																		30	
Embedment depth	m												42.6					45	
Diameter at base	m												9					10	
Storage footprint	m2																		

Understanding size and weight

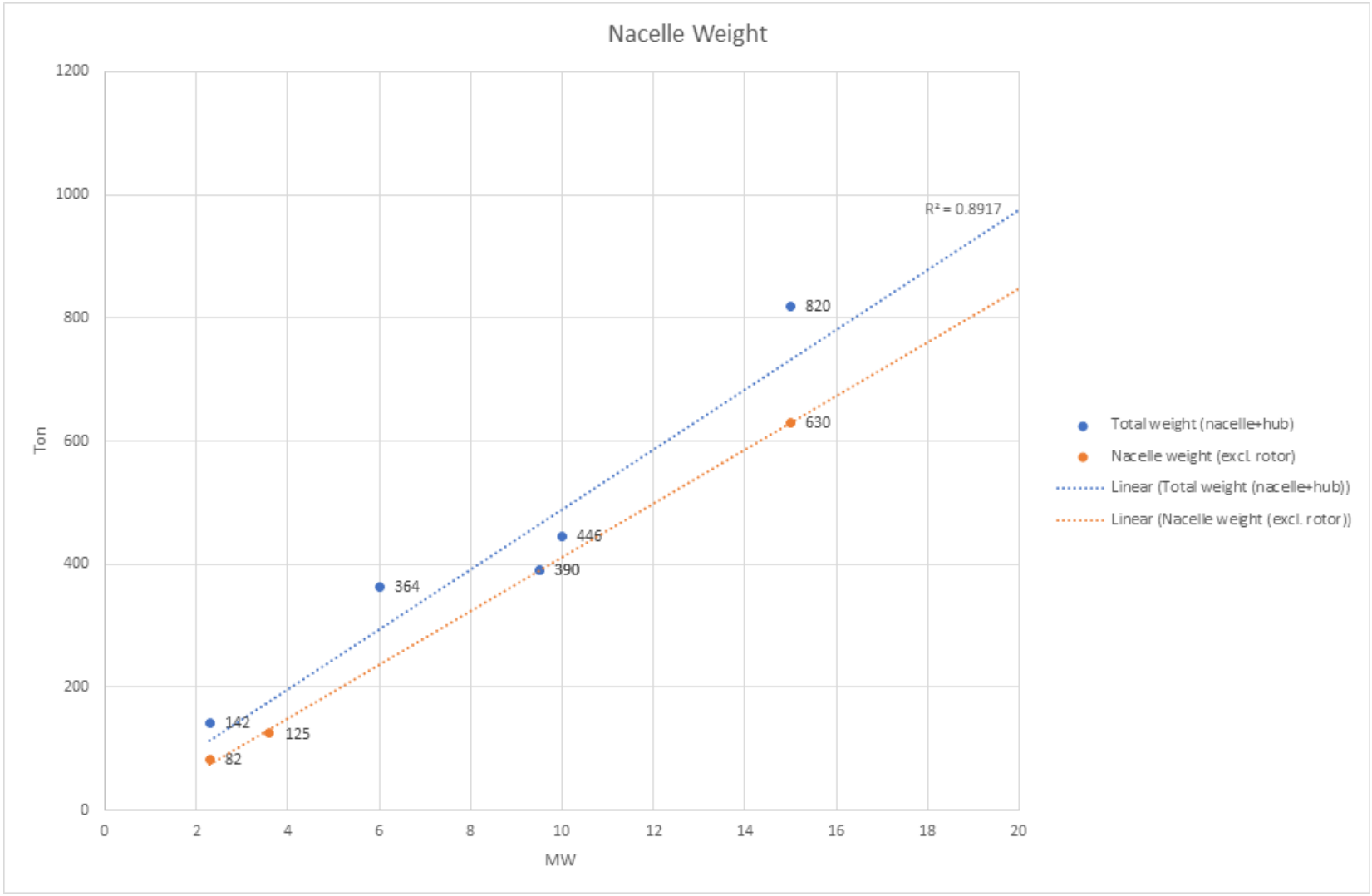




How big is big enough?

Our output is only as good as the data we have available

Indications on nacelle weight when upscaling



Next steps

- We would like for this to be an open source tool
- Available online
- It is not yet completed
- To finalize the tool, we need:
  - Verfication/input on component data from OEM´s
  - Calculated projection based on current/updated data

Recommendation

- We recommend to Wind Logistics Group that OEM´s are engaged
- This can be done by support from Group members/network
- The time it will take is 2-3 weeks
- If technical information from OEM´s is not available, we will engage e.g. DTU Wind Power to do the predictions
  - The cost of DKK 100-200K to carry out the prediction will be sourced from Energy Cluster Denmark under vidensbro (“knowledge bridge”) funding scheme

Discussion and decisions

- Discussion items:
  - Relevance for multiple purposes
  - Keep the tool up-to-date with latest data

- Decisions:
  - 8 YES
  - 0 (zero) NO

  - Recommendation supported

Agenda
Wind Logistics Group meeting 1200-1600 CET

Transportens Innovationsnetværk
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Speed boat update
- Transport concept for big wind turbines

Transportens Innovationsnetværk
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September 22, 2020 online call:
- decision to split in 3 sub-speed boats

Specifications for existing and future wind ports

Transport, lifting, and handling equipment

Wind vessels of the future

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Transport / lifting / handling equipment - the basic idea

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- Good work was done in the past
  - ➢ Guideline for design of standardized equipment across wind turbine manufacturers
  - ➢ Guideline for lifting operations across wind turbine manufacturers and developers
    - ✓ Newly updated version now available
- Our starting point:
  - ➢ Could we see even more areas that could be improved?
  - ➢ Could the composition of Wind Logistics Group enable the next findings to be worked on?

Our findings

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We looked at 5 different topics which can be organized as follows:

1. We envisaged a story-board with a decision tree displaying how logistical choices are inter-connected, i.e. the choice of vessels (RO/RO vs. LO/LO) and downstream implications e.g. on whether to lift or use SPMTs or similar
2. We looked at the possible use of the same transport frames for several wind turbine manufacturers:
   a) Nacelle and hub frames that can be used from point of manufacture through ports and on board vessels
   b) An adapter flange for blades to enable connectivity between blade and transport frame
3. A specific innovation made by a specific company: Could we help them make it an industry standard?
4. The next generation offshore wind blades are long, heavy, and hard to move/lift. Could we design a new hybrid piece of handling equipment?

Visualization
- attempt to make one of our ideas more realistic

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Original idea: Create a hybrid between a reach stacker and SPMT

- lifting from the bottom

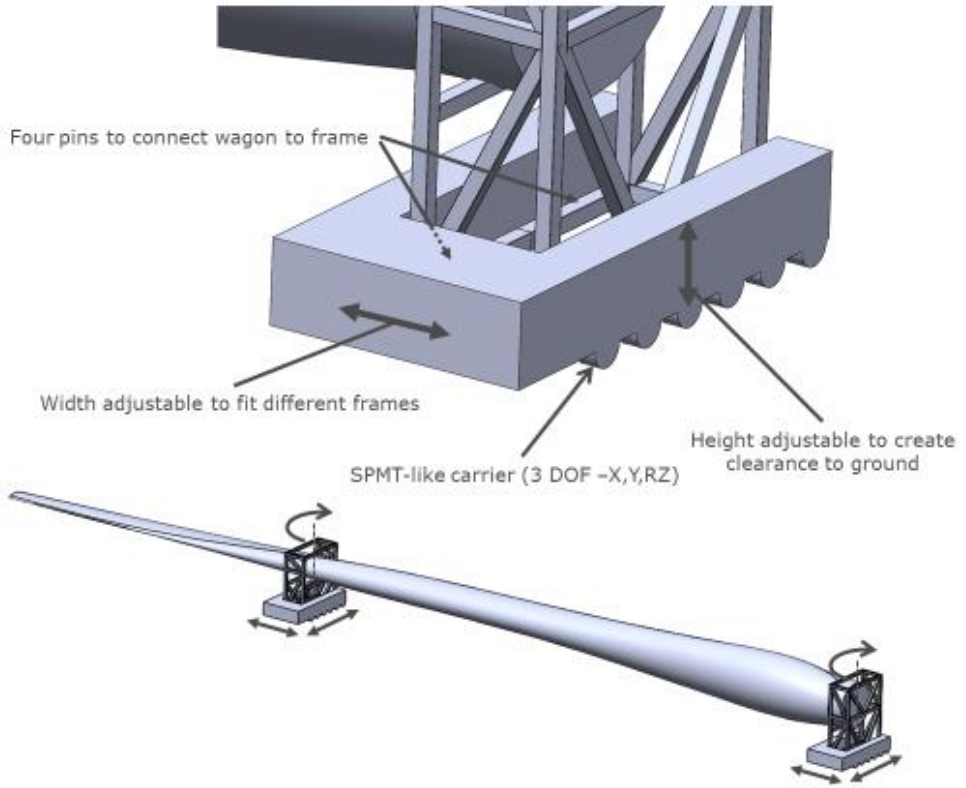
CONCEPT:
BLADE HARBOUR WAGON

SMPT CONCEPT

Functionalities:

Speed:	5-10km/h
Capacity:	40-50MT each
Powertrain:	Electrical/hydraulic
Powers source:	Battery pack
Weight:	XX
Development cost:	XX
Unit cost:	XX

CREADIS



Visualization (2/2)
- option 2: Lifting from above

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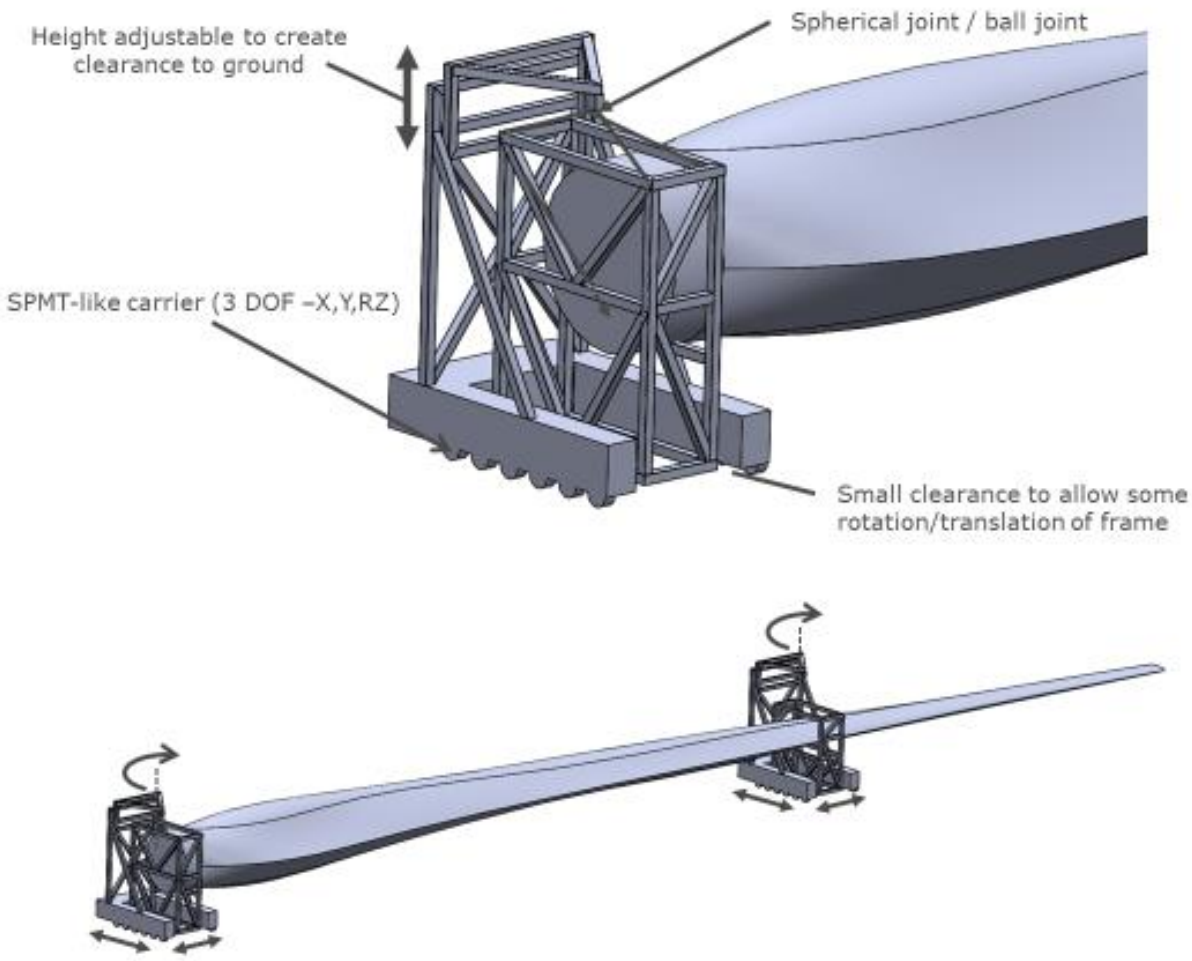
CONCEPT:
BLADE HARBOUR WAGON

REACH STACKER CONCEPT

Functionalities:

Speed:	5-10km/h
Capacity:	40-50MT each
Powertrain:	Electrical/hydraulic
Powers source:	Battery pack
Weight:	XX
Development cost:	XX
Unit cost:	XX

CREADIS



Next steps

- All of our ideas require further work and we could not complete within the time allotted
  - ➢All ideas seem viable so far
- Two ideas can be taken forward immediately:
  - ➢New hybrid tool combining a reach stacker and SPMT
  - ➢Helping a company to make their invention an industry standard
- The other 3 ideas require further mapping

Recommendation

- For the reach stacker/SPMT hybrid, we need to:
  - ➢Understand if this is a need of one turbine manufacturer or more
    - ✓Dialogue with SGRE and Vestas-MHIVOW
  - ➢Formalize project including develop budget and work plan
  - ➢Discuss with local manufacturer with track-record like N C Nielsen
- For the idea to make the invention and industry standard, we need to initiate dialogue with the company
- For the remaining 3 ideas, we recommend to Wind Logistics Group that further work can be done by expanding the sub-speed boat to include turbine manufacturers and possibly developers
- Additional progress can be done during December 2020 – March 2021

Discussion and decisions

- Discussion items:

- Decisions:
  - 7 YES
  - 0 (zero) NO

  - Recommendation supported

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Wind vessels of the future
- the basic idea

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- Supply and demand of vessels now and in future
- Growing wind turbine sizes / weights
- Standard ways of operating and managing
- Ability to bridge gap between vessel owners and OEMs
- Future proofing of new capacity

Our findings

We looked at 6 different topics which we can group together

1. The upscaling of wind turbines is important for vessel future proofing in terms of weights/dimensions/heights/cranes (the sub-speed boat on existing and future ports looked at this)
2. The OEMs do things differently (e.g. RO/RO vs LO/LO operations, stacking of blades or not) and several areas of value creation can potentially be unlocked if ways of working are standardized:
   a) Transport vessel design/construction (incl. heavy-lift capabilities)
   b) Feeder-barge installation solutions to “fixed” installation vessel offshore
   c) Installation vessel design/construction (jacked or floating)
   d) Commonly shared transport equipment across OEMs (with interfaces)
3. The market for floating offshore wind is yet to mature; high risk/high reward potential for early movers in “bleeding edge” market

Limited practical applicability

Several obstacles and limitations were identified:

- Not enough factual information and data is available
- The OEMs do not have the same ways of working
- Incentive from OEMs to drive change and standardize in order to unlock the potential value creation opportunities identified

Next steps

- We would like to propose that some of our ideas can be formalized and made into projects to be worked on
  - ➢This is realistically not feasible given the limitations encountered
- Further input and potential collaboration could be sought from other efforts rendered where overlap may exist (WindEurope, MegaVind?)
- Some of the topics identified may justify further work in the Wind Logistics Group cross-supply chain membership team
  - ➢We have different skills within the Wind Logistics Group team member composition
  - ➢A different or extended team with additional skills is required to take this forward
  - ➢Commitment to streamline and standardize is necessary on the part of the OEMs

Recommendation

- We recommend to Wind Logistics Group that size of future WTGs is identified (through assumptions or calculations) and that the OEMs need to take part in the work to be performed by this sub-speed boat
- This can be done by collaborating with the existing/future ports sub-speed boat on the size of WTGs and obtaining commitment from the OEMs that the potential for cost savings identified is of interest
- We cannot do it internally in this sub-speed boat alone and therefore ship owners, naval architects, and OEMs are important stake-holders
- If this sub-speed boat is organized properly, significant progress could be made during the 1st quarter of 2021
- To continue the work in this sub-speed boat, no investments are needed at this time except voluntary input from the key stake-holders
  - So far, the work done is not sufficiently specific to e.g. apply for funding in a separate project or formalized work process

Discussion and decisions

- Discussion items:
  - Value creation pathway must be clear to those funding
  - OEMs needed in applications for funding

- Decisions:
  - 7 YES
  - 0 (zero) NO

  - Recommendation supported

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We proceed as follows:

- Lack of USA infrastructure
  - ➢Follow recommendations
- Transport concept for big wind turbines
  - a) Specifications for existing and future wind ports
    - ✓Follow recommendations
  - b) Transport/handling/lifting equipment
    - ✓Follow recommendations
  - c) Wind vessels of the future
    - ✓Follow recommendations

The mother vessel Wind Logistics Group

- We meet again in this forum

➢Wednesday, April 21, 2021

✓8 YES

✓0 (zero) NO

✓DATE SELECTED

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Thank you for today's meeting!

We meet again (online or face-to-face) on April 21, 2021

- details will be advised