


GLOBAL WIND ENERGY SHIPPING AND LOGISTICS

LOGISTICS INNOVATION COLLABORATION WITH PORT OF RØNNE AND OFFSHORE CENTER BORNHOLM

JANUARY 27, 2016, RØNNE, DENMARK

Prepared for WINDFORCE Baltic Sea Bornholm 27–28 January 2016 *Denmark/Bornholm in focus*

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BACKGROUND & INTRODUCTION

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Broad industry support

PhD objective is for the research to be useful to industry:

Reference Group

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WIND MARKET SIZING AND OUTLOOK

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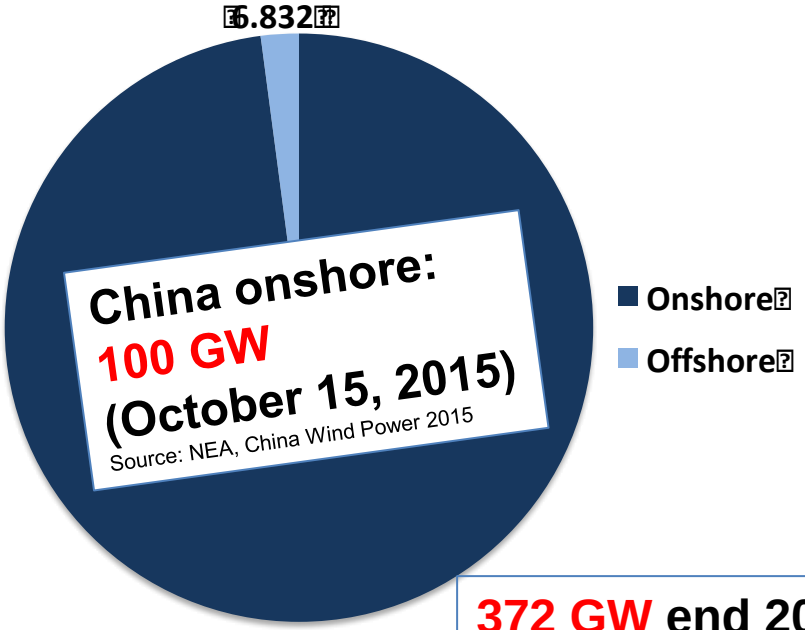
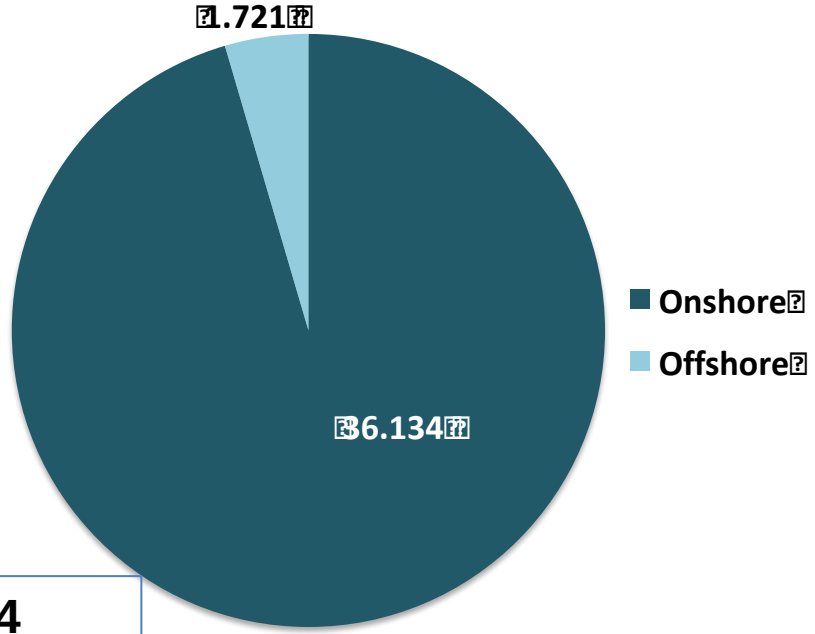
Onshore and offshore distribution

Cumulative distribution ultimo 2013 (MW)



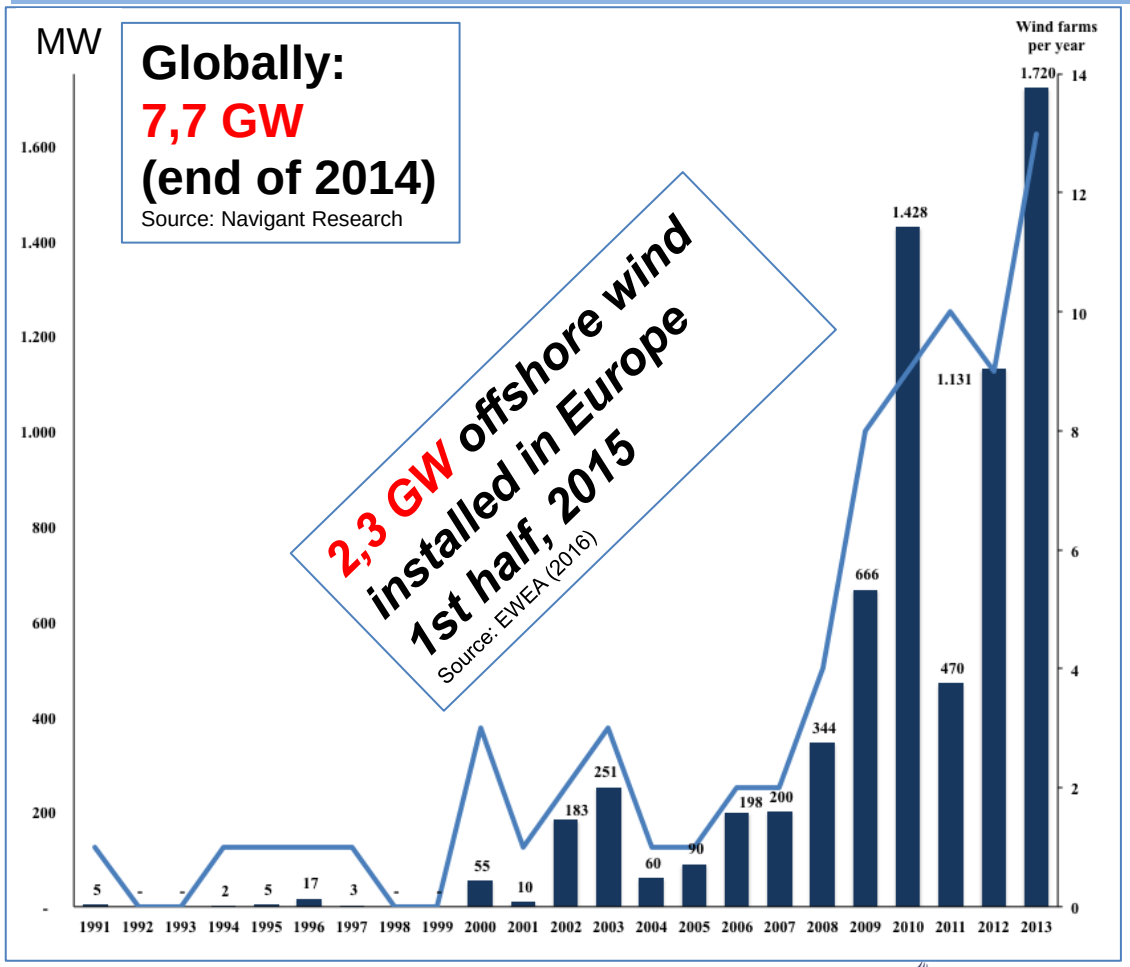
Installed distribution in 2013 (MW)



372 GW end 2014
7.7 GW offshore wind
Source: Navigant Research (2015)

Source: BTM Consult a part of Navigant (2014) and own construction

Number of offshore annual MW and wind farms installed up to and including 2013



Year	MW installed	Number of wind farms
1991	5	1
1992	-	0
1993	-	0
1994	2	1
1995	5	1
1996	17	1
1997	3	1
1998	-	0
1999	-	0
2000	55	3
2001	10	1
2002	183	2
2003	251	3
2004	60	1
2005	90	1
2006	198	2
2007	200	2
2008	344	4
2009	666	8
2010	1.428	9
2011	470	10
2012	1.131	9
2013	1.720	13

Source: BTM Consult a part of Navigant (2014a) and own construction

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LOGISTICAL CHALLENGES

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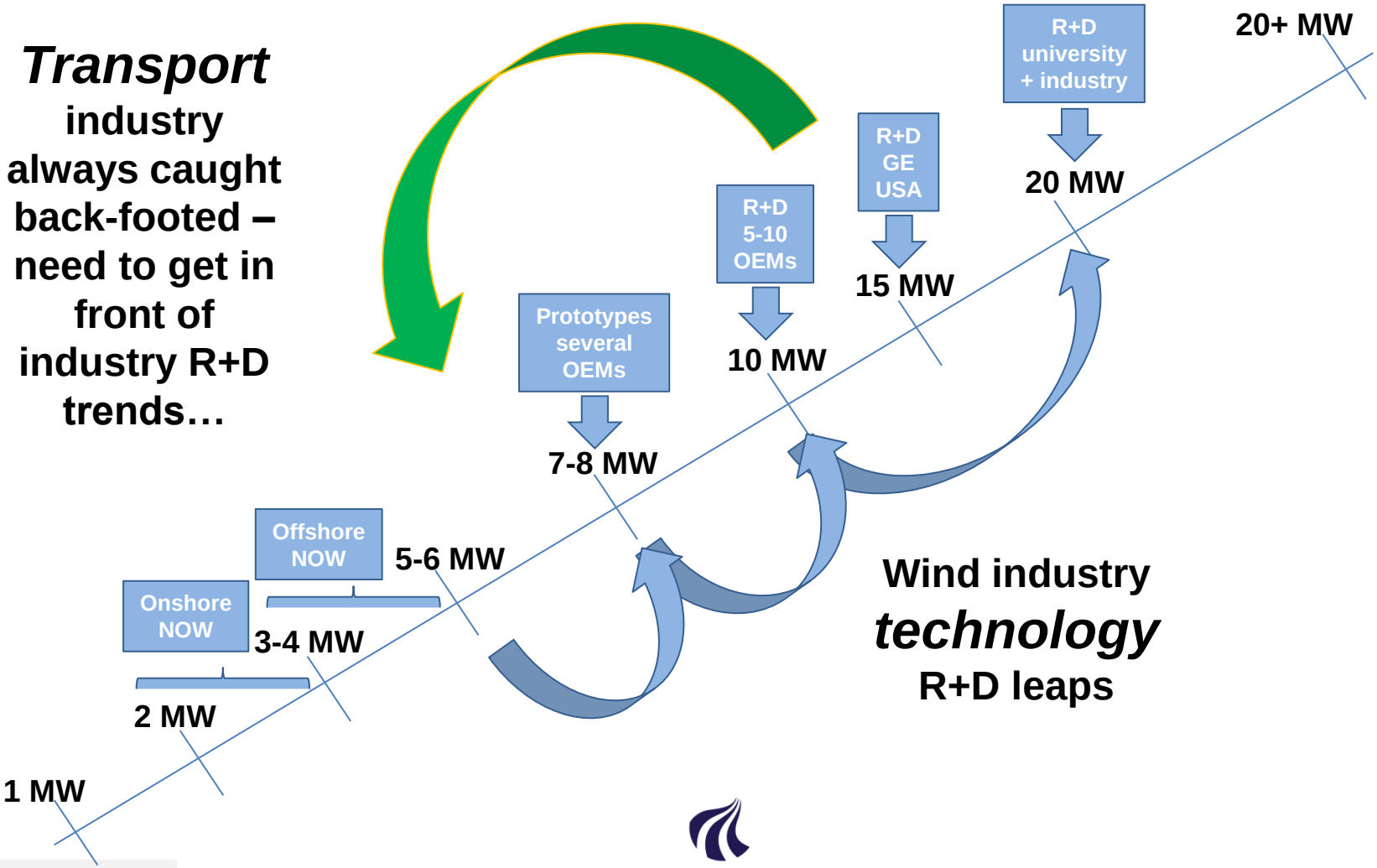
DIMENSIONS - ROAD

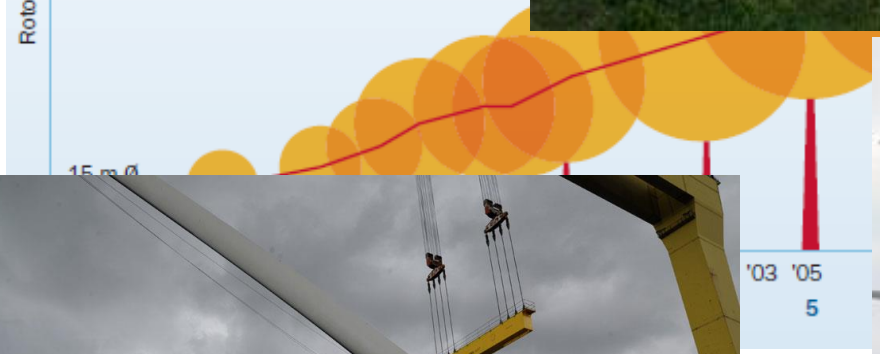
Source: Danish Shipowners' Association, courtesy Siemens Wind Power

Innovation – what comes first?

Transport
industry always caught back-footed – need to get in front of industry R+D trends…



RACE FOR LARGER WTG OUTPUT
- AND IMPORTANCE OF SHIPPING/LOGISTICS/SCM



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Source: Upwind Project (design limits and solutions for very large wind turbines) and Aalborg University Copenhagen photos

R+D - logistics

Implications on:

- **Infrastructure (roads, bridges, tunnels, viaducts, storage facilities, ports)**
- **Logistics and shipping assets (trucks, trains, vessels, helicopters)**
- **Lifting equipment (land-based cranes, sea-borne cranes)**
- **Transport equipment (lifting equipment, transport frames, seafastening)**
- **Health, safety, security, environment, and quality (HSSEQ)**

Makers of wind turbines (OEMs):

The pioneers

N·E·G MICON Powerful Simplicity

Vestas

BONUS Energy A/S

SIEMENS

GE

NASA

The "other" Europeans

ENERCON ENERGY FOR THE WORLD

NORDEX We've got the power.

ALSTOM

Gamesa

AREVA

Adwen AN AREVA GAMESA COMPANY

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Examples of the Asian "newcomers"

金风科技 GOLDWIND

SINOVEL 华锐风电

联合动力 United Power

HYUNDAI HEAVY INDUSTRIES CO.,LTD.

SAMSUNG

UNISON

SENVION wind energy solutions

SUZLON POWERING A GREENER TOMORROW

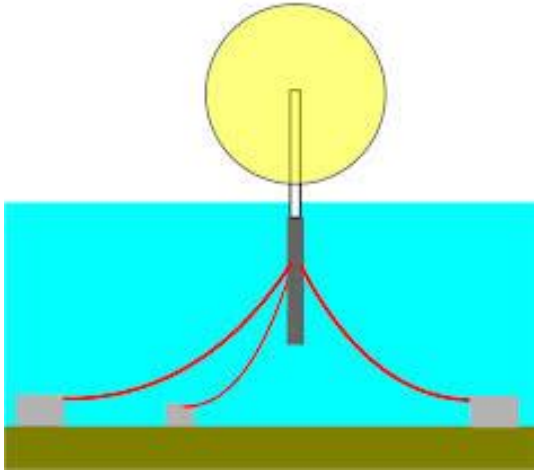
ENVISION

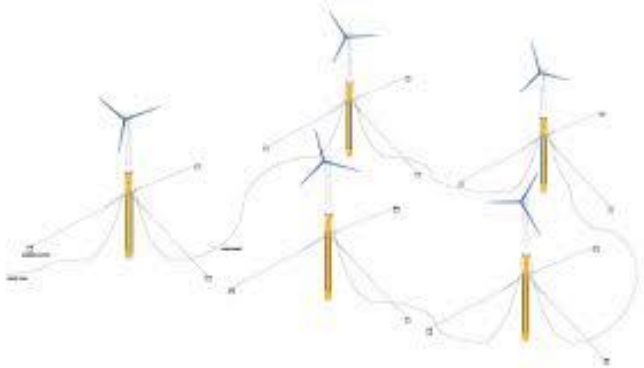
Source: AAU research, DHL Global Forwarding, Renewable Energy Solutions

And what about…?

Floating turbines…

- Installation?
- O&M?





How big is big enough?

Weight & Dimensions	Full nacelle weight (t)	Hub weight (t)	Total Hub Mass (t)	Blade Length (m)	Blade weight (t)	Tower weight (t)
Siemens 2.3 MW	82			45		
Repower 6.15 MW	325			61		
Siemens 6 (7) MW	364	96	360	75	27	
Samsung 7.5 MW				83		
Vestas 8 MW	390			80		
NREL/DTU 10 MW	446	106-180	700	86-100	42-57	628
NREL 15 MW		303	1000	125	100	1000
DTU 20 MW	1061	299		125	118	1985

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Source: AAU research, NREL, DTU Risø Wind, Siemens Wind Power, Renewable Enerergy Solutions

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RESEARCH FINDINGS

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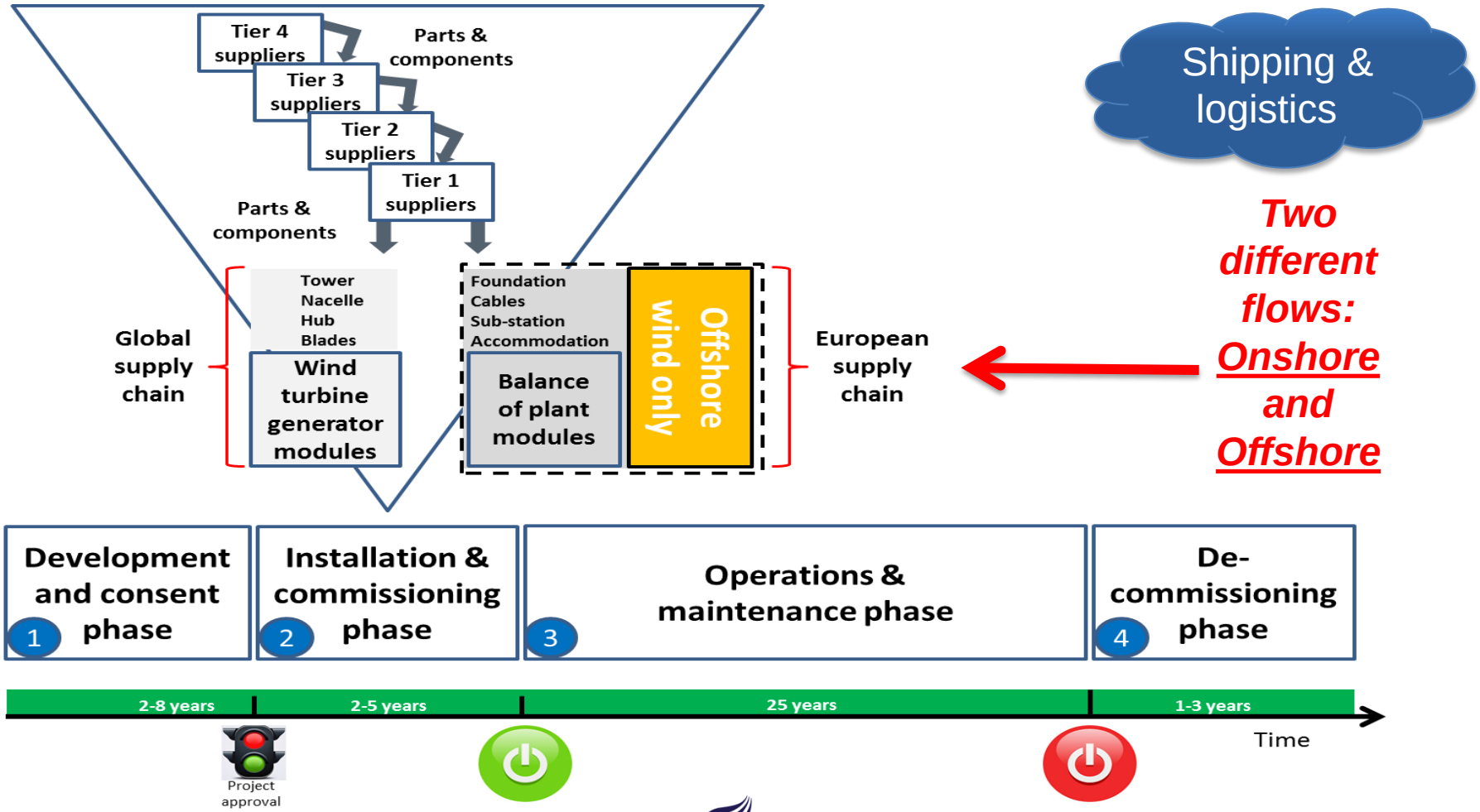
Single project life-cycle E2E



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Source: LogMS conference paper, 2013, Singapore 2013, Poulsen et.al.

Very different supply chains

Each life-cycle phase have very different characteristics

- Different supply chains
- Different logistics and shipping needs
- Different supply chain constituencies and contract set-up

Wind energy supply chains						
Wind farm phase	***Development & Consent (D&C)***	***Installation & Commissioning (I&C)***		***Operations & Maintenance (O&M)***		***De-commissioning (De-comm)***
Supply chains	D&C chain	I&C chain - Inbound	I&C chain - Outbound	O&M - Preventive	O&M - Breakdown	De-comm chain
Description	Site surveys, birds, wildlife, sea, seabed	Inbound assembly parts and components	Outbound wind modules for wind farm site	Personnel, parts, and components	Personnel, parts, components, and modules	Restoration of site for new wind farm or to original condition
Characteristics	Specialized vehicles (onshore) and vessels (offshore)	Mainly a homogenous flow using ocean containers and air; some project cargo	Project cargo/break-bulk	Mainly service boats, crew transfer vessels and some larger vessels	Service boats and helicopters, some larger vessels like MPV, tug&barge, WTIV	Project cargo/break-bulk

Source: Brand new research to be published soon. Watch this space!

CASE STUDY:
ANHOLT OFFSHORE WIND FARM

Fact box

- Operator: DONG Energy
- Ownership: DONG Energy, PKA, and PensionDanmark in JV
- Construction cost: DKK 11.5B
- Number of positions: 111 WTG's
- WTG type: 3.6 MW geared Siemens Wind Power
- Foundation type: MP/TP
- Total windfarm output: 400 MW
- Area covered: 88 km2
- Distance from installation / service port (Grenå): 15 km
- Water depth 15.5 – 18 meters

Source: DONG Energy, MTH, AAU research (meetings and site visits), EAWE conference paper, 2013 (Poulsen et.al.)

Case: O&M logistics cost reduction

Pre
Exploratory

#1
Brainstorm

#2
Ranking

#3
2 groups
Idea development

#4
2 groups
Implementation

#5
Review

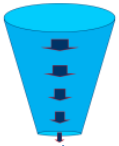
#6
Present to CRF

18 interviews
- 14 F2F
- 4 phone

= 36 ideas

8 additional ideas

Grouping:
- **Standard rules**
- **Optimize utilization of vessels**
- **Stand alone projects**
- **”Maybe”**
- **”No go”**



2 additional ideas

3 ideas selected

24/7

Lean

Concept

Business case elements

Calculations

Implementation planning

Risk analysis

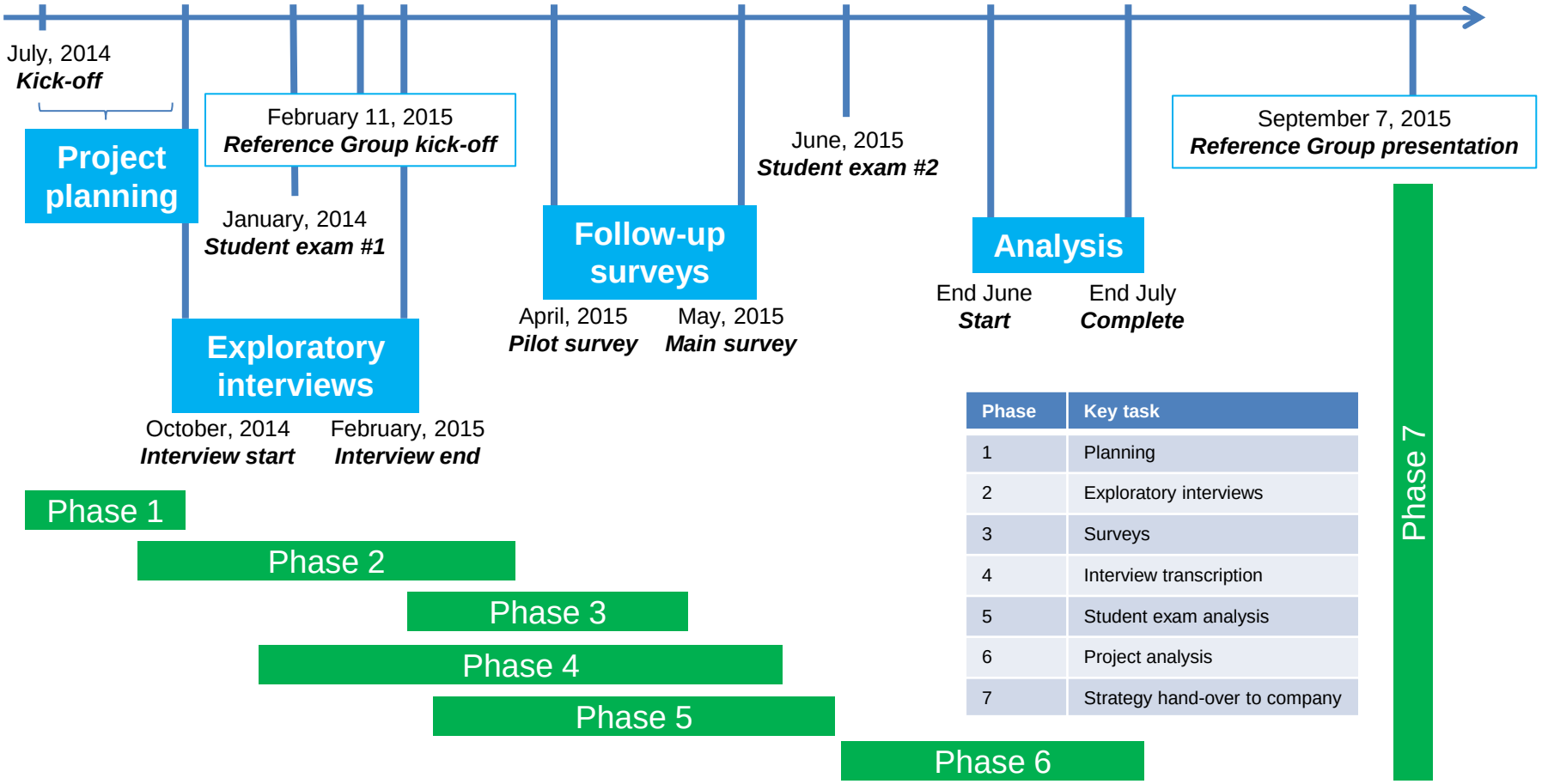
Likeliness

Business case #1

Business case #2

Phone interview

Case: Logistics innovation



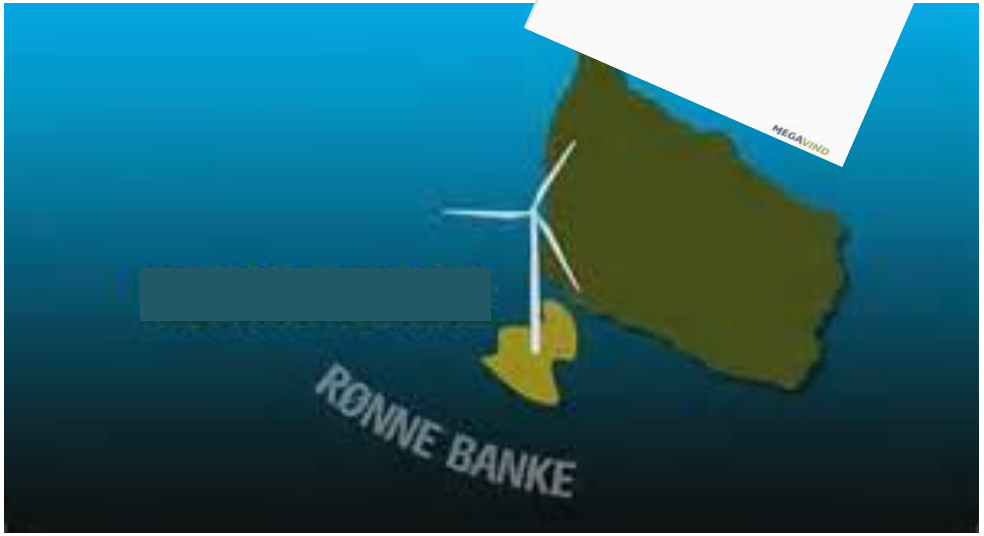
Phase	Key task
1	Planning
2	Exploratory interviews
3	Surveys
4	Interview transcription
5	Student exam analysis
6	Project analysis
7	Strategy hand-over to company

Case: Testing – logistics and shipping

1. Small scale test – DTU, Force
2. Shore turbines – Østerild
3. Other parts – LORC

Next up:

In the ocean?



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CONCLUSION

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KEY TAKE-AWAYS FROM TODAY

- Offshore wind market is growing rapidly
- Many projects in the pipeline, under construction, and already in operation
- End-to-end life-cycle view for logistics holds strong potential for cost savings
- Proactive logistics innovation is critical
- Live testing and training offshore is needed

Den Danske Maritime Fond

DDMF grant
2012-097

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Past employers

Select consulting clients

RESEARCH INTERESTS

Global wind energy shipping and logistics

BACKGROUND

25 years of global shipping, logistics, and SCM experience having lived in 8 different countries working at practical, strategic, general management, and consulting level

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