



Institut de Recerca en Energia de Catalunya  
Catalonia Institute for Energy Research



## **KIC Project NEPTUNE: Development of EOLOS floating LiDAR**

**EIT KIC InnoEnergy Ms Renewable Energy - RENE**

**RENE Innovation Seminar, February the 2nd, 2015**

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# IREC: Catalonia Institute for Energy Research Barcelona – Tarragona

## Mission

IREC was created on July 31, 2008, and began its activities in January 2009. Its mission is to become a centre of excellence and an international benchmark organization through ...

- **Development of new technological products**
- **Medium and long-term research**
- **Development of scientific and technological know-how**

**... in the field of energy.**



# IREC: Catalonia Institute for Energy Research

## Barcelona - Tarragona

### GOVERNING BODY

- Catalan Ministry of Enterprise and Labour
- Catalan Ministry of Economy and Knowledge
- Spanish Ministry of Economy and Competitiveness (CIEMAT)
- Spanish Ministry of Industry, Energy and Tourism (IDAE)
- University of Barcelona (UB)
- Technical University of Catalonia (UPC)
- Rovira i Virgili University in Tarragona (URV)
- ENDESA
- GAS NATURAL FENOSA
- Fundación REPSOL
- ENAGÁS
- Compañía Logística de Hidrocarburos CLH
- ALSTOM Wind



# KIC InnoEnergy



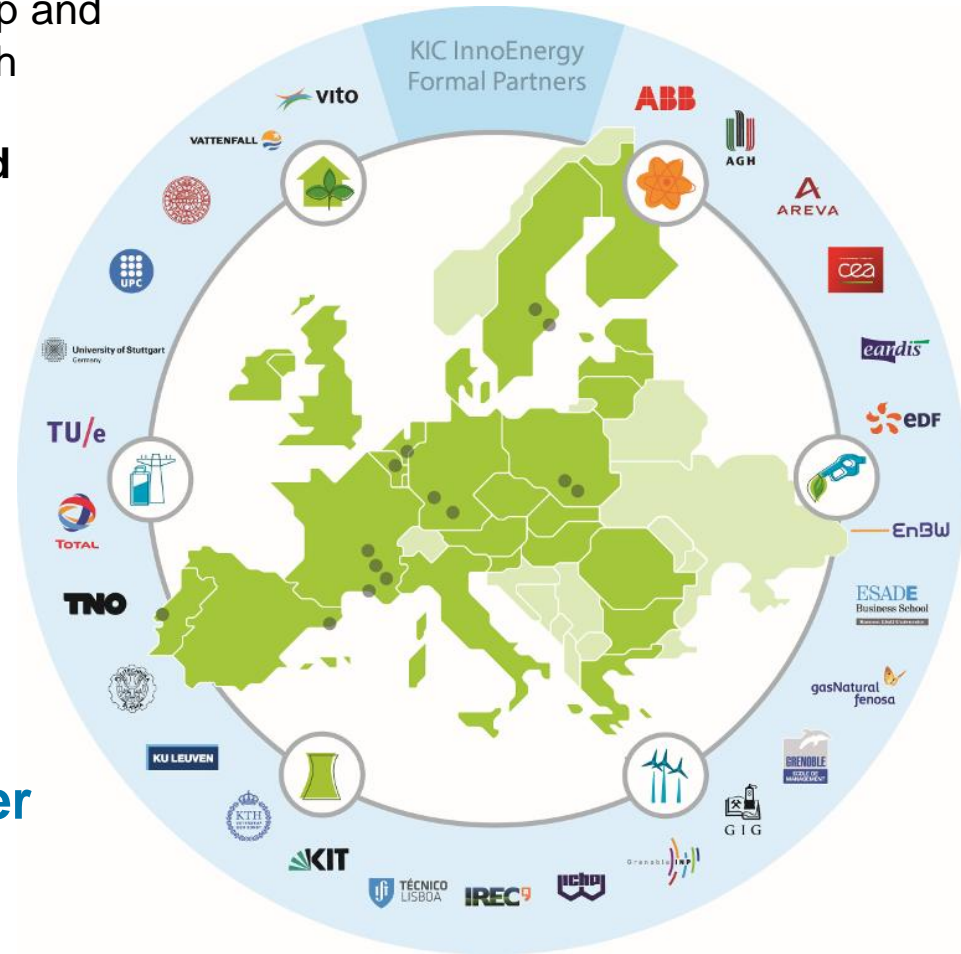
## KIC InnoEnergy

A European company fostering the integration of education, technology, business and entrepreneurship and strengthening the culture of innovation with the strategic objective of becoming the **leading engine of innovation in the field of sustainable energy.**

## Iberia Office

In charge of managing KIC InnoEnergy activities in Spain and Portugal, as well as **the thematic field Renewable Energy** at a global level. Activities comprise innovation, business creation and education initiatives in the field of sustainable energy

**IREC is full and founding partner**



# NEPTUNE Project

## Mission

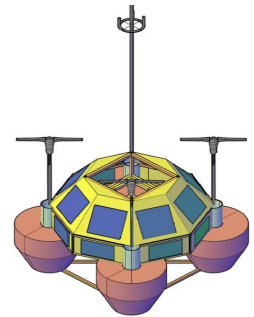
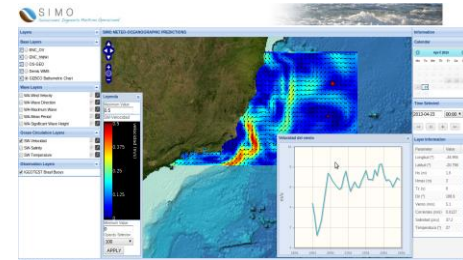
The NEPTUNE project develops equipment and tools to plan and operate better and overall reduce costs in wind farms



# Neptune

## Products

- NEPTOOL: a hindcast and forecast model for wind, wave and sea currents measurements for offshore wind farms. Will be exploited by SIMO
- EOLOS buoy: a Floating LiDAR Device (FLD) able to measure wind, waves and sea currents. Will be exploited by a **recently created Spin-off**



## Partners



Laboratori d'Enginyeria Marítima  
UNIVERSITAT POLITÈCNICA DE CATALUNYA





# NEPTUNE Project

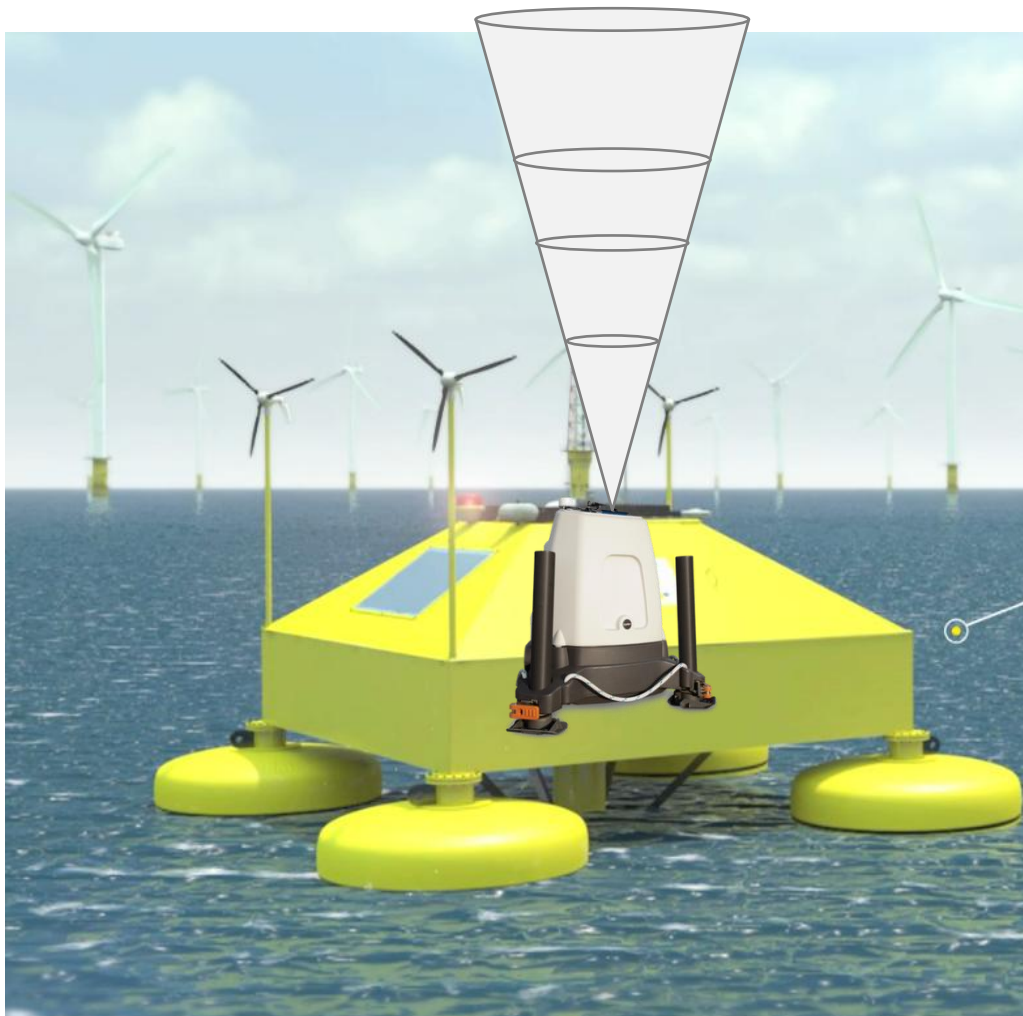
## Motivation

- ✓ Offshore wind farm investments need reliable wind assessments to estimate the wind power production at the site.
- ✓ Performing wind assessments with no high quality on-site data increases the uncertainty, hindering the project's bankability and increasing the financial risks of the project.
- ✓ Currently, Offshore wind developers use expensive bottom fixed meteorological masts, that can cost up to 10M€ and take various years to deploy due to environmental and permit restrictions.



**Market need**

# EOLOS Floating LiDAR System



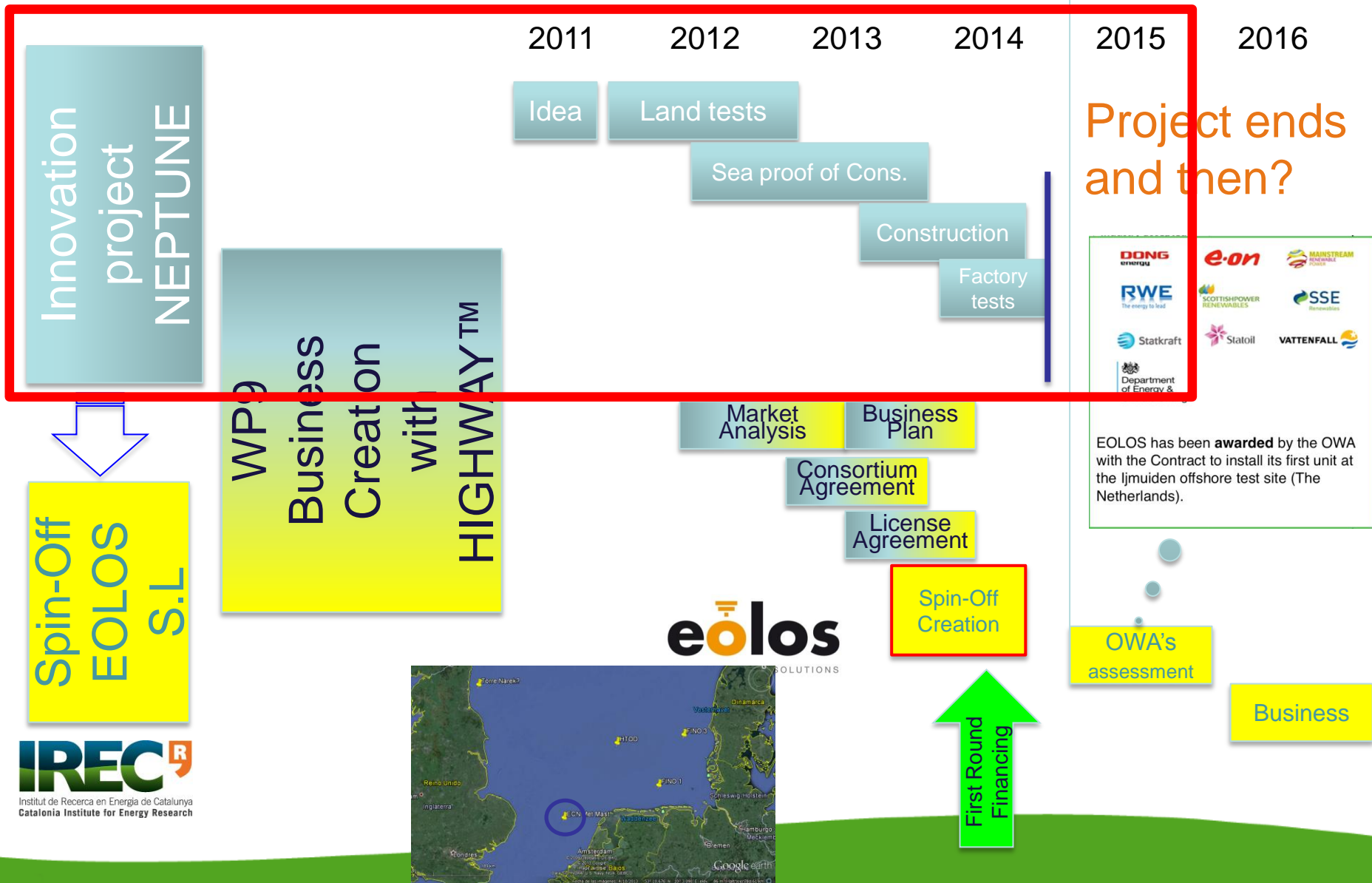
- ✓ Energy autonomous
- ✓ Wind measurements up to 200m
- ✓ Wave measurements
- ✓ Sea current measurements
- ✓ Easy transportable
- ✓ Suitable for harsh conditions  
Water depth > 15m\*

\*No braking waves



# NEPTUNE

## From innovation project to Business



# Test Roadmap for EOLOS

## Development phases:

### 1. Test Campaign I:

- LIM motion simulation platform, UPC – Barcelona

### 2. Proof-of-concept development:

- To test in limited offshore conditions, UPC – Barcelona

### 3. Test Campaign II:

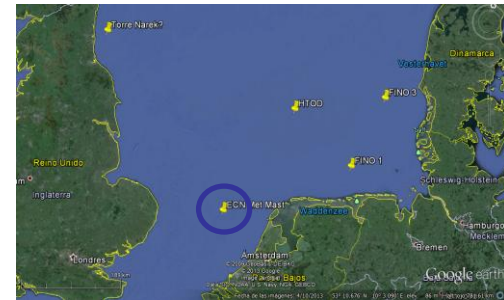
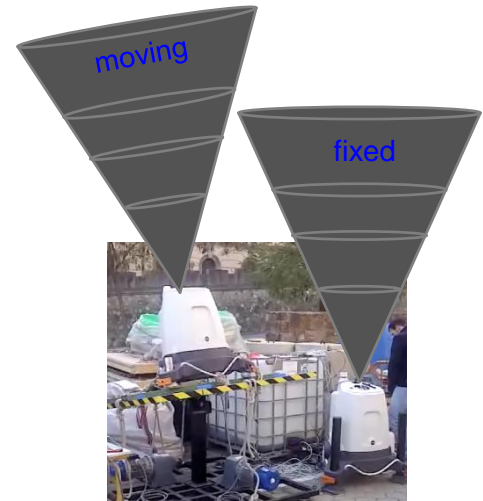
- Floating Lidar Proof-Of-Concept vs. fixed Lidar in LIM test station, Pont del Petroli – Badalona, May 2013

### 4. Prototype development:

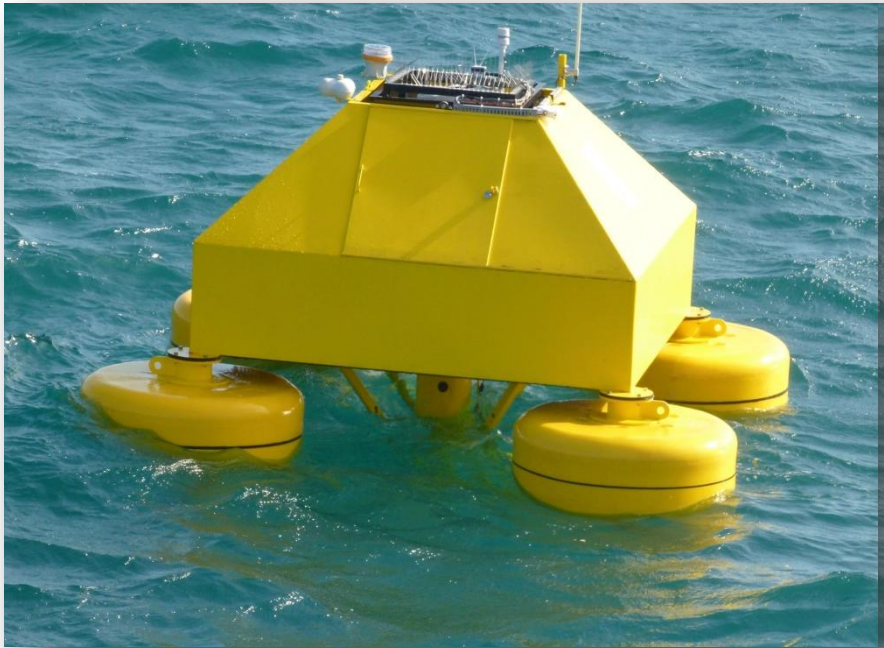
- To test in real offshore conditions
- Commercial suitability

### 5. Test III First Unit Assessment Campaign:

- Long term measurements against offshore metmast
- External consultant assessment



# Proof-Of-Concept Tests: The buoy



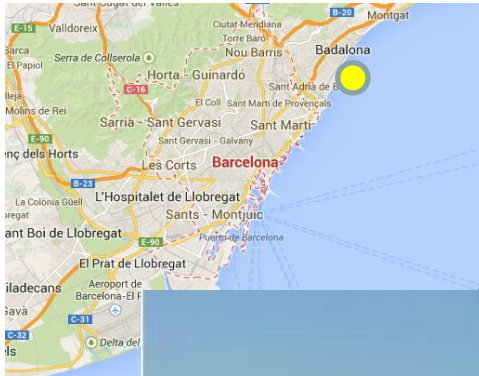
## Proof-of-concept characteristics

- ✓ Only temporary for tests in Mediterranean Sea
- ✓ Energy from a cable
- ✓ Wind speed measurements up to 200m
- ✓ Turtle design of the EOLOS

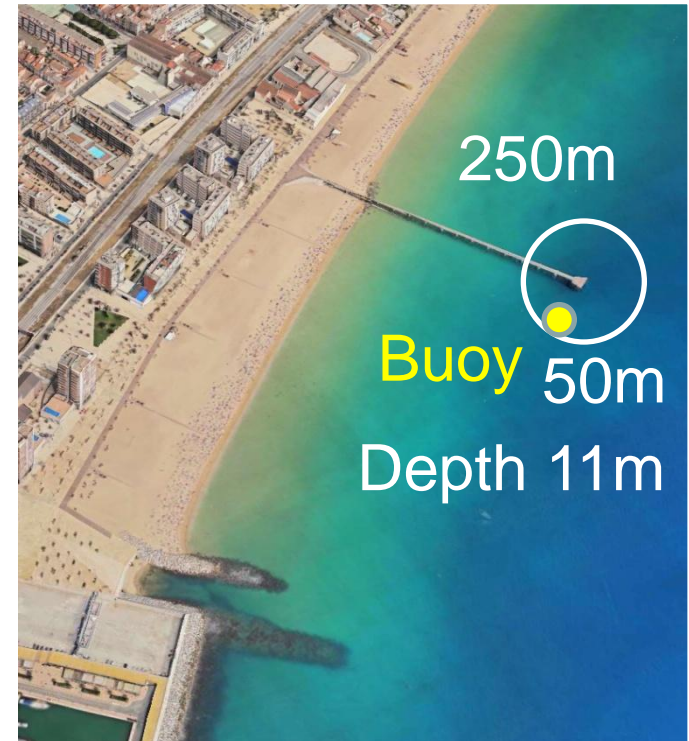
# Proof-Of-Concept Tests: The site

## 2. Test Campaign II:

- Floating Lidar vs. fixed Lidar in LIM test station, Pont del Petroli – Badalona, May 2013



Pont del Petroli - Badalona

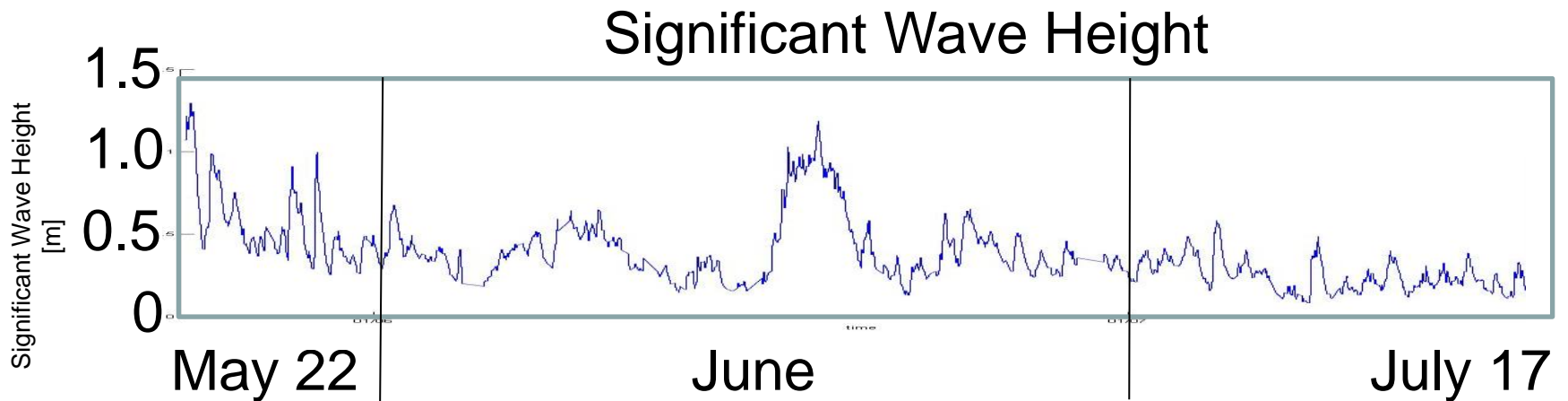
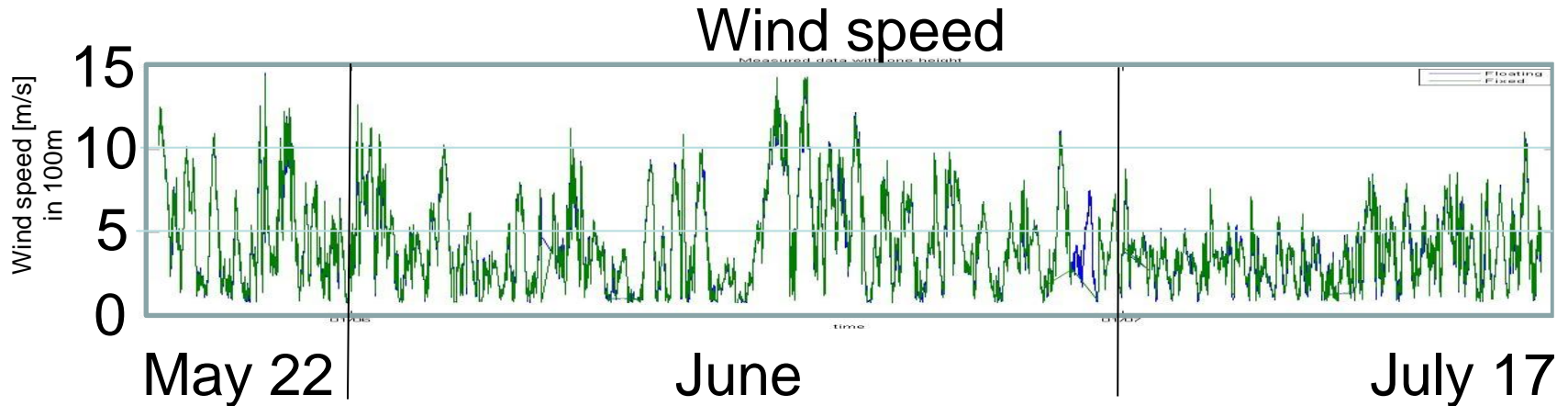




# Proof-Of-Concept Tests: Set-up



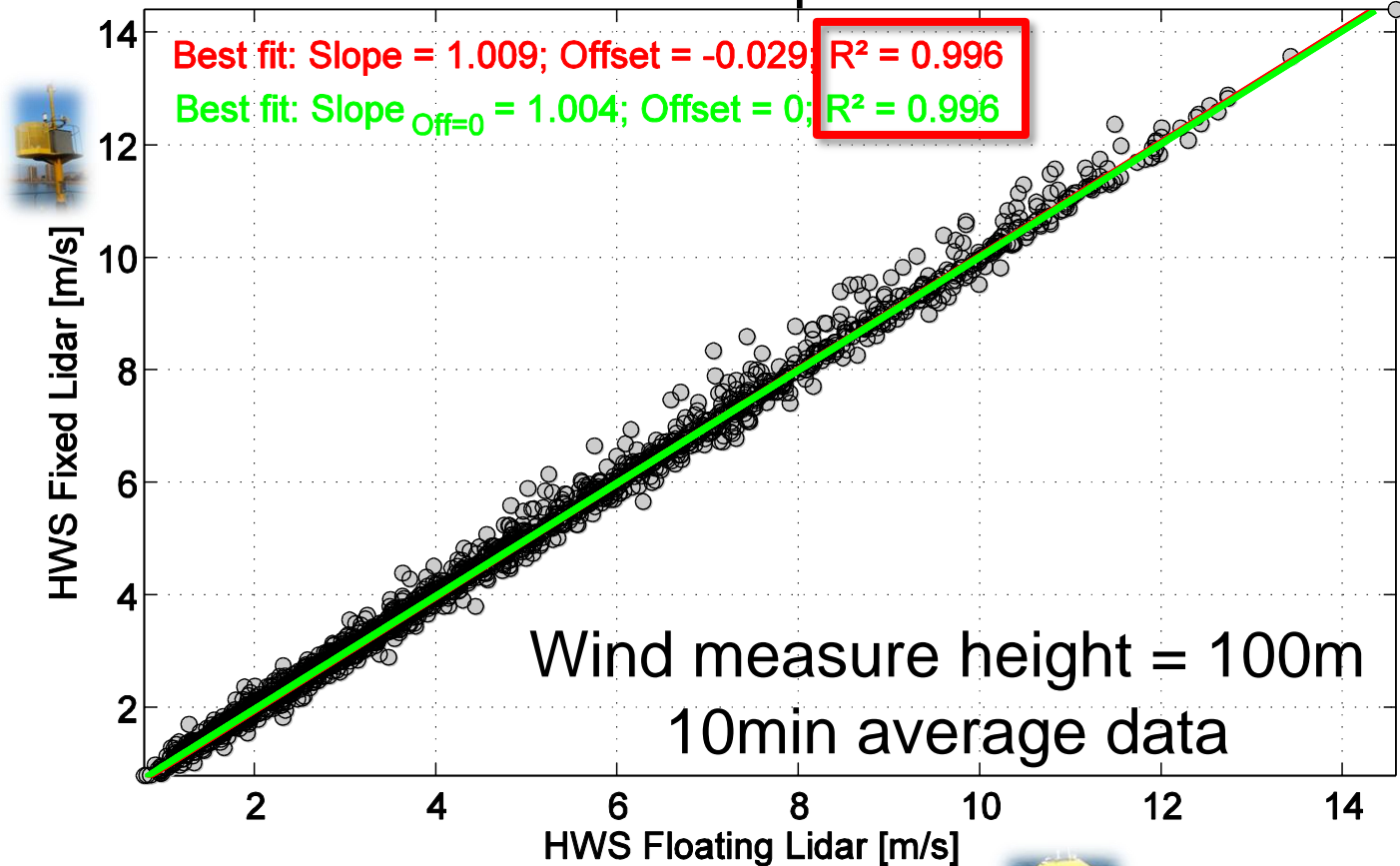
# Proof-Of-Concept Tests: Site Conditions





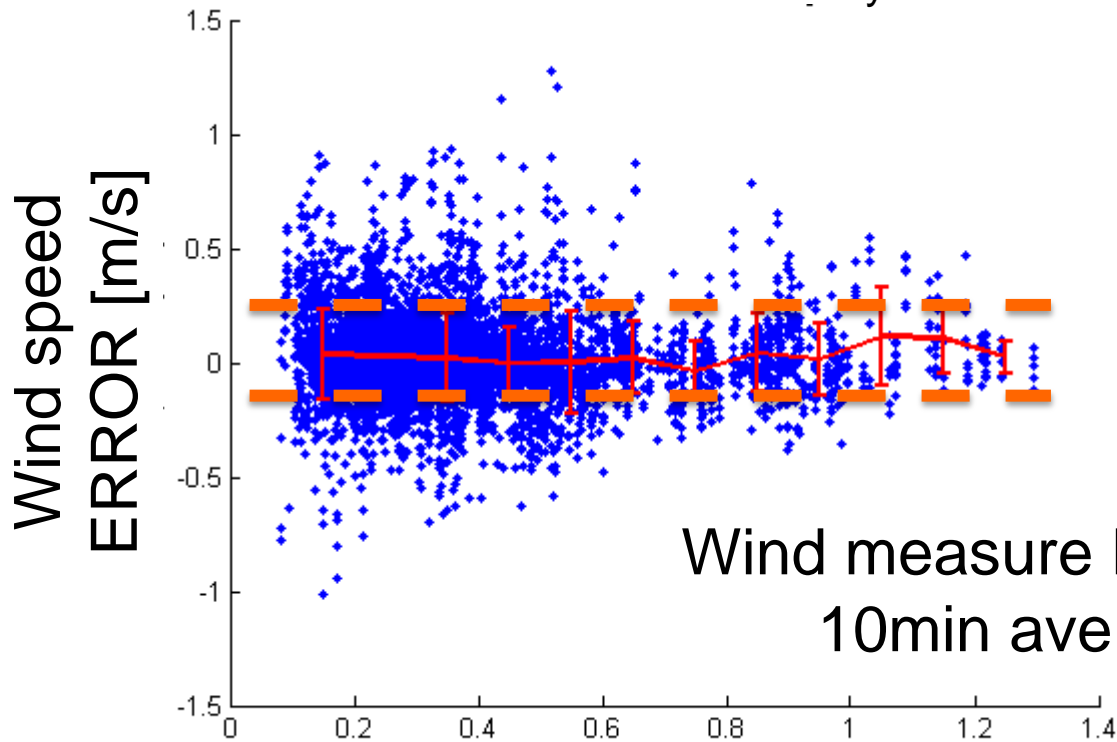
# Proof-Of-Concept Tests: Correlation

## Horizontal wind speed scatter plot



# Proof-Of-Concept Tests: Error vs. Wave Height

$$\text{Windspeed error} = V_{\text{buoyLiDAR}} - V_{\text{fixed LiDAR}} \text{ [m/s]}$$

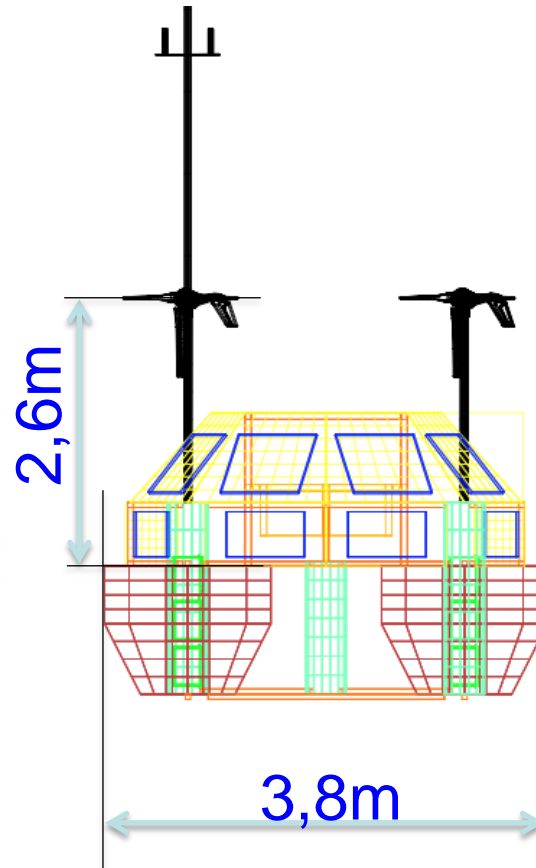
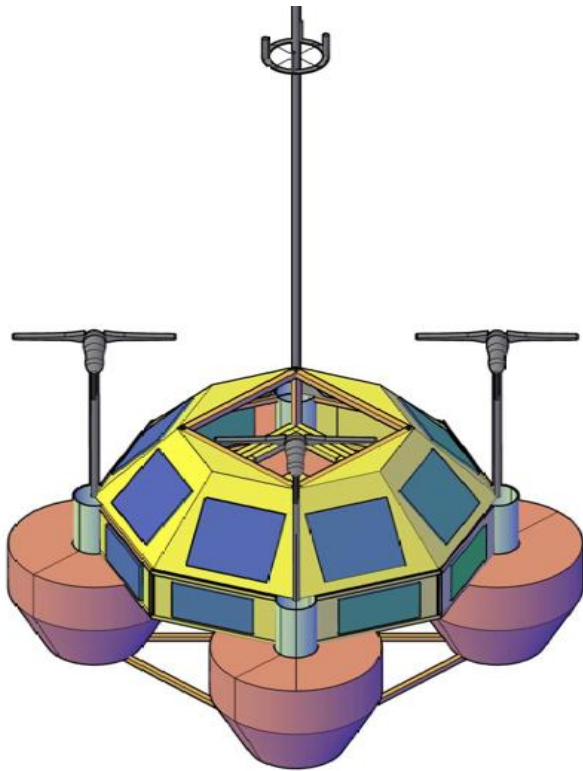


Significant Wave height  $H_s$  [m]



# EOLOS Final Prototype Concept

Ready to deploy



- ✓ Mass = 3 tn
- ✓ Battery autonomy >60h
- ✓ Power generation > consumption
- ✓ Design waves:  $H_{\max}=17\text{m}$
- ✓ Data transmission via radio modem or satellite
- ✓ Configurable from land
- ✓ Data storage on board
- ✓ Wave and current measurements
- ✓ Wind vane for optimal buoy orientation

# Offshore Meteomast Ijmuiden (NL)



## Role of ECN:

- Instrumentation and maintenance
- Measurements and validation
- Publication of data on website

## Met mast and sensors:

- 3 heights: 25, 57, 87m
- Sensors: Wind speed & direction, air pressure, temperature, rel. humidity.
- Daily transfer to ECN through satellite connection

## Lidar validation:

- wind speed & direction at 10 levels between 90m and 315m

## Campaign:

- 4 years, started Nov. 2011
- Buoy for sea current and wave data

## Results:

- Database available online
- Availability of signals in 2012: mast 96%, Lidar 94% , buoy 97%

## Location:

- North Sea, 75 km West of the coast of Ijmuiden, water depth 28m



# OWA Roadmap

The prototype measurements will be evaluated with the KPI from the:

Carbon Trust Offshore Wind Accelerator roadmap for the commercial acceptance of floating LIDAR technology



CTC819 Version 1.0, 21 November 2013



# OWA Roadmap

## Intro

### Target

Provide the steps necessary for the commercially acceptance of floating LiDARs within the wind industry.

3 main phases of product development are presented:

PHASE	REQUIREMENTS	USES	UNCERTAINTY
Baseline	LiDAR wide-spread accepted	Complement Fixed Met mast	Depends on assessment with met mast
Pre-Commercial	Pilot Validation and KPI compliance	Stand alone or with Met Mast	4-7%
Commercial	More trails and commercial deployments	Stand alone or with Met Mast	2-4%

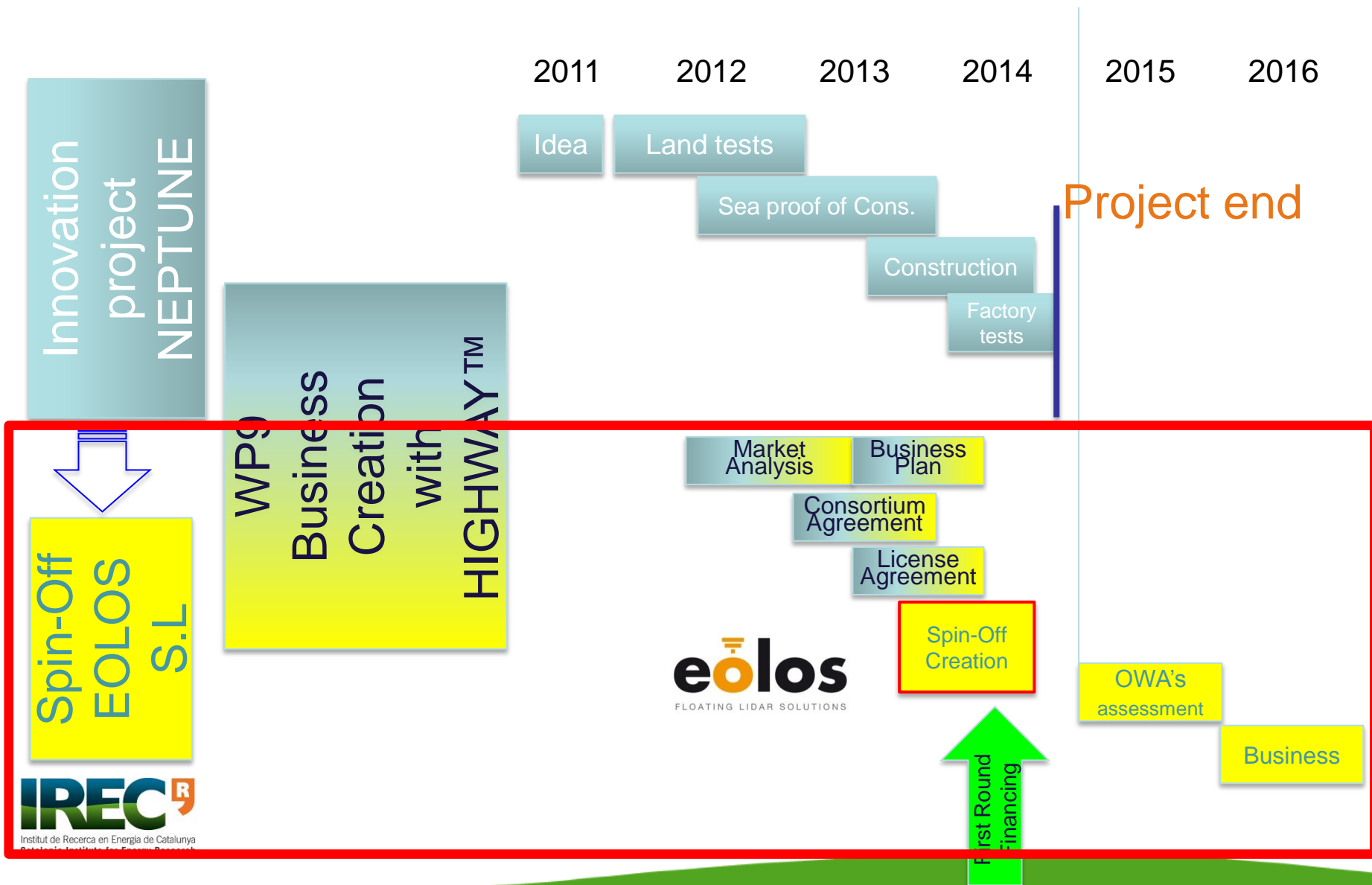


# OWA Roadmap

## KPI Evaluation

CONCEPT	PARAMETER	KPI
System Availability	Monthly	> 90%
	Overall	> 95%
Horizontal Wind Speed	R <sup>2</sup>	> 0.98
	Slope	0.98 - 1.02
Wind Direction	R <sup>2</sup>	> 0.97
	Slope	0.97 – 1.03
	Offset	< 5 °

# From innovation project to Business



# Market analysis: Positioning of EOLOS



# Conclusions and Outlook

## Target

Options on how to exploit the foreground of the project

Business for NEPTUNE LIDAR BUOY EOLOS				
1		Constitute NEPTUNE Company to commercialize Lidar Buoy	Invest in NEPTUNE company	Major Shareholder
				Minor Shareholder
			No investment	
2		Technology Transfer	Willing to invest seed capital to find buyer	<i>(include quantity)</i>
			Not willing to invest	
3		Commercialize internally the service - include in company's portfolio		
4		Do nothing		

# Business Model

## EOLOS will directly offer:

- ✓ Sale of its EOLOS Buoy
- ✓ Rental services of its EOLOS Buoys for periods of minimum 6 months.
- ✓ Operation of EOLOS Buoy and data gathering

## EOLOS will offer through partnerships and agreements

- ✓ Maritime operations: installation, maintenance and decommissioning of the Buoy.
- ✓ Data analysis services: forecasts services, wind resource assessments.
- ✓ Complementary services: power curve calculations, wake calculations, etc.

# Conclusion

## Project NEPTUNE

- ✓ Great opportunity that merges knowledge of partners from different environments
- ✓ Product development that suits the needs of the market
- ✓ Successful business creation history

## Greatest challenges

- ✓ Technical
- ✓ Commercial
- ✓ Management





BOLK SPECIAAL TRANSPORT







# THANK YOU FOR YOUR ATTENTION

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