

# ECN Wind Energy ..... & Racing Aeolus

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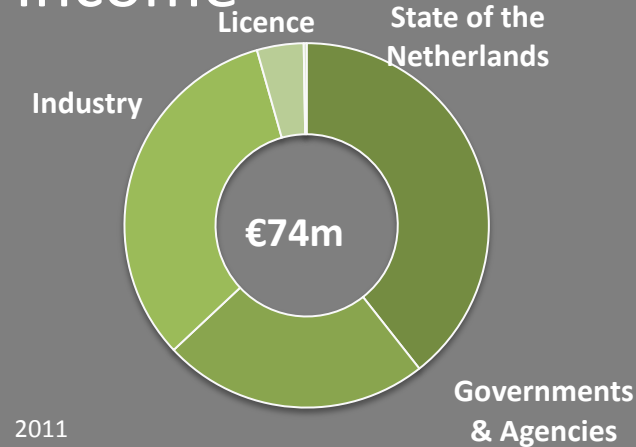
MCN meeting – Den Helder  
20-08-2014

# ECN at a glance

## Mission

With and for the market, we develop knowledge and technology that enable a transition to a sustainable energy system.

## Income



~600  
staff

20  
patents/yr

5  
licences/yr

## History

**1955** Opens as  
Reactor Centre for the  
Netherlands

**1975** Wind  
Energy and Coal  
Programmes

**1985** Fuel Cell  
programme starts

**1990** Solar Energy  
& Environmental  
research programmes  
start

**1994** Biomass  
research programme  
starts

**1998** Energy  
Efficiency in the  
Industry programme  
starts

**2000** Intelligent  
Energy Grids  
Programme starts

**2012** New  
Strategy & Focused  
activities



# Locations

 **ECN  
Petten**  
(head office)

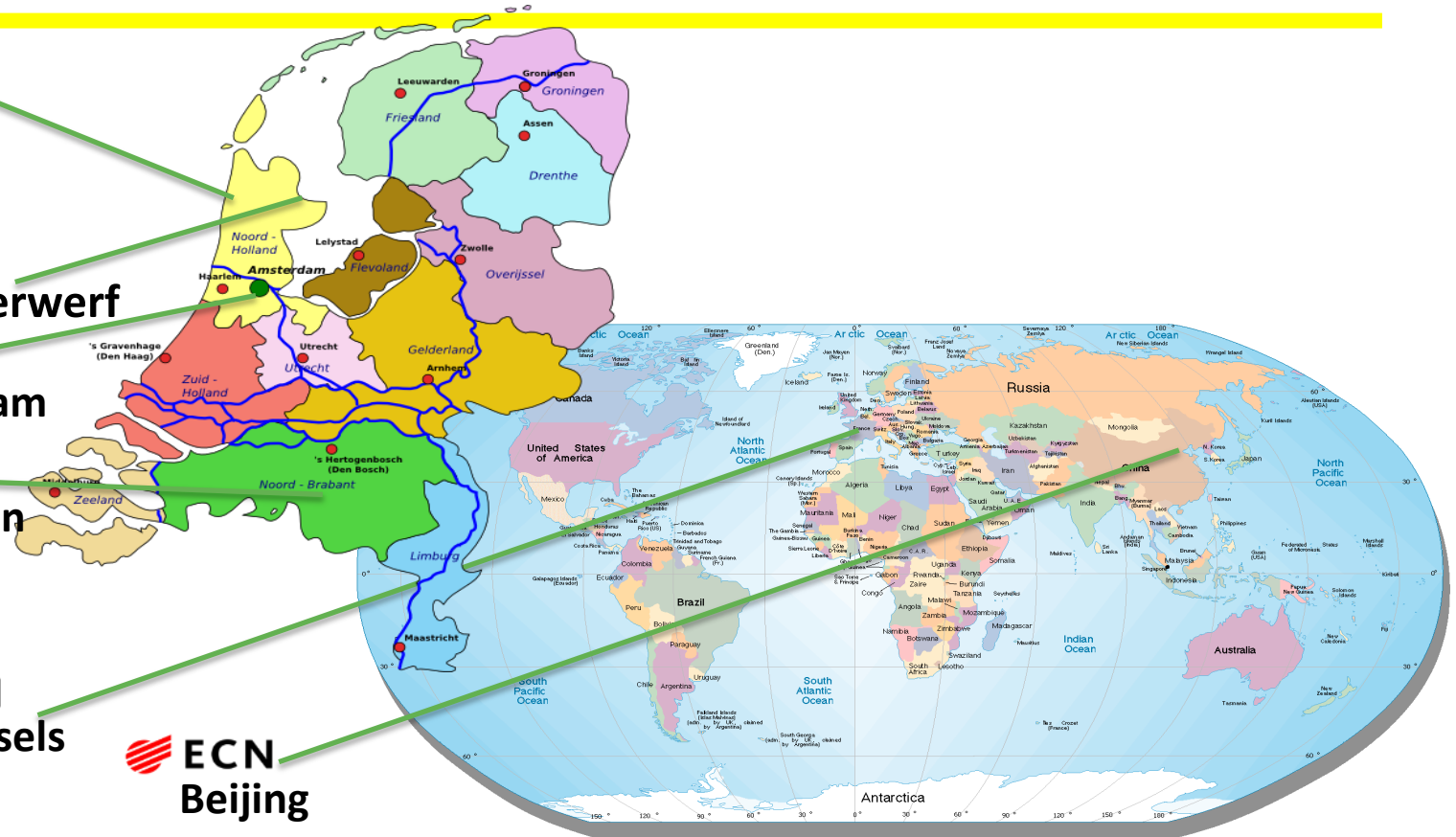
 **ECN  
Wieringerwerf**

 **ECN  
Amsterdam**

 **ECN  
Eindhoven**

 **ECN  
Brussels**

 **ECN  
Beijing**



# What do we do?

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ECN Wind applies world class knowledge, skills and facilities in order to:

- ✓ lower the cost of wind energy
- ✓ increase profitability and efficiency for our customers
- ✓ accelerate new technologies to the market

ECN's customers include manufacturers, project developers, owners and operators, investors, and governments/NGO's.

# Facilities in the Netherlands

Head Office  
in Petten



Offshore parks  
& metmasts



Blade & material  
testing



Test Site EWTW  
Up to 7.5MW



5 x R&D turbines    Scaled wind farm  
5 x Prototypes



# Planned ECN testing facilities

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ECN offshore foundation  
test site  
Operational early 2015?

ECN HQ Petten  
Wind turbines < 1MW

ECN offshore  
wind test site  
Operational mid 2016?

ECN EWTG  
Wind turbines up to 7.5  
MW, first 2 turbine by  
2014, +10 by 2015

ECN EWTW  
Wind turbines up to 7.5  
MW



# ECN Turbine Test site



## EWTW

(ECN Wind Turbine Test site Wieringermeer)

### ECN research turbines

Power: Nordex 2.5MW

Type: Variable speed, pitch

Rotor diameter: 80m

Hub Height: 80m

### 6 Prototypes

Confidential



### Measurement masts

4 x 108m

1 x 100m

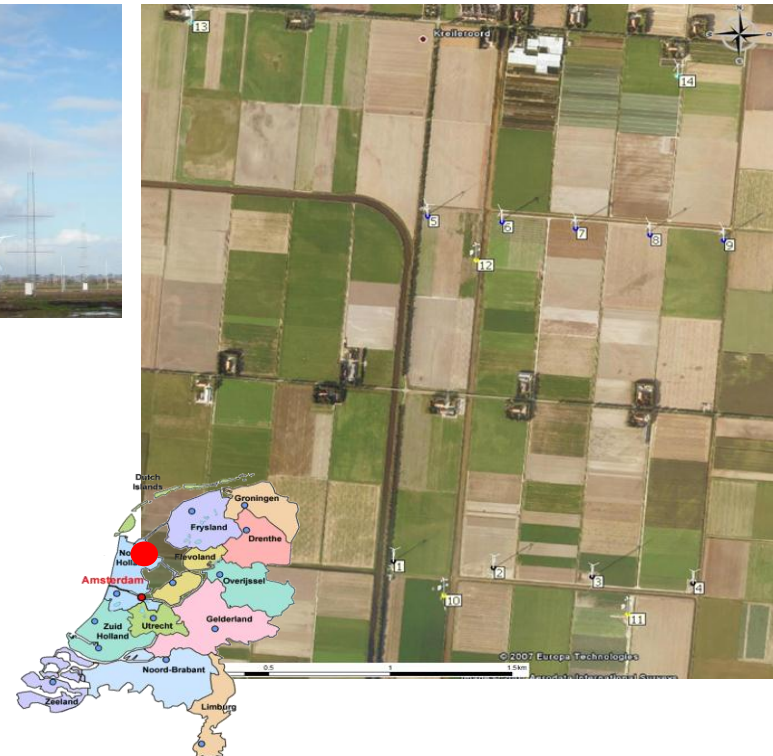
Extensive measurement infrastructure

### Scaled Wind Farm

10, 10kW turbines

7 m rotor diameter

11 metmasts to investigate wake effects





# Offshore wind



# Why Offshore wind? → Some challenges

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- Offshore harsh environment
  - Wind Conditions – (extreme)
  - Wave Conditions
  - Salt water environment
- Limited accessibility for
  - Installation
  - Maintenance and Repair



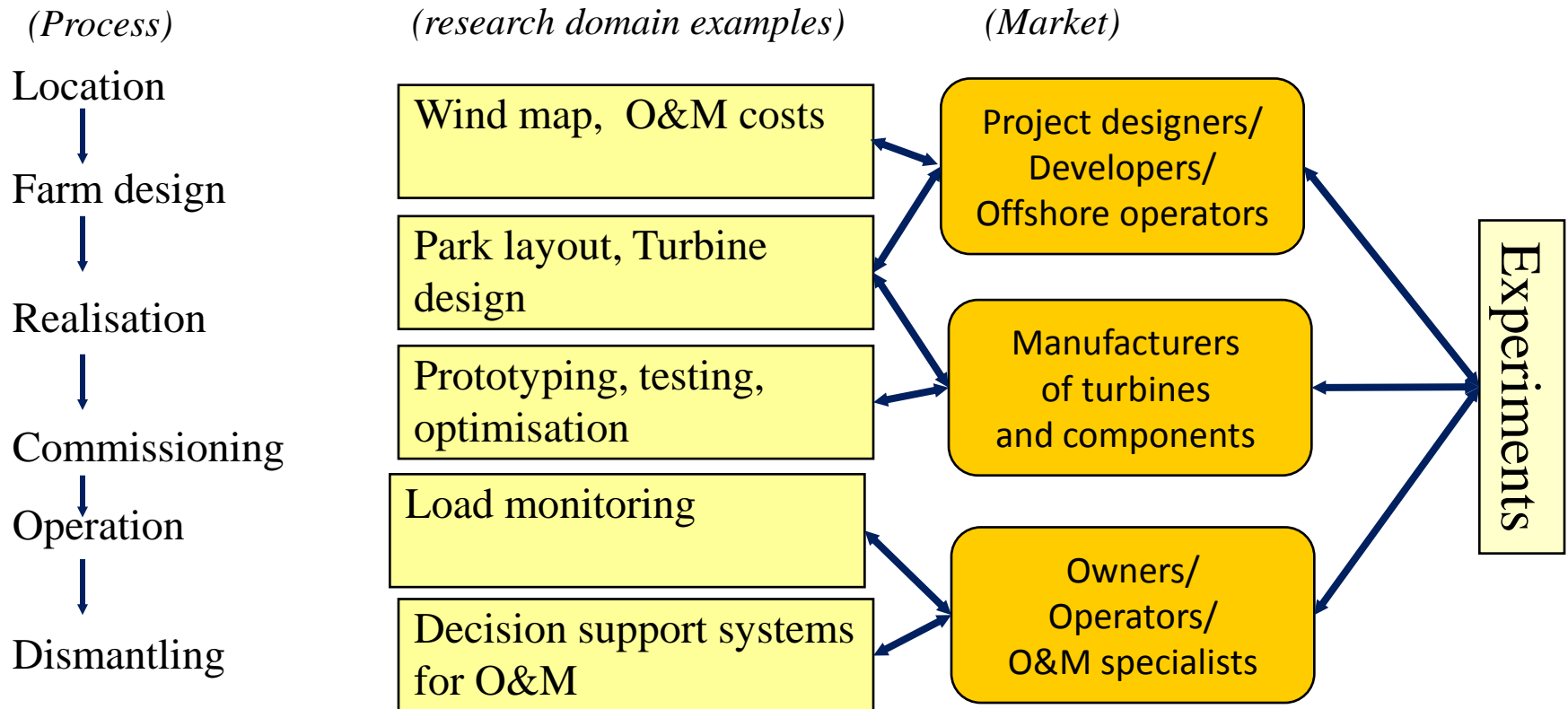
## **Necessity for:**

- (1) Robust and cost effective Wind Turbine Design
- (2) Smart Wind Farm design, installation and maintenance planning
- (3) Validated designs with tests and experiments.

# ECN Wind in offshore to date

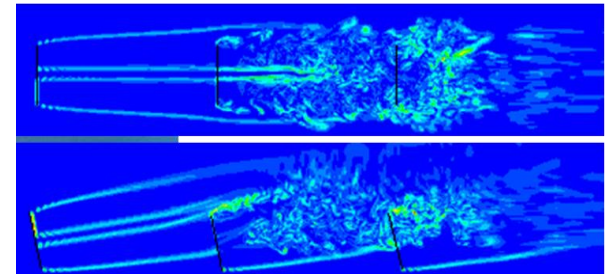
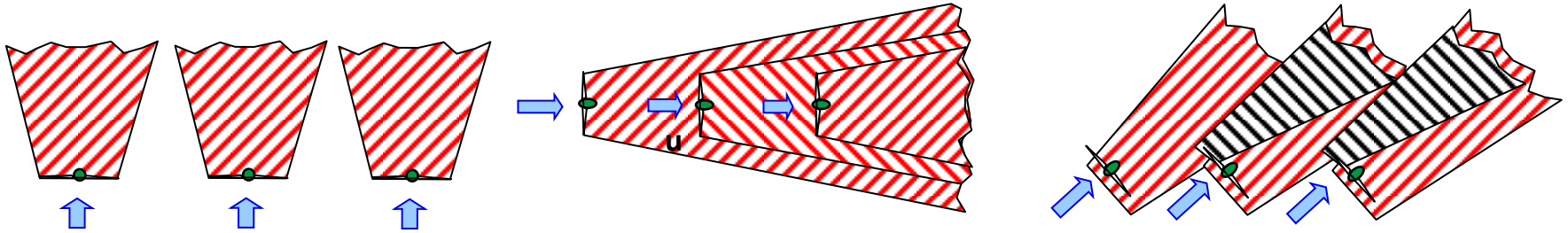
Project Name	Year	Capacity (MW)	Country	ECN	Other	ECN	Other	ECN	Other	ECN	Other
North Hoyle	2003	60	UK		Siemens						
Arklow Bank	2004	25	UK	Grontmij	Grontmij	Fu.Delft	Mammoet van Doord	Grontmij	ECOFYS	Grontmij	
Scroby Sands	2004	60	UK		Siemens						
Kentish Flats	2005	90	UK		Siemens						
OWEZ	2006	108	UK	ECOFYS	Robert Niekens	Fu.Delft	herotel	Siemens	Siemens	Siemens	
Barrow	2006	90	UK		Siemens						
Lillgrund	2007	110	Sweden	Grontmij	Grontmij	Siemens	ABB	Siemens	Vestas	Siemens	
Burbo Bank	2007	90	UK		Siemens		Mammoet van Doord	Siemens		Siemens	
Prinses Amalia	2008	120	UK	Fu.Delft	ECOFYS	Siemens	Mammoet van Doord	Siemens	Eneco	Siemens	
Inner Dowsing	2009	97	UK		Siemens		herotel	Siemens	Siemens	Siemens	
Lynn	2009	97	UK		Siemens		Mammoet van Doord	Siemens	Siemens	Siemens	
Rhyl Flats	2009	90	UK		Siemens		Robert Niekens	Siemens			
Horns Rev II	2009	209	Denmark				Siemens	Siemens			
Robin Rigg	2009	180	UK		Siemens		Siemens	Siemens			
Gunfleet Sands	2009	173	UK	ECOFYS	Siemens		Siemens	Siemens	ECOFYS		
Alpha Ventus	2010	60	UK	Grontmij	Grontmij	Fu.Delft	ABB	Siemens	Siemens		
Belwind I	2010	165	Belgium	Grontmij	Grontmij		herotel	Siemens	Siemens		
Rødsand II	2010	207	Denmark	Grontmij	Grontmij		Siemens	Siemens			
BARD 1	2010	400	Denmark				Damen	Siemens			
Thanet	2010	300	UK		Siemens		Siemens	Siemens			
Walney I	2010	184	UK	Grontmij	ABB		Siemens	Siemens	P&G&B		
Greater Gabbard	2010	504	UK		Siemens		Siemens	Siemens	SEA-IP		
EnBW Baltic I	2010	630	Germany	Robert Niekens	Robert Niekens		ABB	Siemens		Grontmij	
Ormonde	2011	150	UK			Fu.Delft		Siemens			
Sheringham Shoal	2011	317	UK	ECOFYS	Siemens		Siemens	Damen	ECOFYS		
Walney II	2011	184	UK		Siemens		Robert Niekens	Siemens	P&G&B		
London Array	2011	185	UK	Grontmij	Siemens		Siemens	Siemens	SEA-IP		
Thornton Bank II	2012	48	Belgium		Siemens	Fu.Delft		Siemens	SEA-IP		
Anholt	2013	111	Denmark		Siemens		Siemens	Siemens	SEA-IP		
Thornton Bank III	2013	400	Belgium		Siemens	Fu.Delft		Siemens	SEA-IP		
Lincs	2013	270	UK		Siemens			Siemens	SEA-IP		
Borkum West II	2014	200	Germany	herotel	Grontmij			Siemens	SEA-IP	Atos	

# Core focus area: Reducing Cost of Energy



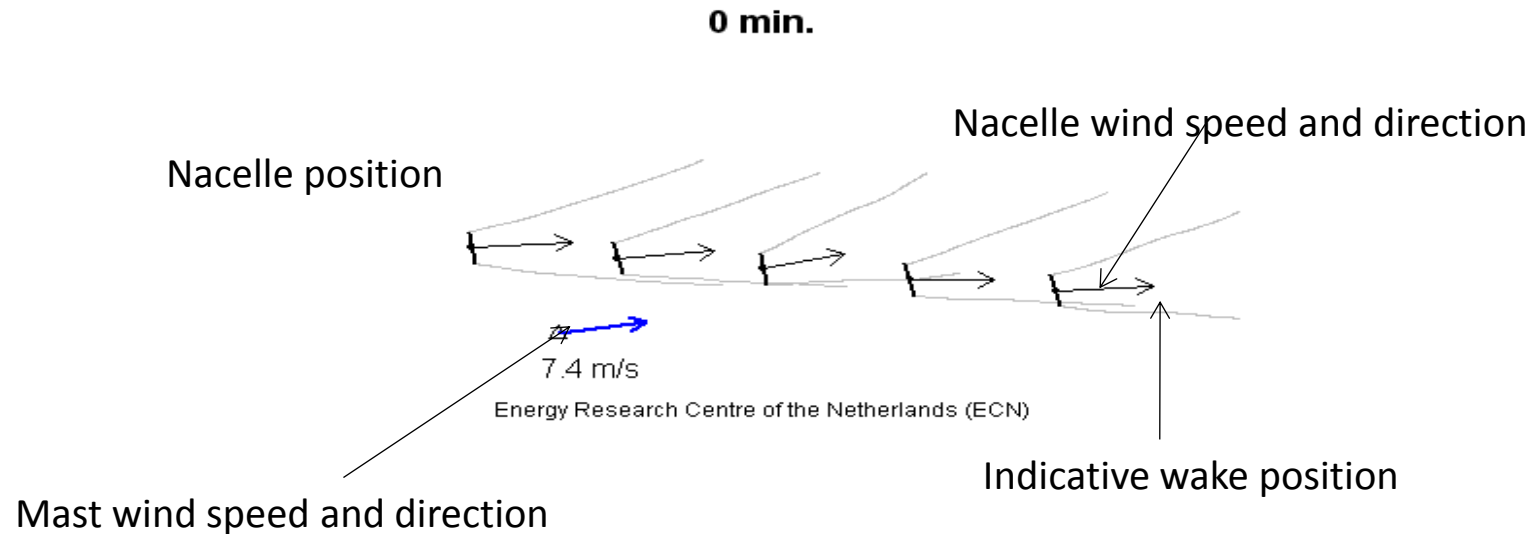
# Example

Wind farm Control- Increasing park efficiency  
by 0.5 to 5%



# Meandering measured at EWTW

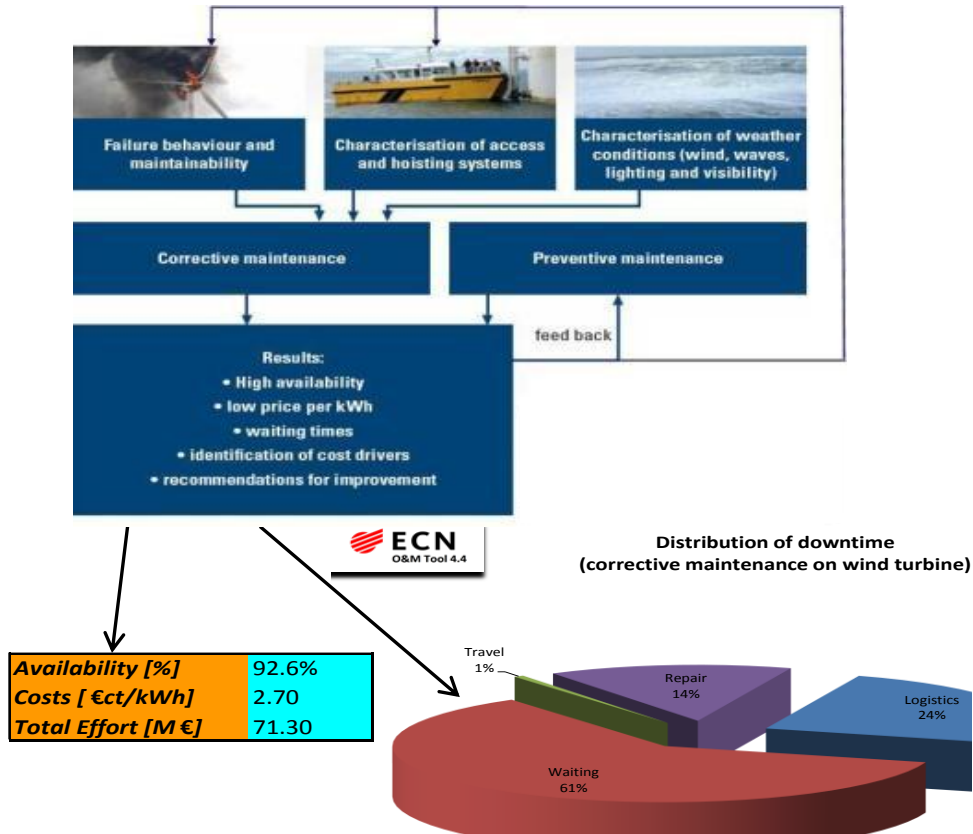
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- Meandering effects mainly of relevance for loads
- Energy production is generally averaged over the wind directions which filters out meandering effects

# Example

## Offshore wind farm O&M strategy



- Determine the most cost effective O&M strategy during:
  - Planning
  - Operation
- Industry leading tool
- Only OM tool validated by GL

# Example

## Measurements (accelerating technologies)

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- Accredited for: Noise, Power Performance, Mechanical Loads, and Meteo
- **Onshore and offshore**
- Floating Lidar
- Prototype development and certification
- Own test facility for prototypes with good infrastructure





# Example

## Floating wind turbine design

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- Semi-Submersible
- Special mooring 50 to 100m depts, conventional system for > 100m
- No active ballasting needed
- No braces: easy fabrication & no fatigue sensitive details with limited access
- Stable when afloat: installation with tugs on pre-laid mooring system
- Specific design can be adapted to site conditions and usage: meteorology mast, substation etc.



# Some of the ECN Wind Energy Customer References & Partners



## Operators & Windfarm developers



## Turbine Industry & design



## R&D / Education



# Students and .....

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# MMIJ - Facilities

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- Location MMIJ
- MMIJ - Meteomast measurements
- MMIJ – LiDAR measurements
- MMIJ – Buoy measurements

# MMIJ - Location

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# Meteomast IJmuiden

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# MMIJ – LiDAR system

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# MMIJ – TriAxys buoy

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