



# Offshore TIMES

Analysis and optimization of O&M concepts for offshore wind farms

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# Operation and Maintenance - Motivation

Degradation

Structural Health Monitoring SHM

Bearings

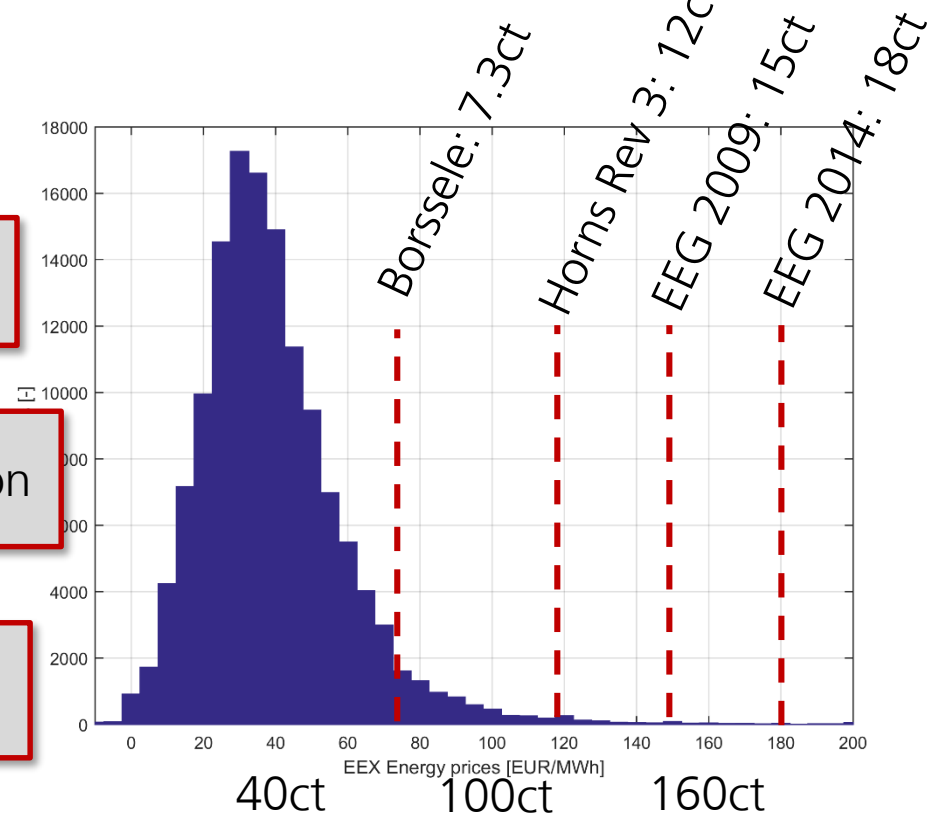
Control methods

Loads and load prediction

Route optimization

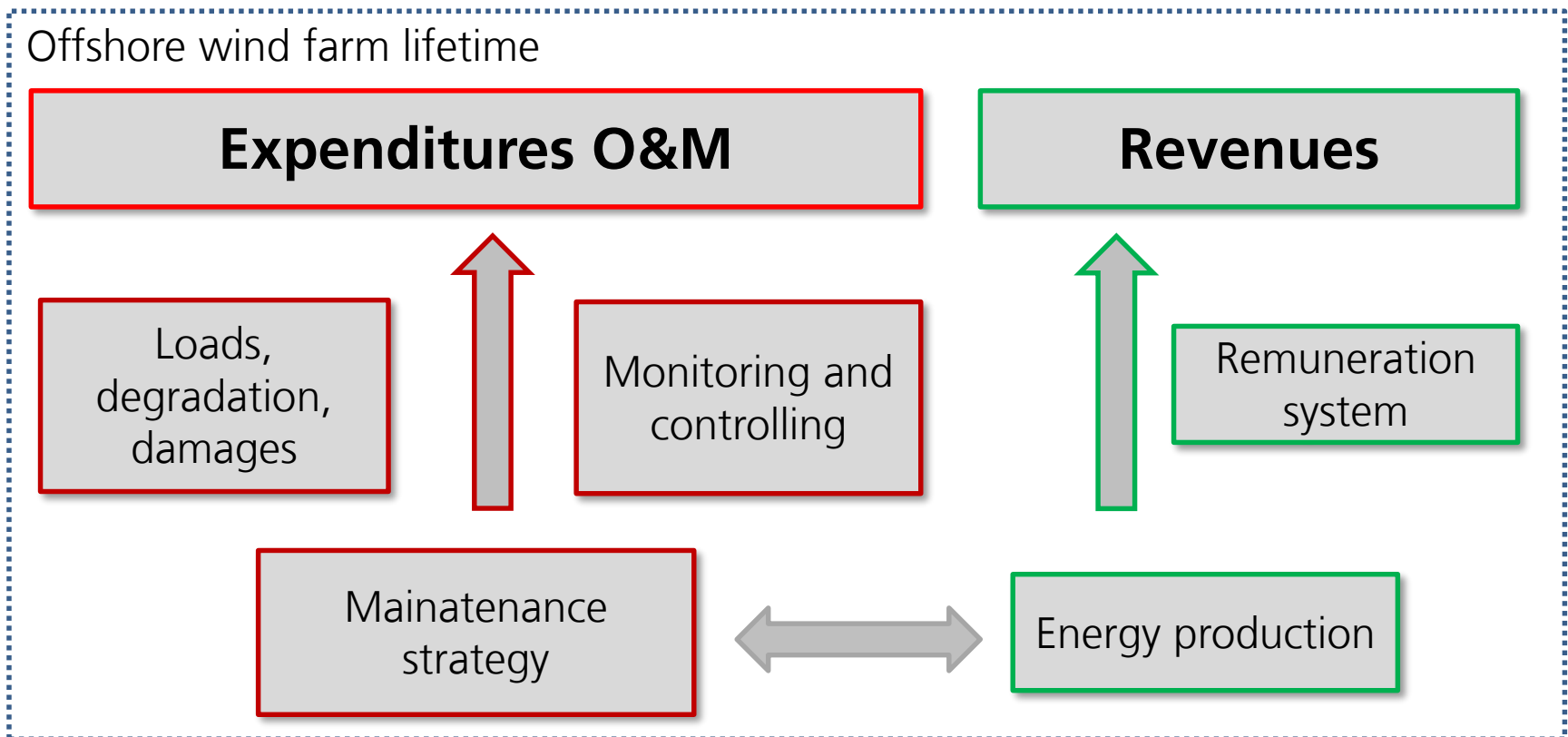
Vessels and technologies

European Energy Exchange - EEX



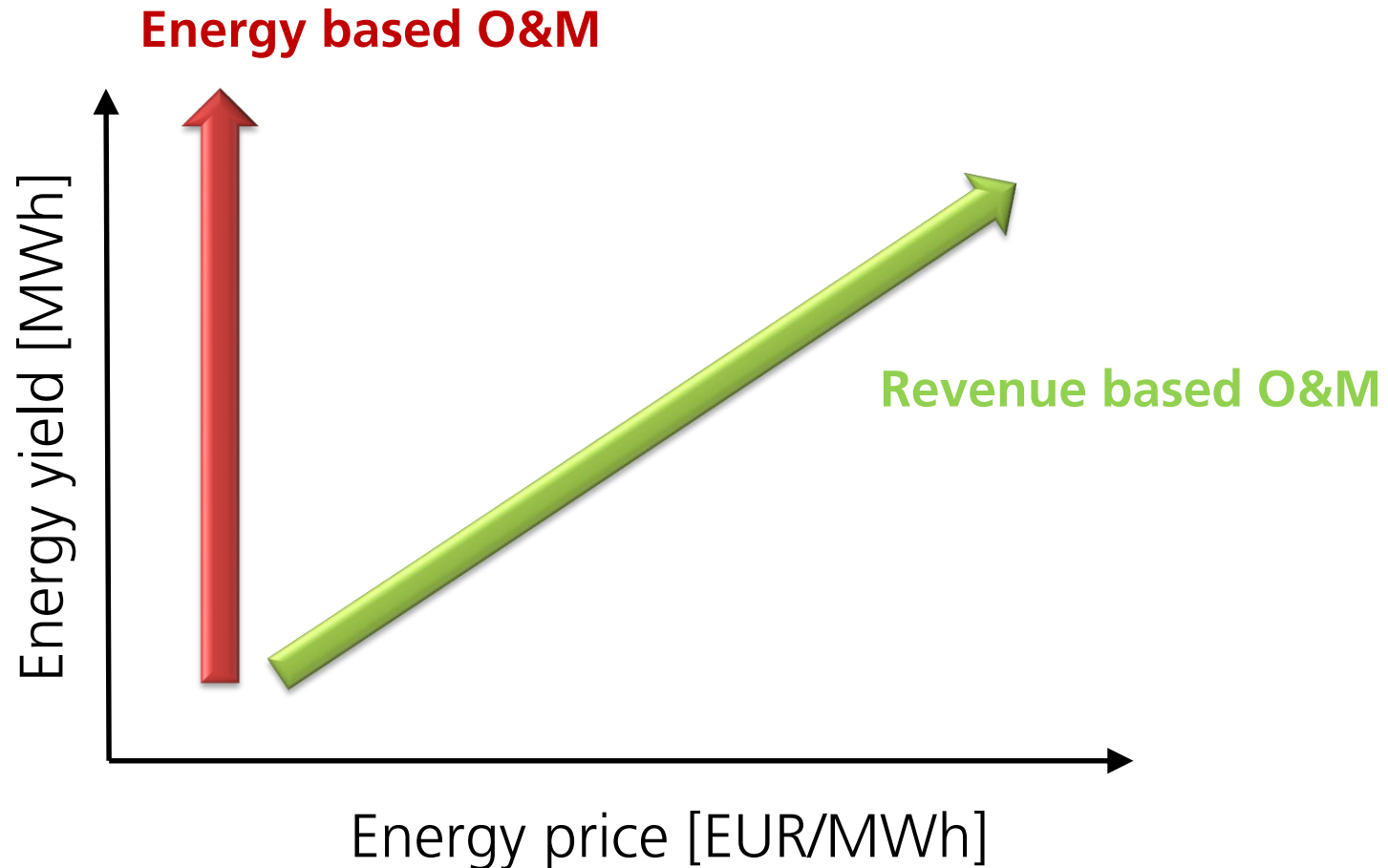
„... we can [not] operate a zero-subsidy wind farm using methods that were adequate for a 100€/MWh“ Clym Stock-Williams

# Operation and Maintenance - Motivation



„... we can [not] operate a zero-subsidy wind farm using methods that were adequate for a 100€/MWh“ Clym Stock-Williams

# Operation and Maintenance - Motivation



# Approach – requirements for O&M assessment

## We require a tool that considers

- **Environmental conditions**, like sea states
- **Resources**, vessels, staff and other tools
- **O&M strategies**, like predictive or corrective maintenance
- **Reliability models** for WT and BoP
- **Wind farms** and **clusters**, flexible and extendible
- **Energy production** and **remuneration**

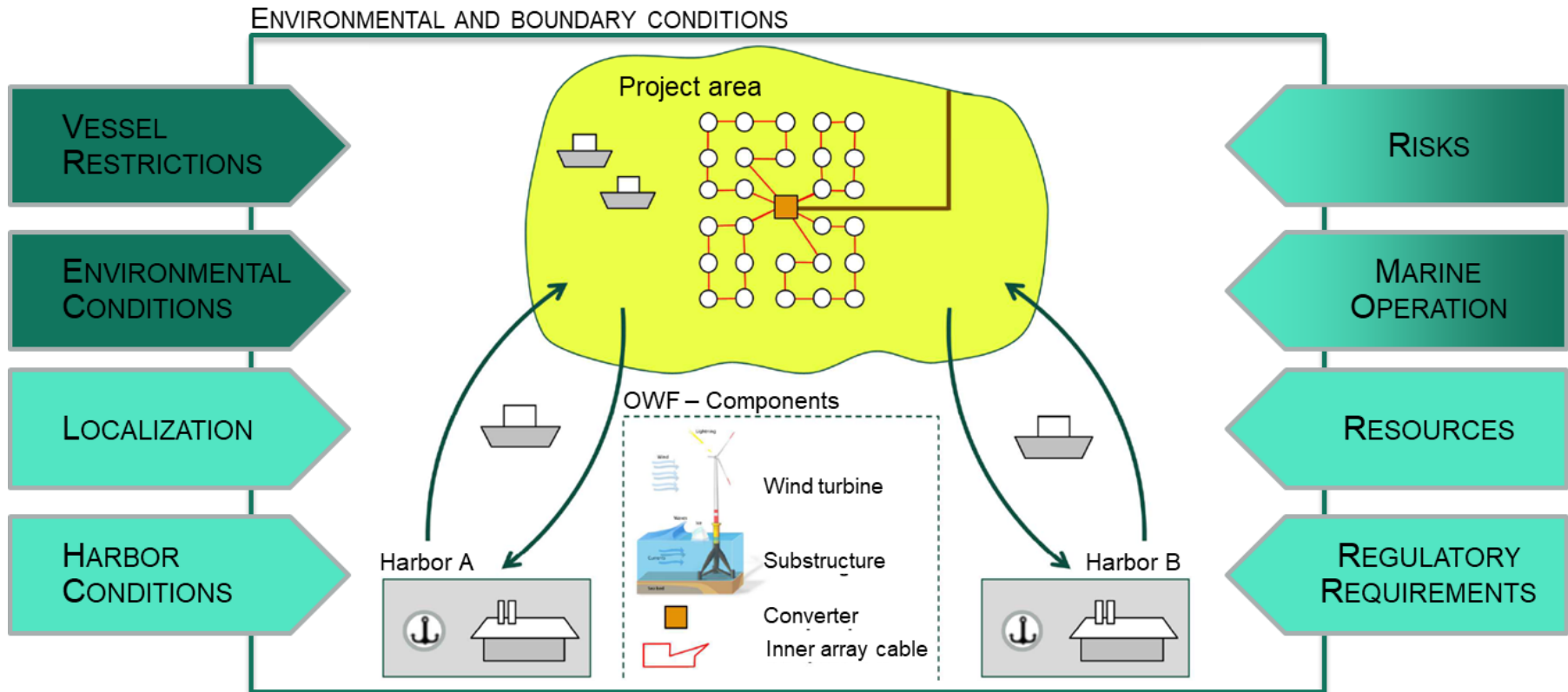
=> **Offshore TIMES -**

Transport, Inspection and Maintenance Software

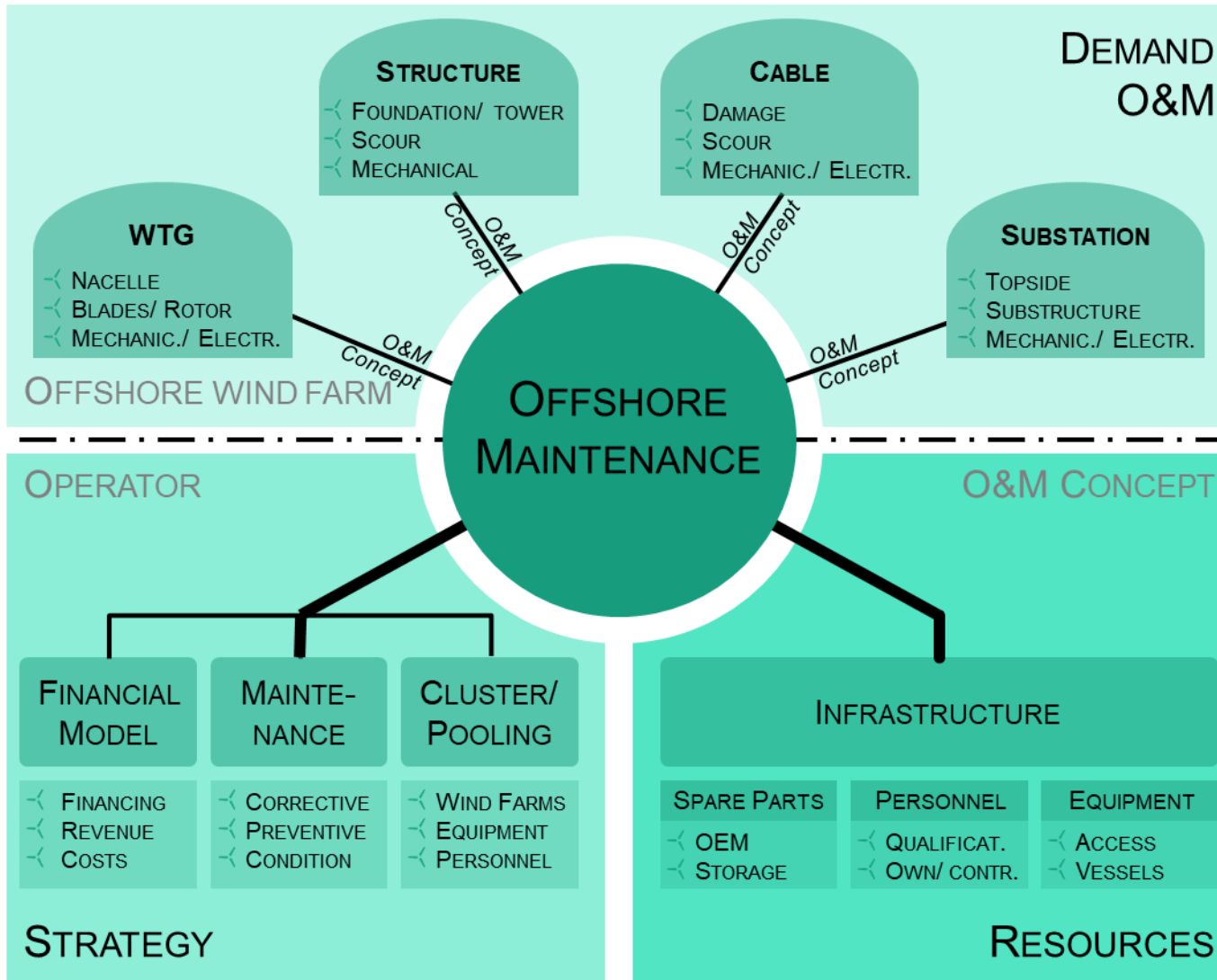
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# Approach – Offshore TIMES

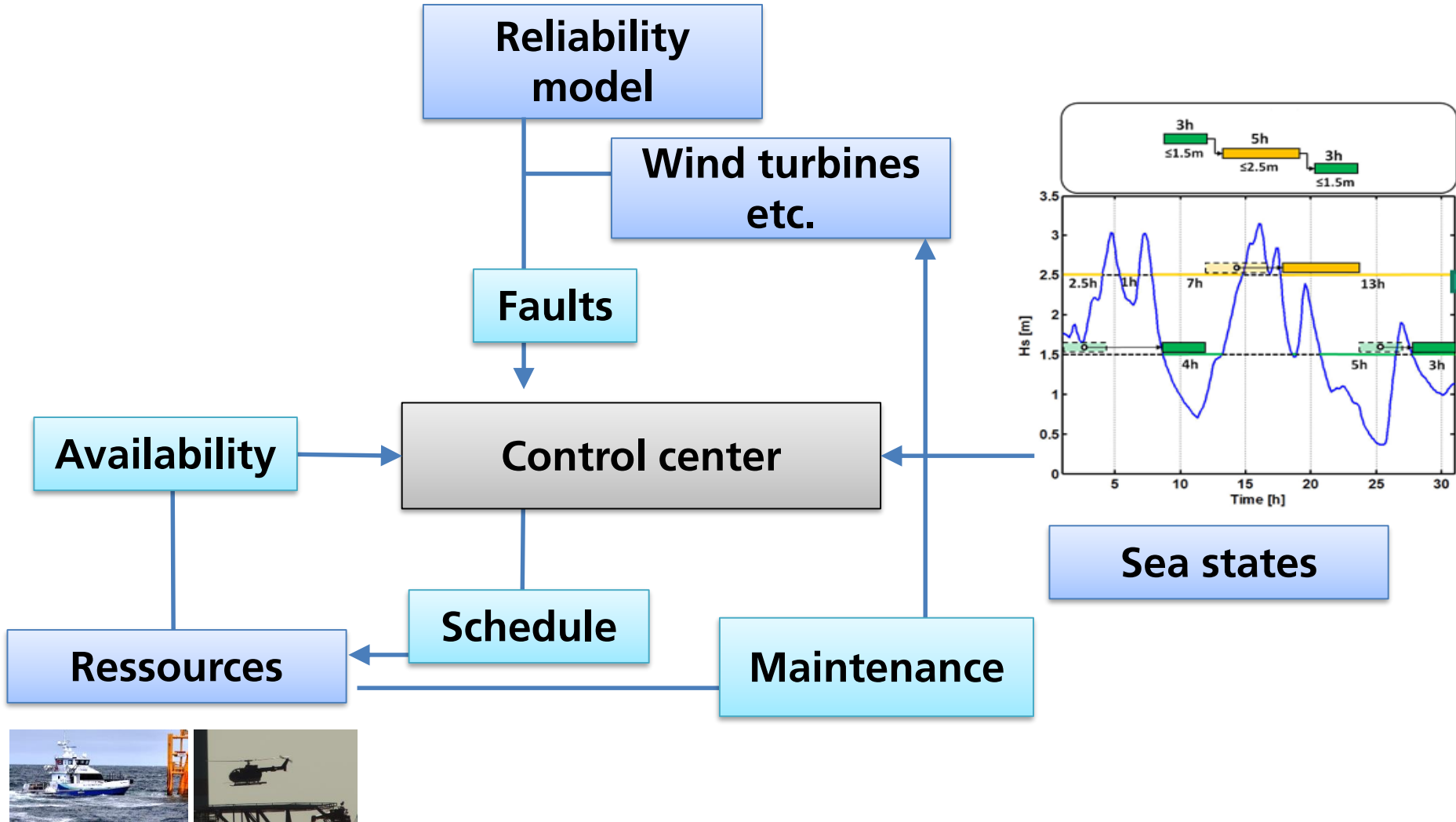
## Transport, Inspection and Maintenance Software



# Approach – Offshore TIMES



# Approach – time series based simulation





# Scenarios

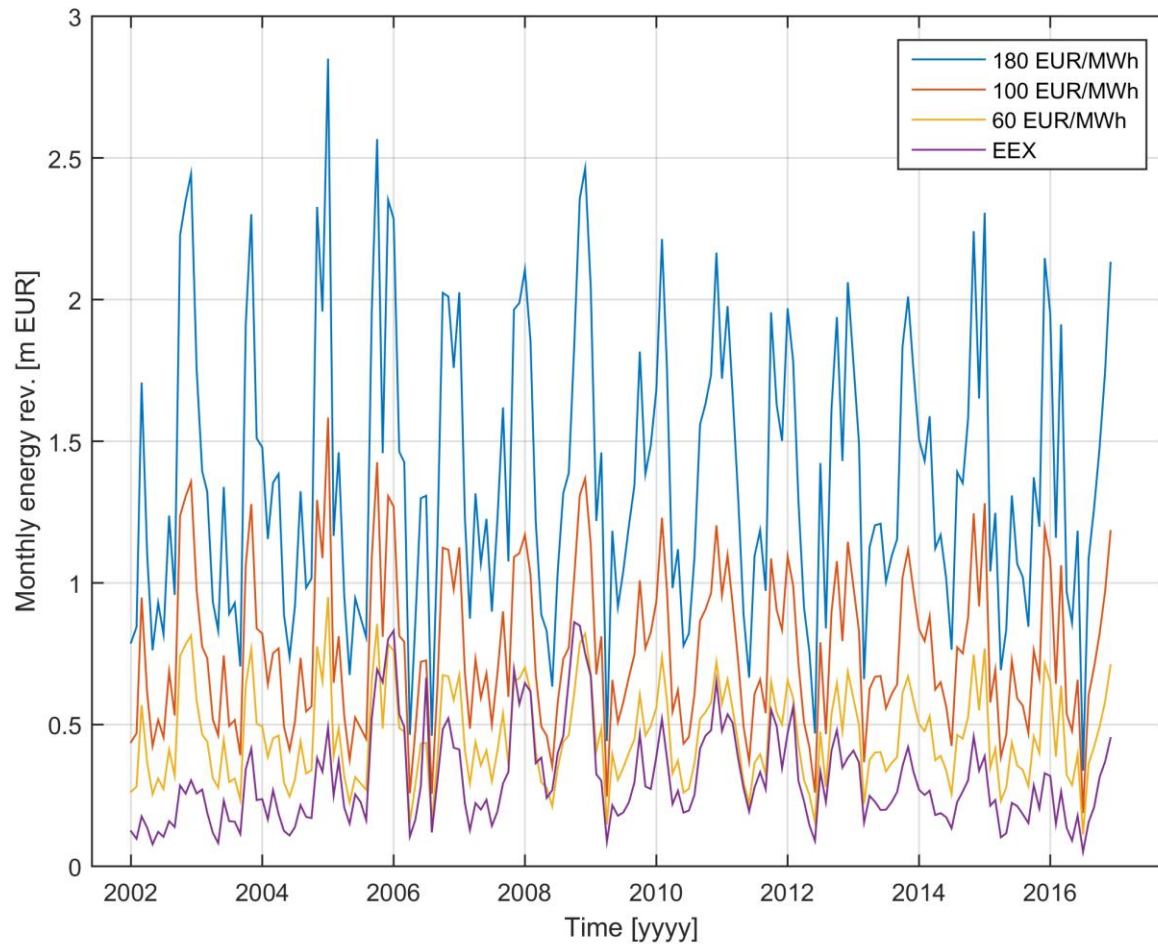
## Two Wind farms (6 x 5MW, 80 x 3.6MW)

- 1) 1+2 CTVs, staff **36** persons
- 2) 1+3 CTVs, staff **48** persons
- 3) 1+4 CTVs, staff **60** persons

## Remuneration

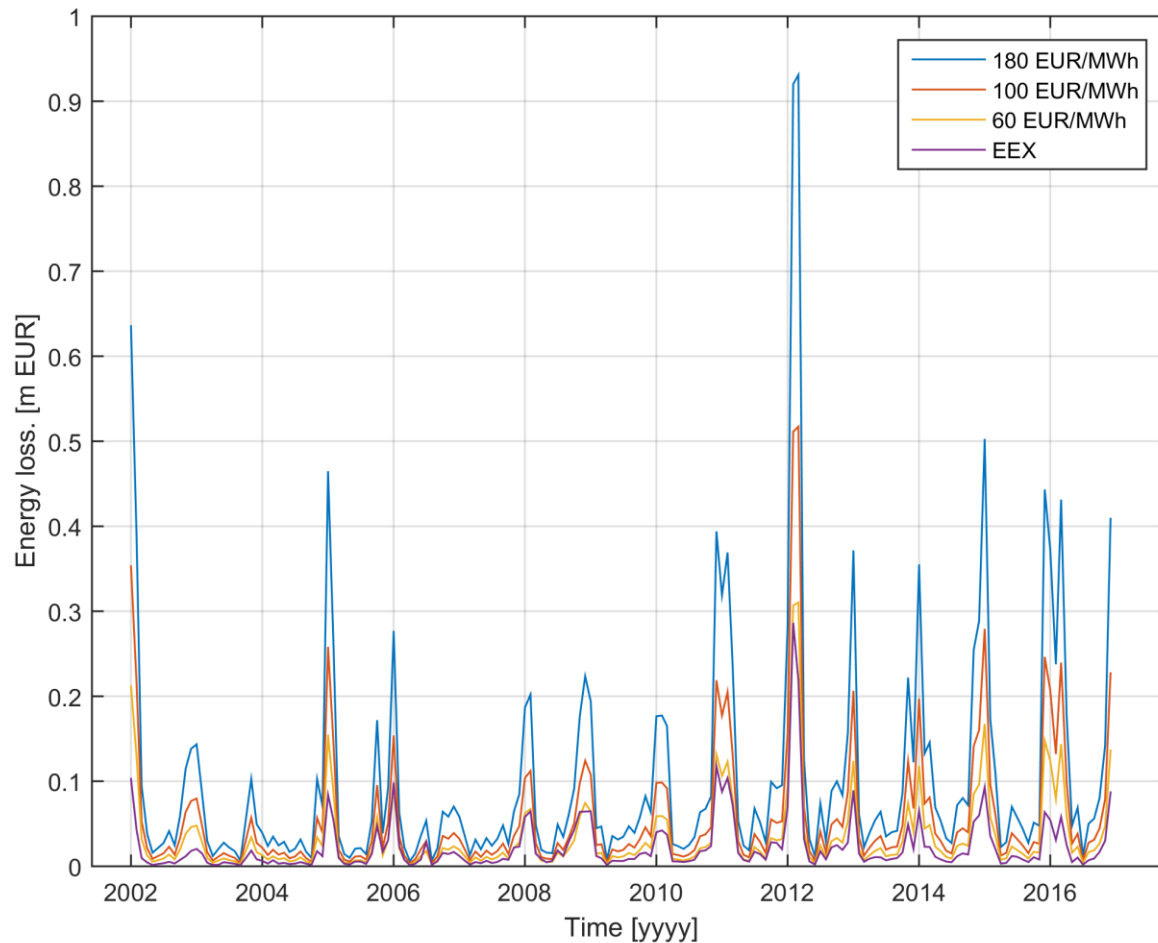
- Fixed 18€ct, 10€ct and 6€ct fixed tariffs
- European Energy Exchange (EEX) prices from 2002 to 2016

# Monthly revenue, scenario 1)



**Monthly and seasonal fluctuations**

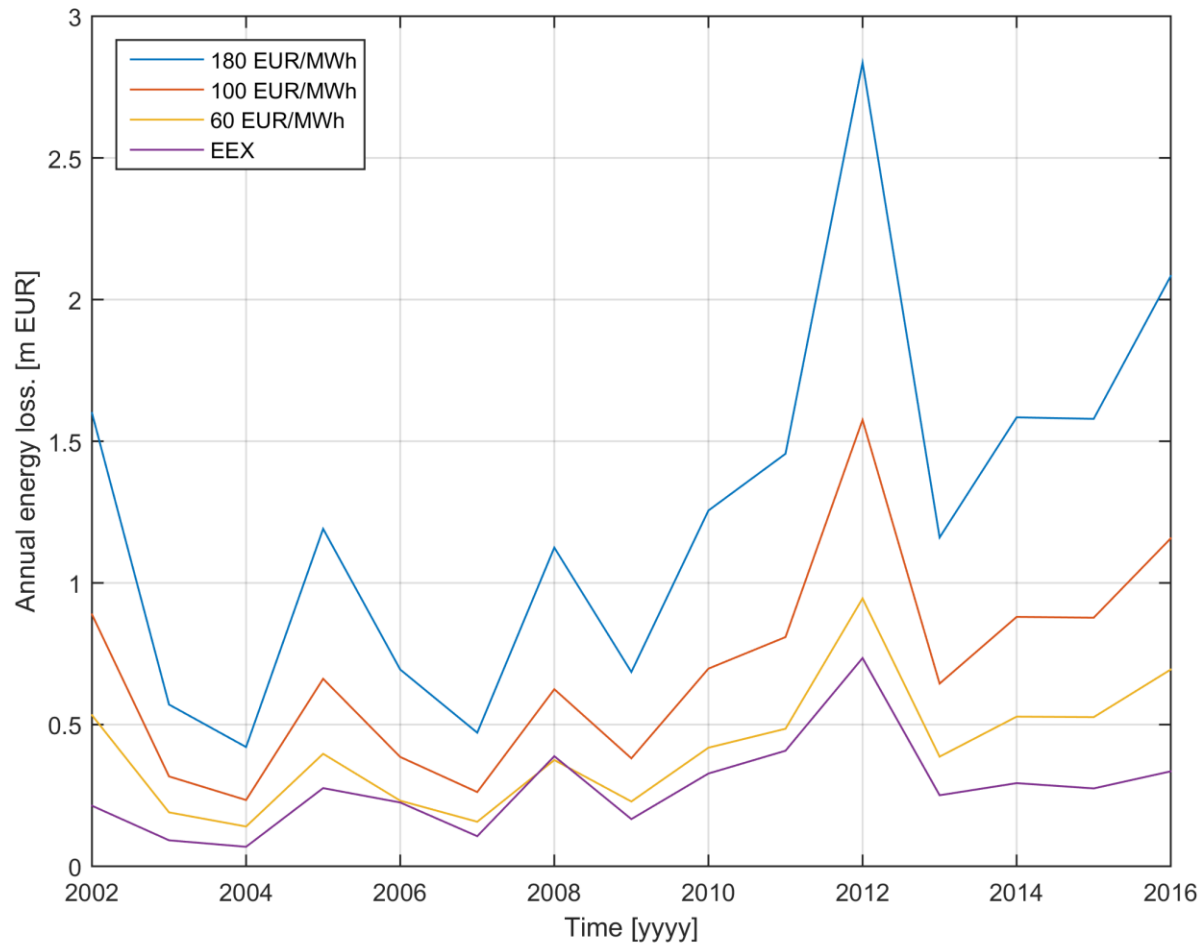
# Monthly revenue loss, scenario 1)



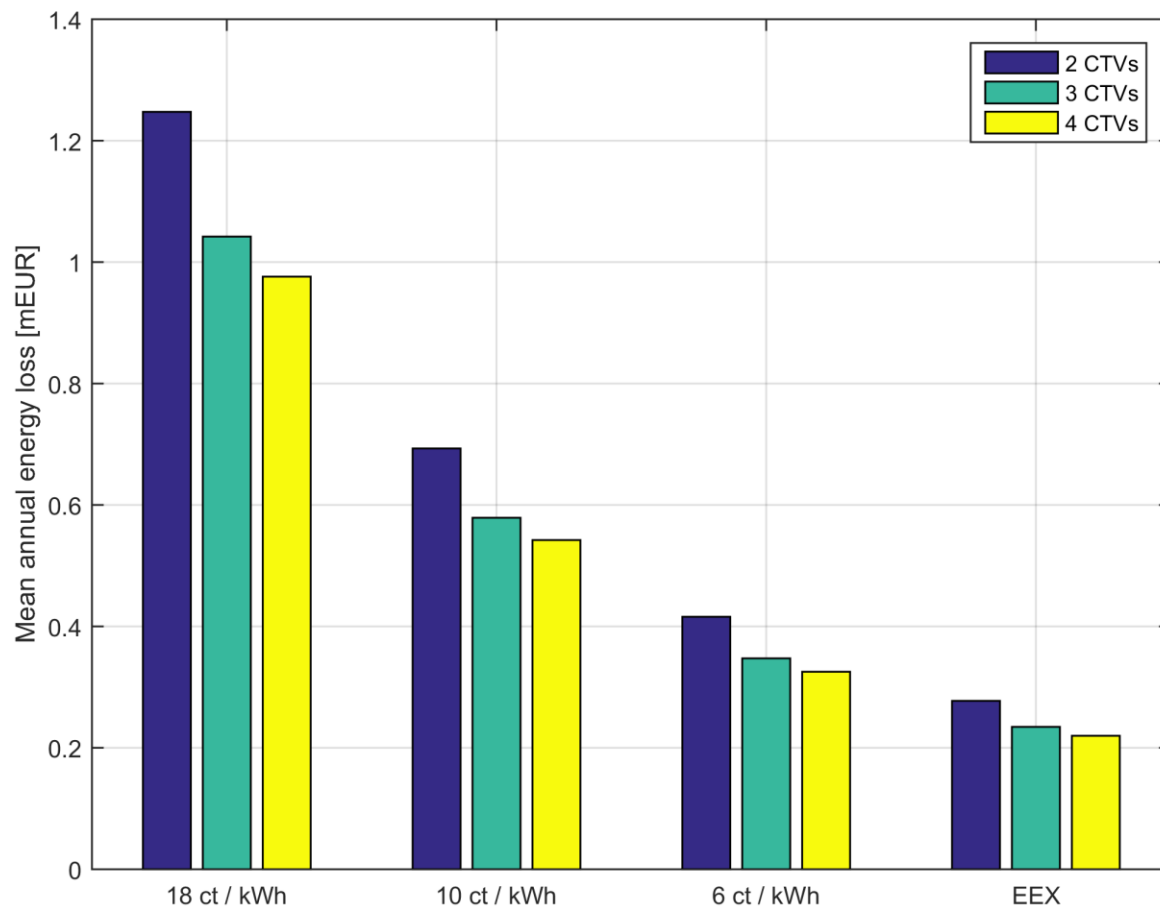
**Monthly and seasonal fluctuations**

**-> Seasonal O&M strategies?**

# Annual revenue loss, scenario 1)



# Comparison of revenue loss, all scenarios



**Effects of different strategies**

**-> Does higher costs for O&M result in lower energy losses?**

- **Analysis of simple O&M strategies for a cluster wind farm using Offshore TIMES**
- **Considering different failure models**
- **Direct comparison between strategies and remuneration systems, e.g. fixed tariffs and EEX**



# Outlook

- Implementing more complex maintenance strategies (seasonal, cluster, ...)
  - Considering operational strategies
  - Revenue or production based strategies
  - Include further topics, like SHM
- 
- Project for assessing O&M for future Multi-MW wind turbines.

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and Energy



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**Thank You For Your Attention**

Any questions?

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