Universität Rostock Traditio et Innovatio

LWET STIFTUNGSLEHRSTUHL WINDENERGIETECHNIK

Schwimmende Plattformen wie die GICON-TLP als Anschlusstechnologie zu XXL Monopiles

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GICON®

Chair of Wind Energy Technology (LWET)

Key data

- founded in 2014
- endowed by the wind turbine manufacturer Nordex SE
- focus is industry-oriented research both onshore and offshore wind energy
- Research topics at the LWET are:
  - Virtual wind turbine (improvement of simulation methods, validation of results, simulation-assisted optimization of wind turbines)
  - Economic efficiency (weight and cost reduction, rotor blades, towers, improved control algorithms
  - Measurements (wind field, wind turbine, operation of research turbine)
  - Grid integration of wind power (decentralized, storage, grid codes)

Outline

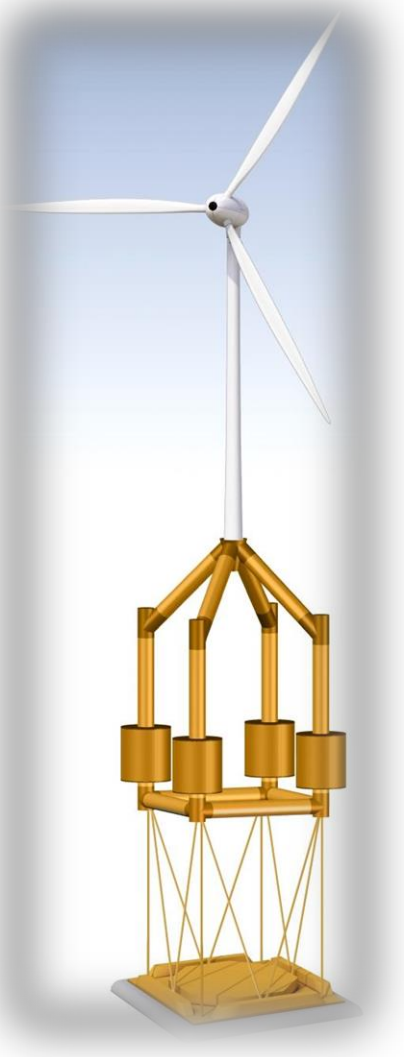
Introduction / Motivation

Floating Offshore Wind

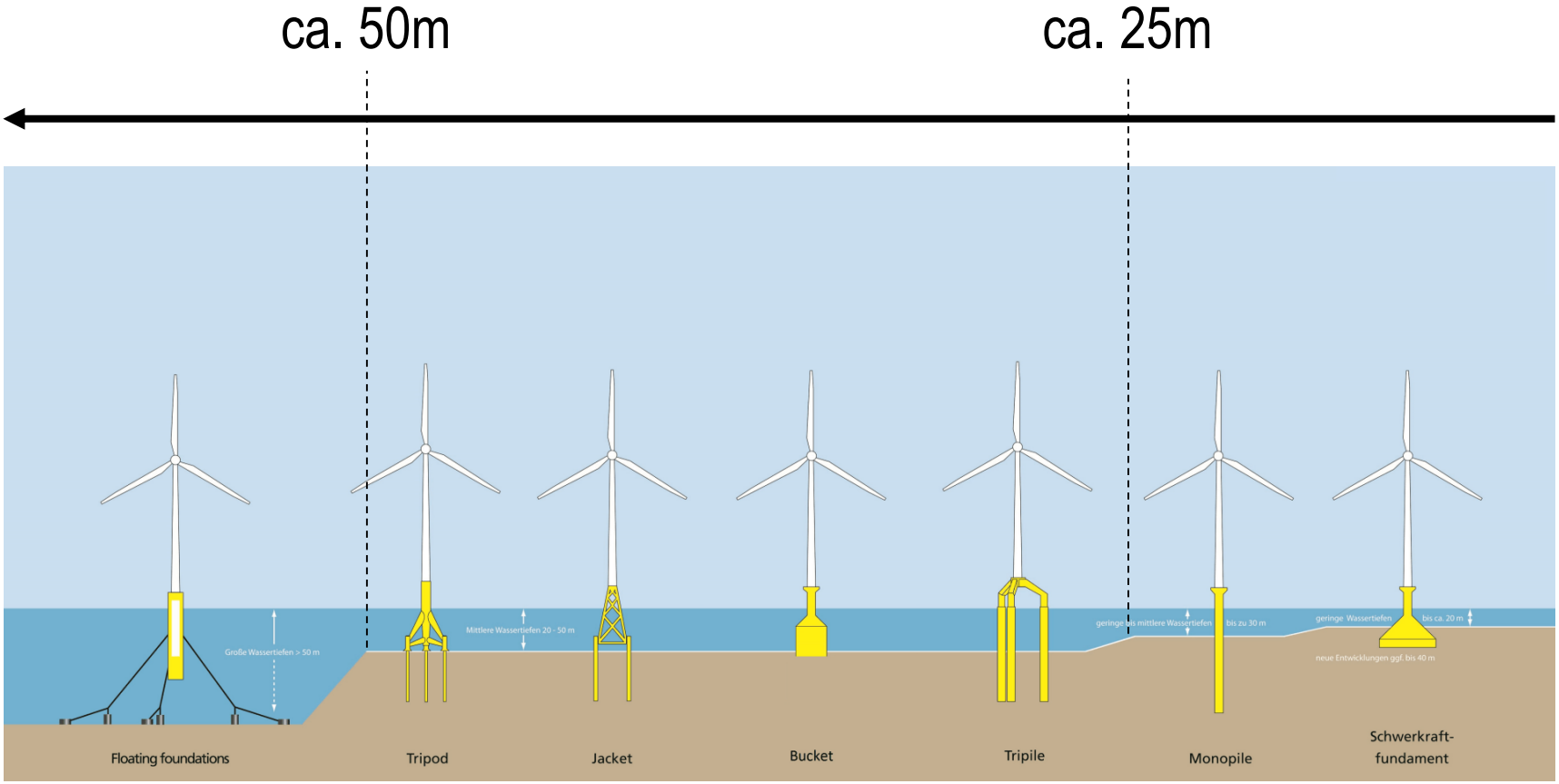
One possible solution: GICON-TLP

Pre-Design of a 6MW+x platform

Summary / Outlook



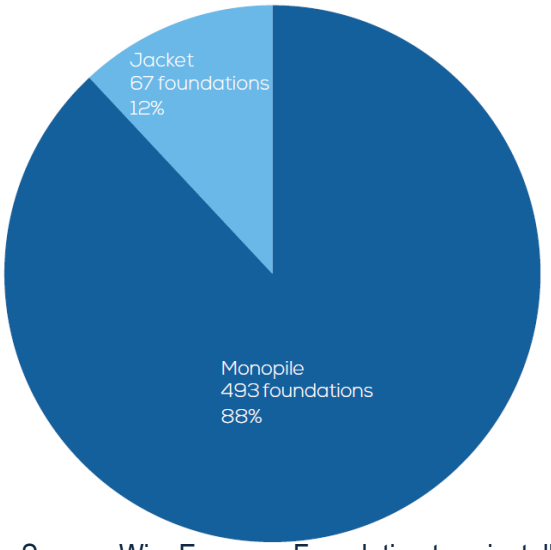
Introduction / Motivation



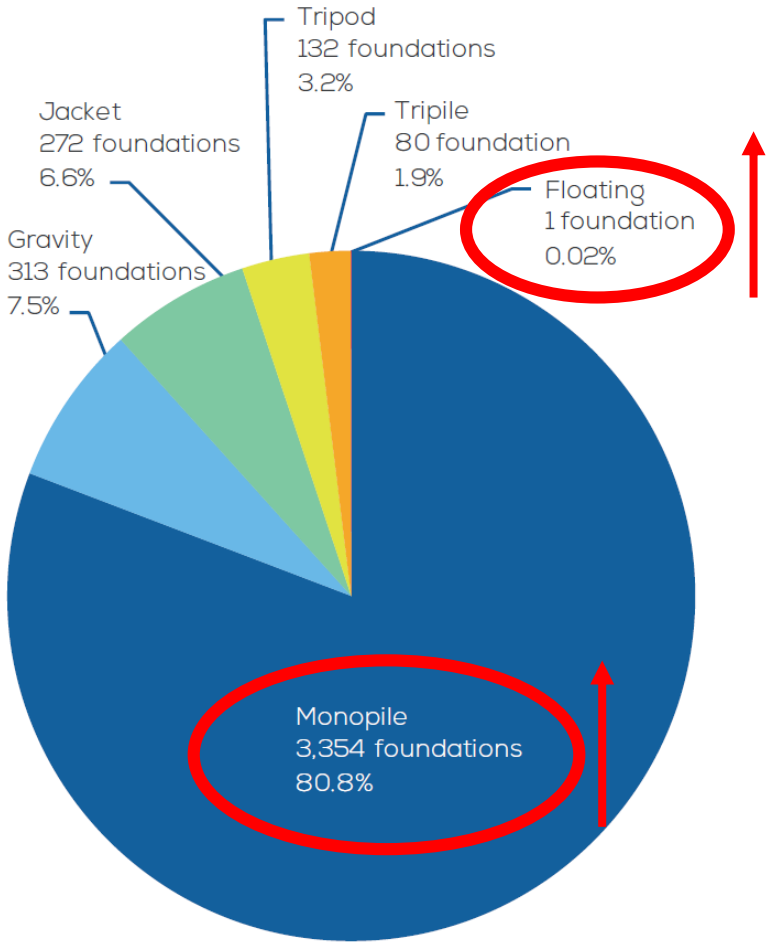
Source: http://www.offshore-stiftung.de/infoterminal/index.php?cat=7&mode=hd Stand: 01.03.2017

- **Monopile** substructures remained by far the **most popular substructure** type in 2016, representing 88% of all installed foundations

- 67 Jackets were installed at Wikinger, representing 12% of all foundations installed.



Source: WineEurope – Foundation typs installed in 2016



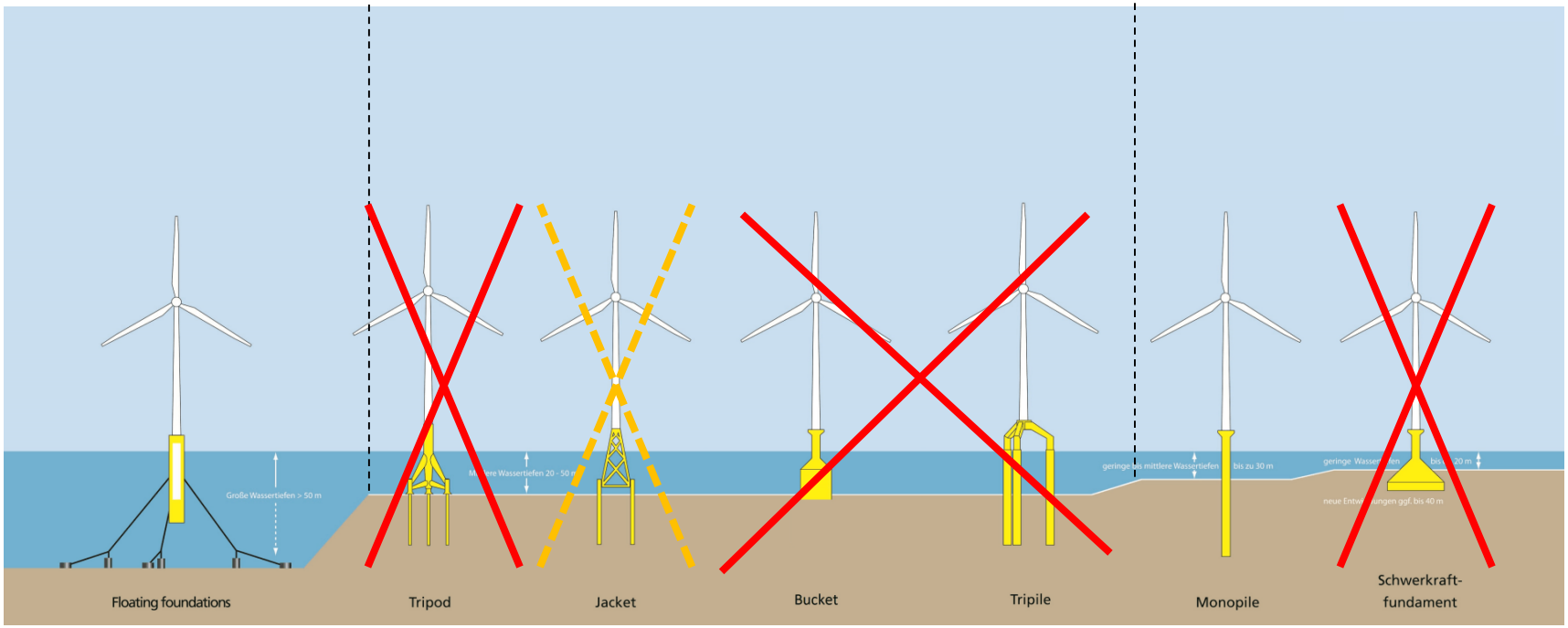
Source: WineEurope – Cumulative foundation typs installed until 2016

Possbile Scenario:

2016
2025

ca. 50m

ca. 25m



Source: http://www.offshore-stiftung.de/infoterminal/index.php?cat=7&mode=hd Stand: 01.03.2017

Scenario 2025

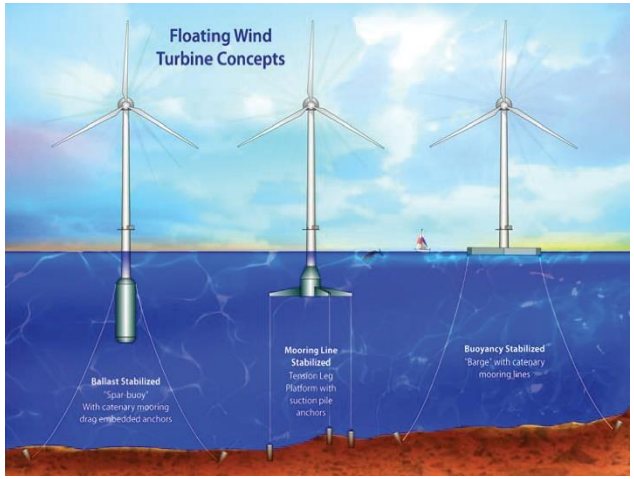
XXL Monopile:

- Water depths up to ~ 35-40m
- Simple design and structur
- Well known and established technology

Source: http://www.erneuerbareenergien.de/xxl-monopile-oder-jacket/150/3882/98051/

Floating Offshore Wind:

- Number of installed systems increasing
- Water depths 40m plus (IDEOL, WindFloat, GICON-TLP)
- Water depths 100m plus (Statoil)



Source: NREL

Floating Offshore Wind

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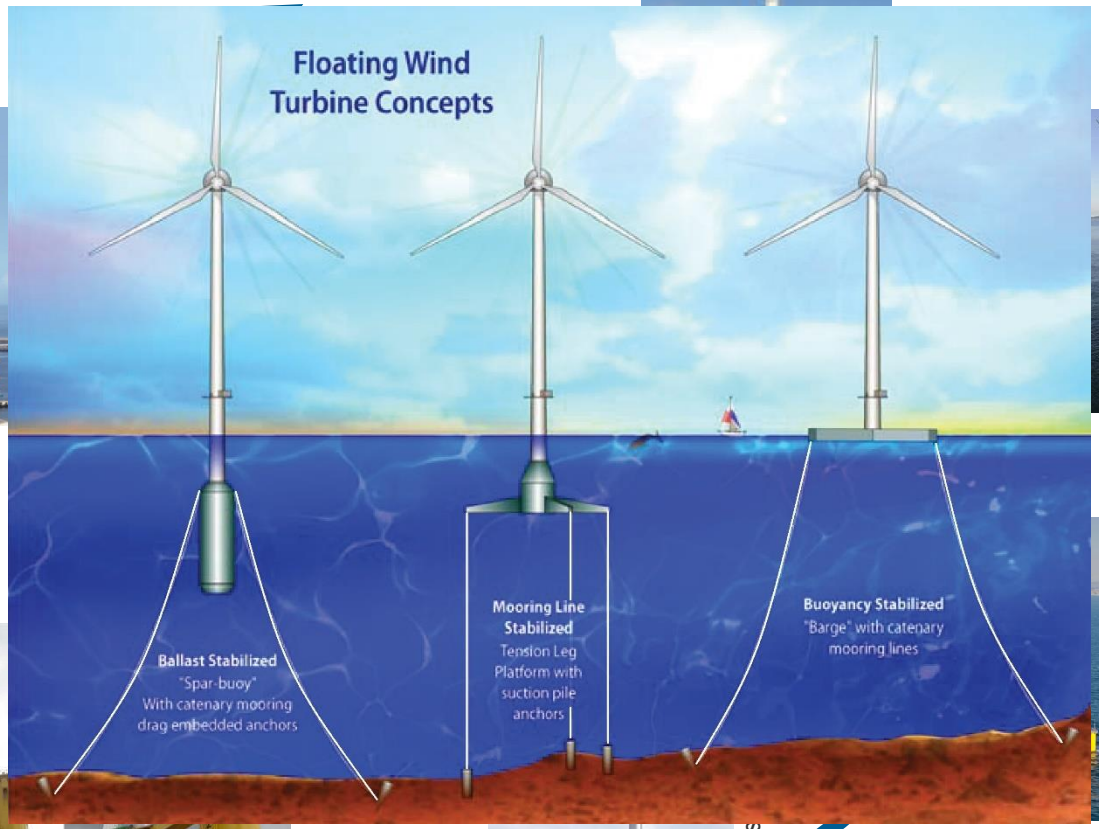

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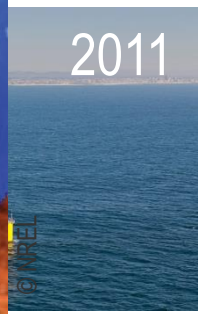


© Wikipedia



Spar-Buoy
© WindPower Offshore

Tension Leg Platform (TLP)


© Kensetsu News

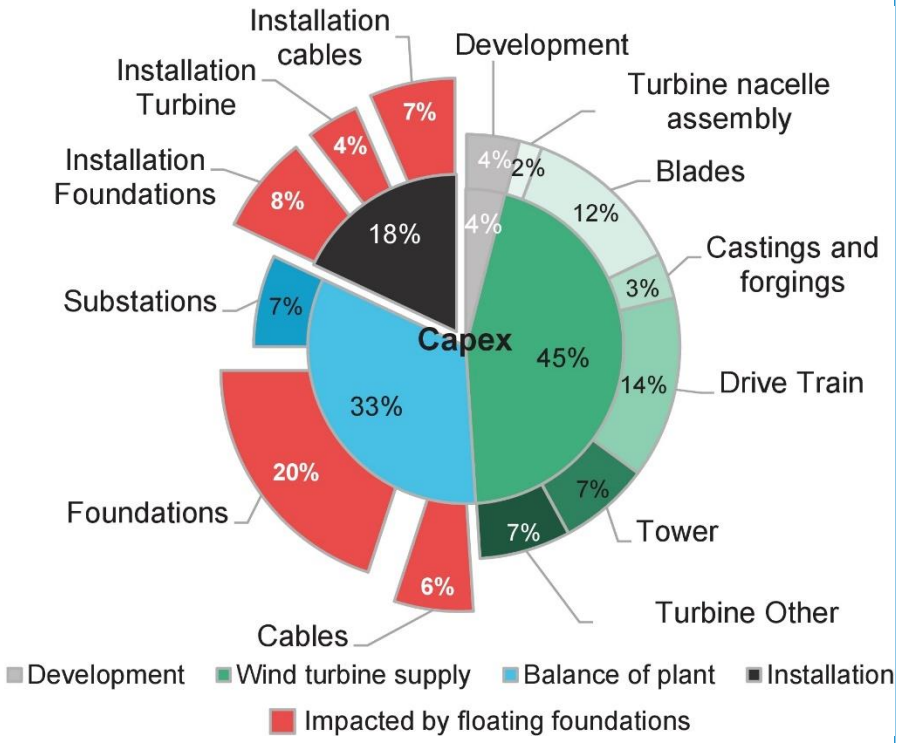
Barge

Cost Reduction:

- LCOE ≤ 10 €ct/kWh
- e.g. reduce the costs for installation (12% impact by floating foundations)

Develop more offshore areas for Wind Turbines:

- floating fundations for water depths ≥ 40m (35m)



Source: Bloomberg New Energy Finance – Figure 5 out of the Bloomberg Report 2015; Harries – Floating Wind: buoyant progress

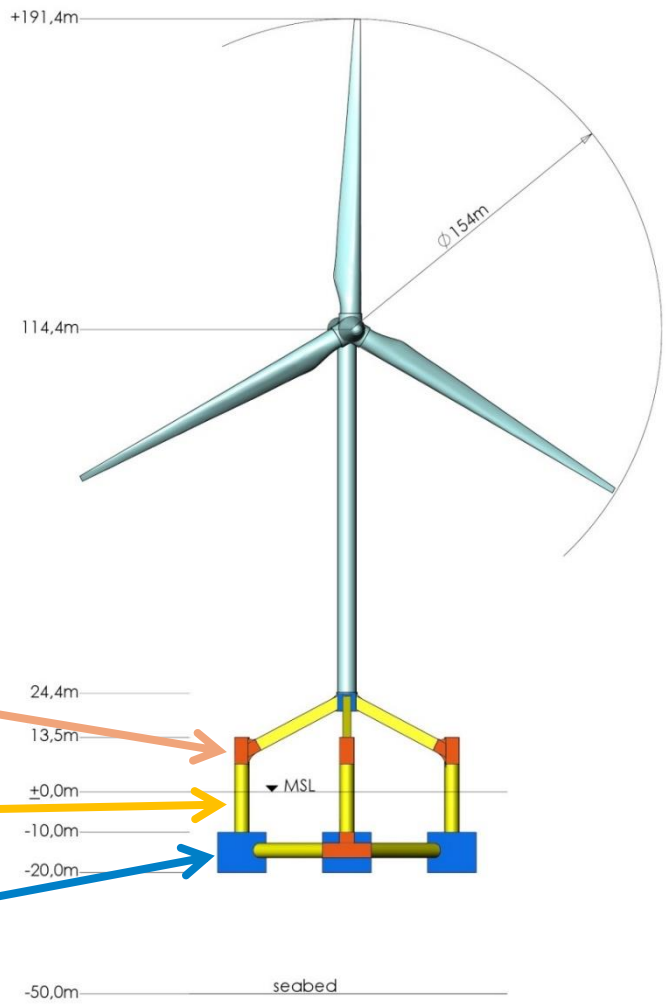
One possibile solution: GICON-TLP

The GICON®-TLP 6MW Design

Advantages of optimized GICON®-TLP:

- Reduced steel mass (Target of 2,500t steel-concrete-combination for 6 MW turbine)
- Reduced fabrication time and costs
- Modular design
- Pre-stressed concrete components
- Reduced fatigue risk

- **Pre-fabricated steel components nodes**
- **Pre-stressed reinforced concrete pipes**
- **Concrete components shells**




Source: SHW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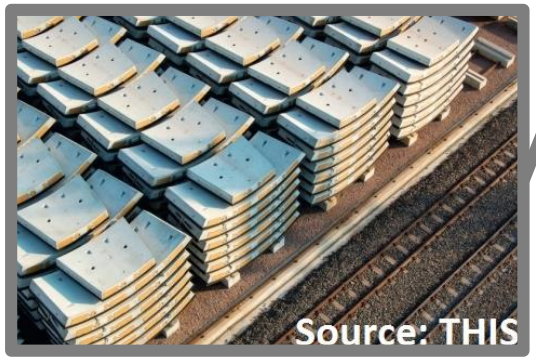
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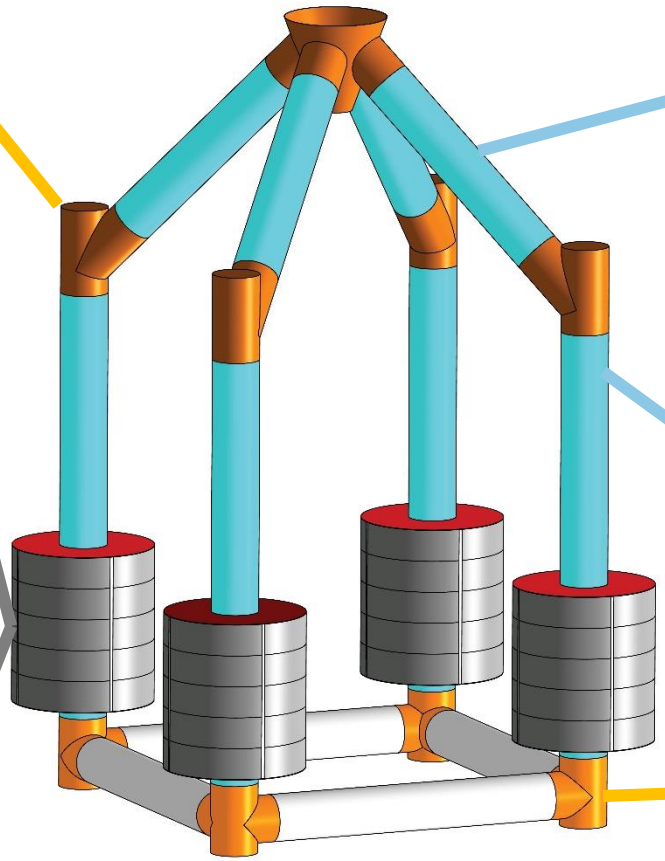
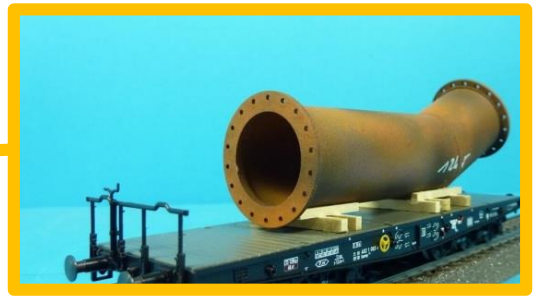



Source: Europoles GmbH & Co. KG


Source: dyba

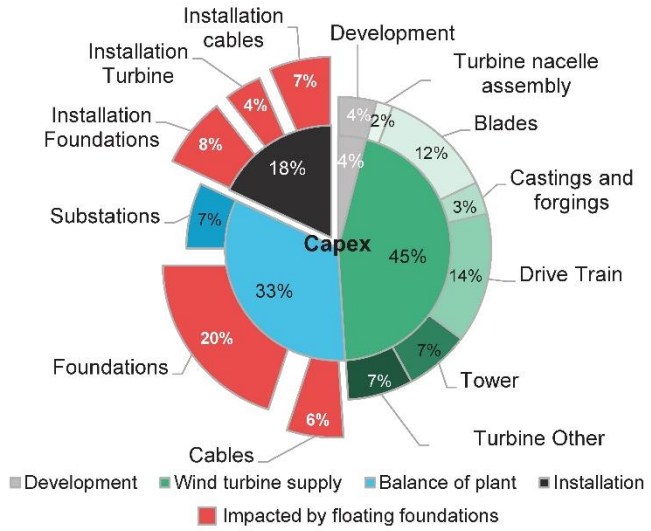


Installation process Video

Source: GICON

Source: GICON

CAPEX – Break Down[3]: Impact of floating foundation

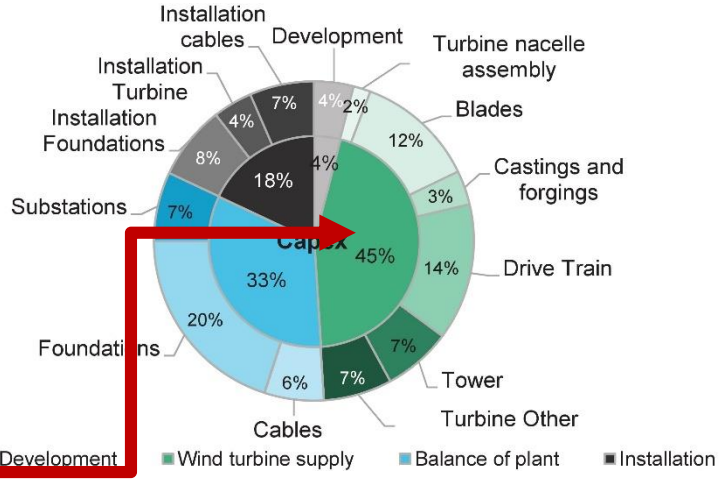


[1] Source: Confirmed ECOVIS Report by Romeike - © 2014
[2] Exchange rate of 30.08.2016
[3] Source: Bloomberg New Energy Finance - © 2015
[4] Source: Confirmed ECOVIS Report by Romeike - © 2016

Source	Wind Offshore 2014	Wind Offshore AIM 2025	GICON-TLP 2020	GICON-TLP 2025
LCOE in €/MWh[3,2]	145	71	95.2[1]	87.8[4]
LCOE in $/MWh[3]	162	79	106	98
LCOE in £/MWh[3,2]	124	61	81	75

Source: EnBW

CAPEX – Break Down[3]: ?Windturbine?



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[1] Source: Confirmed ECOVIS Report by Romeike - © 2014
[2] Exchange rate of 30.08.2016
[3] Source: Bloomberg New Energy Finance - © 2015
[4] Source: Confirmed ECOVIS Report by Romeike - © 2016

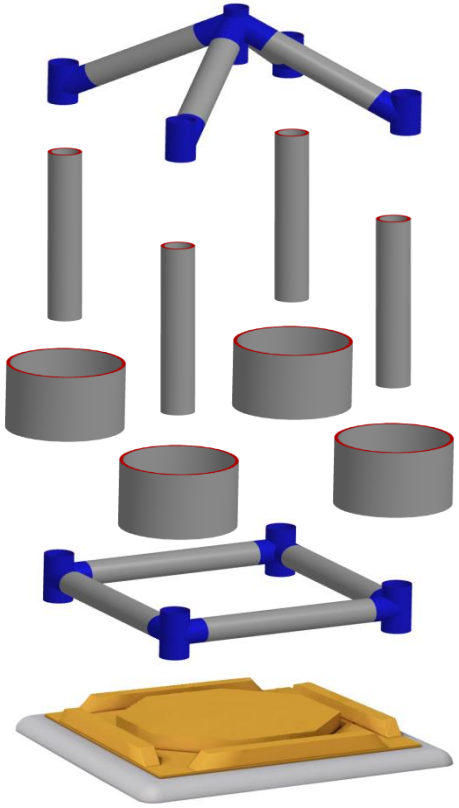
Source	Wind Offshore AIM 2025	GICON-TLP 2020	GICON-TLP 2025	TLP and WT optimized 2025
LCOE in €/MWh[3,2]	71	95.2[1]	87.8[4]	< 71
LCOE in $/MWh[3]	79	106	98	< 79
LCOE in £/MWh[3,2]	61	81	75	< 61

Pre-Design/results for a 6MW+x platform

Assembling

- Dry dock
- Fabricate the anchor (7 days)
- Assemble the horizontal pipes (1day)
- Assemble four buoyancy bodies (2day)
- Assemble the vertical pipes (1day)
- Assemble the angled pipes (2day)
- Assemble the upper part (1day)

- ➢ 14 days for one device
- ➢ E.g. dry dock in Wismar – assembling of up to 5 devices in parallel
- ➢ 125 devices per year

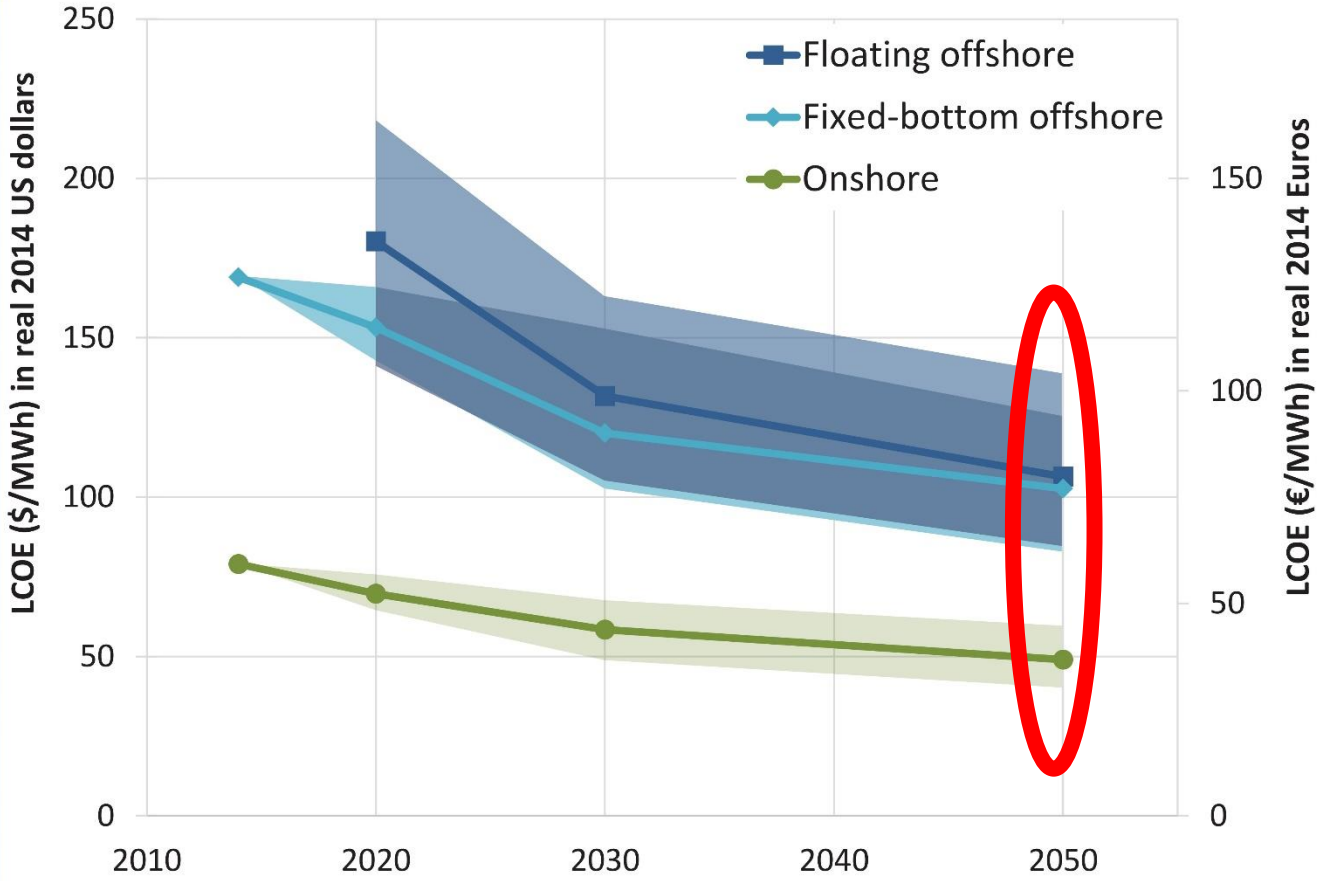


Summary / Outlook

Financial Feasibility/Outlook – IEA Wind Task 26 / June 2016

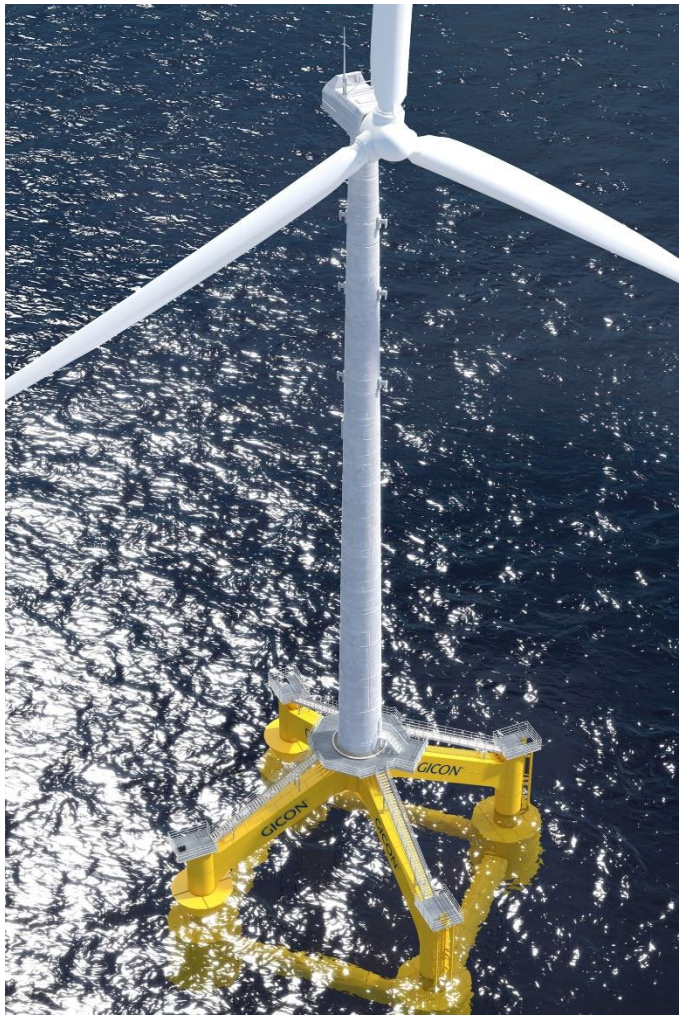
LCOE reductions for floating offshore are expected to be especially sizable between 2020 and 2030

Greater uncertainty in offshore wind LCOE than in onshore LCOE



Source: Ryan Wiser et al / Forecasting Wind Energy Costs and Cost Drivers – The Views of the World's Leading Experts

- XXL Monopile & Floating Offshore Wind – Scenario 2025?
- Decreasing LCOE
- Modular design
- Decreasing assembling time
- Decreasing CO_2 emission and energy demand



Thank you

Acknowledgments:

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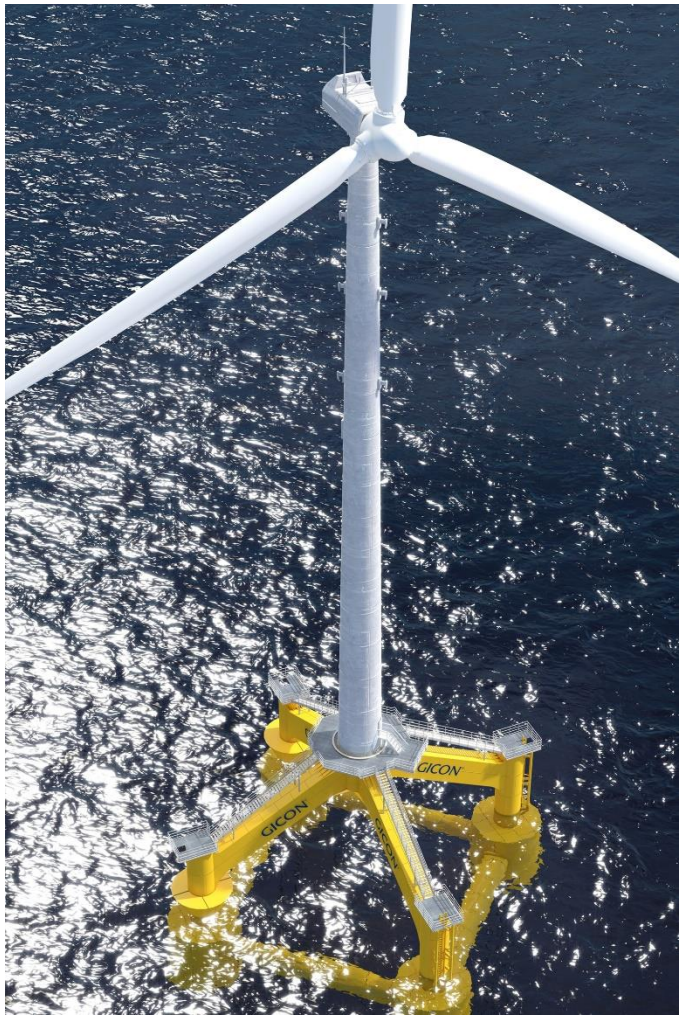
European Union
European Regional Development Fund



Source: GICON

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