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# Supply Chain Innovation in the Offshore Wind Industry

Henrik Stiesdal, 30.06.14

# We have come a long way…

# … To where we are today – Siemens Wind Power, Facts at a glance

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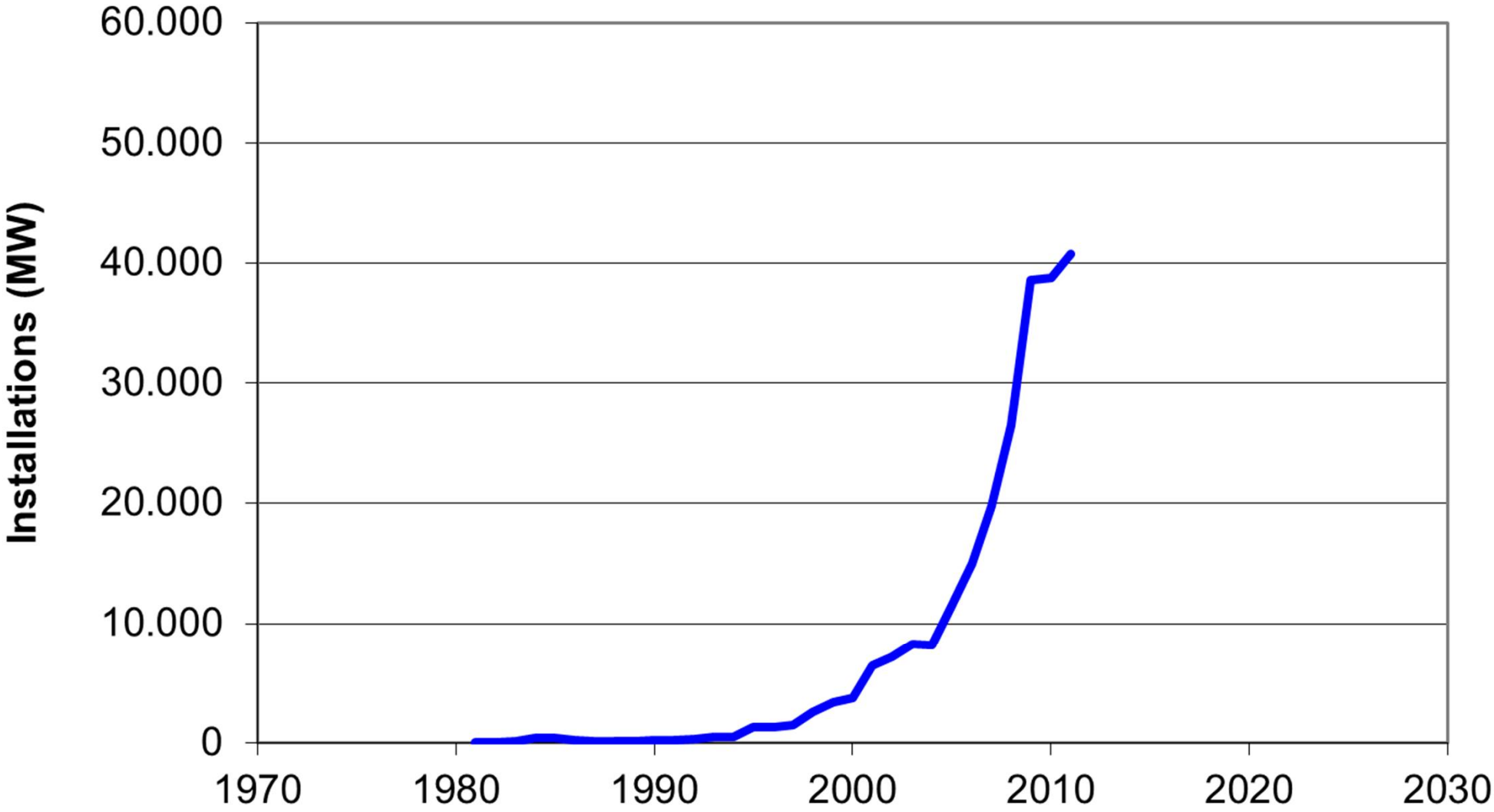
## Siemens Wind Power facts

- One of the world's leading suppliers of wind power solutions
- Installed Base: > 12.000 turbines with ~20.000 MW capacity[1)]
- Installed: ~4.600 MW in 2013
- ~10.900 employees globally (including Service Renewables)
- Record order backlog of ~ € 12 billion (including Service Renewables)
- Revenue in 2013: ~ € 5 billion
- No. 1 in offshore wind power, No.4 overall

1) January 2013

# The wind industry at a glance – World market development



# The wind industry at a glance – World market development

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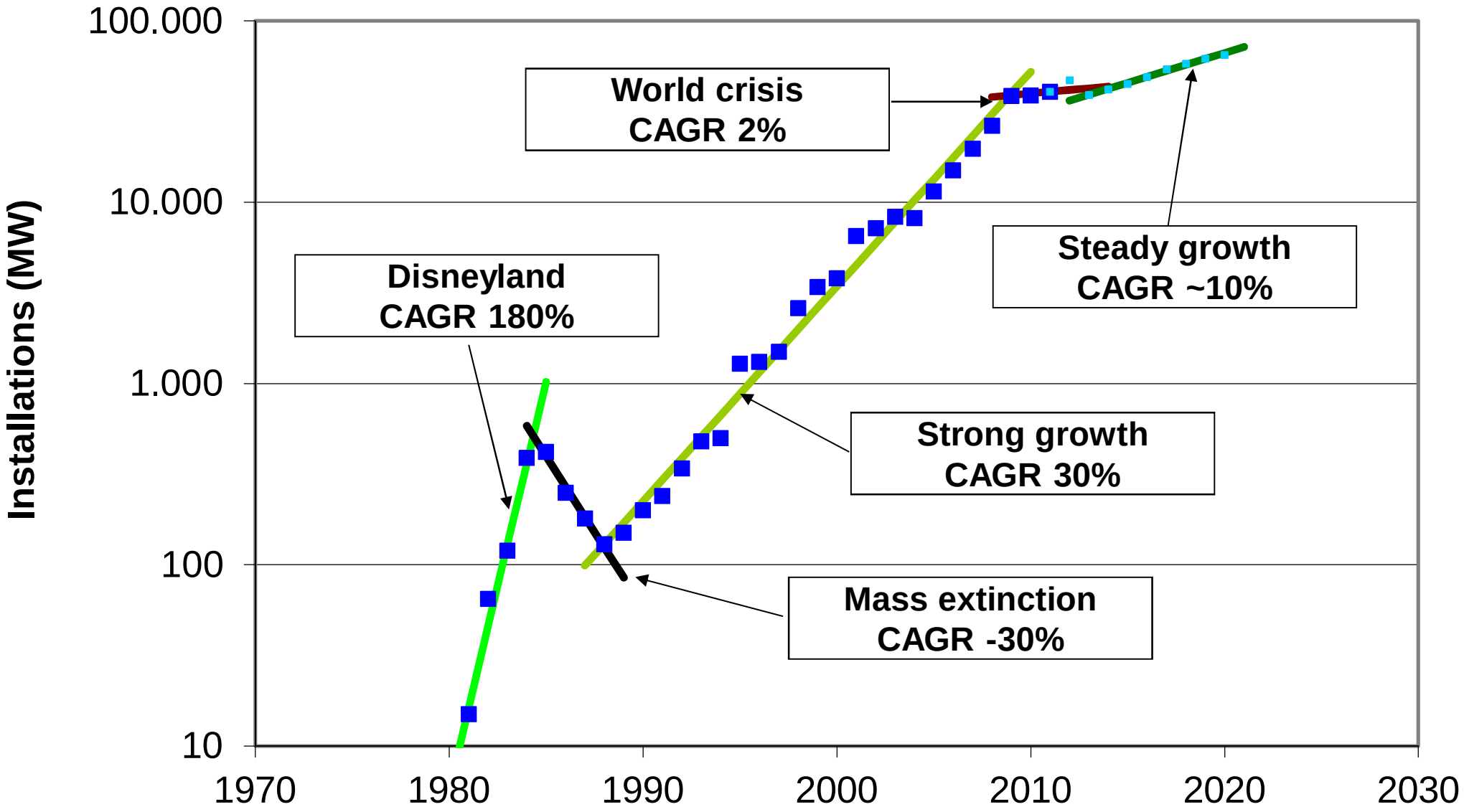

# Wind is the key non-$CO_2$ energy generation source – and offshore is the growth arena

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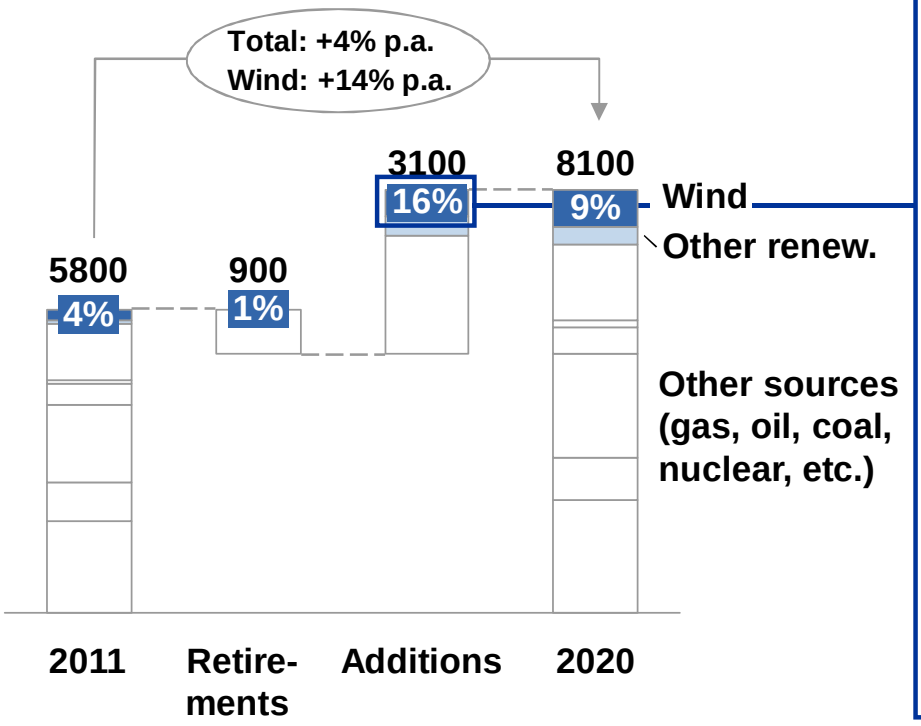
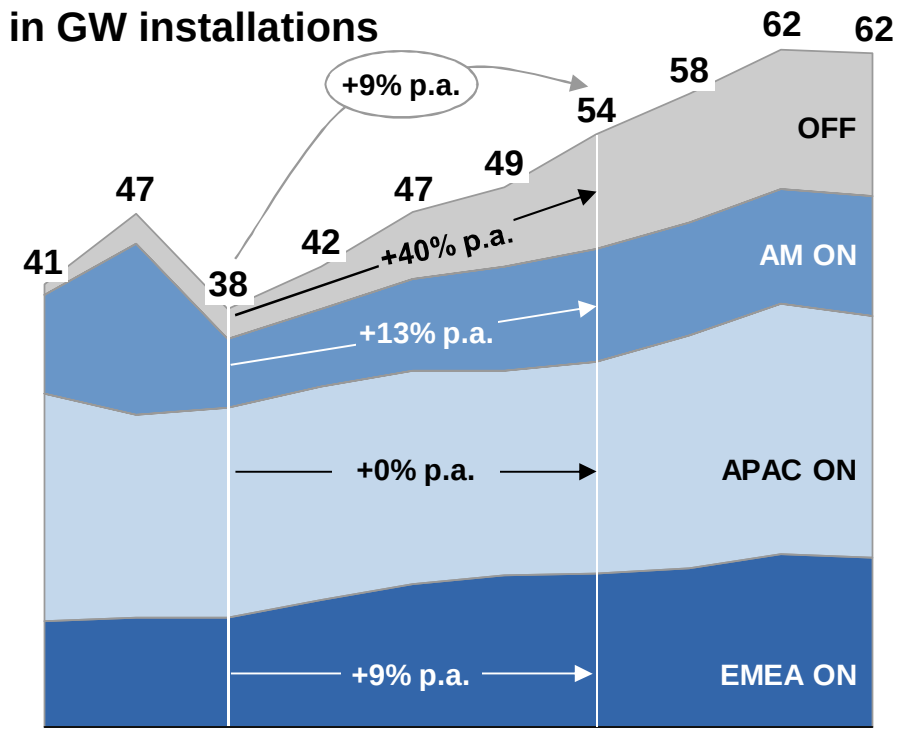
## Total installed capacity, in GW installations




## Global wind market, in GW installations




- Wind with rising importance in energy mix
- Political will to find alternatives to fossil and nuclear

Source: E ST MC

- Offshore is showing strongest growth – covers 1/5 of entire market in 2020
- Onshore returns to stable 40+ GW p.a. after 2014

# Offshore project size development – From 5 MW to 630 MW in 22 years

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| World's 1st offshore wind power plant | World's 1st offshore wind power plant w/ MW turbines | World's largest offshore wind power plant in operation | World's largest wind power market entered in China | World's largest offshore wind power plant in operation | World's largest offshore wind power plant in operation |
|---|---|---|---|---|---|
| 1991 | 2000 | 2003 | 2011 | 2012 | 2013 |
|  |  |  |  |  |  |
| Vindeby | Middelgrunden | Nysted | Rudong | Greater Gabbard | London Array |
| 5 MW | 40 MW | 166 MW | 48 MW | 504 MW | 630 MW |

**Our performance**

- Leading market share and number one in offshore [1].
- Industrialized offshore wind power (from 5 MW to 630 MW wind power plants)
- Market entry into the Asia Pacific region

1. Megawatts commissioned, EWEA, January 2013

# Product development –
# From 30 kW to 6 MW in 30 years

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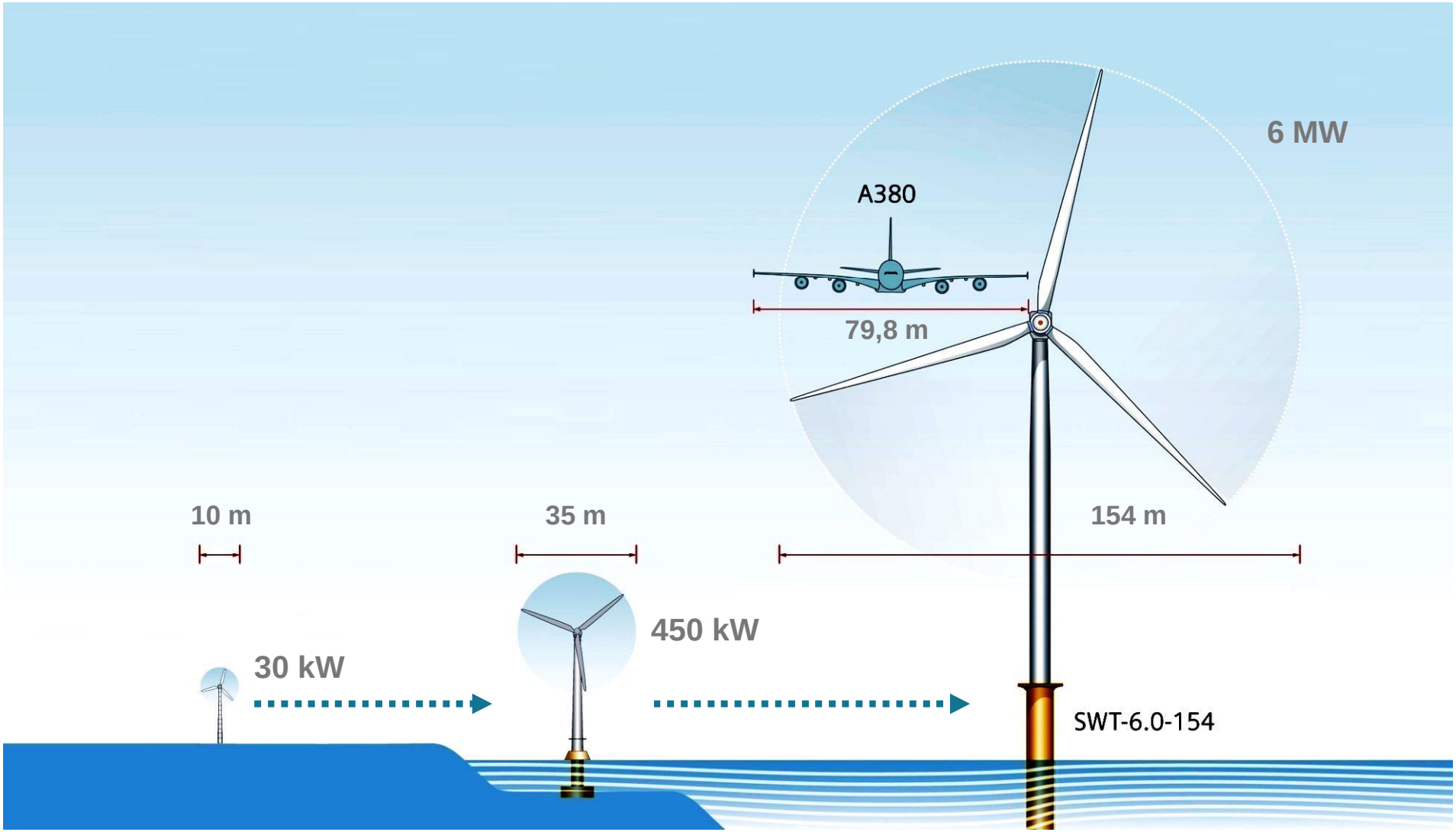

# 30 years of work did not lead to a competitive solution

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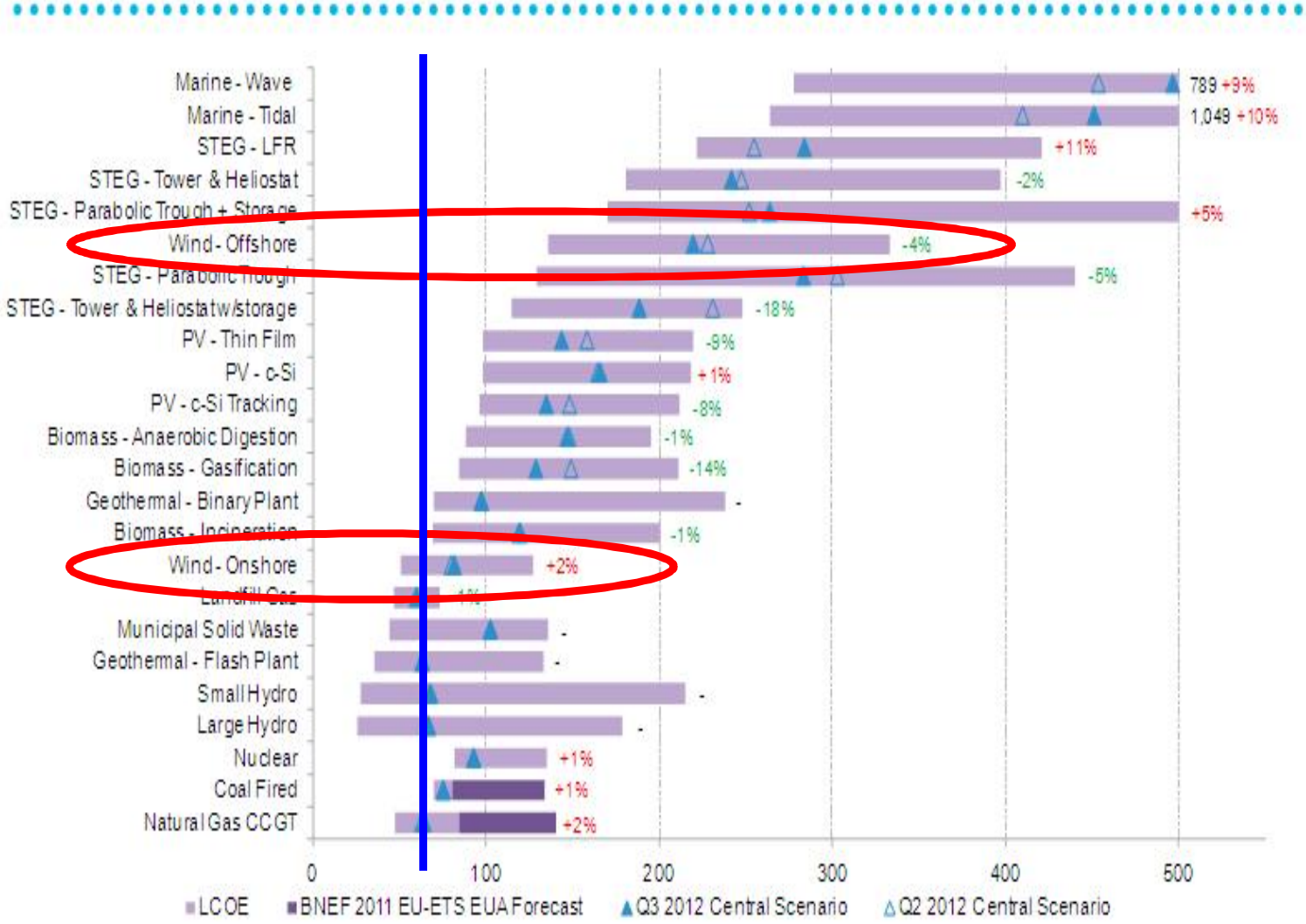
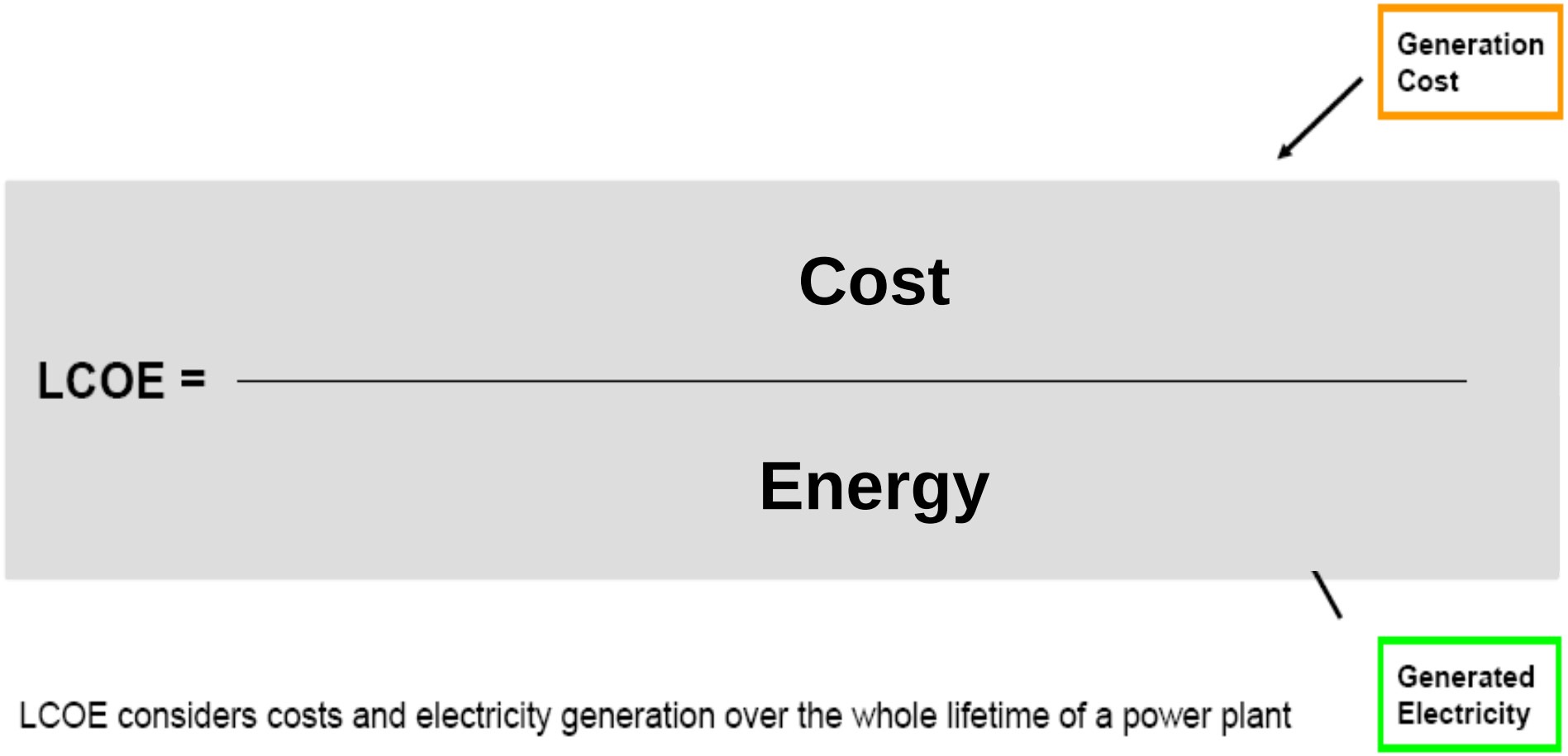



*Source:Bloomberg New Energy Finance. Note: Carbon forecasts from the Bloomberg New Energy Finance European Carbon Model with an average price to 2020 of $30/mt. Coal and natural gas prices from the US EIA and BNEF. Percentage change represents change from Q2 2012*

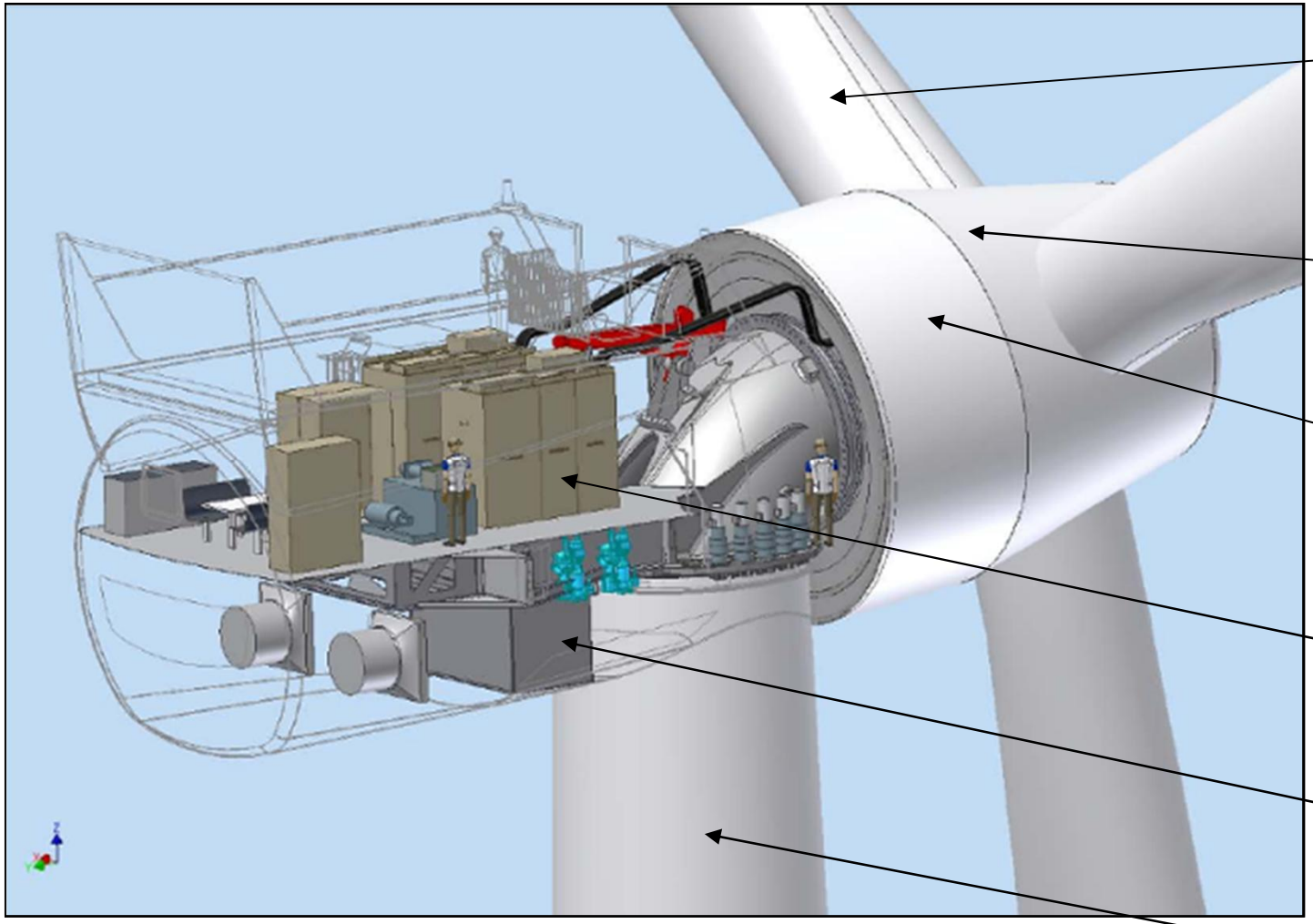
Source: Bloomberg New Energy Finance

# The yardstick is LCOE – Levelized Cost of Electricity




LCOE considers costs and electricity generation over the whole lifetime of a power plant

# The basis for the work – the 6 MW turbine



**Blade**
- 75 m, 25 t
- 20.000 kNm (root)

**Hub**
- Ø4.5 m, 40 t

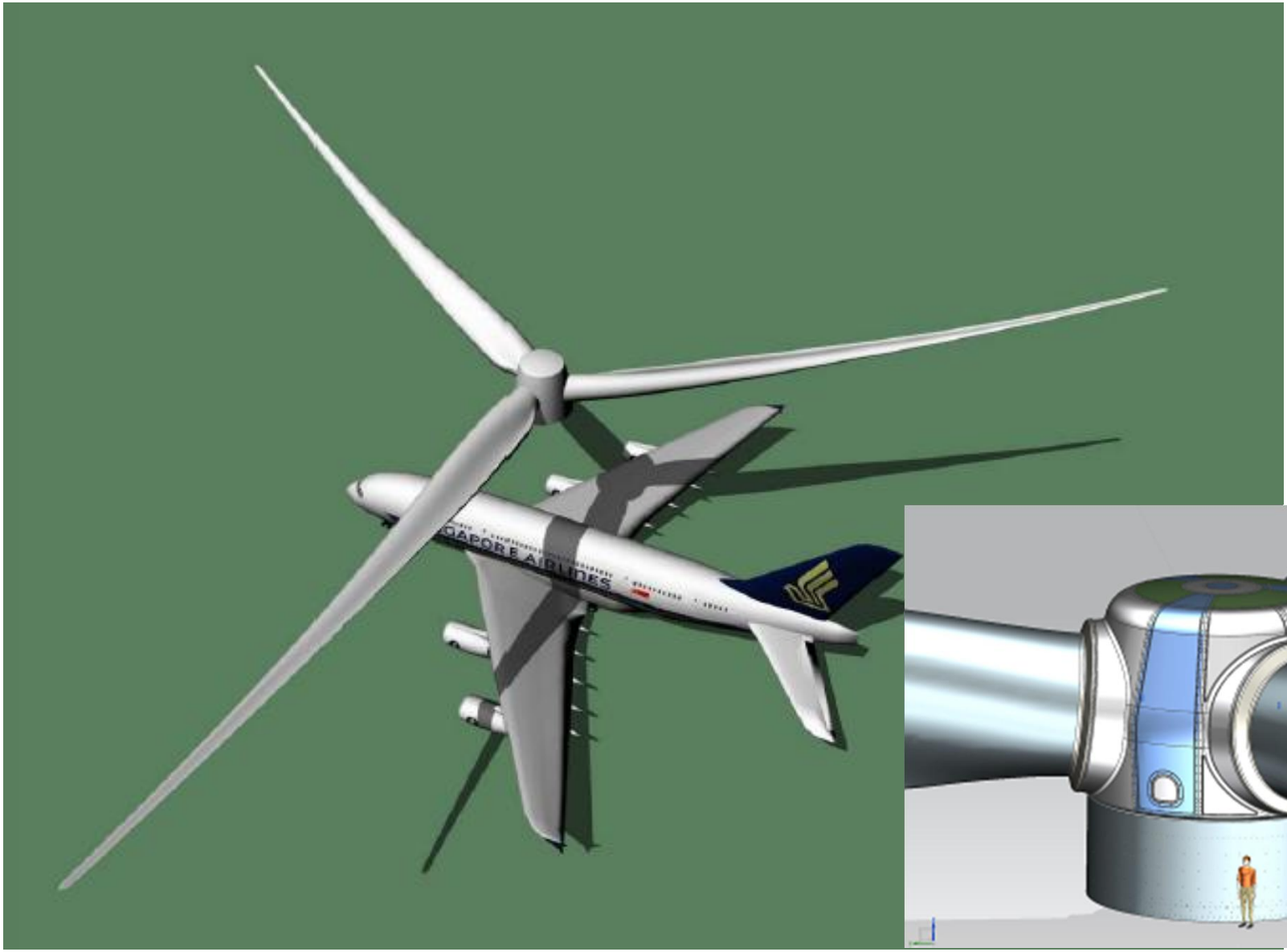
**Generator**
- Ø6.5 m, 100 t
- 5500 kNm torque

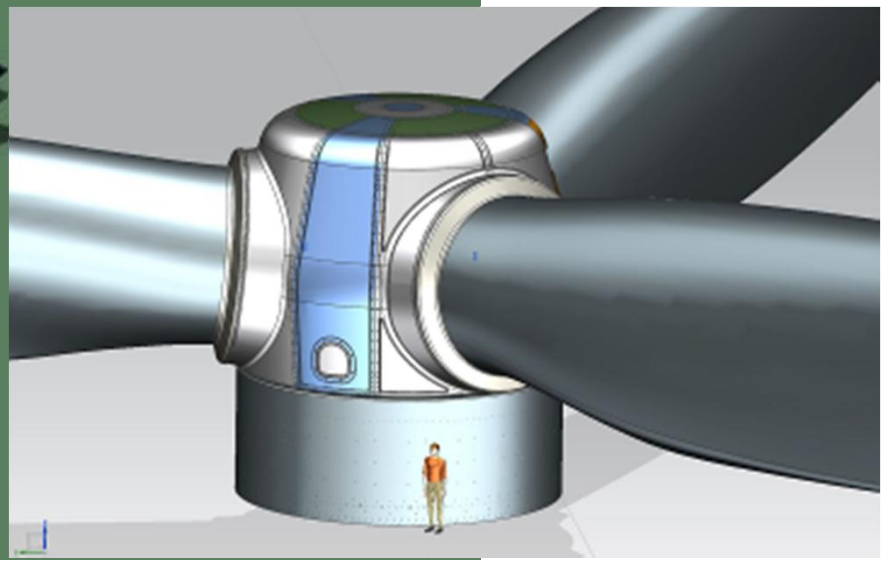
**Power converter**
- AC–DC–AC

**Transformer**
- 7 MVA, 0.69/33 kV

**Tower**
- 100 m, 300 t

# The 154 m rotor for the 6.0 MW is a large piece of equipment …Here with an Airbus A380





# The simulated rotor dimensions are real!
# 6.0-154 Prototype installation

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# The size of the blade leads to new challenges in mold preparation and fiberglass packing

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# The modular approach – borrowing from the auto industry

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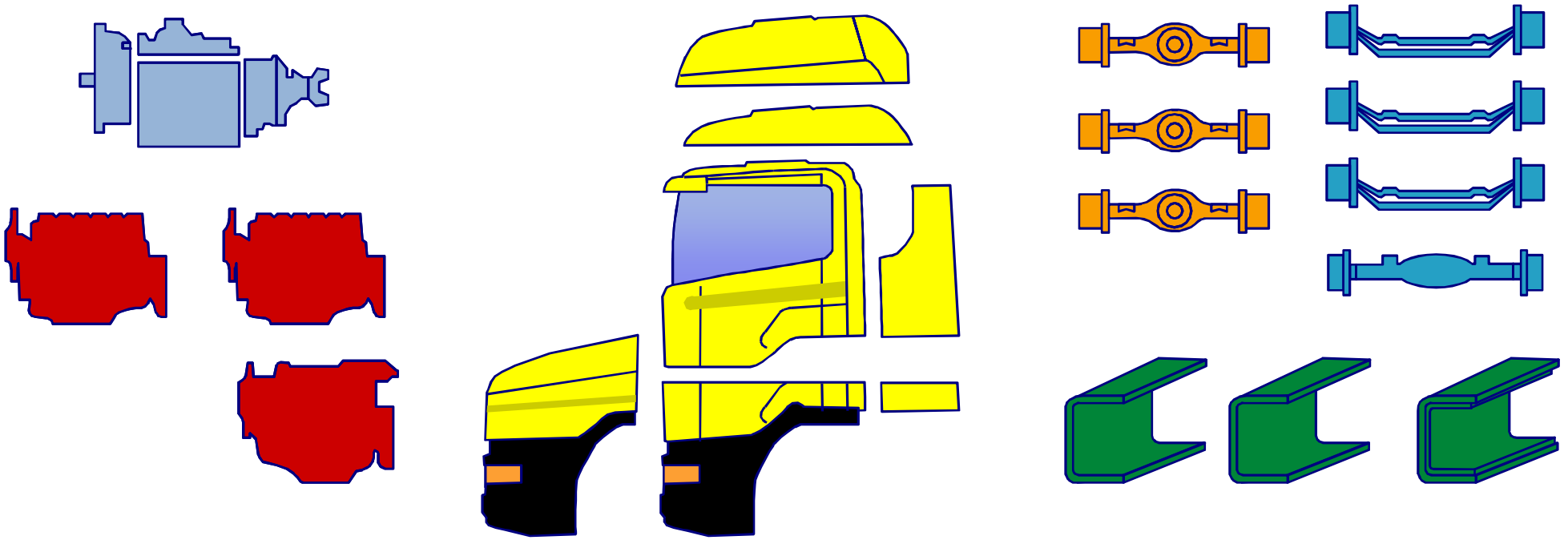
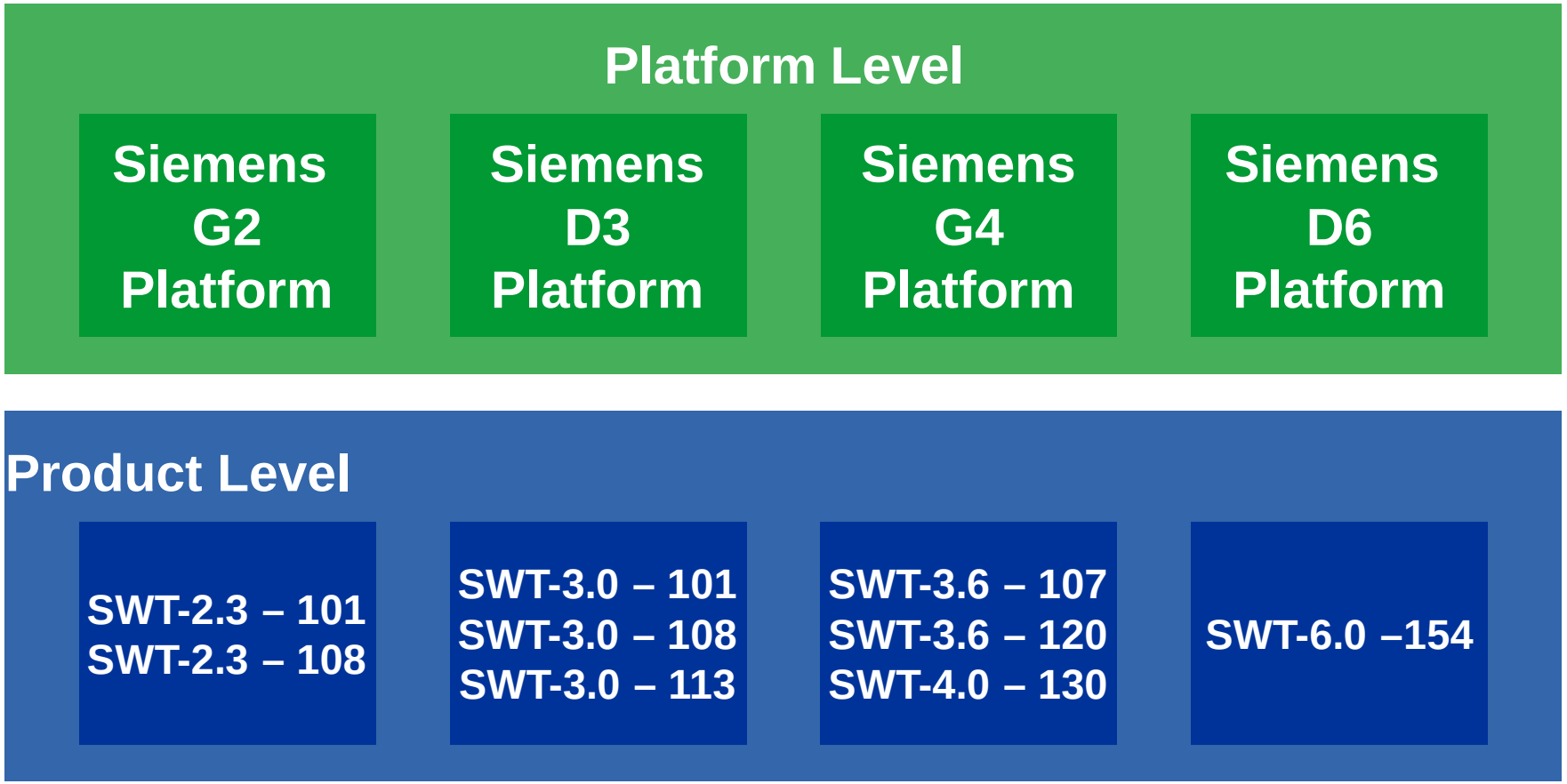
## Meet widest possible demand with minimum number of components

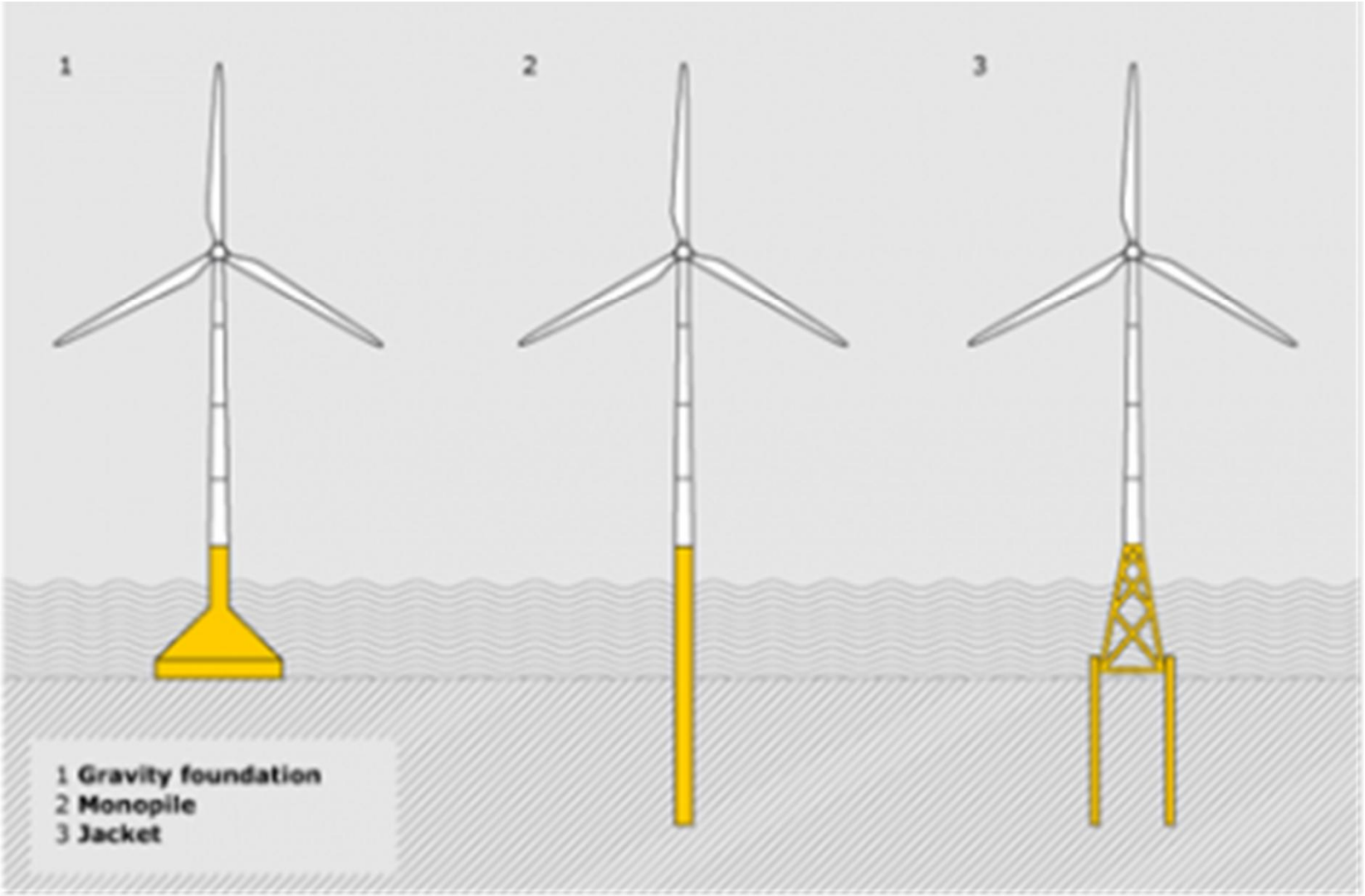


# The Siemens product platforms



# Main lever for installation – dedicated vessels

# Offfshore foundation technologies

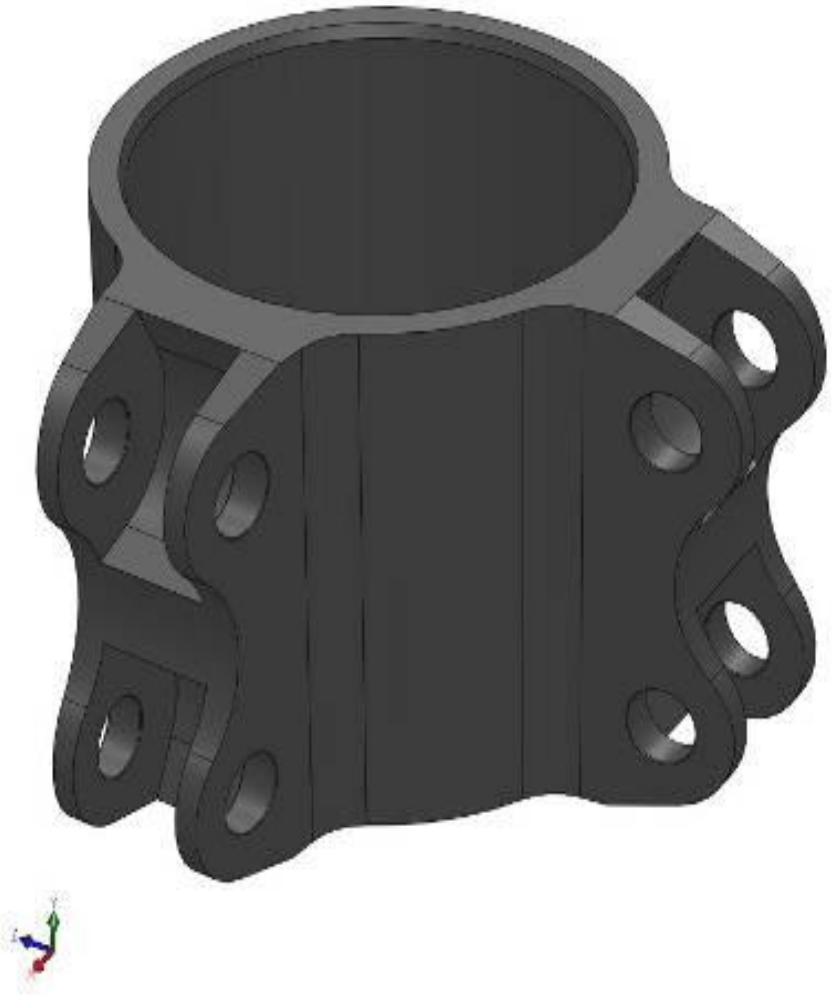


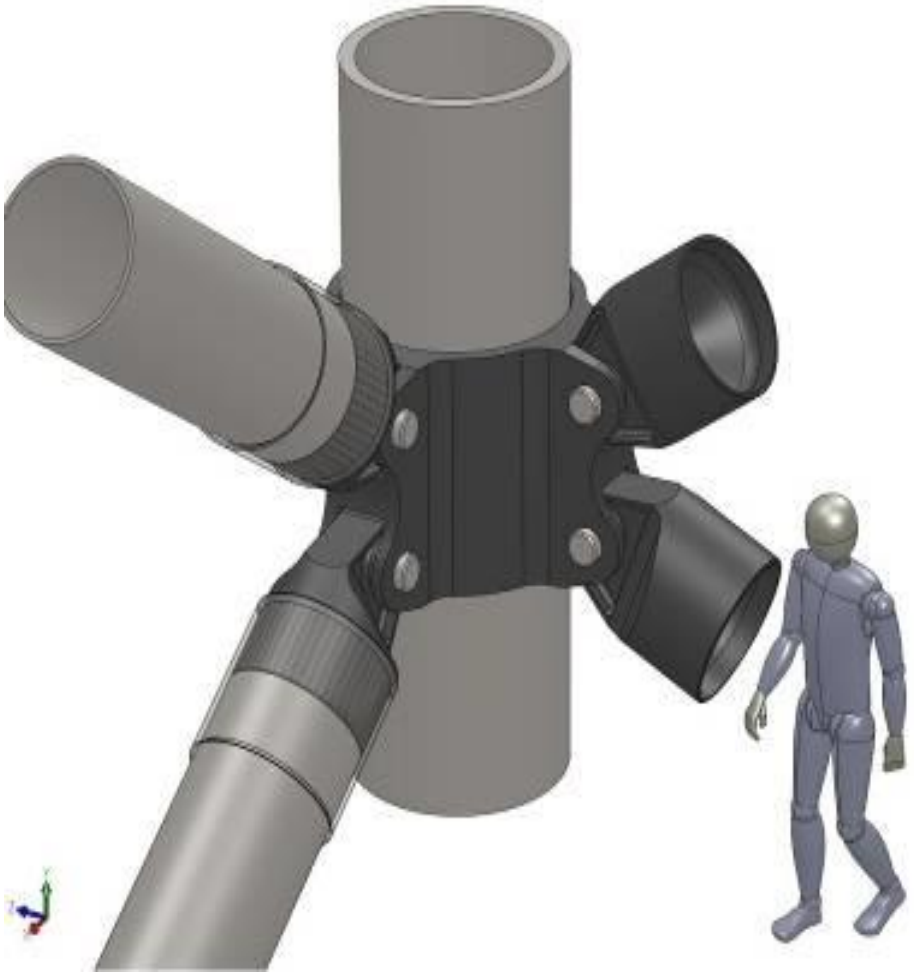

**Source: Climatetechwiki**

# Jacket foundation


**Source: Rechargenews**

# Example of an innovative jacket foundation node





# Concept design

## Bolted jacket with simple TP and suction buckets

1 Innovative TP design with focus on simplicity, cost and functionality

2 Leg pipes from existing mass production facilities.

3 Brace pipes in standard dimensions also from mass production facilities.

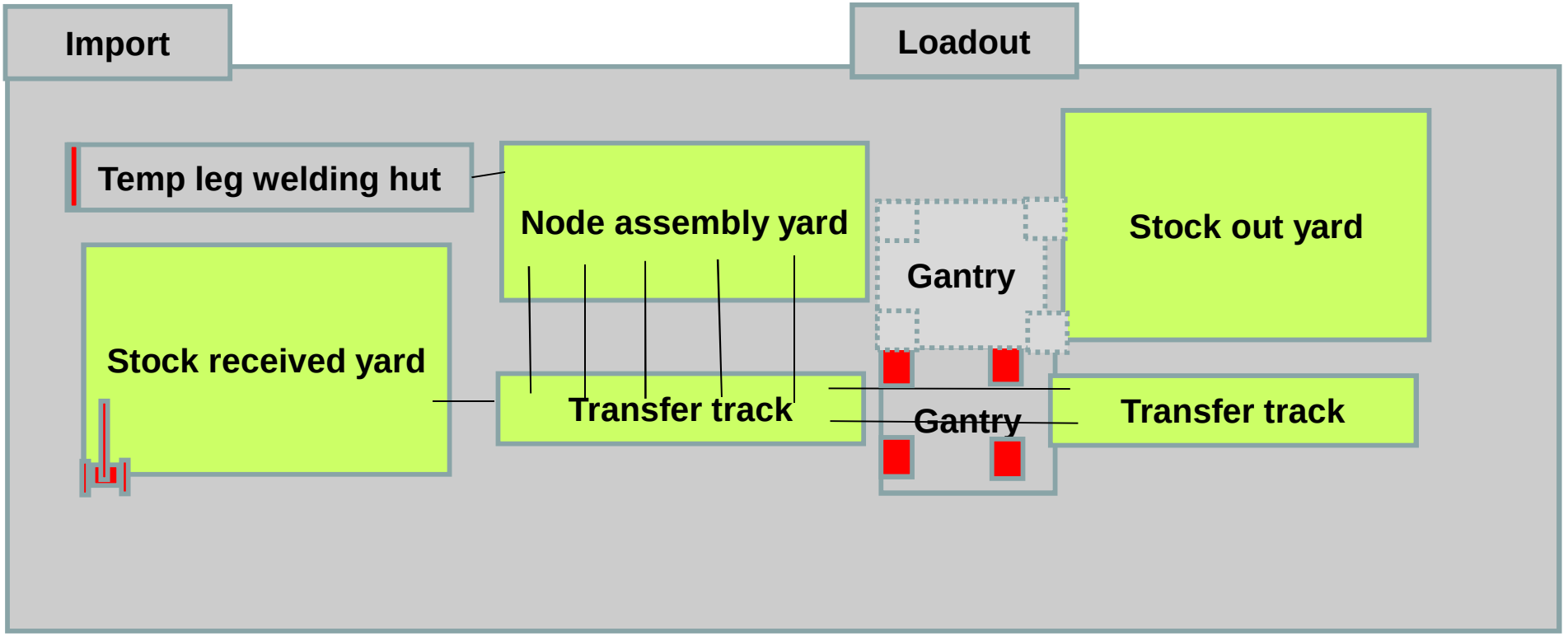
4 Nodal joints produced in an automated production line.

5 Bolted connections between nodes and pipes

6 New corrosion protection system

7 Suction buckets

# Layout of industrialized foundation assembly plant




Crawler crane (100 te)

# A known value chain – a mirror of the wind turbine chain.

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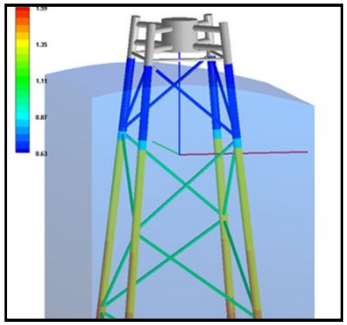
## Approach combines economies of scale and flexibility towards market

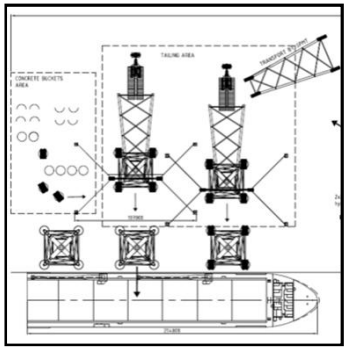
Project specific design

Purchasing modules

Assembly in port

Offshore Installation





# In 2024, offshore wind turbines will look as today – but dimensions and supply chain will be different …

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## Offshore wind turbine design and supply chain

### Product Characteristics

- Power rating: 6 – 10 MW
- Rotor diameter: 154 – 210 m
- Tower height: 80 – 150 m

### Technologies

- Automated blade manufacturing
- Simplified Direct Drive
- Tailored redundancy concepts

### Supply Chain

- Subcontracting of range of sub-modules
- Plug-and-play installation
- Balance of Plant at 30% of today‘s cost

**Energy price (LCOE) < 95 EUR/MWh**

# Your moment of zen

## SWT-6.0-154

- The next generation in offshore wind turbine technology
- Annual energy production  at an offshore site 25 mio. kWh
- Annual energy output of seven pcs. 6 MW at an offshore site equals the electricity consumption of all households in Kolding Kommune (90.000 inhabitants)
- Entering serial production 2014
- **Long term success will be a function of supply chain innovation!**


# Thanks for your attention!