



# Innovating to lower the cost of energy

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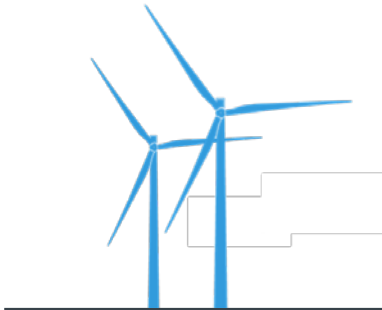
# Vestas in brief

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**+ 22,000**

We employ more than 22,000 people worldwide and have more than 35 years of experience with wind energy



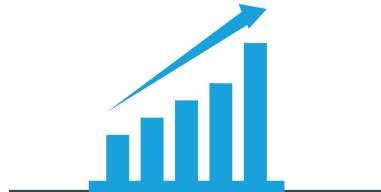
**+ 60,000**

We have more than 60,000 turbines or more than 83 GW cumulative installed capacity in 75 countries worldwide spanning six continents



**+ 38,000**

We have more than 38,000 turbines, or 73 GW, under a service agreement

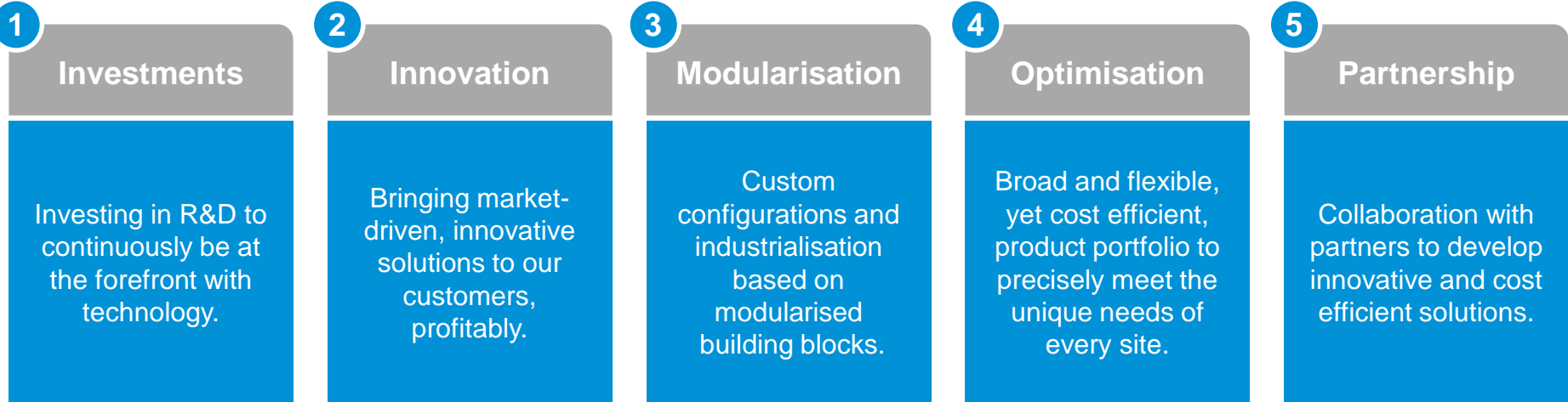


**€ 10,2bn**

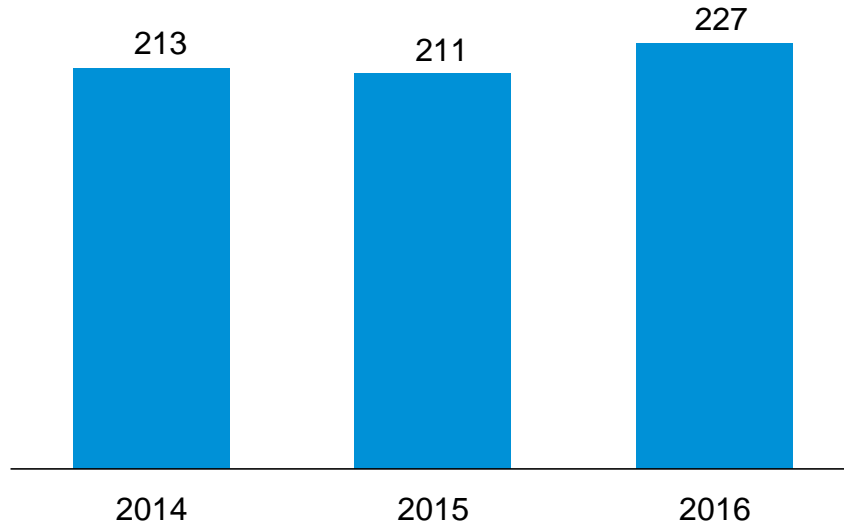
Revenue for 2016 was EUR 10,2bn

# Lowering the cost of energy in five ways

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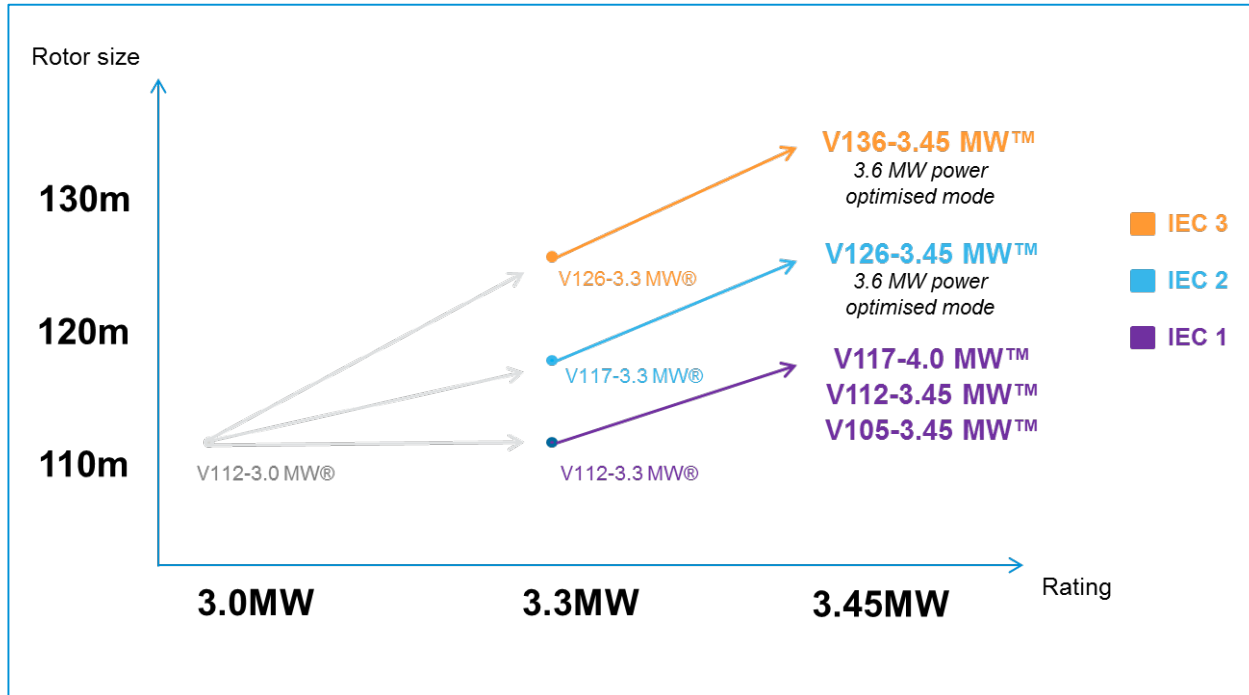


Vestas R&D costs recognised in the income statement:  
mEUR



- As an industry, we need to continuously introduce new technology and effectively integrate proven technologies into our products and services.
- In 2016, we invested more in R&D than any of our peers and continued launching product upgrades and innovations that can lower the cost of energy.

## 3 MW platform turbine optimisations:



## Recent innovations:



### V164-8.0MW

World's most powerful wind turbine updated to 9.5MW



### Multirotor

Challenging scaling rules with multirotor demonstrator



Further utilise model prediction, high performance computing and big data to **support energy systems** dynamics.



Offer ancillary services by improving control and **optimal integration of storage** in wind power plants and wind turbines.



**New technology materials** such as radical weight reduction through Bionic design and Additive Manufacturing.



Exploit **Vestas' access to big data** for diagnostics, remaining useful life analysis, service and after sales optimisation.



**Mobile factory** reducing logistics challenges through portability and offering local labour creation at low investments.



Turbine R&D, value chain simulation, O&M **performance and optimisation** all founded on high performance computing.



2 MW PLATFORM

PRODUCT-CAPACITY  
YEAR OF PROTOTYPE

V90-1.8 MW®	V100-2.0 MW®	V110-2.0 MW®	V116 2.0 MW™	V120 2.0 MW™
2004	2009	2014	2017	2018

Installed\*  
36 GW

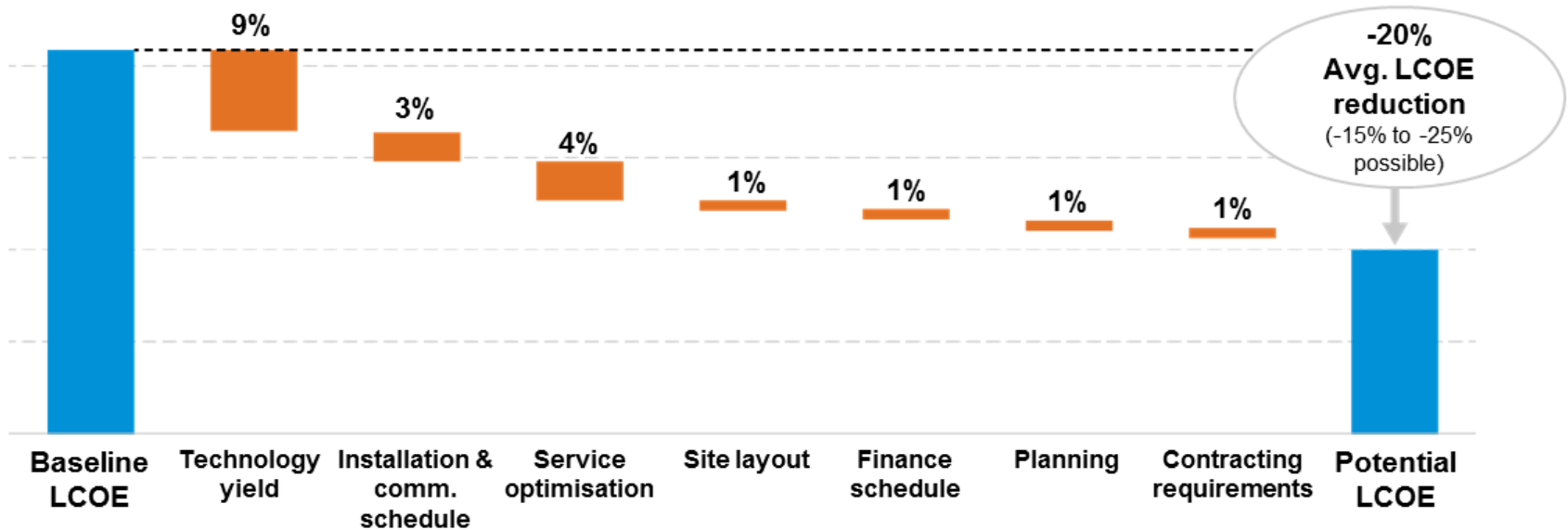


3 MW PLATFORM

V105-3.45 MW™	V112-3.45 MW™**	V117-3.45 MW™	V126-3.45 MW™	V136-3.45 MW™
2014	2013	2013	2013	2016

Installed\*  
13 GW

Potential optimisations across planning, yield, technology, installation and commissioning, servicing and sometimes financing that could reduce LCOE equal to a LCOE reduction of between 15-25%\* - without reducing any safety and quality measures:







Europe's largest onshore wind power project to be built in Central-Norway



Construction has started and commissioning will be completed in 2020



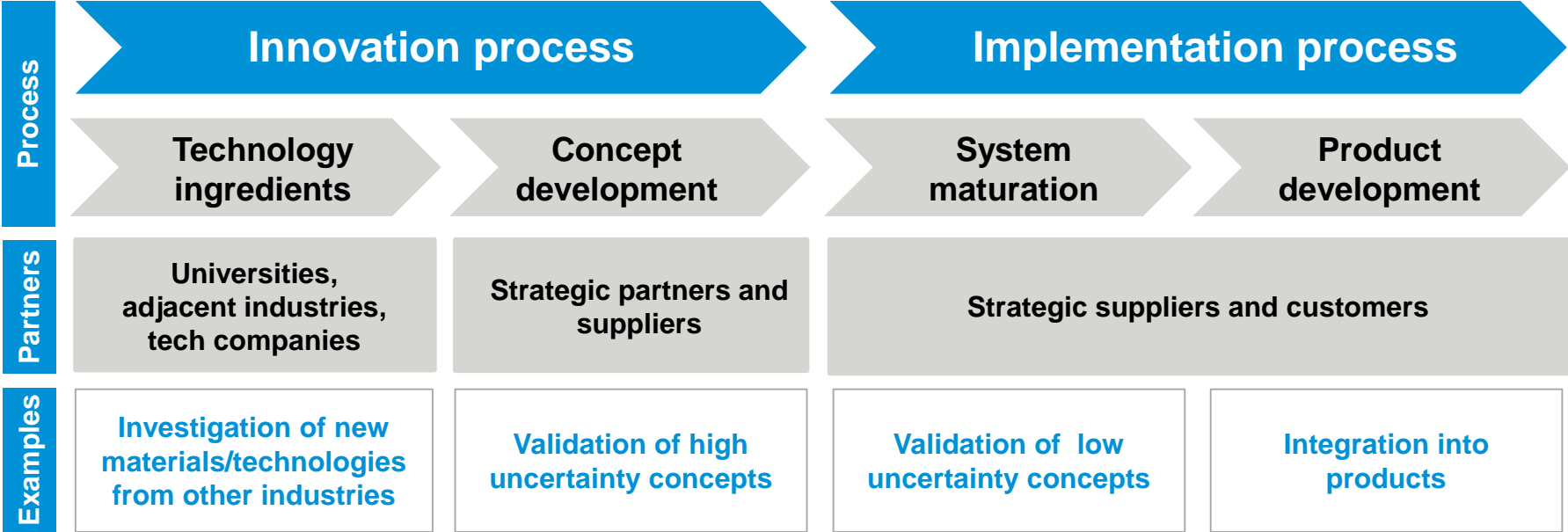
Total investment in the wind farms amounts to approx. EUR 1.1bn



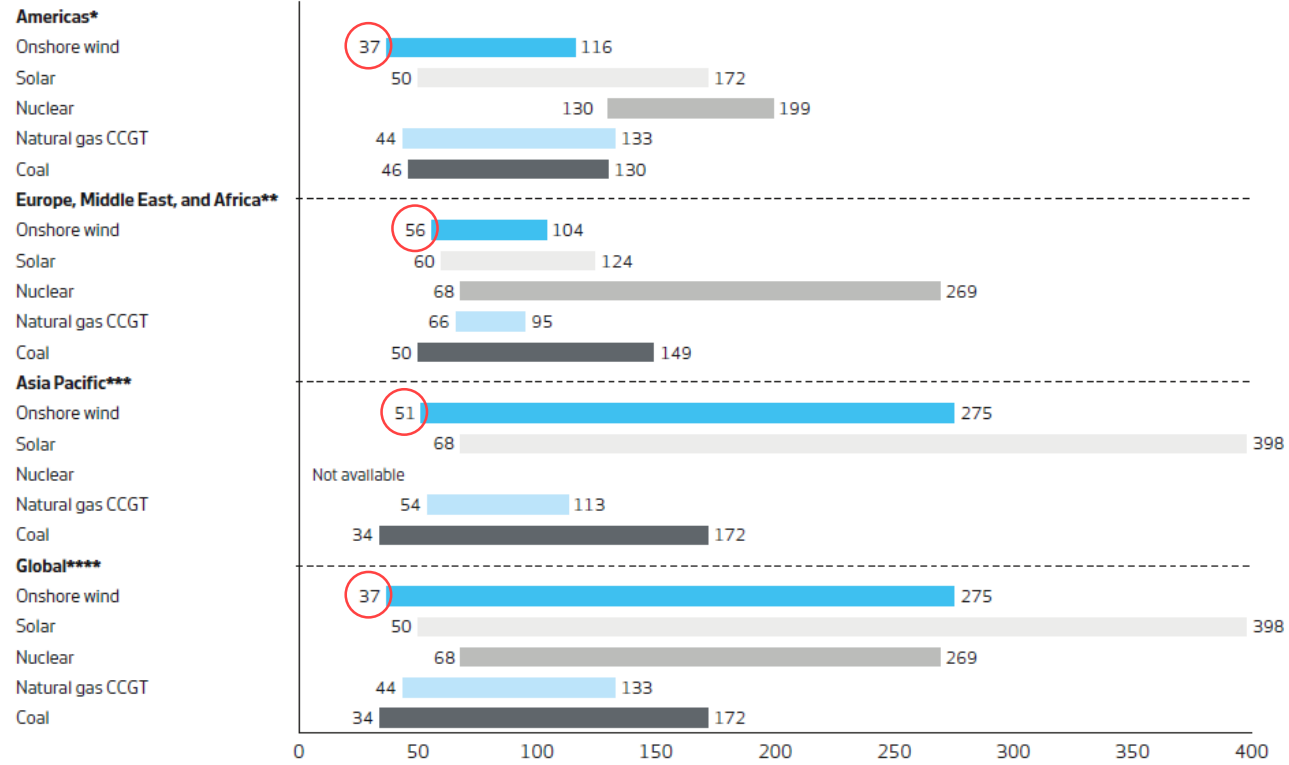
Statkraft, TrønderEnergi and a European investor consortium behind owner Fosen Vind

## Optimisation efforts:

- Availability of better sites in the Fosen area also increased the business case.
- Upgrading the 3 MW platform increasing the power output from 3.45 MW to 3.6 MW.
- Enabling the wind parks to produce the same amount of energy with fewer turbines.



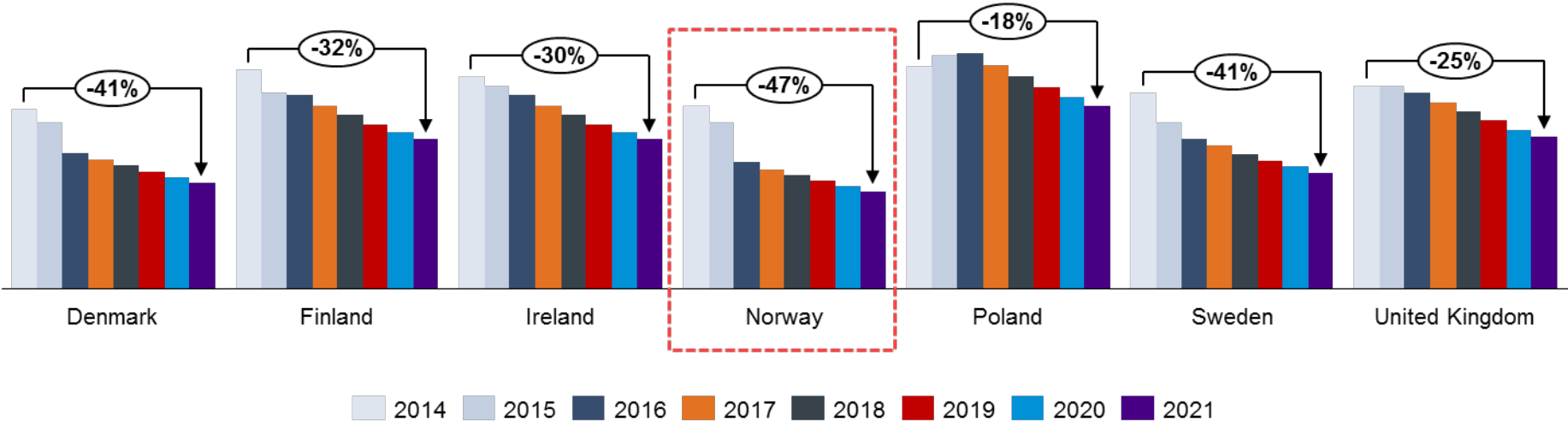
# LCOE today worldwide



- The cost of wind energy has reduced dramatically in recent years and has made wind an economically competitive power source
- On a global average, the price of wind energy has declined by 15 percent over the last five years, or 80 percent over the last 20 years, greatly supporting a strong underlying demand for wind energy

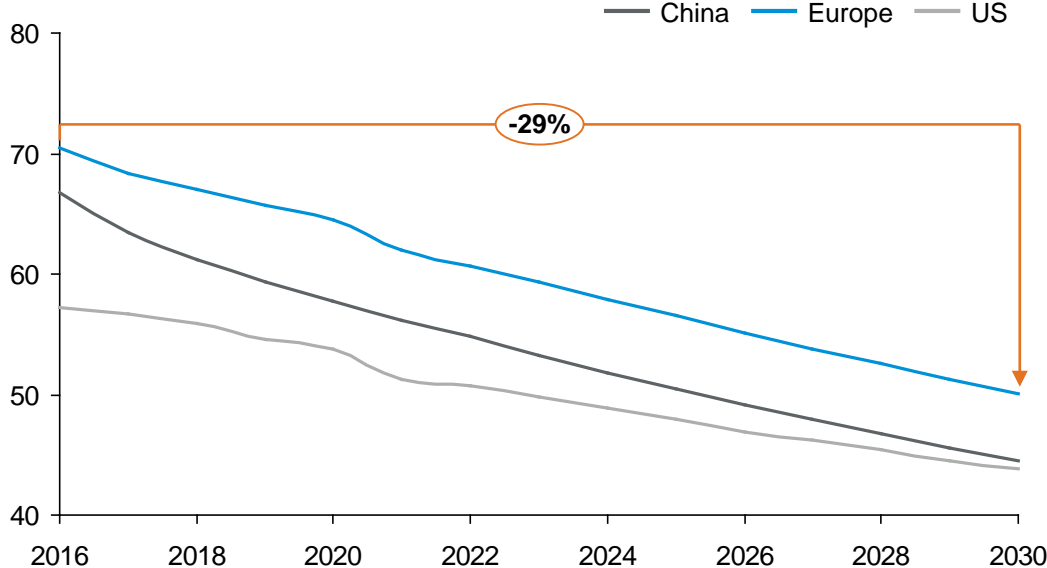
# Vestas LCOE development 2014-2021e

Expected LCOE development, onshore wind, Northern Europe  
 EUR/MWh



# LCOE tomorrow

Expected average LCOE developments for onshore wind  
EUR/MWh



- 1 Investments
- 2 Innovation
- 3 Modularisation
- 4 Optimisation
- 5 Partnership



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