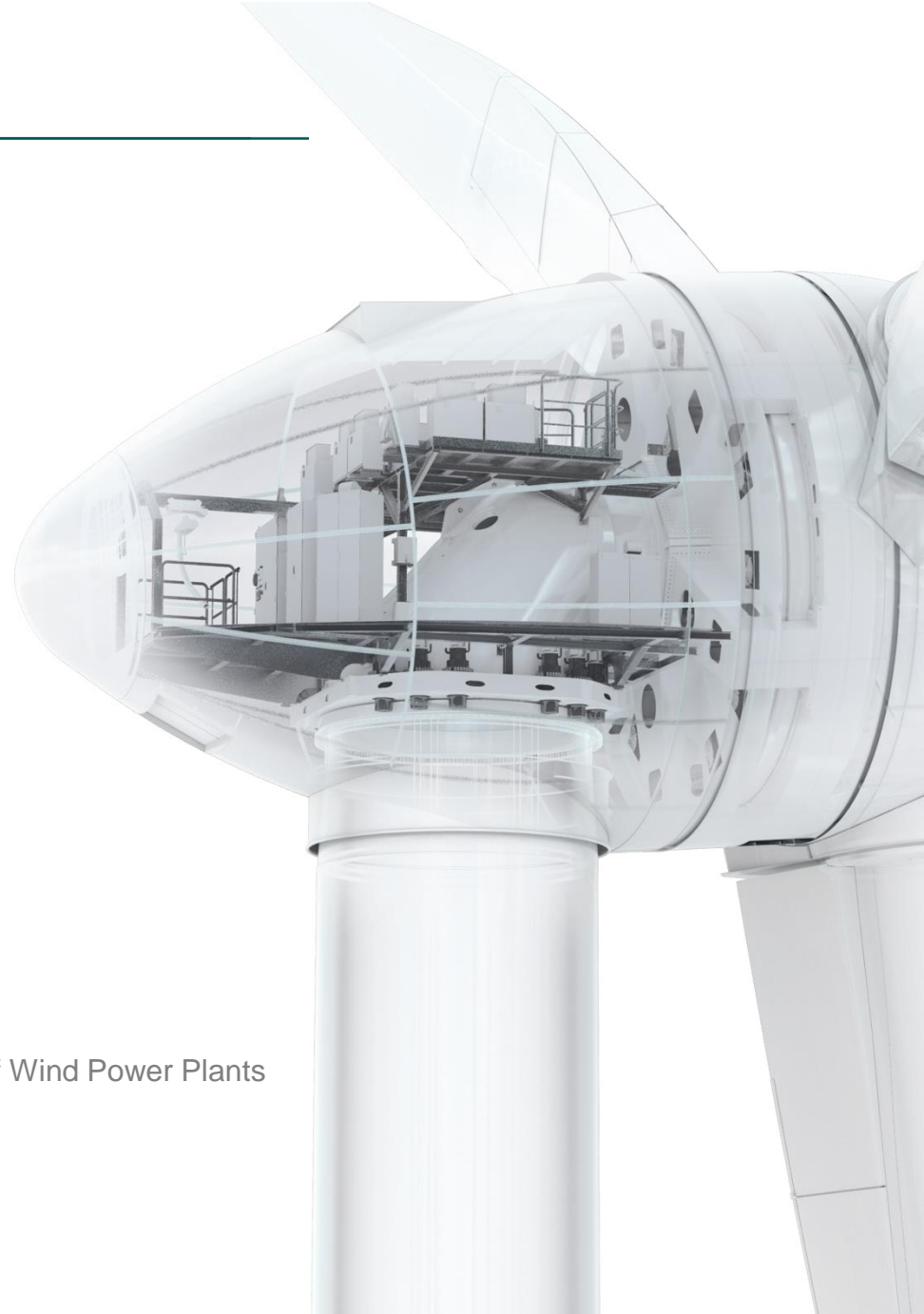




Risk Assessment to Wind Turbine Life Extension

The Future of the Wind Sector | Life Extension and Repowering of Wind Power Plants

Carlos Oliveira | APREN | OE | 07-12-2017



LCOE

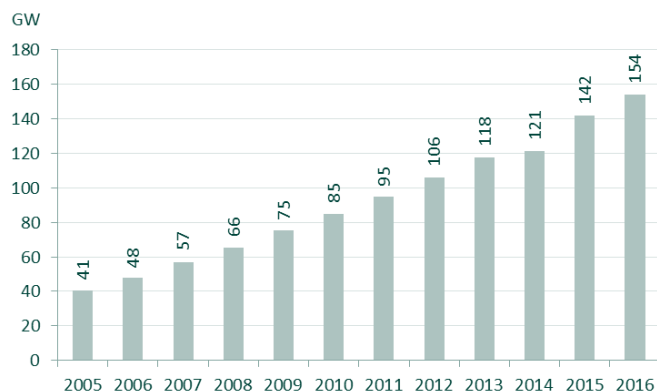


- [illegible]

-

- LCOE has been decreasing consistently
- Pressure for lower LCOE from other generation technologies
- Low LCOE will ensure wind power competitiveness

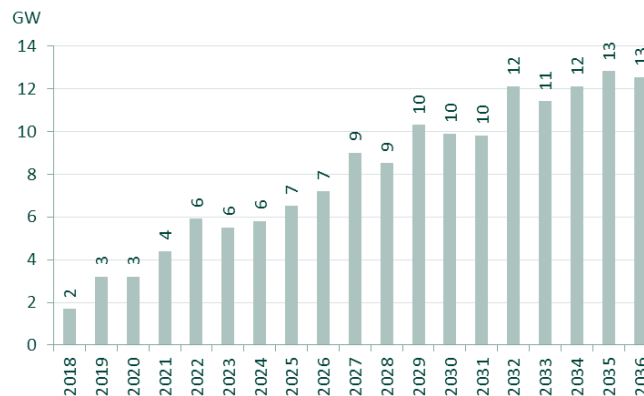
Accumulated power



Cumulative installations in the EU
Source: WindEurope

- EU is a leading region in the World on wind power
- Installations began more than 20 years ago
- Wind energy benefit for the EU towards energy independence

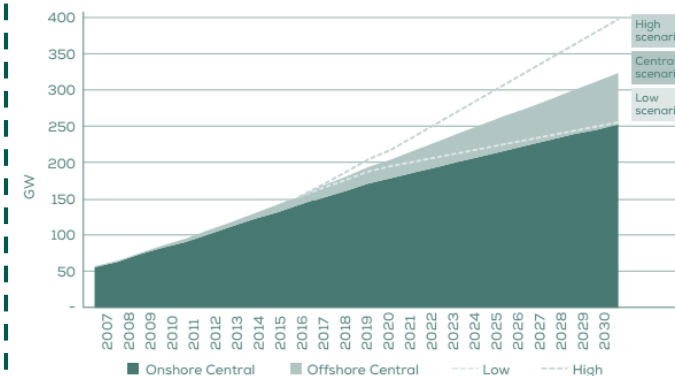
Fleet characterization



Annual installed power reaching 20 years in Europe
Source: WindEurope

- Installation began more than 20 years ago
- Early adopters of wind power
- Fleet age is among the highest in the world

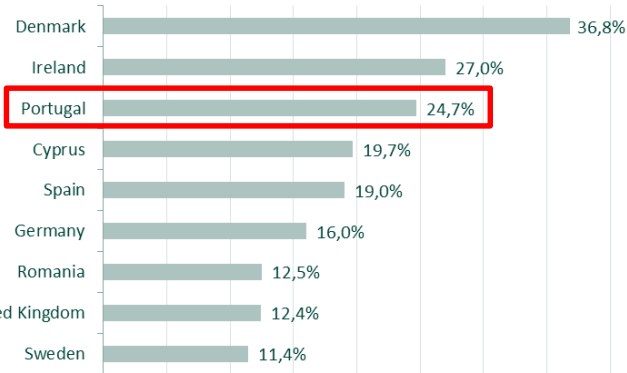
EU 2030 scenarios



Cumulative installations in the EU, 2030 scenarios
Source: WindEurope

- Cumulative wind power capacity set for continued growth
- Old fleet essential part of accumulated capacity
- Essential to achieve EU 2030 scenarios

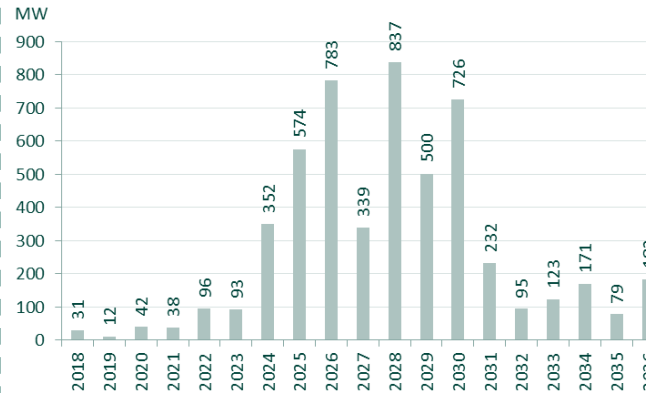
Wind production share



Wind penetration rates in European countries, 2016
Source: WindEurope

- Country with one of the highest share of energy production from wind
- Hard to replace source of energy
- Wind energy benefit for the country

Fleet characterization

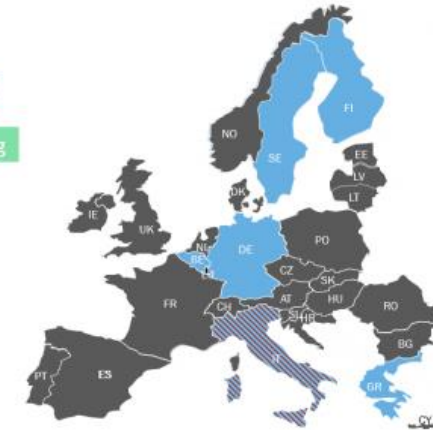


Installed power reaching 20 years in Portugal, 2017
Source: APREN

- Installation began more than 20 years ago
- Early adopters of wind power
- Fleet age is among the highest in the world

Regulatory framework

- Definitions
- Existing incentives
- Fast-track permitting



Regulatory framework for repowering in EU, 2016
Source: WindEurope

- Despite fleet age, there is no framework in Portugal
- Essential to support renewables expansion
- Essential to ensure country energy independence

WHAT are the options

Life Extension



Repower



Decommission



Life Extension



Pros

- No CAPEX
- Short-term decrease of LCOE
- Site specific advantages

Cons

- Usage of less efficient technology / turbines



Repower



Pros

- Potential decrease of OPEX
- Long-term decrease of LCOE
- Lower visual impact
- Increased AEP
- Higher grid support

Cons

- Need of CAPEX
- Lack of repower incentives

Repower



Old windfarm



Decommission



Pros

- No benefits

Cons

- No future for wind energy
- No viable alternative to substitute source of energy
- Problem for Portugal energy independence
- Miss 2030 targets for renewable energy
- Loss on direct and indirect wind energy related GDP
- ...

WHAT are the real options

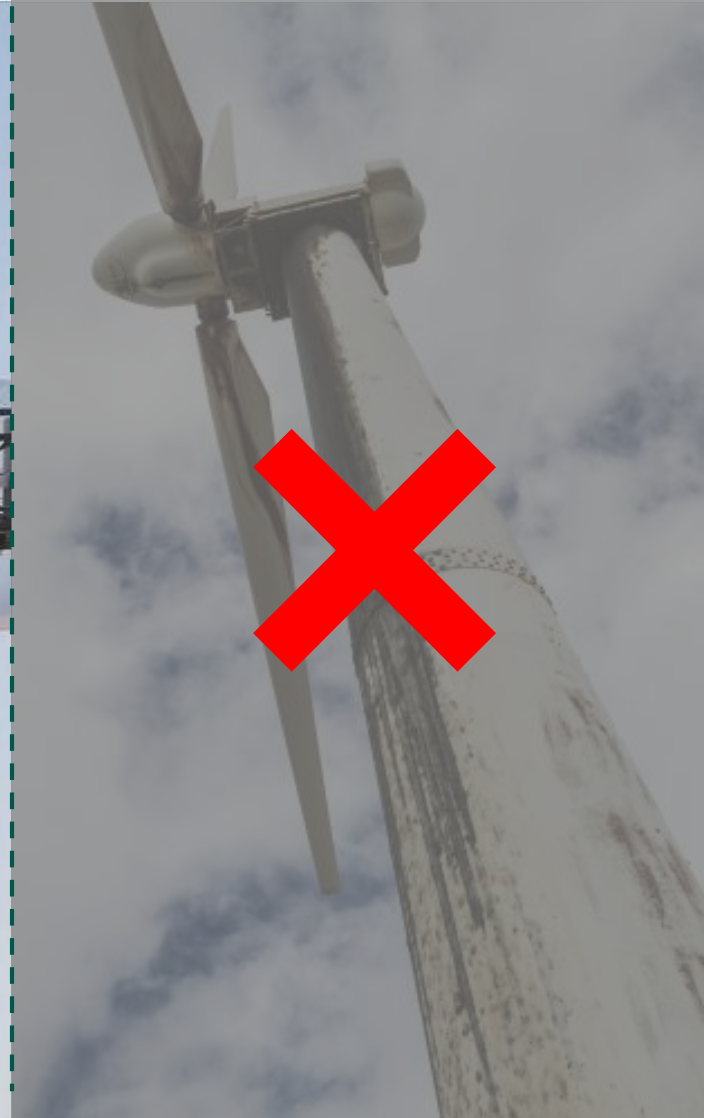
Life Extension



Repower



Decommission



Life Extension

Analytical assessment

Wind modeling

Operation data

WT aeroelastic
model

Site loads vs.
design loads

Practical assessment

WT inspections

WF inspections

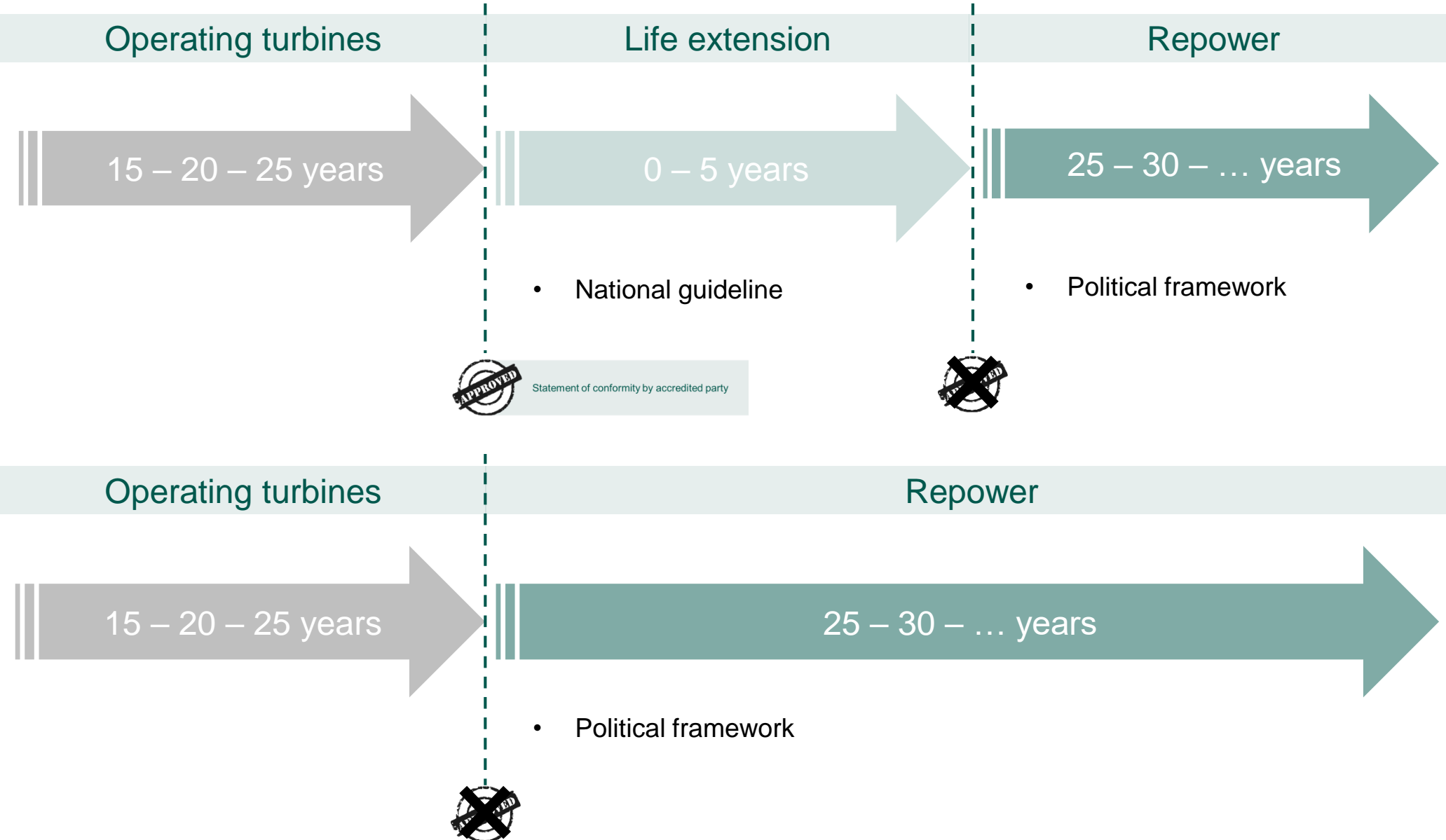
O&M records

Visual inspection



Statement of conformity by accredited party

International harmonization: DNVGL / BWE Example Netherlands: NPR 8400



| | | |
|----------------------------|--|---------------------------------------|
| Life Extension | | |
| National guideline needed | Short-term solution | |
| | Case by case | |
| Repower | | |
| Political framework needed | Long-term solution | |
| | Tender system | Incentives scheme |
| | More efficient turbines | Ensure wind power |
| | Potential for market price | Energy independence |
| | Portugal competitiveness in the global market ?? | Portugal energy import/export balance |



THANK YOU FOR YOUR ATTENTION



ENERCON GmbH
Dreekamp 5 | D-26605 Aurich
Telephone: +49 4941 927-0 | Fax: +49 4941 927-109