

# Wind Value: End of life Choices for Wind Farms

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# Agenda

Introduction



Issues at the end-of-life



Wind Value's findings



Next

# What happens to the old wind turbines ?

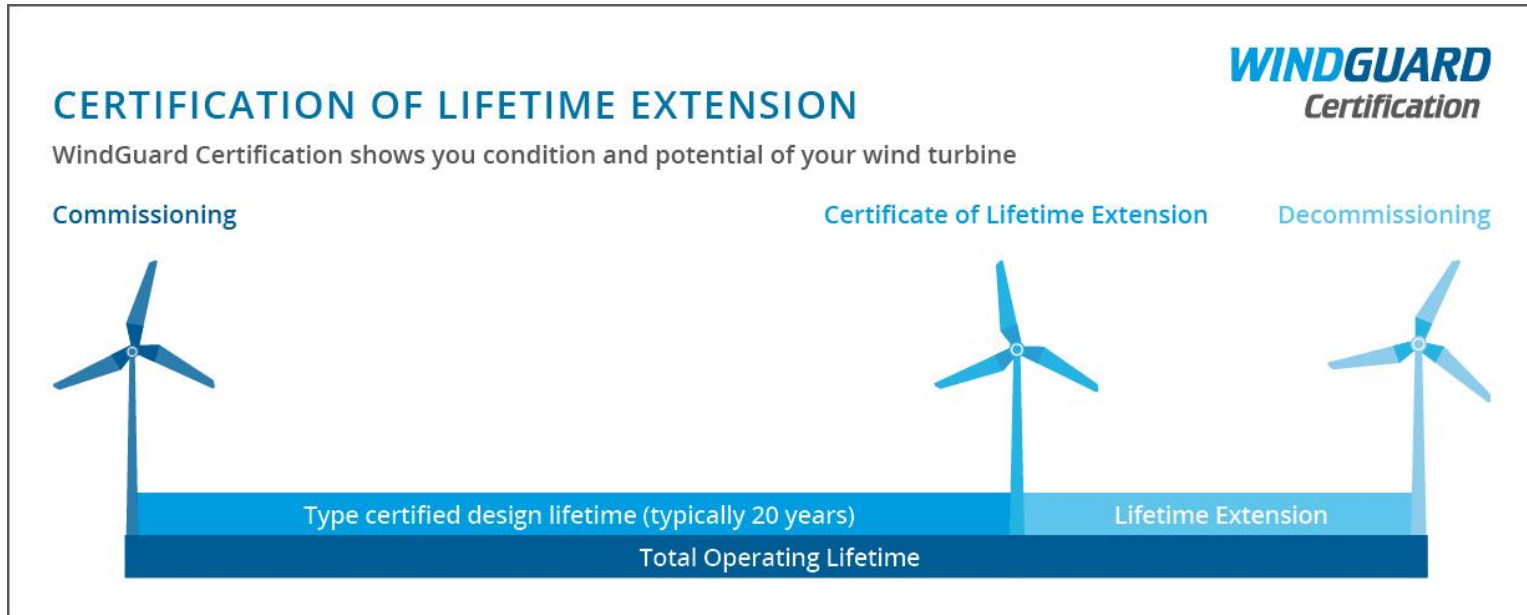
## Decommissioning



## Repowering



## Life-Extension



# What to consider at the end of life

## Operating permits

- A need for new permit
- Life extension certification

## Electricity markets (price, regulatory policies, demand)

- Any regulatory support?
- Electricity price trends
- Forecasted demand

## Turbine condition (O&M, Availability, Profitability)

- What are the failure rates?
- How high are the O&M costs?
- Any financial risks involved?
- What about risk to people and the environment?

## What end of life choice is economically viable?

- Decommissioning
- Life-extension
- Repowering

## Energy communities

- Community engagement
- How does it impact end of life choices

# Wind Value Findings

## 1. The Financial Risks from Wind Turbine Failures: A Value at Risk Approach

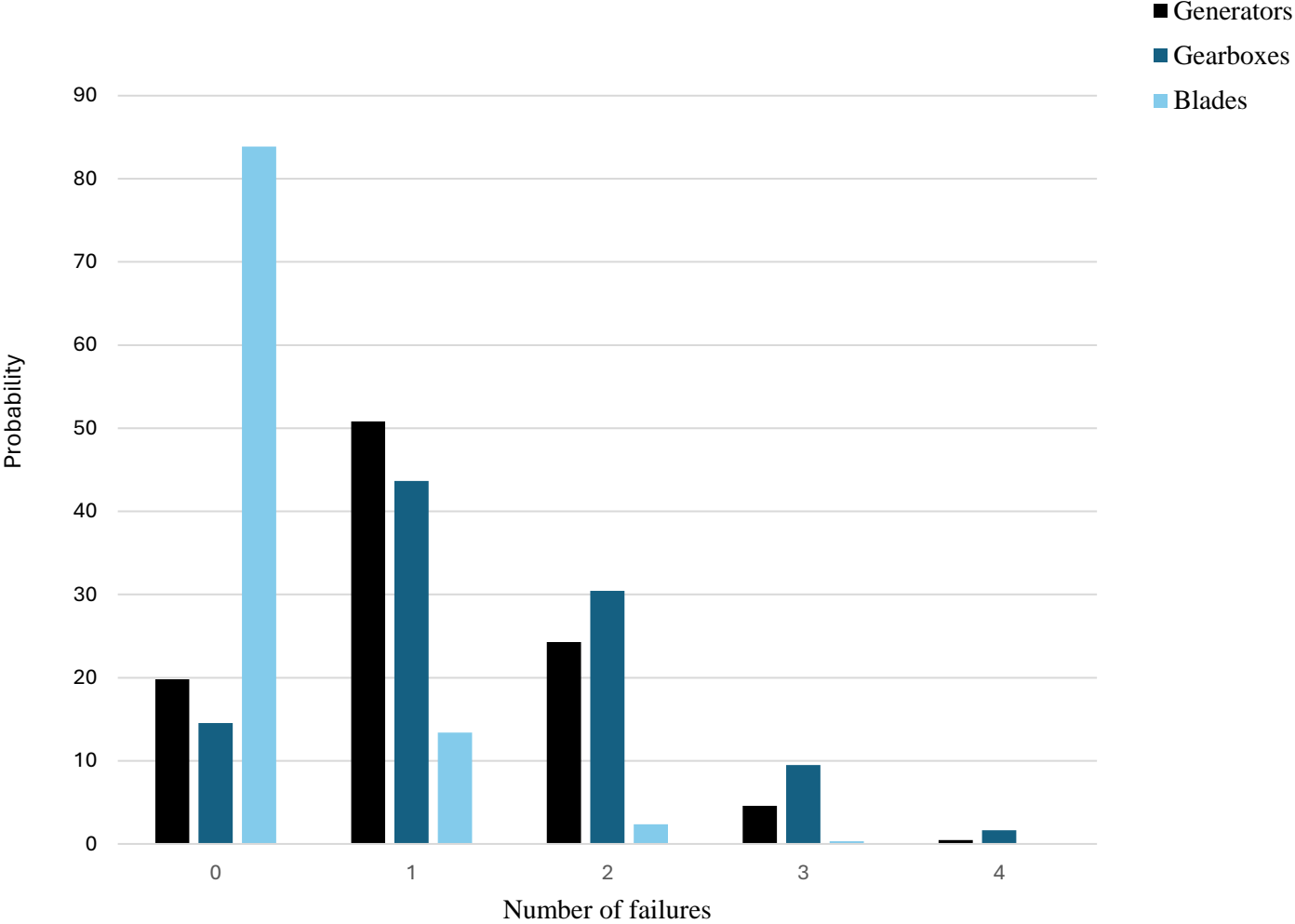
We used industry failure data, Monte Carlo simulation, and discounting factor techniques to analyse how

(a) Turbine failures cause financial costs and risk in wind farms

(a) Diversification (size of the farm) impacts risks' magnitude

(a) Failure Rates

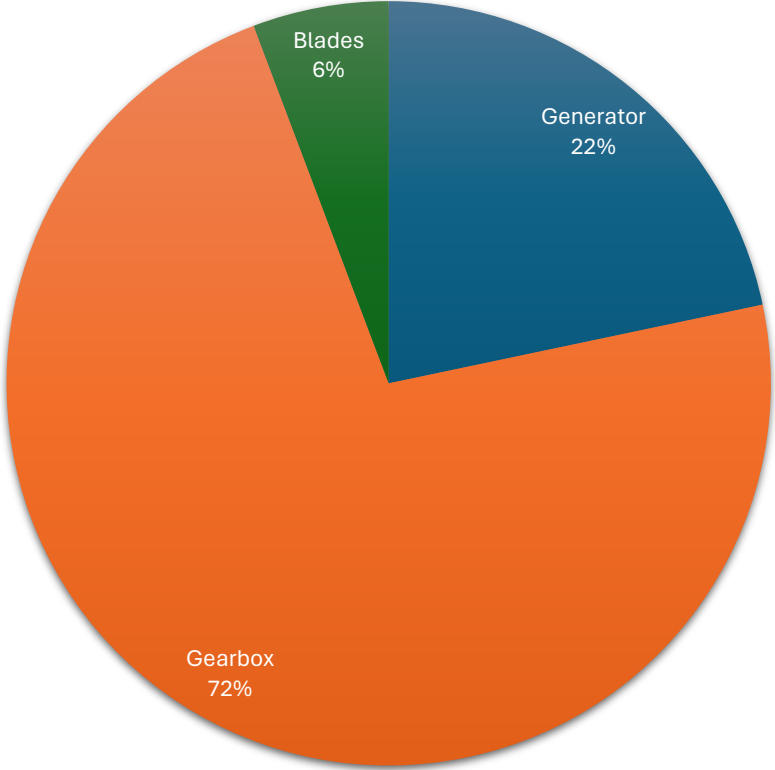
Numbers of Component Failures During 20 years



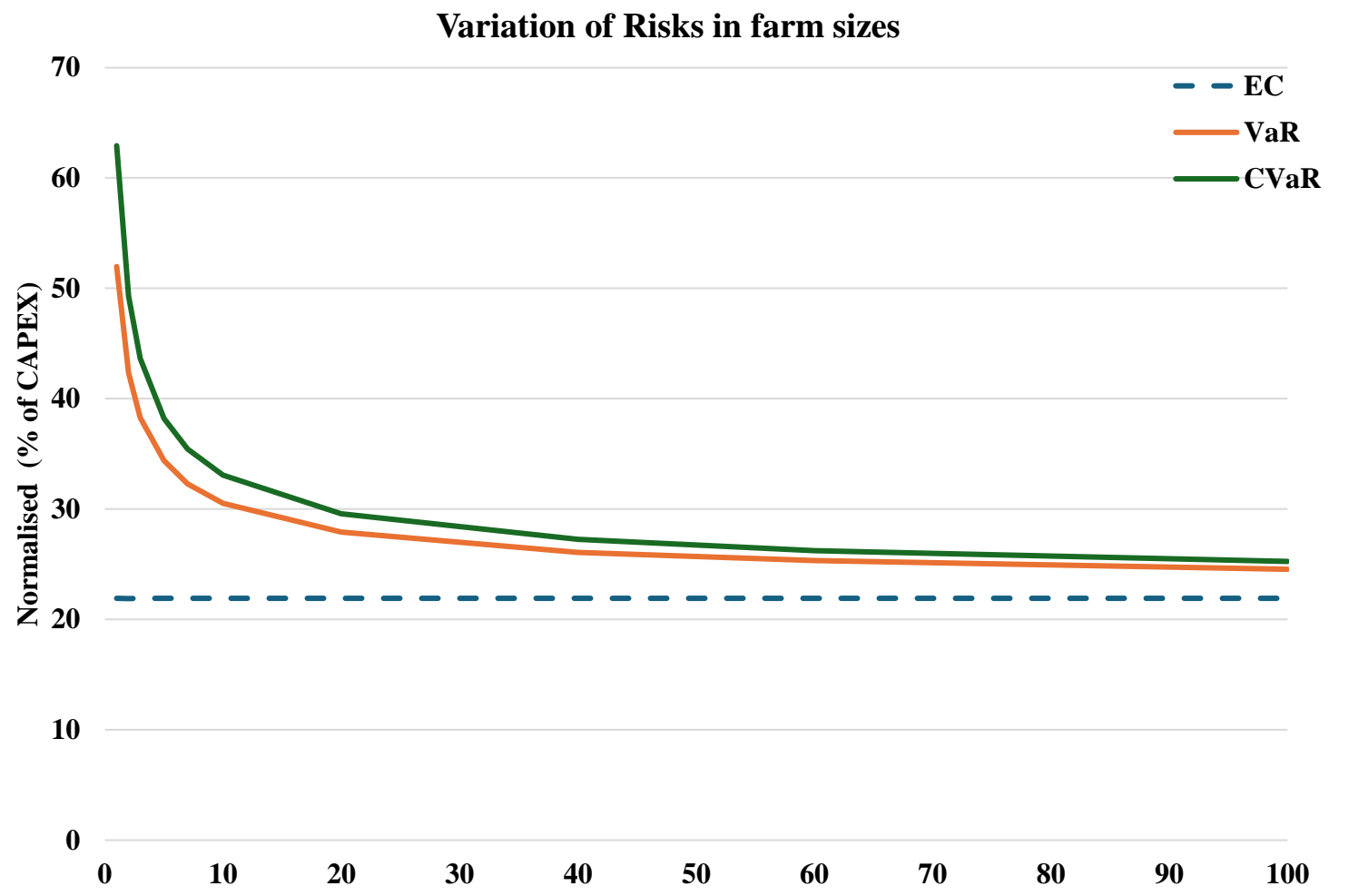
- Gearboxes fail the most, followed by generators and blades are the least likely to fail.

(b) Cost Analysis

Components cost distribution



(c) Risk Analysis





# Wind Value Findings With Embedded Option Analysis

## 2. The effect of electricity markets on the end-of-life decisions for Irish Wind Farms: A real option analysis.

- During the first life of the wind farm there are three embedded options, the abandon, wait and see, and expansion options. These are present as a consequence of owning a wind farm.
- During the second life not all of these are present, depending on the state of the wind farm.
- We examine the embedded options which are part of the second life choices available after the end of the first life.
- **Decommissioning** has no income, no expenses and no embedded options.
- **Life Extension** lasts for a further 10 years during which there are both an abandonment option and a wait-and-see option. We assume that at the end of 30 years the foundations etc would be too degraded to repower.
- **Repowering** has all the same embedded options as the first life wind farm.

# Wind Value Findings With Embedded Option Analysis

## 2. The effect of electricity markets on the end-of-life decisions for Irish Wind Farms: A real option analysis.

- By using real option analysis, we investigate the economically viable end-of-life investment option for wind farms amidst market uncertainties. The value of the embedded option is added to the NPV. The value of the option changes with:
  - Demand
  - Market prices
  - REFIT and RESS prices
- Re-powering is the most economically favourable decision across various price scenarios.
- The effects are more pronounced with REFIT & RESS prices

Second Life = Decommissioning			
(€)	Spot	REFIT	RESS
NPV	0	0	0
No Option Value	0	0	0
extended NPV	0	0	0

Second Life = Life Extension			
(€)	Spot	REFIT	RESS
NPV	36,429,894	56,139,320	90,081,479
Abandon			
Wait and See	32,963,132		
Extended NPV			

Second Life = Repower			
(€)	Spot	REFIT	RESS
NPV	51,856,947	71,566,373	105,972,462
Abandon			
Wait and See	32,963,132		
Expansion	46,922,106		
Extended NPV			



# Next Steps in Research

What do communities want?

What are the communities risk attitudes towards investing in renewable technology?

What is a good way to describe investment risk to communities?

# Thanks

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