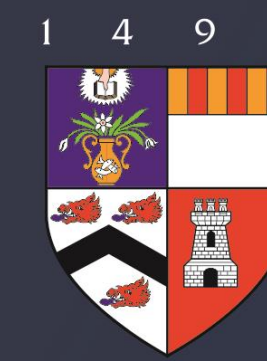


The Economic Feasibility of UK Onshore Wind Repowering and the Costs Reduction Potential

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BACKGROUND

What are the **challenges**?

- ✓ Difficulty in finding new wind farm sites with excellent characteristics
- ✓ Less efficiency of the old turbines
- ✓ Higher old wind farm Operating and Maintenance costs

What can we **do**?

REPOWERING: the effort to gain the power from existing wind farms that have not been efficiently generating the energy by turbines replacement or upscaling

INNOVATIONS: knowledge creation involving all respective parties of the projects

- ✓ to have lower costs per energy generated
- ✓ to establish onshore wind technology as the lowest cost of the new energy generation

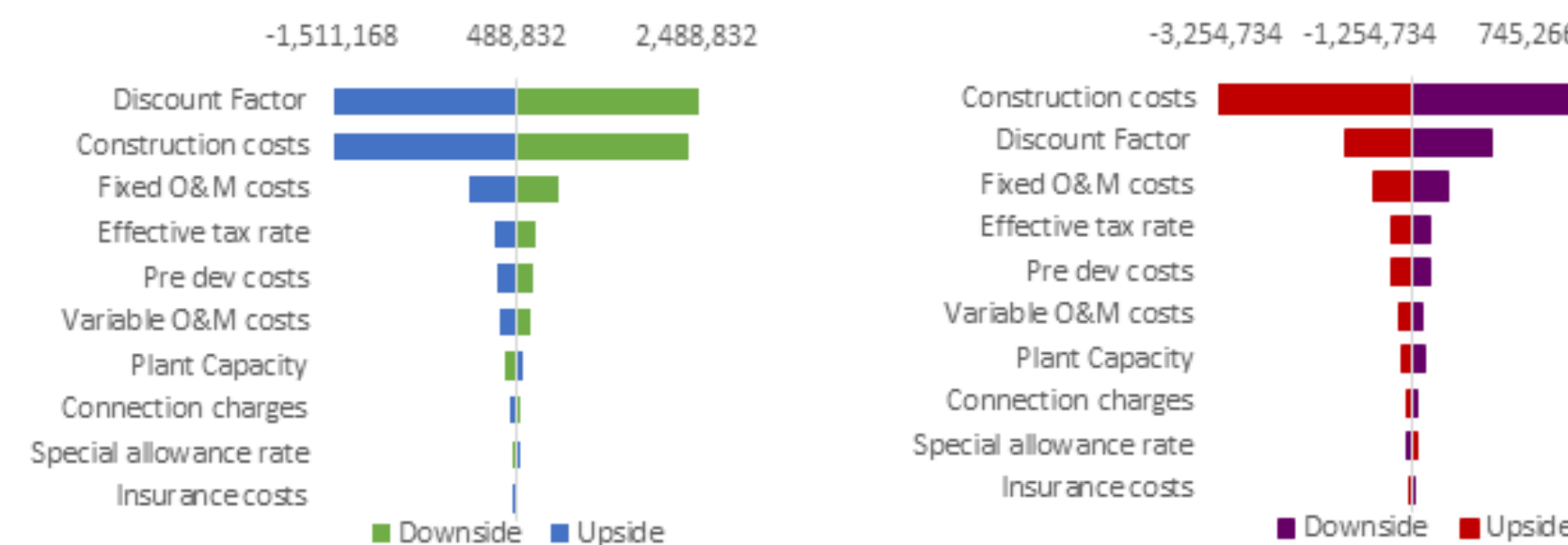
METHODOLOGY

- ✓ Multiplicative Binomial Lattice
- ✓ Monte Carlo Simulation
- ✓ Ordinary Differential Equation
- ✓ Sensitivity Analysis

FINDING

Continuing Existing Wind Farm Project	Repowering Project (extending life time)
LCOE: 103 £/MWh	LCOE: 93 £/MWh

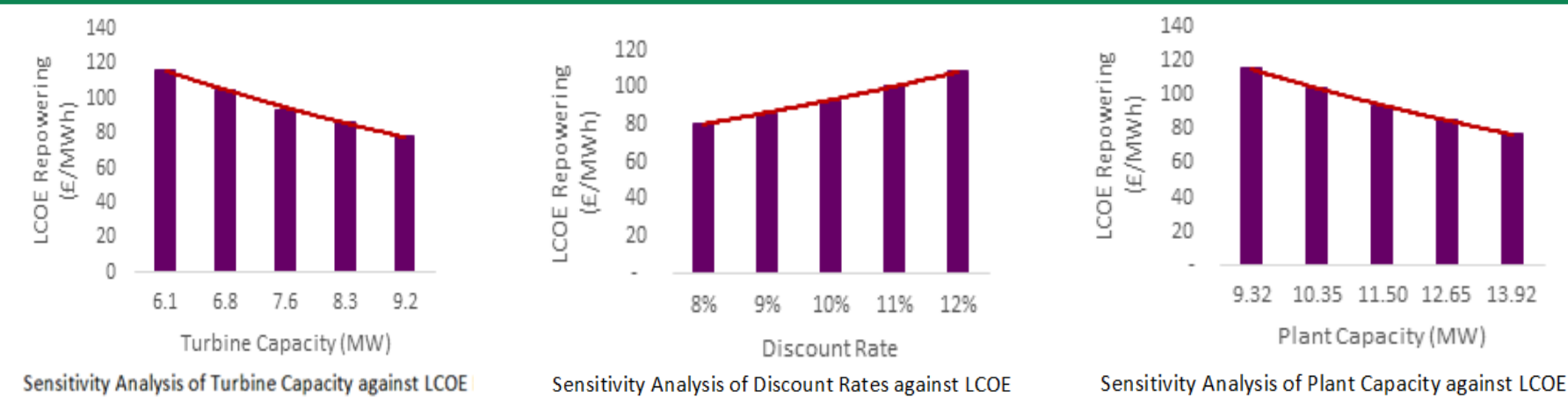
Tornado Diagram of the Input Parameters to the Net Present Value Sensitivity



Tornado Diagram for NPV sensitivity of Continuing Existing Wind Farm Project

Tornado Diagram for NPV sensitivity of Repowering Project

The Most Sensitive Innovation Activities for the LCOE Reduction

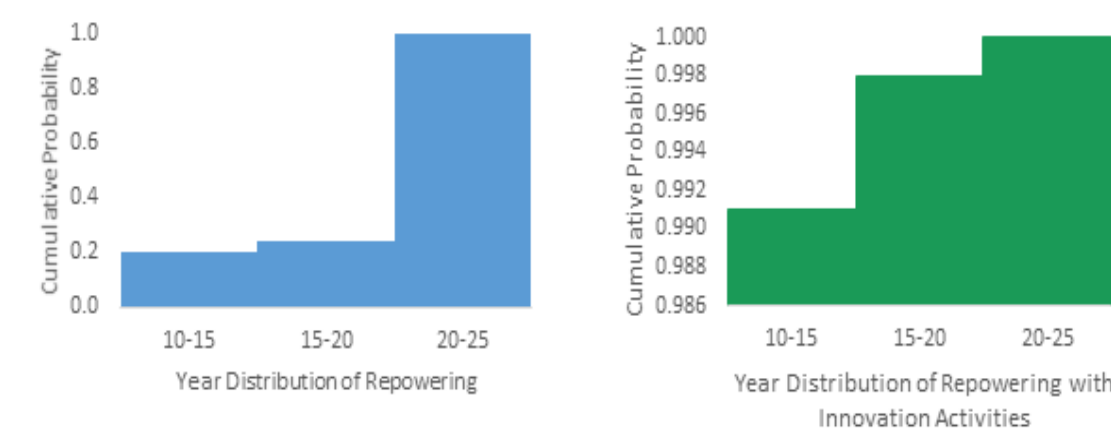


Sensitivity Analysis of Turbine Capacity against LCOE

Sensitivity Analysis of Discount Rates against LCOE

Sensitivity Analysis of Plant Capacity against LCOE

The Impact of the Innovations to the Repowering Optimal Time



Optimal Timing for Repowering before Innovations

Optimal Timing for Repowering after Innovations

CONCLUSIONS

REPOWERING vs **Continuing existing wind farm project**:

- ✓ **Repowering** generates **lower LCOE** than continuing existing wind farm, about 10%

By doing **INNOVATIONS**,

- ✓ **Shorter optimal timing** for Repowering, **between 15 and 20 years** of operations
- ✓ **LCOE is reduced** up to 11%

The **MOST** influencing **INNOVATION** activities for the **LCOE reduction**:

- ✓ Larger turbine capacity
- ✓ Larger plant capacity
- ✓ Lower discount rate

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