

Comparative economic analysis between wind farms operating under different subsidy schemes and combined cycle gas turbine plant

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Introduction

Targets:

- 15% of the UK's energy consumption from renewable sources by 2020;
- reduction in GHG emissions by 80% by 2050 compared to 1990 levels.

Supplementary targets:

- deployment of gas – fired generation as baseload and peak – load technology;
- gradual reduction in the share of gas after 2020 accompanied by growth in the share of renewables in order to meet carbon emissions target by 2050.

How the targets are supposed to be met

- Subsidy schemes: CfD, RO, FiT.
- Carbon price floor to promote renewables

The research questions:

- ‘Which support scheme, if there is any, is the most efficient to make wind energy more profitable than gas energy?’;
- ‘How does profitability of CCGT plant depend on load factor under higher renewables penetration?’.

Methodology

Discounted cash flow analysis:

1. Calculation of post – tax cash flow;
2. Calculation of investment criterions: NPV, IRR, Payback period – for evaluation of individual project's effectiveness;

NPV/I and LCOE – for economic comparison between the projects.

- Sensitivity analysis: +/- 20% variation in market price, subsidy tariffs, costs, load factor, discount rate.
- Monte – Carlo simulation on load factor, carbon price, strike price, tariffs, ROCs with the use of triangular distribution; electricity and gas price with the use of logistic distribution; and on capex and opex with the use of lognormal distribution.

Results

Criterion	CCGT	CFD	RO	FIT
Pre-tax NPV	£k26,223	£k12,898	£k62,351	£527,410
Post-tax NPV	£k9,157	£k3,916	£k31,350	£233,518
IRR	11.96%	10.70%	12.08%	11.65%
NPV/I	0.08	0.05	0.14	0.10
Payback Period	12	11	10	11
LCOE	£65.19	£94.57	£96.52	£63.70

1. All the projects are profitable. The wind farms under RO and FiT schemes give the greatest returns per pound invested compared to other projects;

2. The small – scale wind farm has the lowest LCOE followed by CCGT

3. Sensitivity analysis

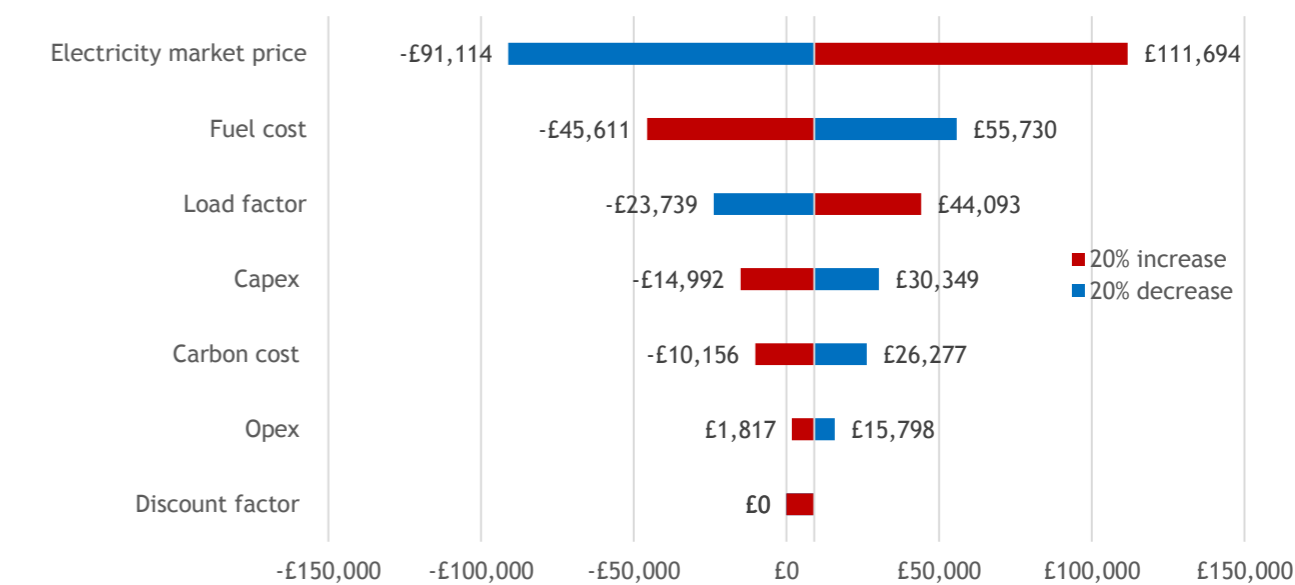


Figure 1. Sensitivity analysis for value inputs of CCGT project.

Conclusion

- RO is the best scheme, however it is being phased out to provide onshore wind with the subsidy-free route to the market, and an important role belongs to the Carbon price in order to enhance competitiveness of onshore wind versus gas – fired generation.

The main obstacle: the market carbon price is low.

If the Government organizes transition to the subsidy – free market for renewables, it should either use target – consistent carbon price, which is higher than the market carbon price, or continue to use support schemes such as RO and FiT.

- With higher renewables penetration many gas-fired plants will be operating at reduced load factors and therefore suffer from losses.