COMMERCIAL COST-BENEFIT ANALYSIS OF DOGGER BANK WINDFARM

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- All analysis and conclusions are solely the responsibility of the authors.

Case analysis Dogger Bank

- The largest offshore windfarm project in the world
- Plans to generate 5% of UK electricity production
- An average strike price of GBP 40.96/MWh (in 2012 terms)
  - CfD, Contracts for Difference, UK government guarantees a fixed electricity price for the first 15 years
- Owned by Equinor (40%), SSE Renewables (40%) and ENI (20%)
- SSE is development operator and Equinor is operations operator
- Estimated Capex of 9 billion GBP
  - Investment started in 2020
- Planned capacity of 3.6 GW
- Depth 20-35 m, 130-190 km from shore
- 13 and possibly 14 MW GE wind turbine generators
  - Several hundreds

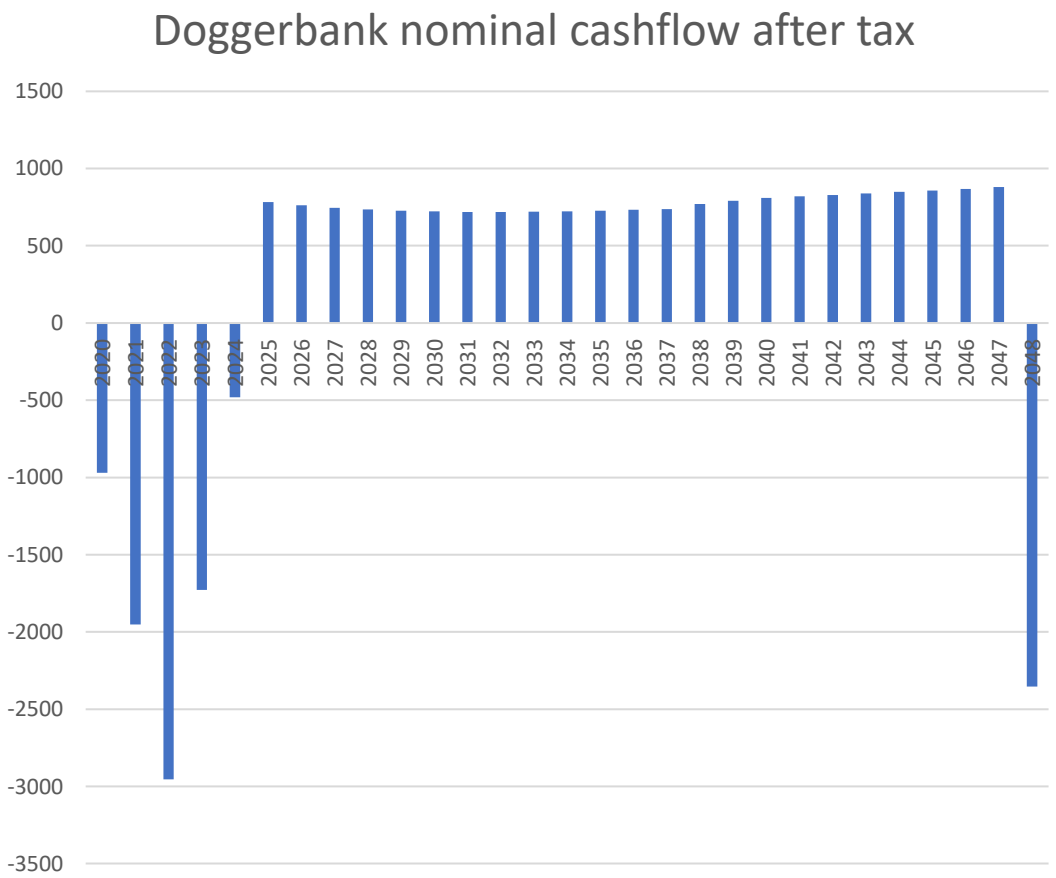
Project reference group

- Wind turbine industry researchers at the University of Århus
- Equinor
- Researchers at NHH, NMBU, NTNU and Norce
- Industry specialists
  - Supplier industry, utilities and oil industry

Project assumptions

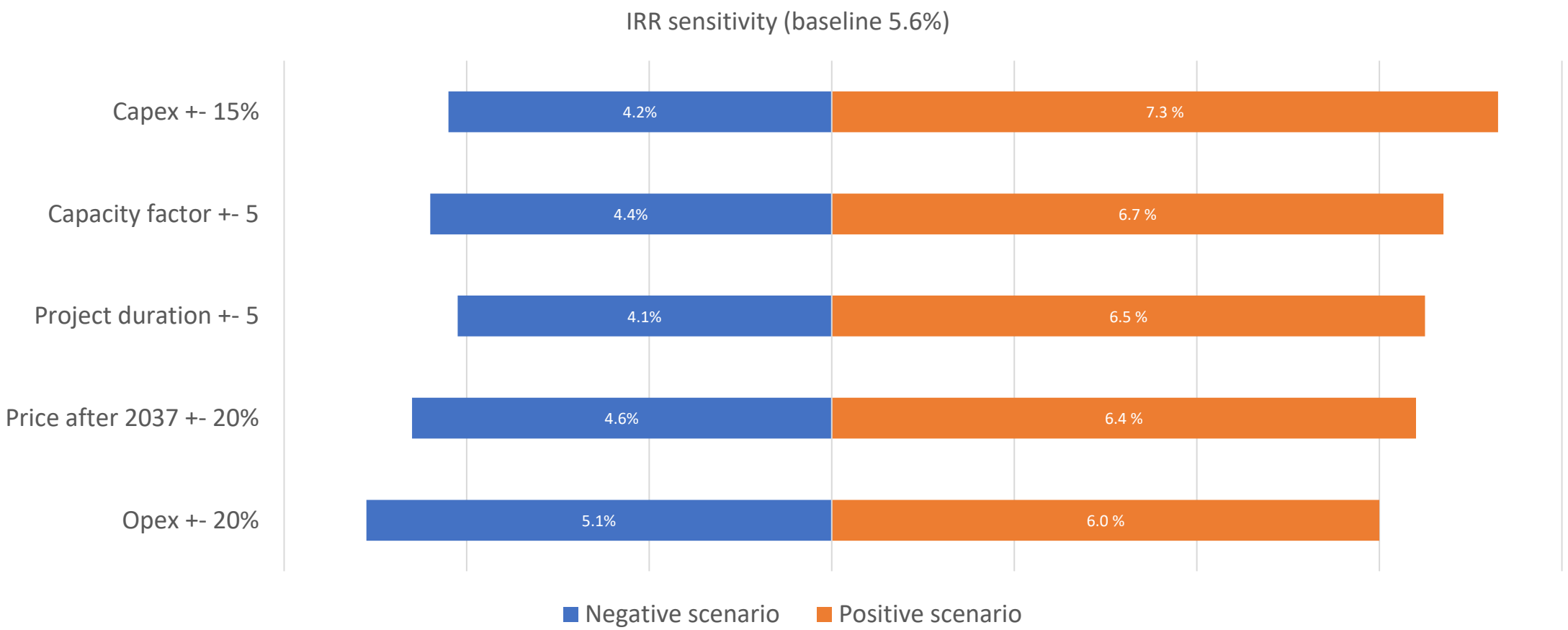
- Discount rates
  - Fixed price period
    - 5,9 % nominal
  - Uncertain price period
    - 8.5% nominal
- Project duration
  - 25 years
- Electricity price
  - The fixed CfD-price is GBP 45.83 for DBA and GBP 48.09, in 2020-terms
  - For 2038-2050 we use the average of the last three years in Denmark (38.96 GBP/MWh) and similar for the UK (71.86 GBP/MWh); and multiply by 0.9, an intermittency wind power discount
    - Denmark has a higher share of offshore wind, and UK is moving in this direction
    - Intermittent wind production over-weighted in periods of low electricity price (cannibalisation)
- Opex
  - 25% of capex, in NPV terms
- Decommissioning cost
  - 25% of Capex, nominal
- Capacity factor
  - 55%

Project economics calculation

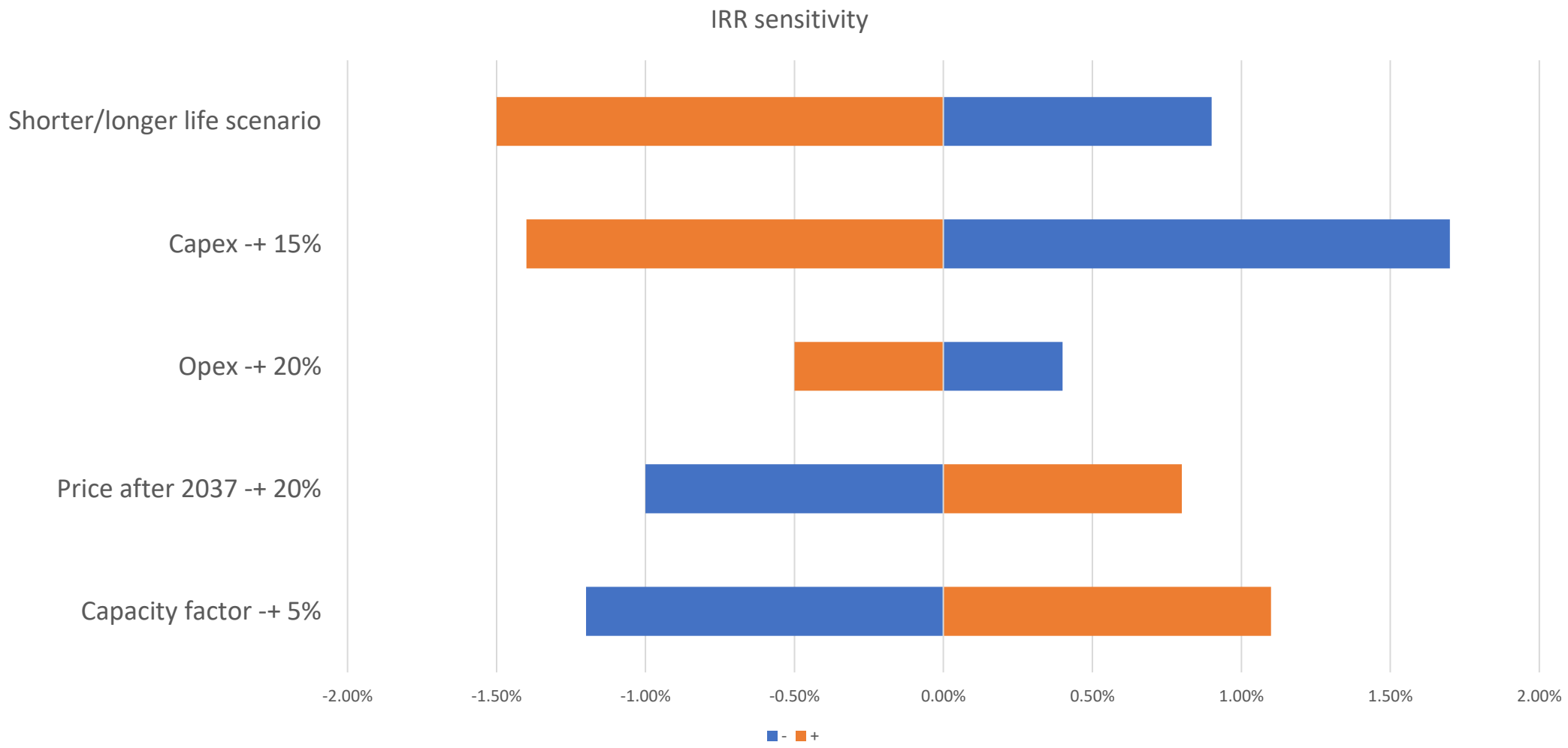


- IRR total capital 5.6% nominal
  - 6% nominal before tax
- NPV -970
- Payback time 17 years

IRR sensitivity



Sensitivities, IRR change



Sensitivities are not symmetric

- Cost overruns more likely than cost cuts
  - Average cost overrun 9.6 % for offshore wind
  - Benefits from going from 12MW to 13/14 MW turbine?
- Reduction in electricity price more likely than an increase?
  - UK has plans for 300% increase in offshore wind capacity by 2030 and an 1000% increase by 2050
  - Neighbouring countries increases capacity
    - Capacity increases faster than increased demand and enhanced system flexibility?
    - Higher demand contingent on lower electricity price?
- The everything-else-equal assumption not likely for increased project duration?
  - Contingent on increased investment and operating cost?