

Presenting the Future

An assessment of future costs estimation methodologies in the electricity generation sector

1st April, 2014, UK Energy System in Transition: Technology, Infrastructure and Investment
Edinburgh Centre for Carbon Innovation

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The TPA remit and approach

- A core function of the UKERC since 2004, based at Imperial College Centre for Energy Policy and Technology (ICEPT)
- Provide independent, policy-relevant assessments addressing key issues and controversies in energy
- Develop accessible, credible and authoritative reports relevant to policymakers, other stakeholders and wider public debate
- Approach based on a systematic search and appraisal of the evidence base, synthesis, and expert and peer review

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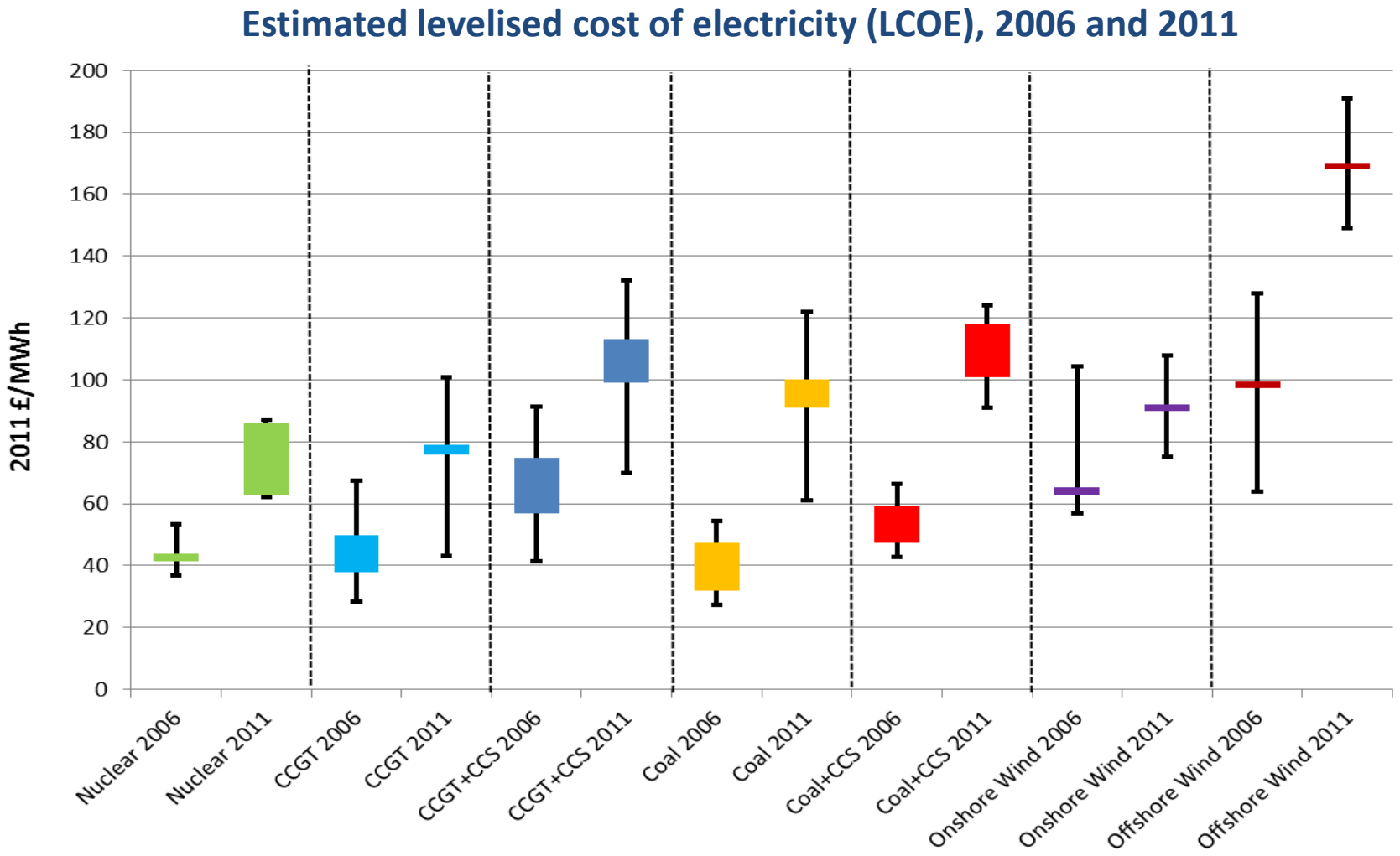
The context


Estimated levelised cost of electricity (LCOE), 2006 and 2011
2011 £/MWh
200
180
160
140
120
100
80
60
40
20
0
Nuclear 2006
Nuclear 2011
CCGT 2006
CCGT 2011
CCGT+CCS 2006
CCGT+CCS 2011
Coal 2006
Coal 2011
Coal+CCS 2006
Coal+CCS 2011
Onshore Wind 2006
Onshore Wind 2011
Offshore Wind 2006
Offshore Wind 2011

Why estimates matter

- Key input to policy:
  - Successive Energy White Papers
  - Stern Review
  - CCC Renewable Energy Review
  - Energy system models such as MARKAL/TIMES
- Help identify which technologies merit support (and how much)
- Policy can also bear upon costs, which bear upon policy…

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‘Presenting the future’
Preliminary questions from scoping note

- How do past estimates and expectations of future costs compare with experience to date?
- Do methodologies differ in terms of their forecasting accuracy?
- Have methodological approaches changed?
- How robust are future costs estimation methodologies?
- How susceptible are the different approaches to exogenous factors?
- What are the strengths and weaknesses of the methodologies?

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Approach

- Systematic review of the literature on cost estimation and forecasting methodologies
- Six technology case studies:
  - Nuclear
  - Combined Cycle Gas Turbine (CCGT)
  - Coal and Gas-fired Carbon Capture & Storage (CCS)
  - Solar Photovoltaics (PV)
  - Onshore Wind
  - Offshore Wind

  Available at:
  http://www.ukerc.ac.uk/support/tiki-index.php?page_ref_id=2863
- Synthesis and conclusions

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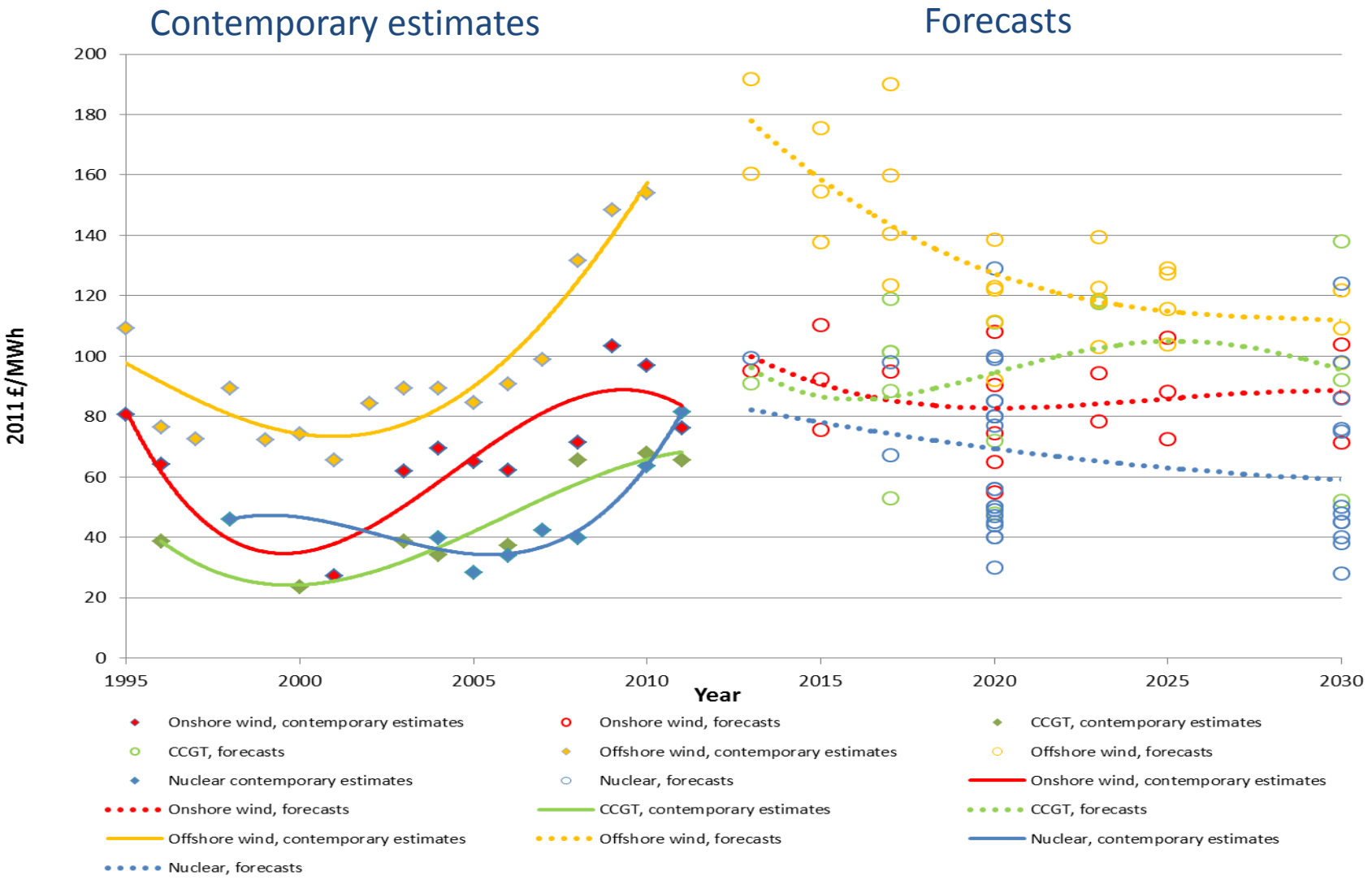
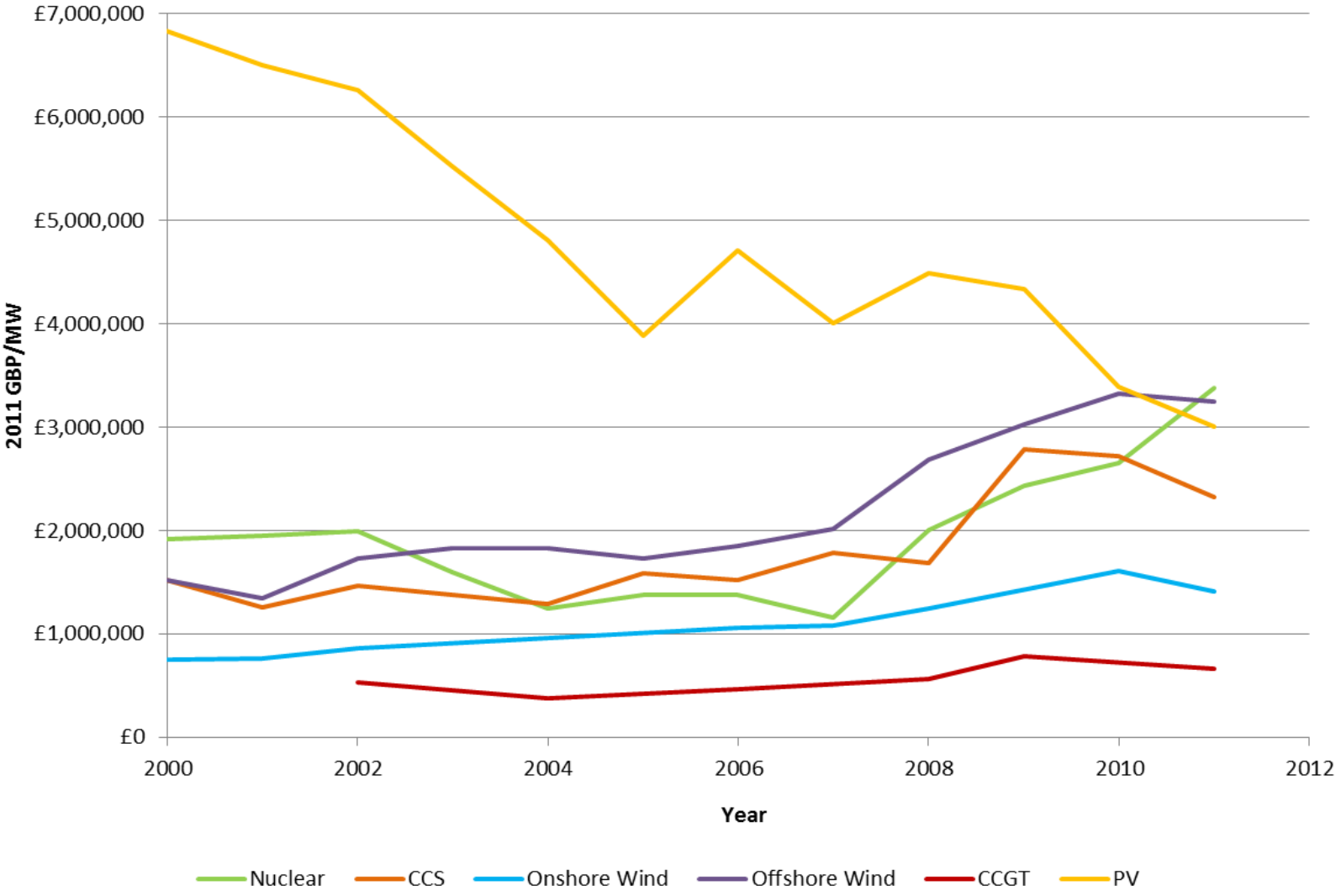
LCOE trajectories

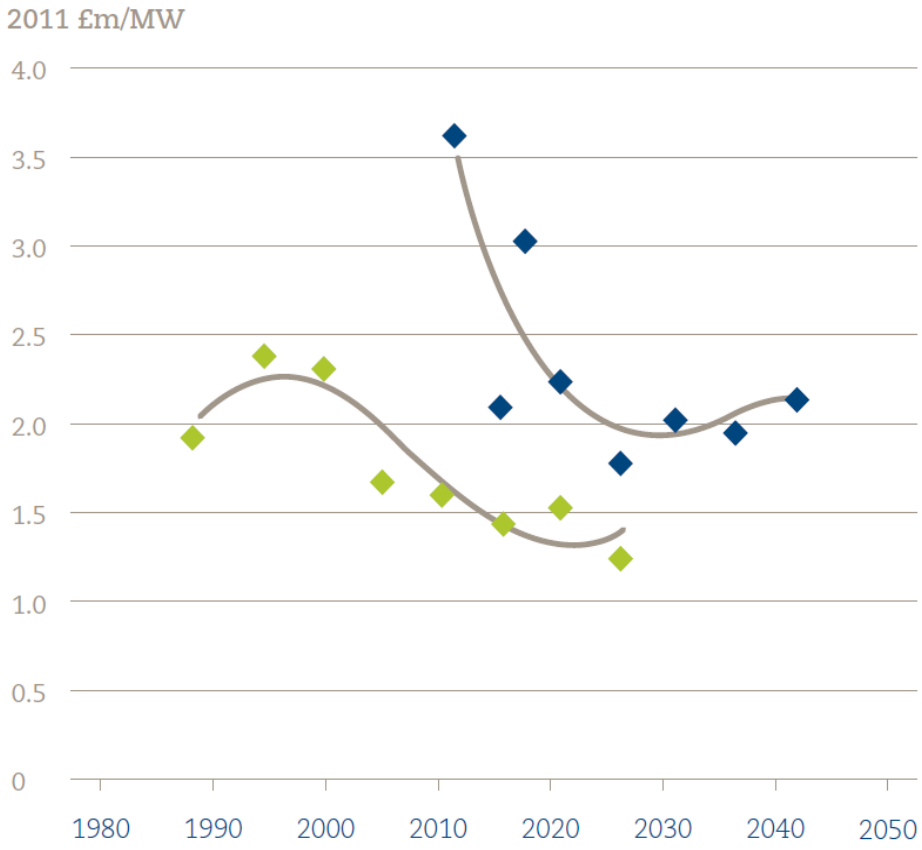


Cost trajectories – capex

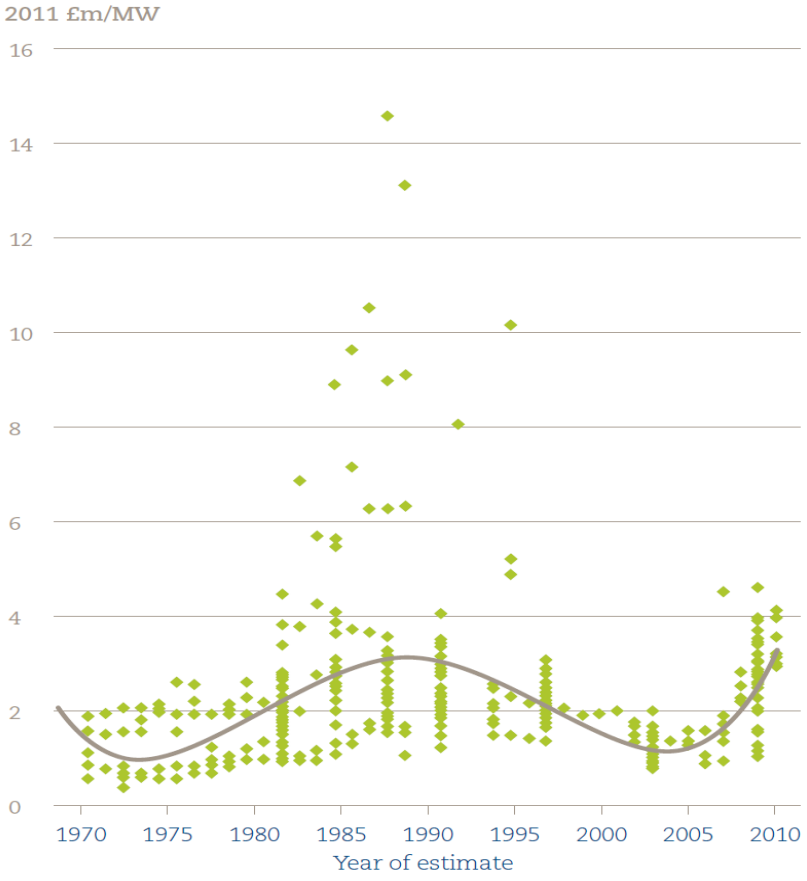


Selected case study 1 – Nuclear

In-year means of forecast capex, worldwide, pre and post 2005



Estimated contemporary capex, worldwide



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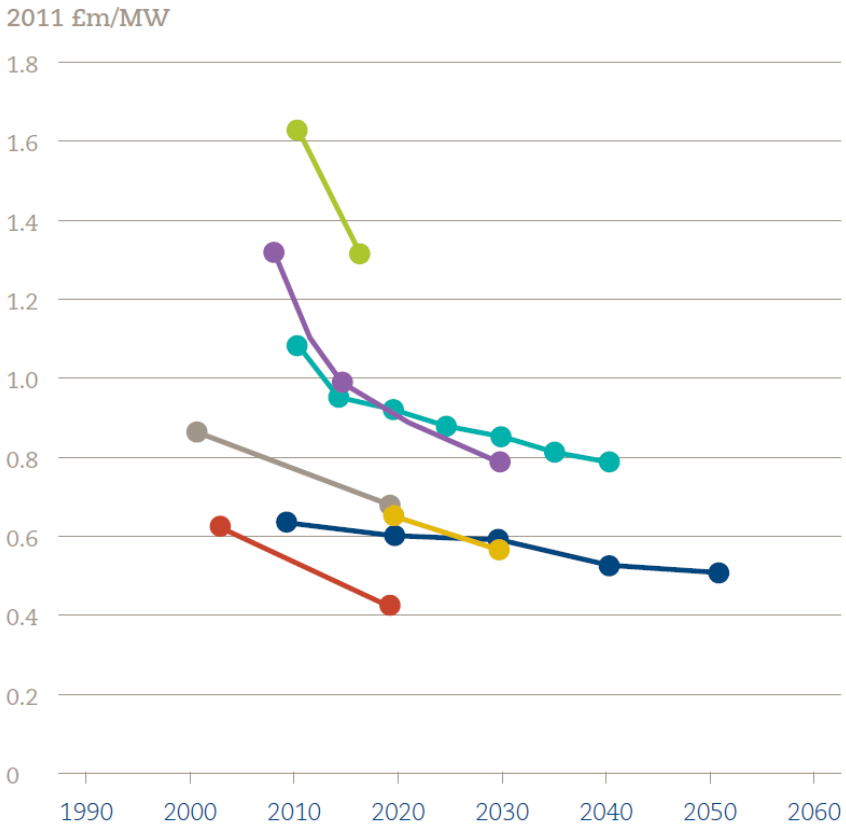
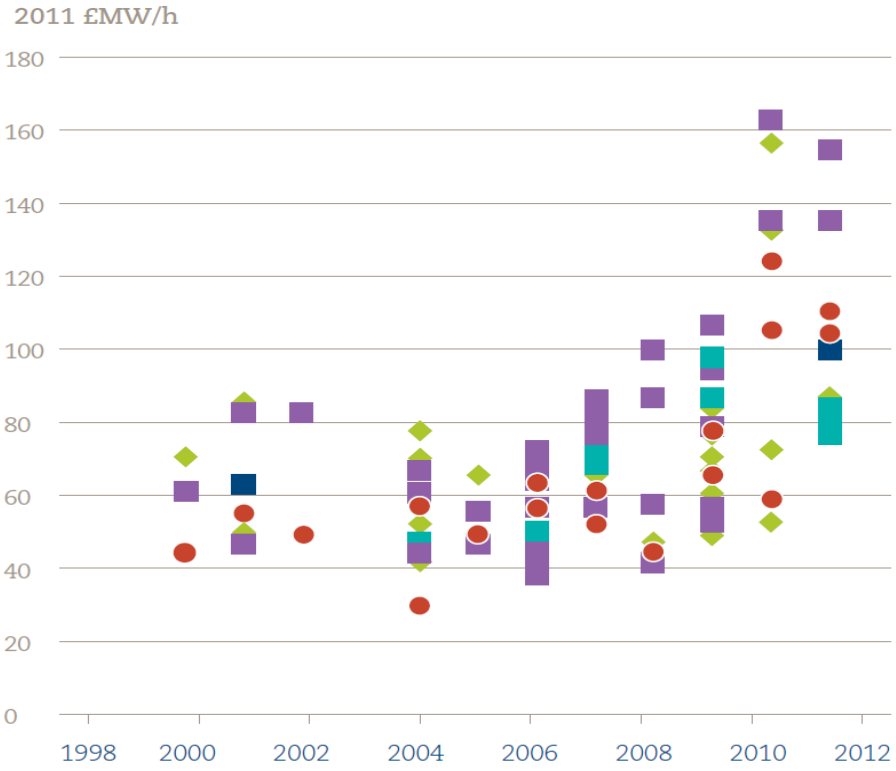
Selected case study 2 – CCS

Capex forecasts, post-combustion gas CCS



PB power (2011)	Martisen et al (2007)
MottMacDonald (2011)	Fluor (2004)
IEA (2010)	Marsh et al (2003)
Van den Broek et al (2009)	

Estimated contemporary levelised cost



Post comb coal CCS	Pre-comb gas CCS
Oxyfuel coal CCS	Post-comb gas CCS
Pre-comb coal CCS (IGCC)	

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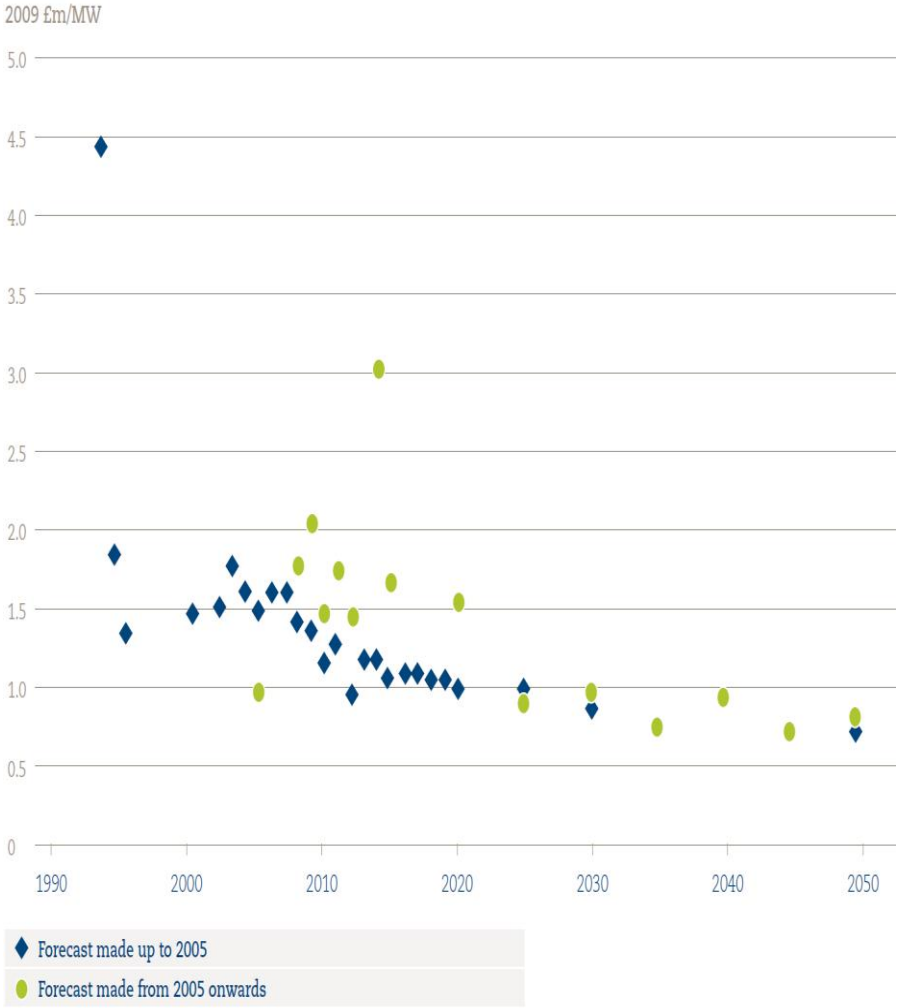
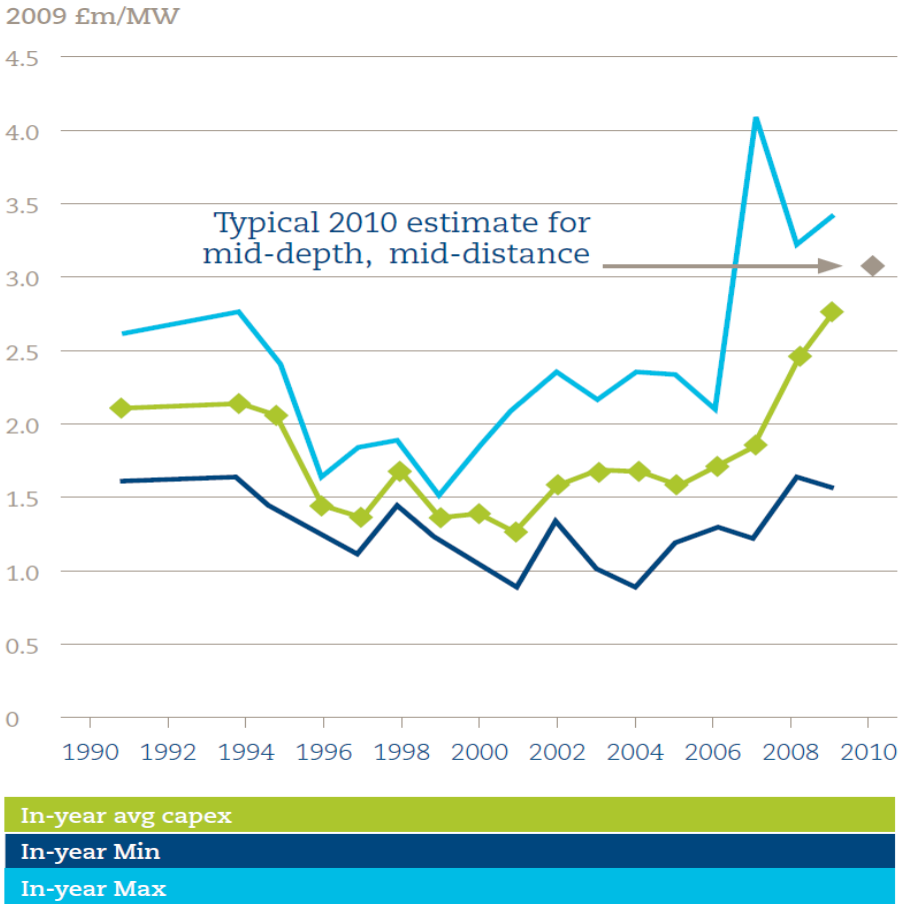
Selected case study 3 – Offshore wind

In-year means of forecast capex, pre and post 2005



Range of contemporary capex



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General observations

Past experience shows both exogenous 'sideswipes' and endogenous factors can override learning effects & economies of scale etc

- Example exogenous factors:
  - Commodity prices increases e.g. steel, copper, silicon
  - Fuel price increases e.g. coal and gas
  - Cost of finance
  - Unfavourable currency movements
- Example endogenous factors:
  - Increased safety, or environmental, requirement e.g. nuclear, or coal FGD
  - Lack of competition re components e.g. OSW turbine market
  - Supply chain constraints e.g. components and support/installation services
  - Greater depth and distance e.g. UK OSW
  - Increased O&M
  - Disappointing reliability = reduced availability = poor load factors
- Experience curve uncertainties & appraisal optimism
  - Can be overwhelmed by other factors and exogenous shocks
  - Need for reliable and disaggregated data and sufficient volumes and time
  - Acknowledge the uncertainties explicitly
  - Recognise that it is an inherently stochastic process

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Conclusions

- Clear empirical evidence that the cost of electricity generation can fall through time and as deployment rises – learning happens. But
  - learning is not inevitable and quality of projection a product of data, assumptions, judgement, etc…
  - learning can be overwhelmed by other factors – temptation to focus on potential for cost reductions risks ignoring prosaic issues such as supply chain constraints
  - Initial roll-out of a technology may result in short-term bottlenecks, 'teething trouble' and other issues –short term costs may rise before they can fall
- Some of the uncertainties revealed by the case studies are exogenous, inherently unpredictable and may exhibit high volatility – what to do about these?
- Some of the endogenous cost drivers are more 'known' and lend themselves more readily to future projection – but this is not always well done
- One size does not fill all – technology specifics are paramount to cost reduction prospects. Small, mass produced and modular = 'better' at learning?
- Communication of uncertainty is key. There is a trend towards improved 'appraisal realism' in recent analyses

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Final thoughts

- We should not be surprised when (not if) our forecasts are wrong
- Whilst cost reductions from learning can and do happen they can still be overwhelmed by other factors
- Understandable temptation to focus on potential for cost reductions risks ignoring more prosaic issues such as supply chain constraints and regulatory regimes
- Some recognition that costs can rise in the early stages of a technology, but this rarely shows up in the headline numbers
- Fundamental tension between inherent uncertainties and the need to make decisions now
- Not so much about picking winners based on current forecasts – more about the political will required to follow through when costs (almost inevitably) diverge from a smooth downward trajectory

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