Imperial Centre for Energy Policy and Technology

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UK Energy Research Centre
Researching pathways to a low carbon future



Presenting the Future

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

BIEE SEMINAR – IMPLICATIONS FOR WIND POWER

Robert Gross, Phil Heptonstall , Imperial College and UKERC

The TPA remit and approach

- A core function of the UKERC since 2004
- 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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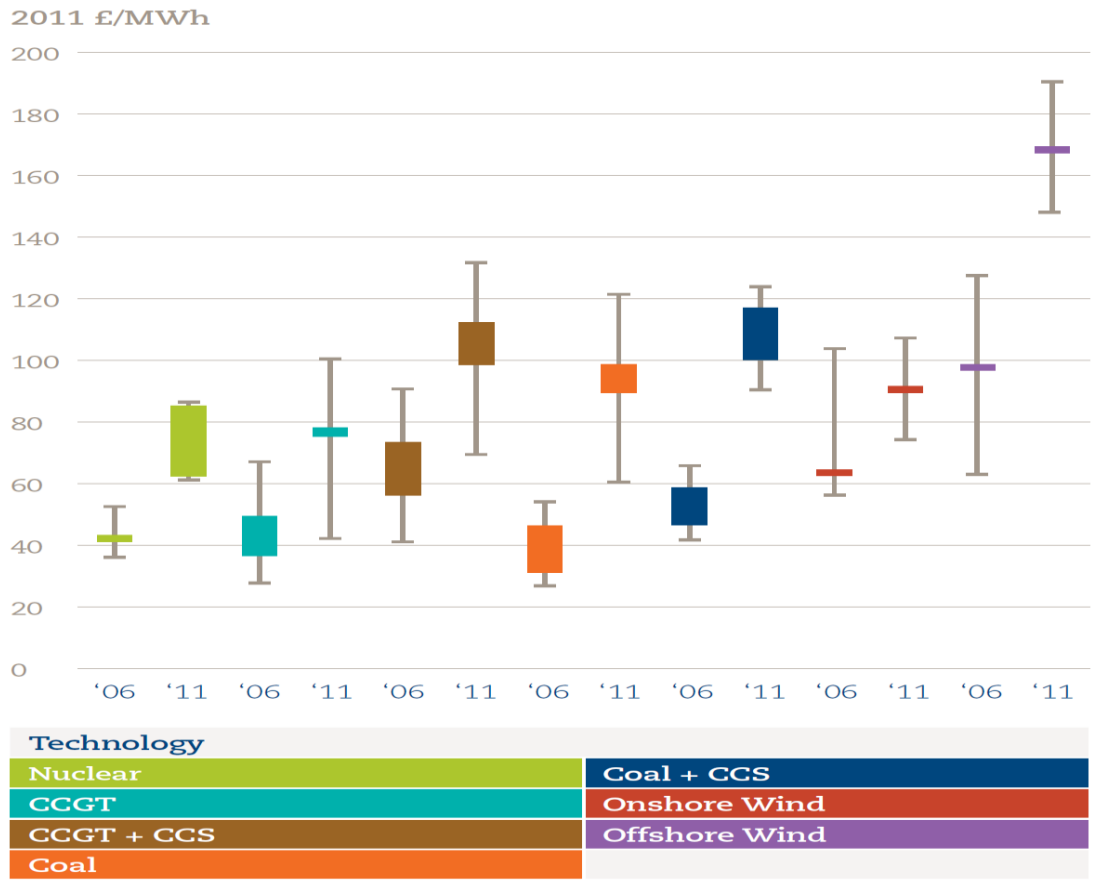
The context

Figure 2.3: Comparison of 2006 and 2011 cost estimates[6]



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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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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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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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Forecasting future costs:
Methods and approaches

- Experience curves:
  - Grounded in empirical observations that learning and cost reductions do happen
  - Can help identify the level of investment and deployment required to drive down costs but…
  - Are susceptible to uncertainties over selection of the correct starting point, learning and deployment rates
  - Concern over the use of proxy values from similar technologies
  - May be more applicable to some technology characteristics than others (modular vs. large-scale)
  - Can be overwhelmed by other factors

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Forecasting future costs:
methods and approaches

- Engineering assessment (and expert elicitation, stakeholder workshops, etc.):
  - Can inform detailed parametric models
  - Don't need to rely on previous trends
  - Can allow for discontinuities, but…
  - Expert opinions can differ
  - May suffer manipulation / excessive optimism
  - Still difficult to get right for emerging technologies

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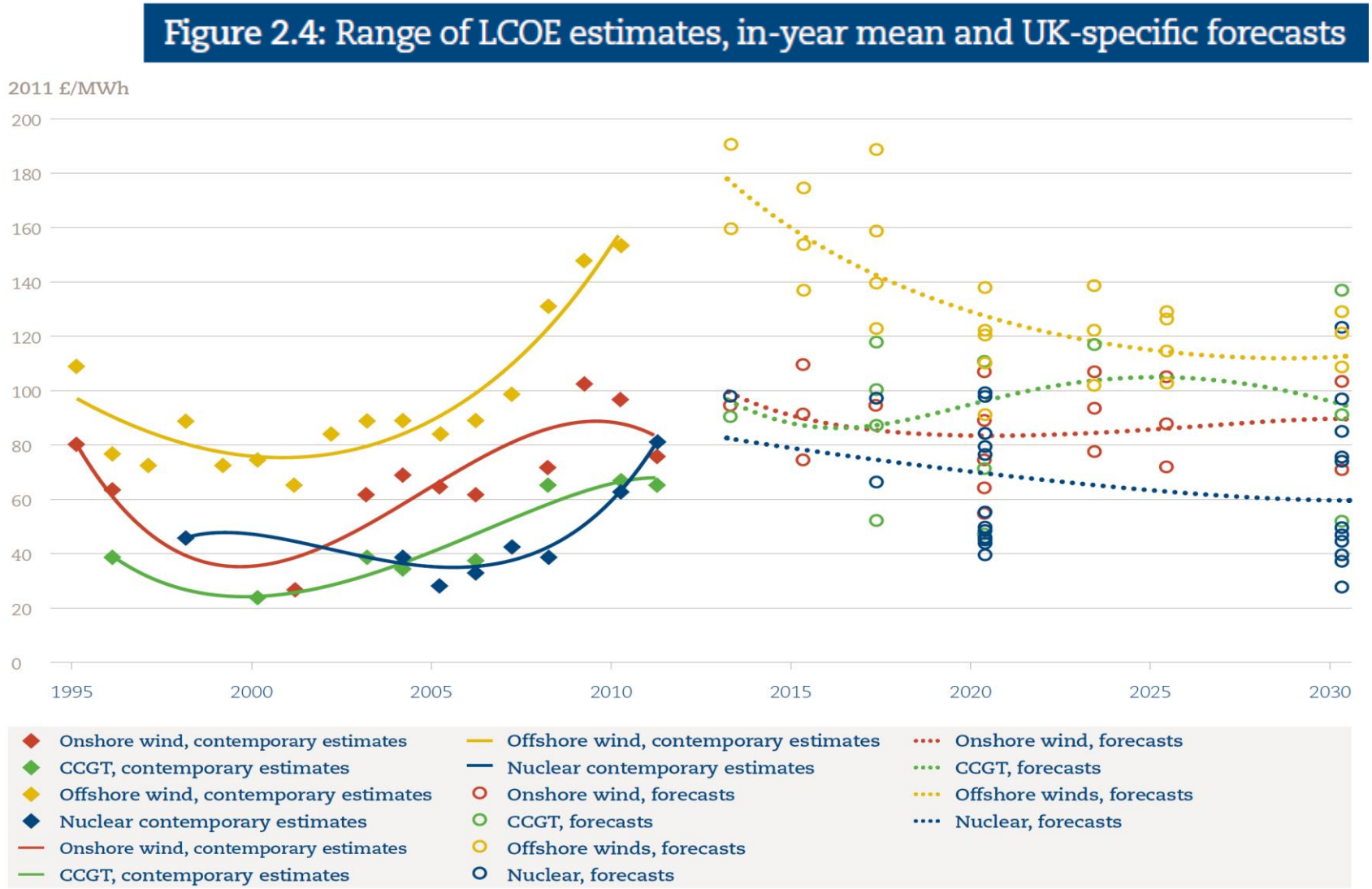
Cost trajectories – LCOE



The case studies

- Nuclear
- Combined Cycle Gas Turbine (CCGT)
- Coal and Gas-fired Carbon Capture & Storage (CCS)
- Onshore Wind
- Offshore Wind
- Solar Photovoltaics (PV)

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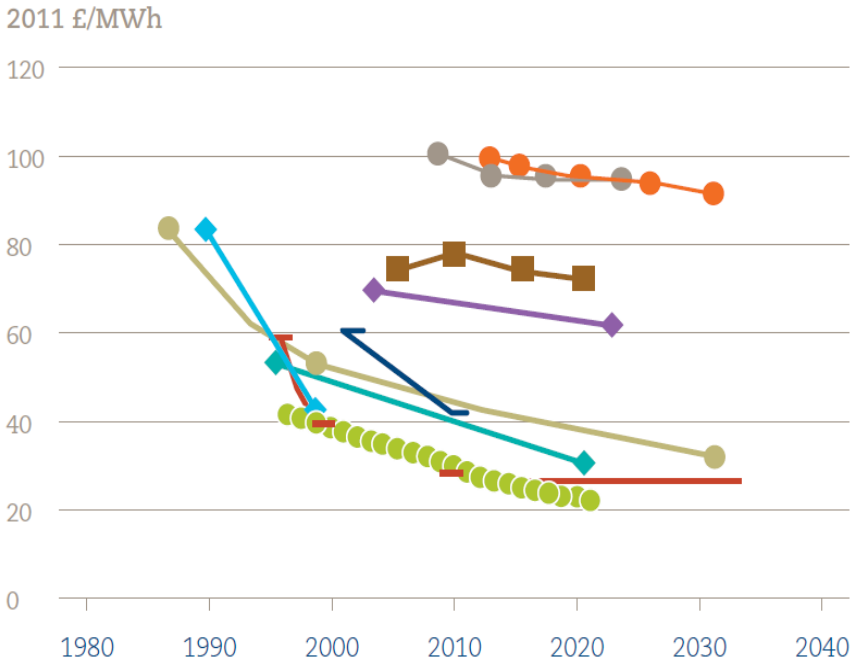
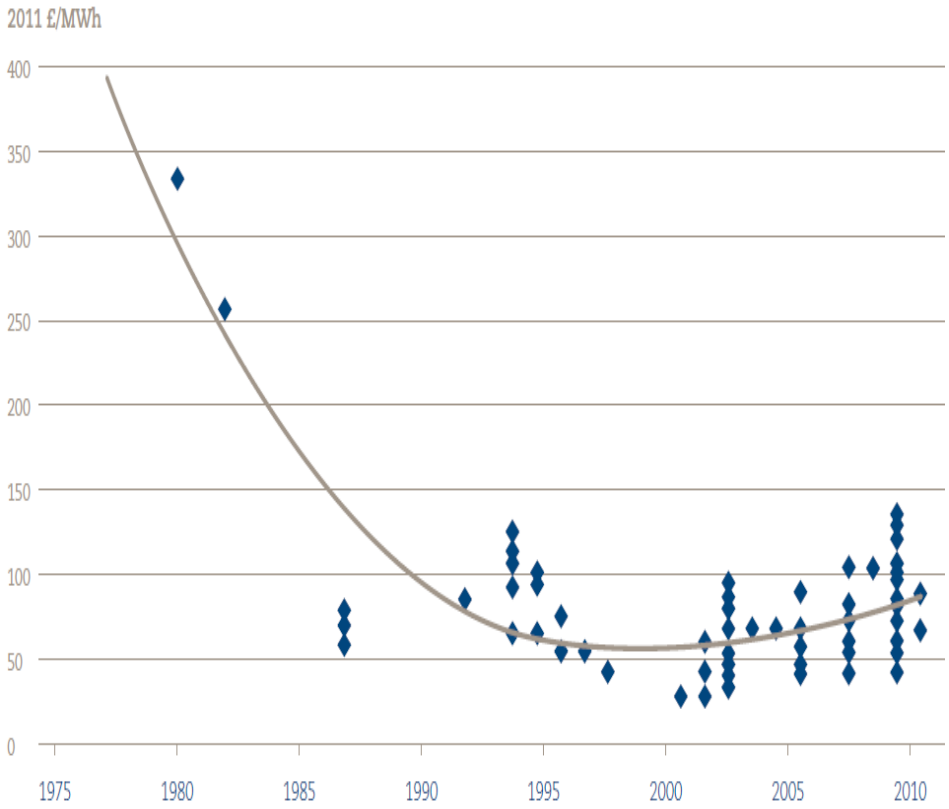
Onshore Wind

Figure 4.8: Range of levelised cost expectations for onshore wind



Parsons Brinckerhoff (2004)	IEA (2003)
Neji (1999)	DoE/EPRI (1997)
DTI/E&Y (2007)	IEA (1993)
Flavin and Lenssen (1990)	Mott MacDonald (2010)
EWEA/Greenpeace (1999)	DECC (2012)

Figure 4.10: Range of levelised costs of onshore wind since 1980



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Offshore wind

Figure 4.11: In-years means of offshore wind forecast capex, comparing pre and post 2005 estimates

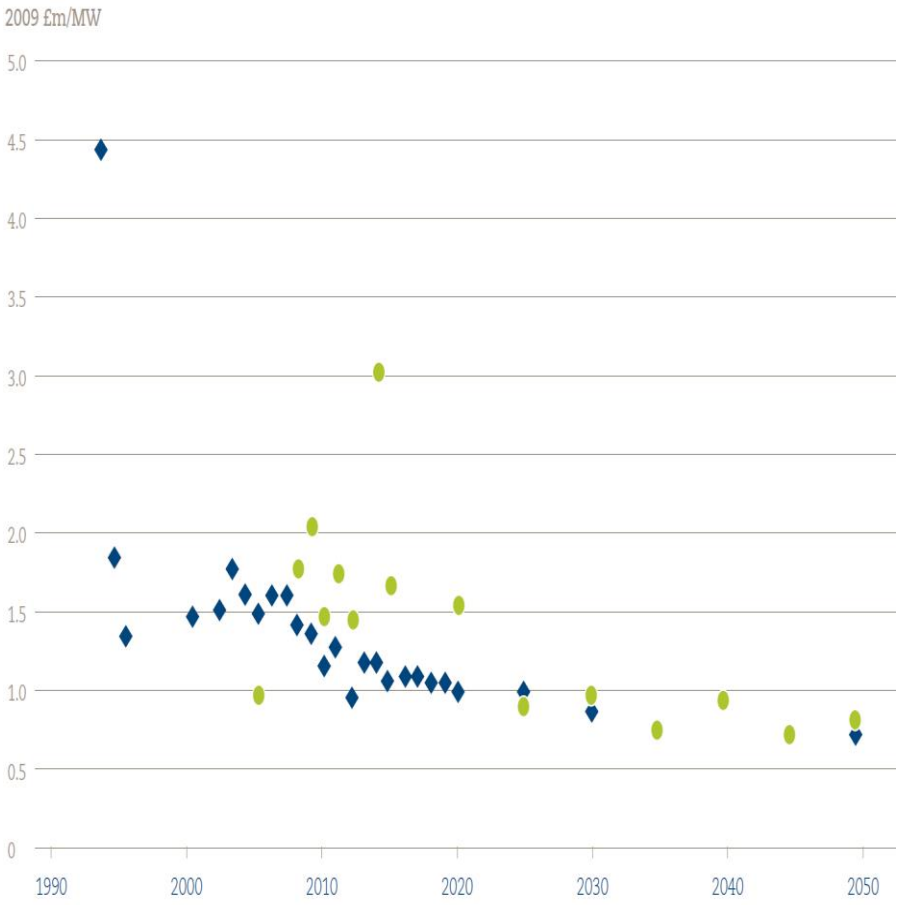
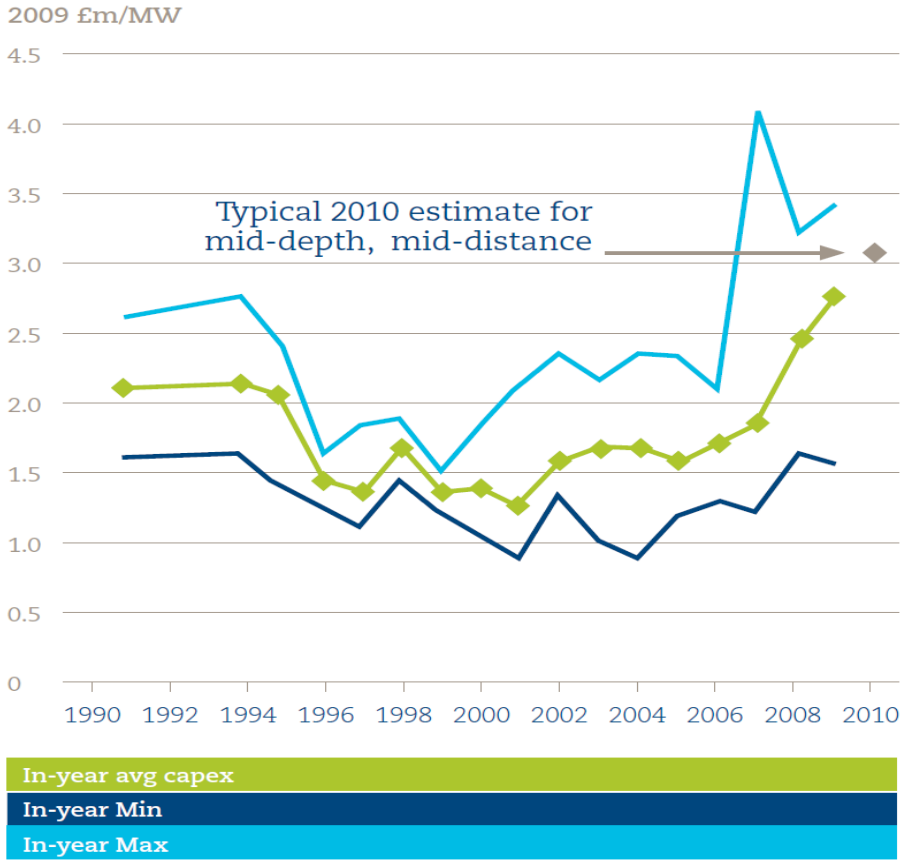


Figure 4.12: Range of offshore wind actual capex, 1990 to 2009



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Methodological themes

Issues arising from the collection, presentation, interpretation and comparison of cost data and forecasts:

- Continued appraisal optimism
- Technology and deployment immaturity
- Dependence on, and sensitivity to, input data
- Price as proxy for cost
- Compound learning systems
- Appraisal realism
- Variability of estimates and forecasts

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Endogenous themes

Relate to learning effects and innovation, scale effects and standardisation, and technological, commercial and regulatory conditions within the sphere of influence of relevant actors:

- Learning effects
- Barriers to learning
- Economies of scale
- Standardisation
- Project duration
- Country and market environment
- Policy environment
- Regulatory environment
- Physical environment

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Exogenous themes

Cost issues that are largely beyond the ability of either the actors involved in a generating technology or policymakers more generally to influence or mitigate them:

- Commodity and labour costs
- Feedstock prices
- Interest rates and financing costs
- Exchange rates
- Exogenous policy effects

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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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UK Energy Research Centre

+44 (0)20 7594 1574

www.ukerc.ac.uk

robert.gross@imperial.ac.uk

philip.heptonstall@imperial.ac.uk

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