How much energy (and CO_2) consumption can (really) be saved from the UK building stock?

EPRG WINTER SEMINAR
7TH DECEMBER 2012

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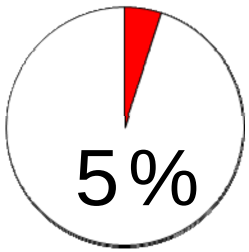
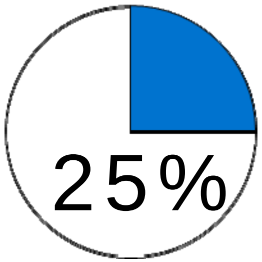
Three key messages

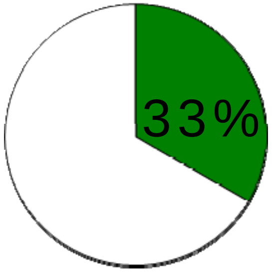


of dwellings consume

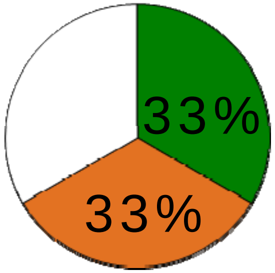


of the energy

Decarbonising electricity supplied to buildings will reduce domestic sector CO_2 emissions by

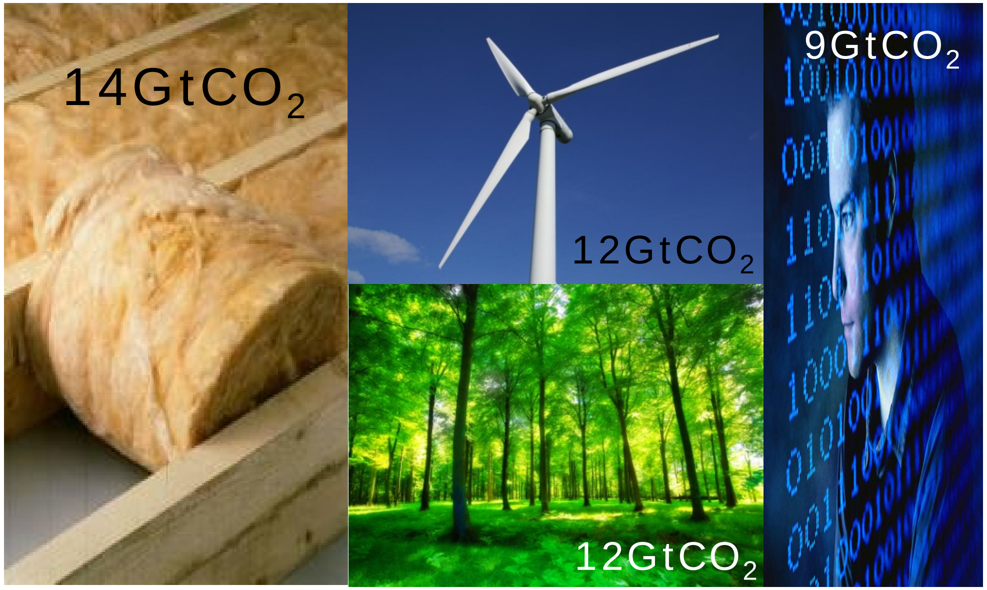


Retrofitting the existing building stock will reduce emissions from domestic sector by a further



Energy efficiency remains important

“ If energy efficiency does not lead to a decrease in fossil fuel demand, the chance of achieving the IPCC’s most relaxed CO_2 mitigation scenario will be unlikely” *- IPCC AR4 WG3*



McKinsey 2009

Key statistics

TOTAL UK ENERGY CONSUMPTION

40%

Consumed within buildings

HM Government (2006)

20%
Hot water

20%
Lights + Appliances

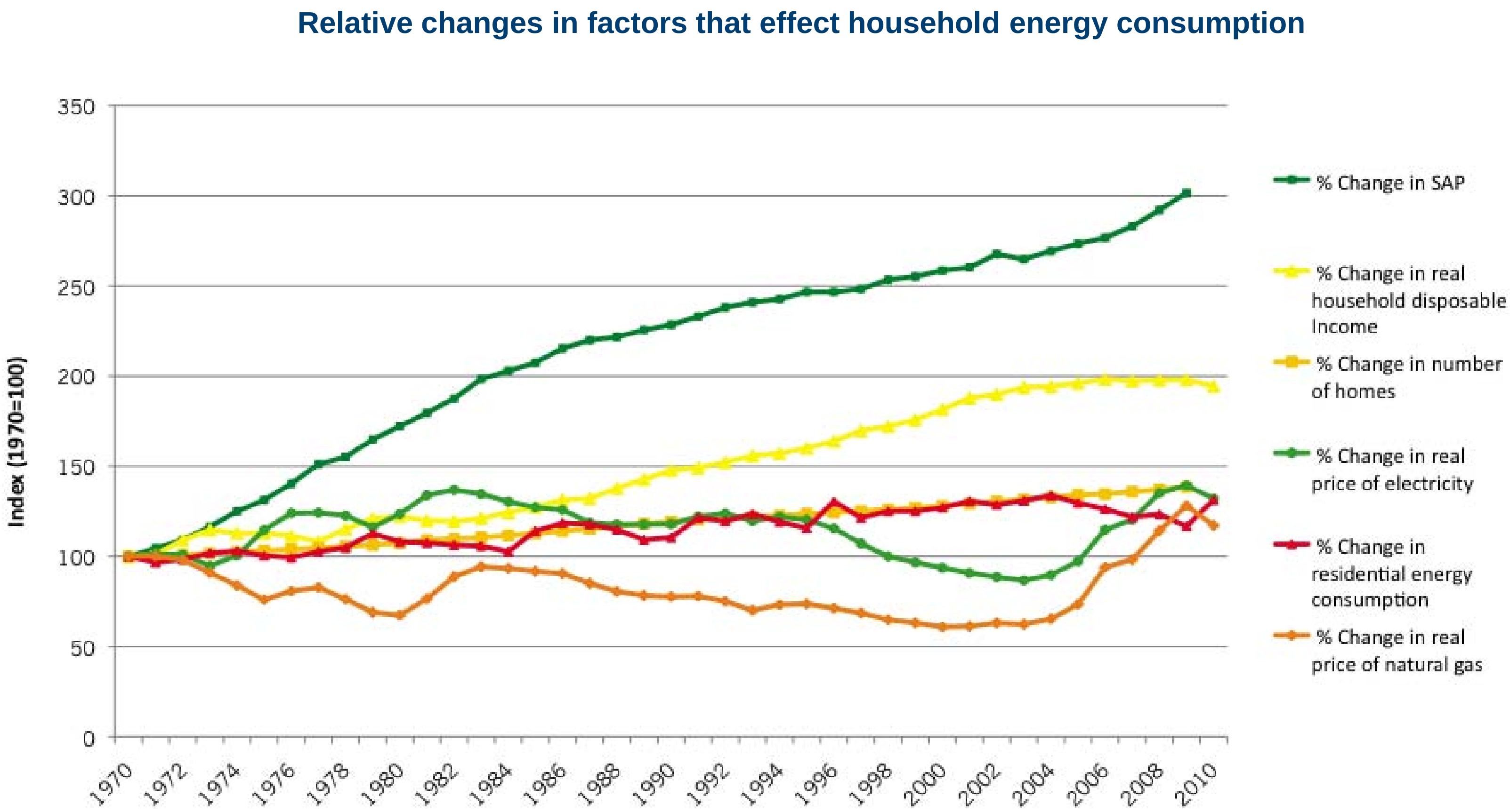
60%
Home heating

DOMESTIC HEATING BY FUEL TYPE

84%

Natural Gas

Trends in energy use for English dwellings



Data source: DECC Domestic Energy Consumption in the UK Tables

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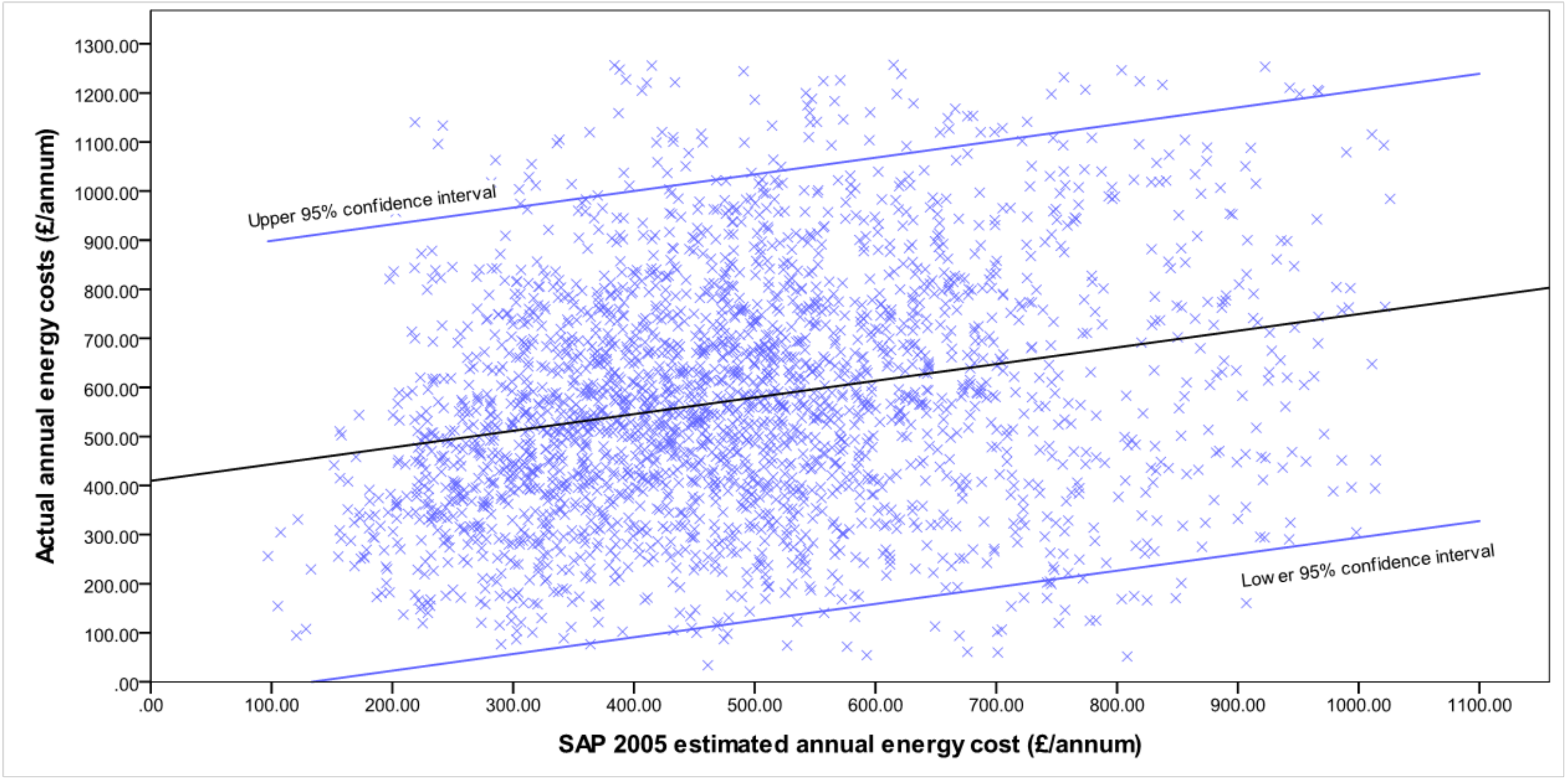
Building stock model predictions

Actual vs predicted energy consumption from UK dwellings



Existing stock models poorly predict energy consumption

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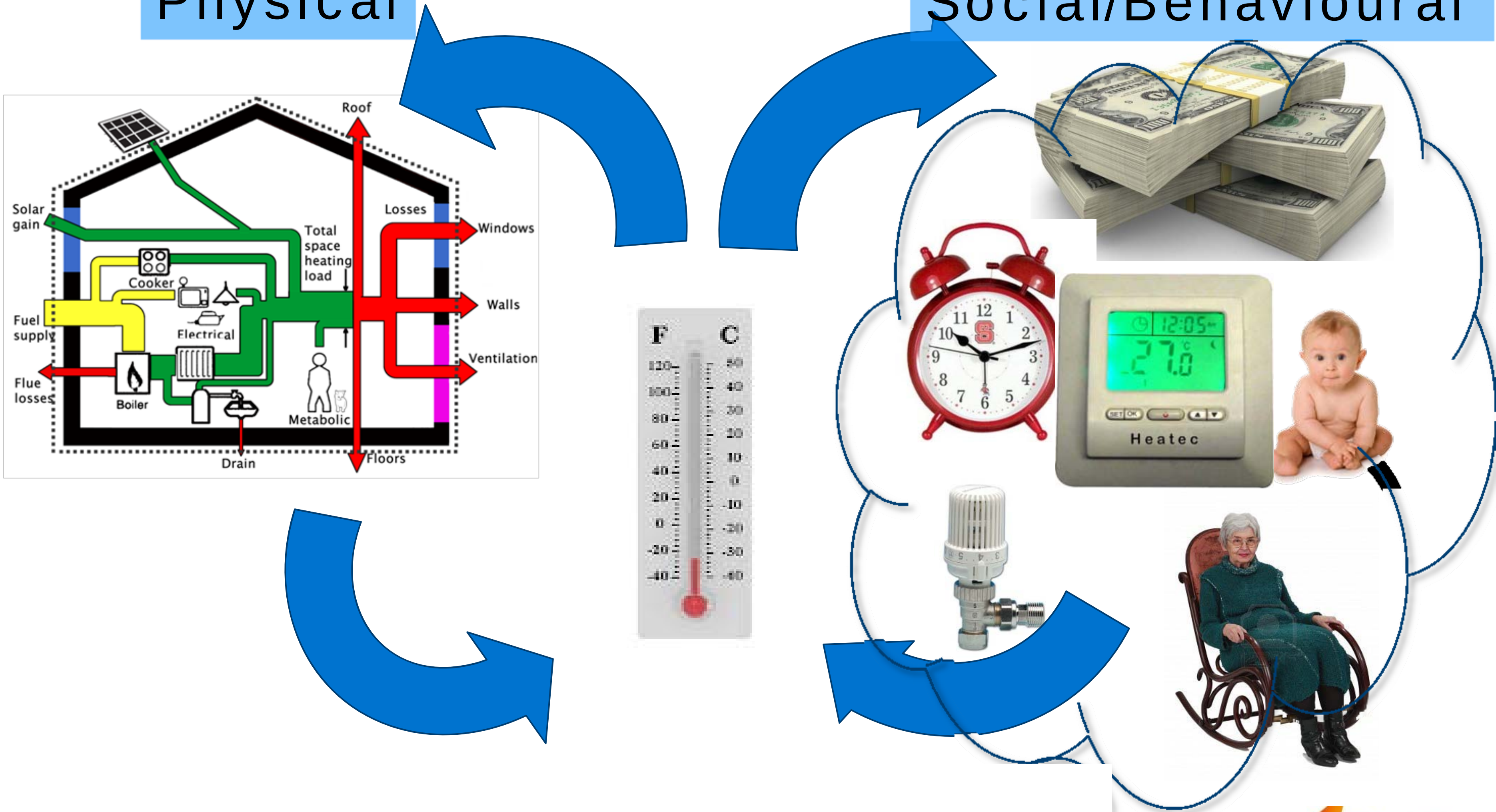
Modelling household energy demand using BEESM

Physical

Social/Behavioural



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Projecting energy and emissions using BEESM

Aim: Estimate feasible CO_2 reductions from energy-efficiency measures

Scenario 1
BAU

- Electricity is decarbonised to 95% by 2050
- New buildings meet 'zero carbon' post 2016
- Fuel demand shares remain constant (i.e. gas for heating)

Scenario 2
RETROFIT

- Scenario 1 **+**
- Buildings renovated (randomly) to technology benchmarks
- Penetration of technologies follow logistic s-curves

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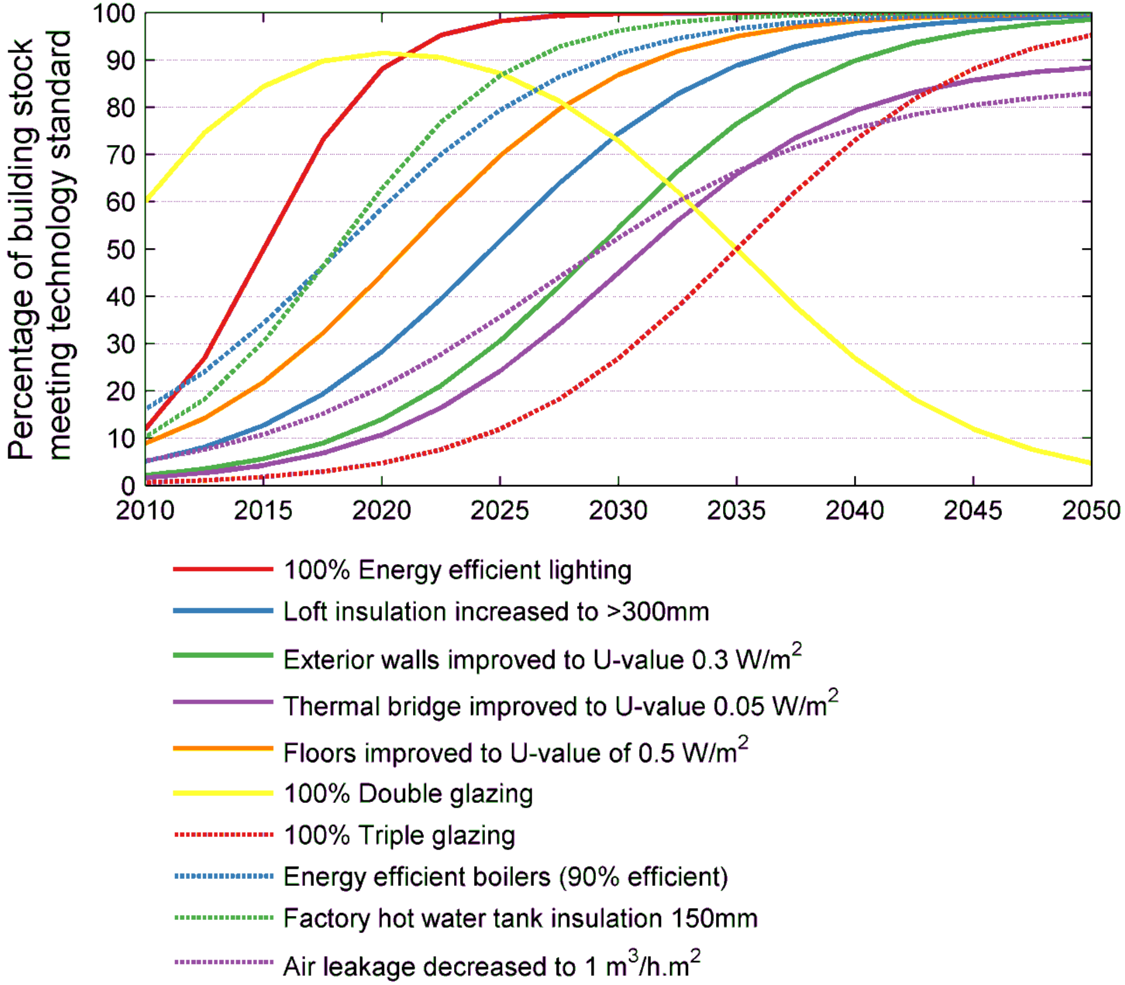
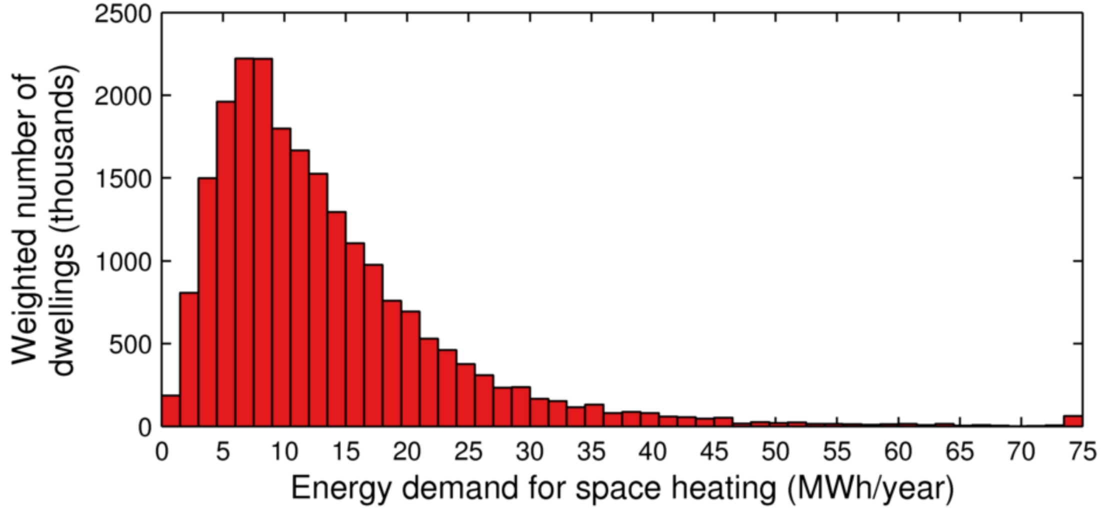
Feasible penetration rates in BEESM

Logistic penetration s-curves for different technology benchmarks

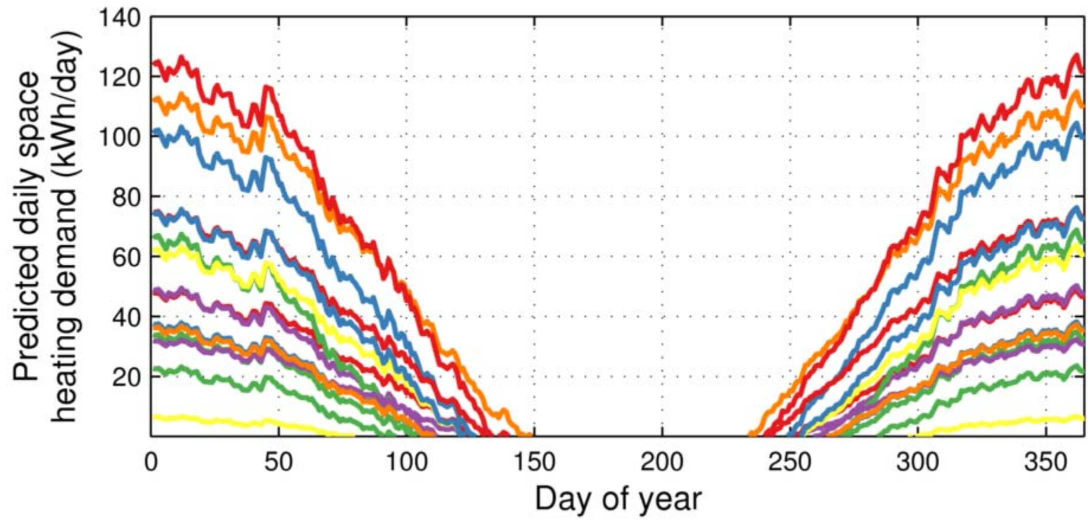


Energy demand for space heating in BEESM

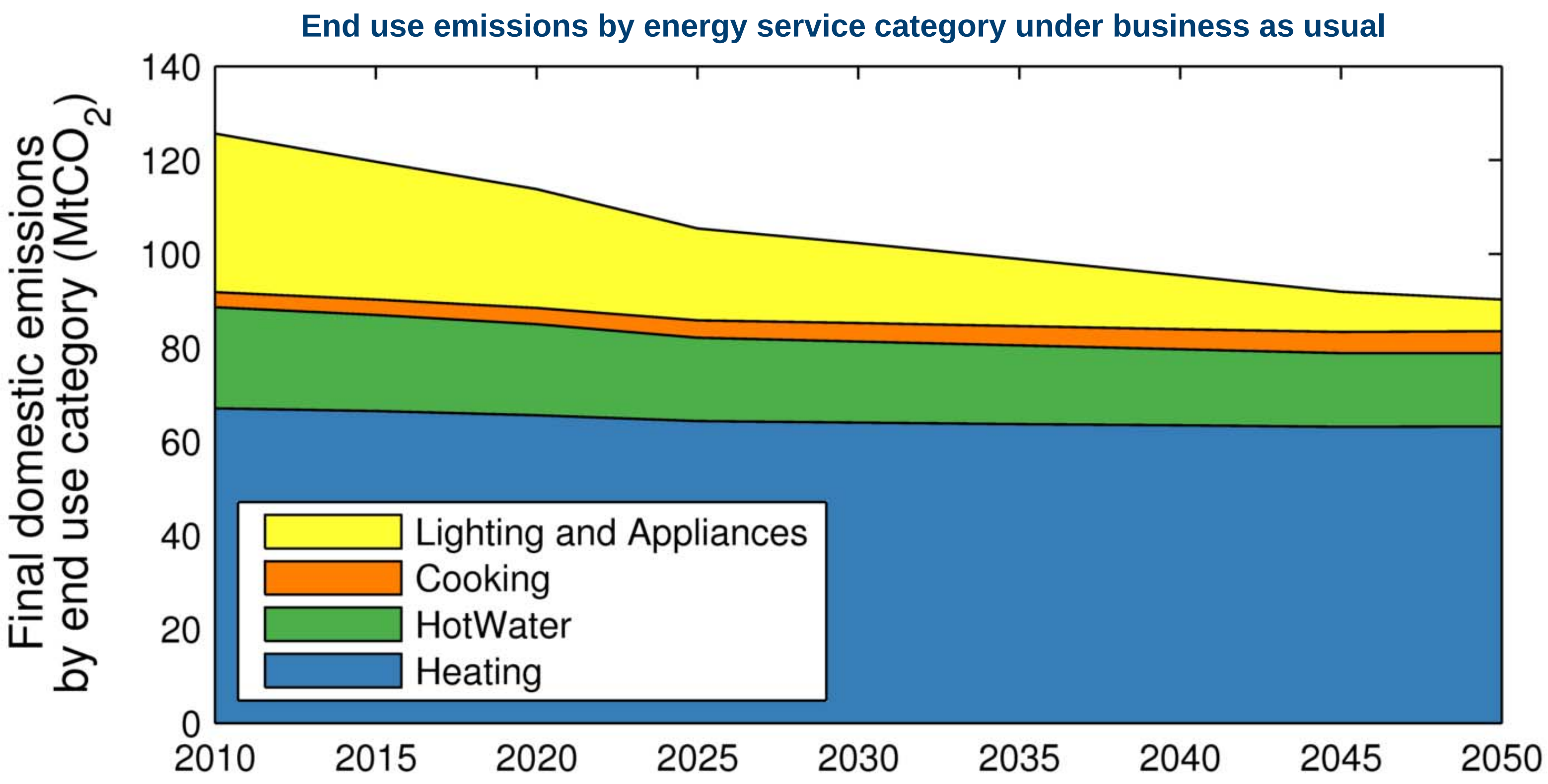
Weighted histogram for net annual space heating energy requirement in 2010



Annual space heating demand profiles for fifteen randomly selected dwellings



BAU scenario emissions projections in BEESM



Decarbonising power will reduce emissions in domestic sector by 42 $MtCO_2$ (33%)

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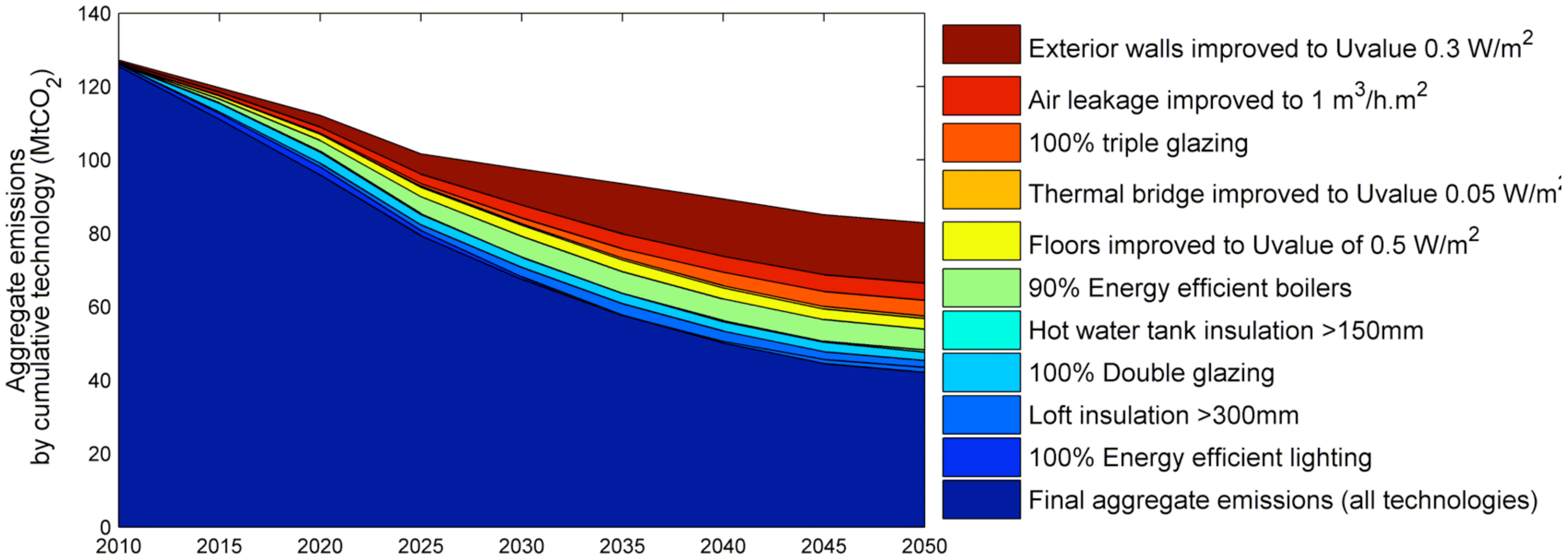
Retrofit scenario in BEESM

Aggregate emissions reductions from retrofitting the existing building stock

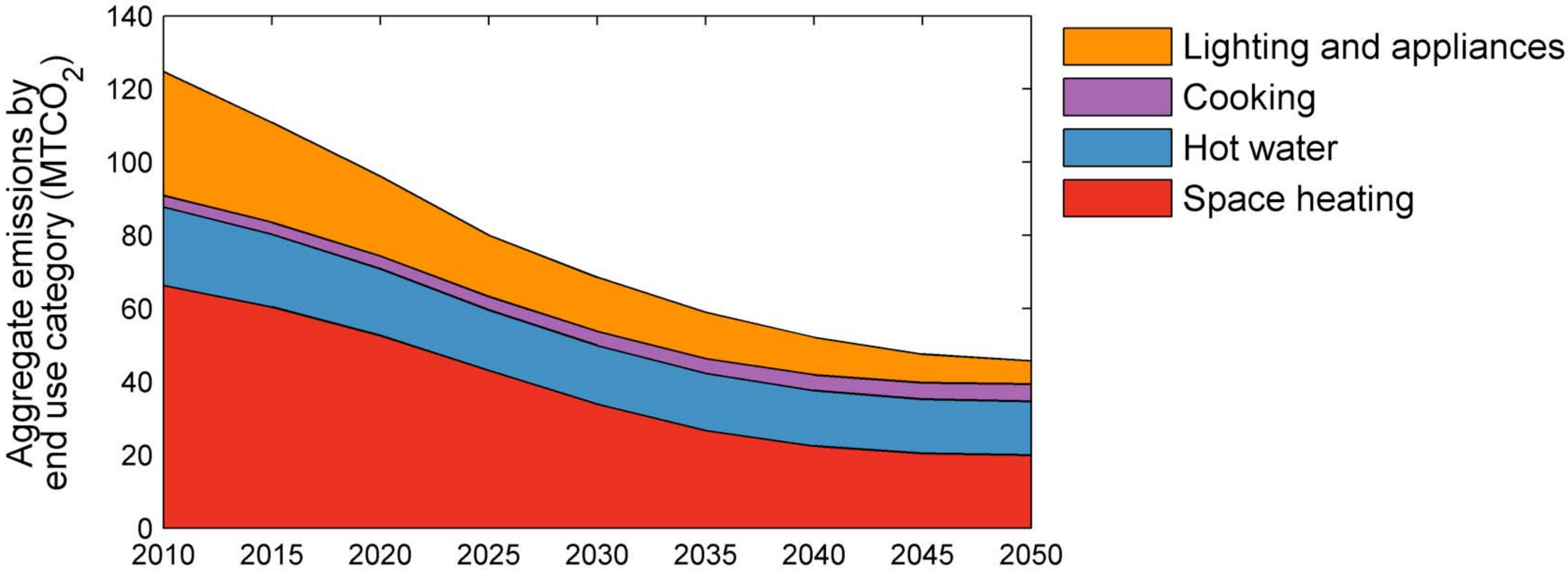


Retrofitting building stock will reduce emissions by further 41MtCO_2 (33%)

Energy efficiency technologies need to be modelled as a portfolio

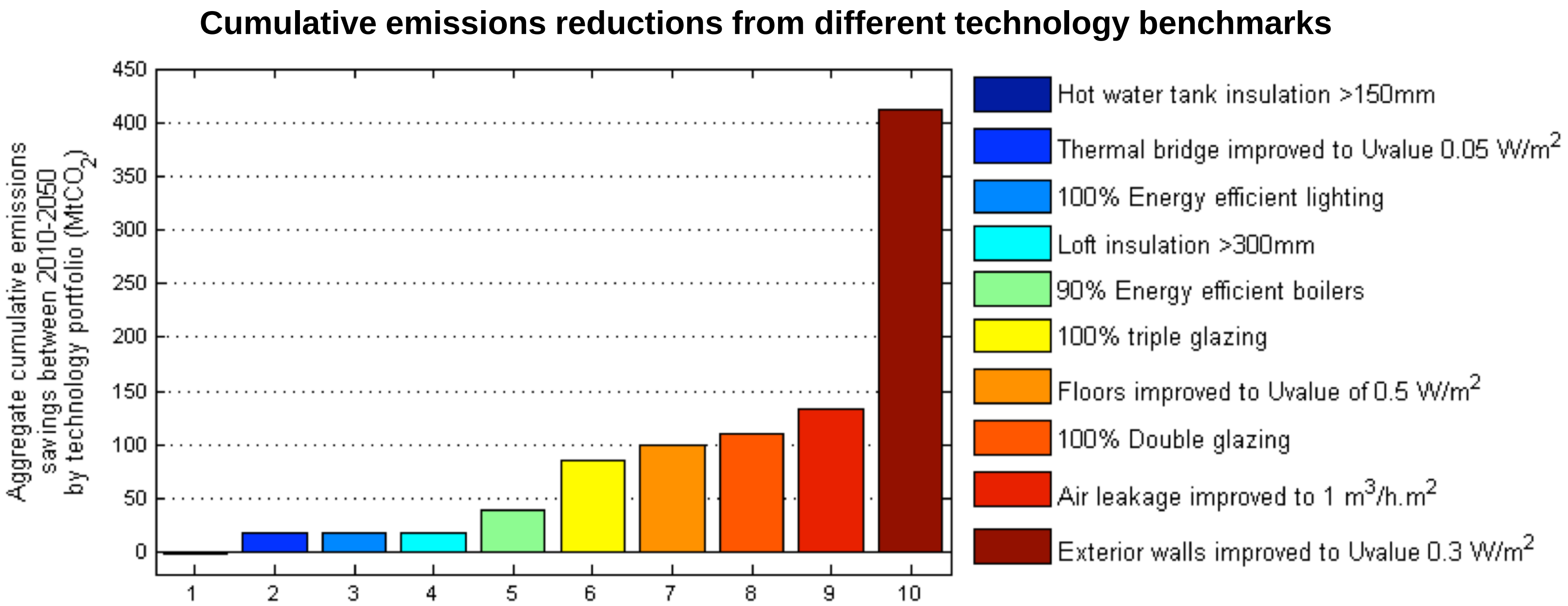
Energy consumption by end-use in BEESM

Projections of energy demand by end use category



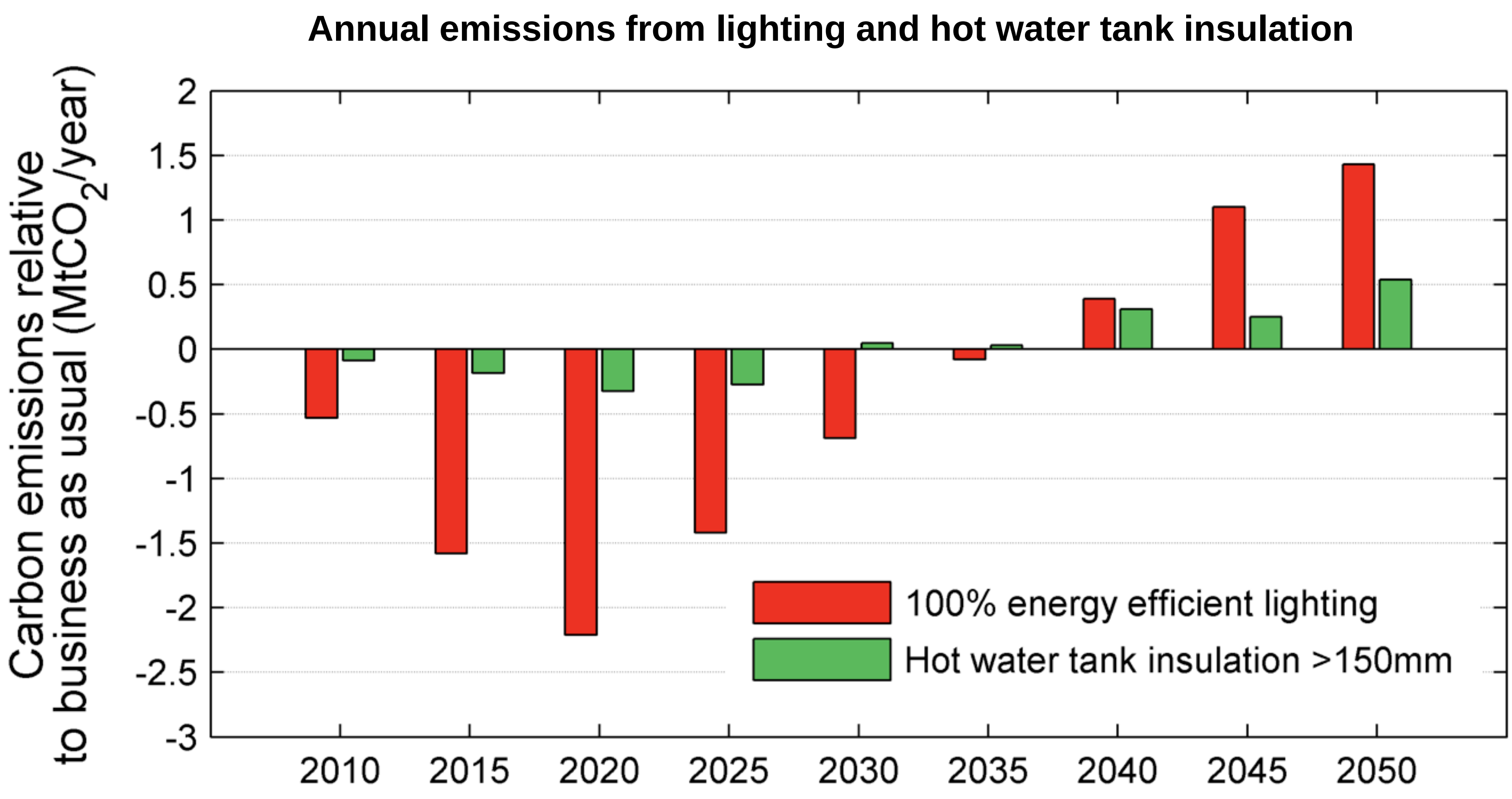
Hot water and appliances dominate emissions by 2050

Abatement potential by technology in BEESM



Improving U-value of exterior walls is most effective at reducing emissions

Emissions from lighting and hot water tank insulation



Hot water tank insulation and energy efficient lighting lead to an increase in CO_2 emissions as power sector is decarbonised.

Conclusions

- **Walls, Glazing and leakiness are most important technologies**
- **33% emissions saved by decarbonisation of power sector**
- **33% emissions saved from retrofitting buildings**
- **Additional 200 TWh of low carbon energy required by 2050**

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Please contact me with any questions

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Acknowledgements

Dr Michael Pollitt and Professor Doug Crawford-Brown. Cambridge Econometrics and the Cambridge Trusts for providing me with the funding for the PhD. UCL Energy institute for providing the data and financial support. Dr Nick Eyre and Professor Lester Hunt for examining my thesis. Any blind reviewers and co-authors who provided valuable comments

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