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Developing the UK Energy System
Energy System Modelling Environment (ESME)

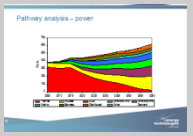
Jo Coleman, Deputy Strategy Director

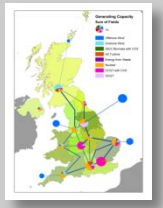
ETI - Addressing 2020 and 2050 energy challenges by...

Setting strategic direction

World-class ETI capability in energy system modelling and strategic analysis

ESME
Energy System Modelling Environment





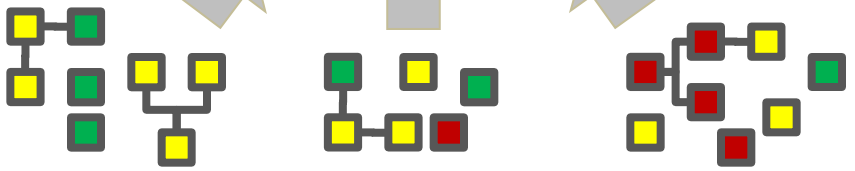
Focused on the integrated UK energy system – power, heat, transport and associated infrastructure

Which energy technologies do we need and when?

Creating commercial confidence

Viable commercial operation

ETI Delivery of engineering demonstrations of innovative low carbon energy systems



Innovative technologies, sub-systems and information

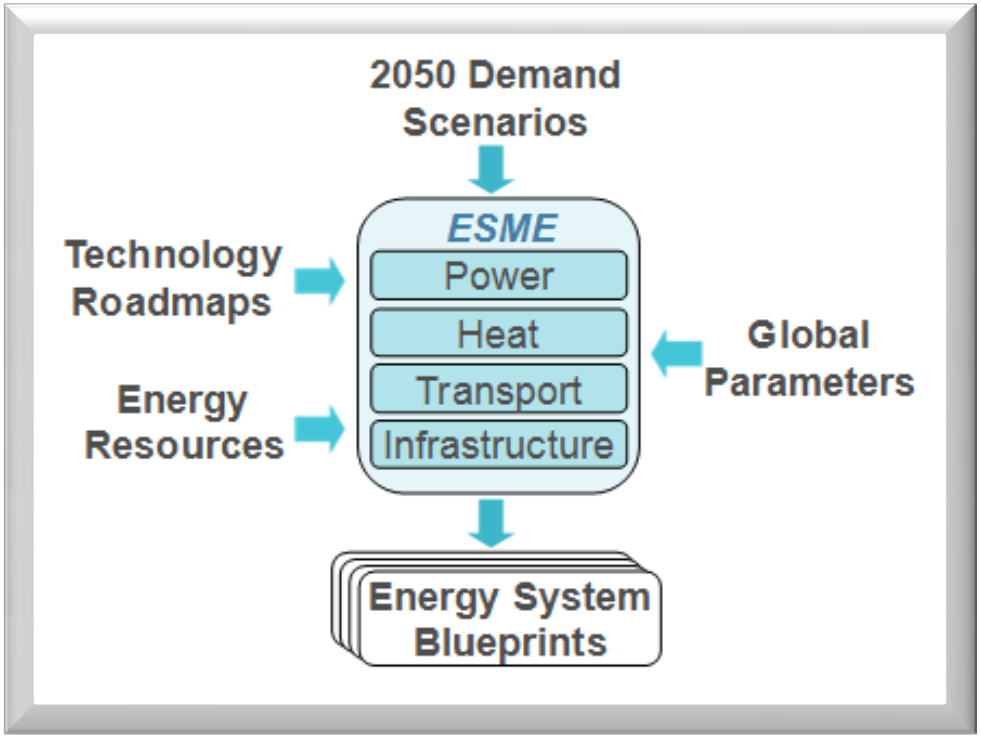
What might the UK energy system look like in 2050...

- Decided by global developments – not just UK events, decisions and policy
  - UK and global economy
  - Industry and technology developments
  - UK demand changes – scale and segmentation
  - Global socio-political events
  - ...
- The future is uncertain and we need energy system designs that allow for this

Energy System Modelling Environment

A national energy system design tool; integrating power, heat, transport, industry and infrastructure

- Addressing the energy trilemma
  - Affordable, secure, sustainable
- Distinctive modelling approach
  - Least cost optimisation (policy neutral)
  - Probabilistic treatment of uncertainties
  - Includes temporal variations
  - Considers geographic factors
- Internationally peer reviewed
- Informed by ETI members, advisors and ongoing ETI projects



ESME
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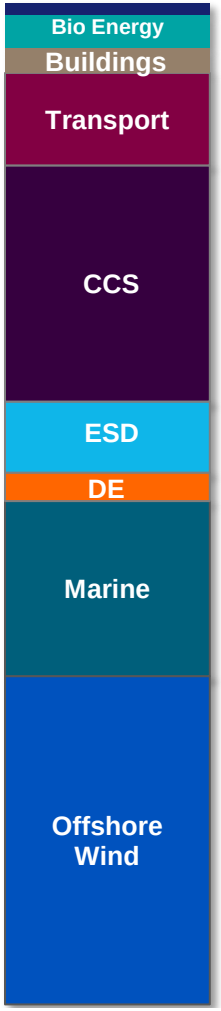
ESME integrates knowledge from across ETI programme areas



Models informing ESME:

Local authority GIS Waste resource modelling tool
Bio Value Chain Model

Single Building Thermal Efficiency model
Buildings Thermal Efficiency Stock Model

Transport LDV Cost model

Benchmark models of IGCC/CCGT/ USCPC

2050 Energy Infrastructure cost model

PLEXOS dispatch model
Macro DE Heat Network Costing model

PerAWAT Marine Array Modelling Suite
Tidal Resource Continental Shelf Model

Offshore Wind Energy cost model

ESME
Energy System Modelling Environment

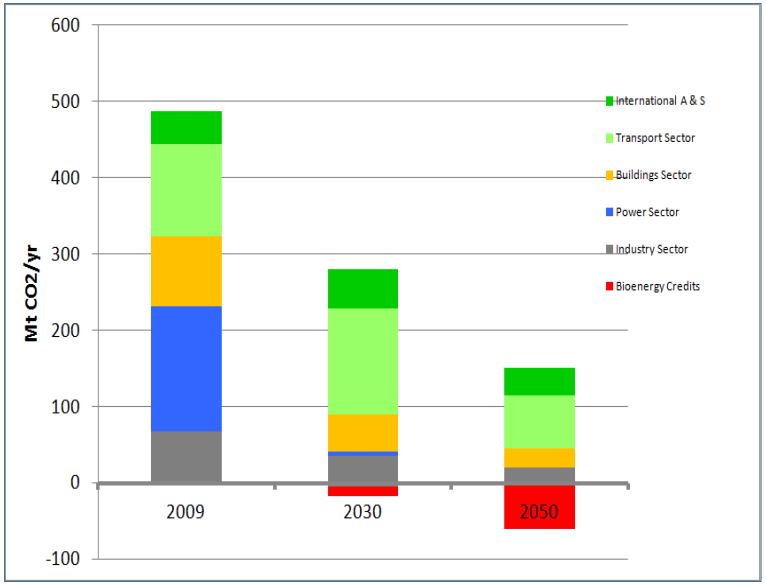
In place
Under development

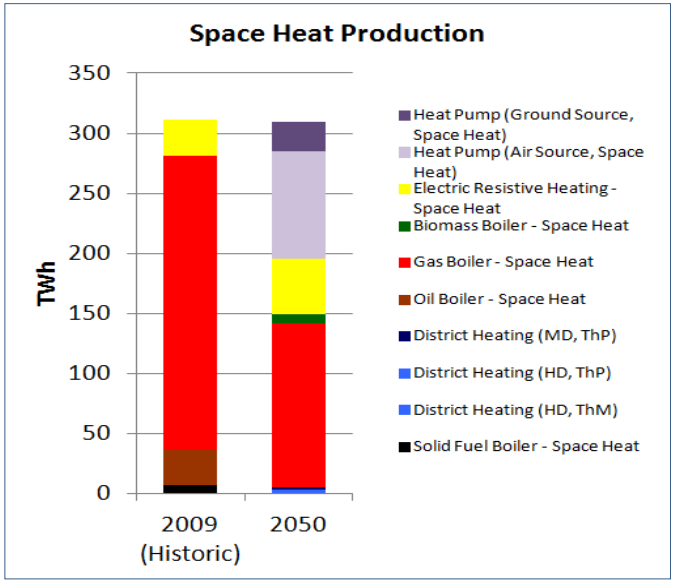
ETI Members are using ESME and exploring ways to leverage further

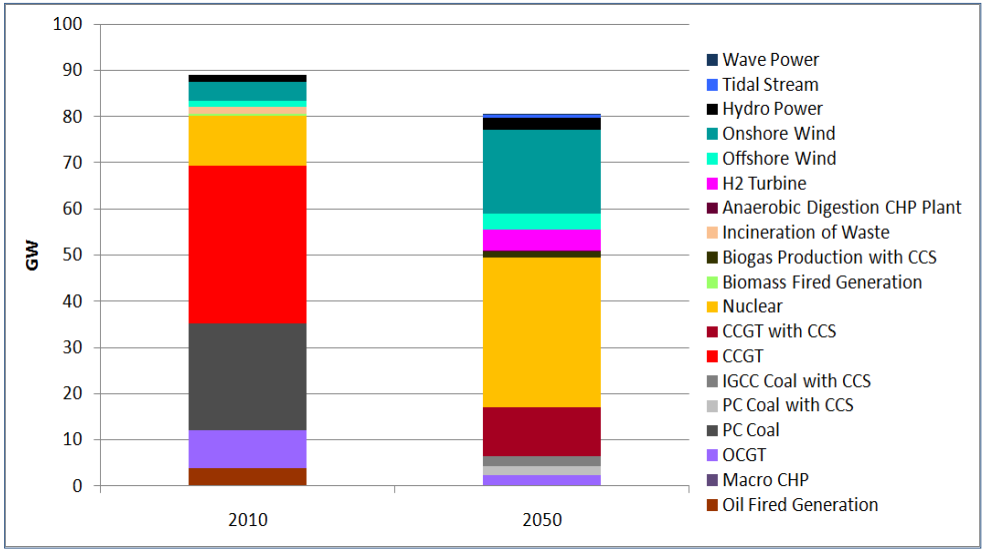
- Underpinning business strategy and technology development choices
- Informing UK Govt policy
  - Renewable Energy Review
  - Technology Investment Needs Assessment's
  - The Carbon Plan
  - Bioenergy Strategy
- Individual Members are developing own versions for specific countries of interest

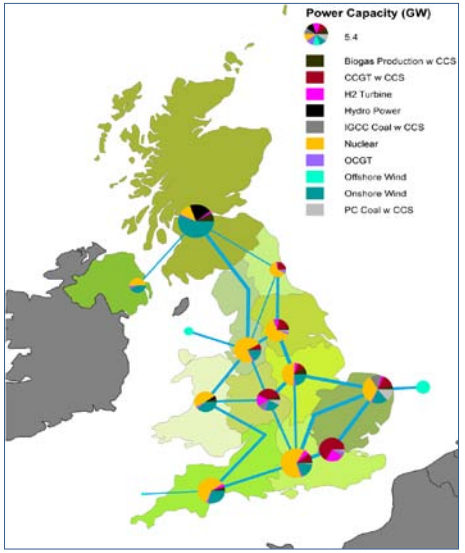
ESME
Energy System Modelling Environment

Typical ESME Outputs





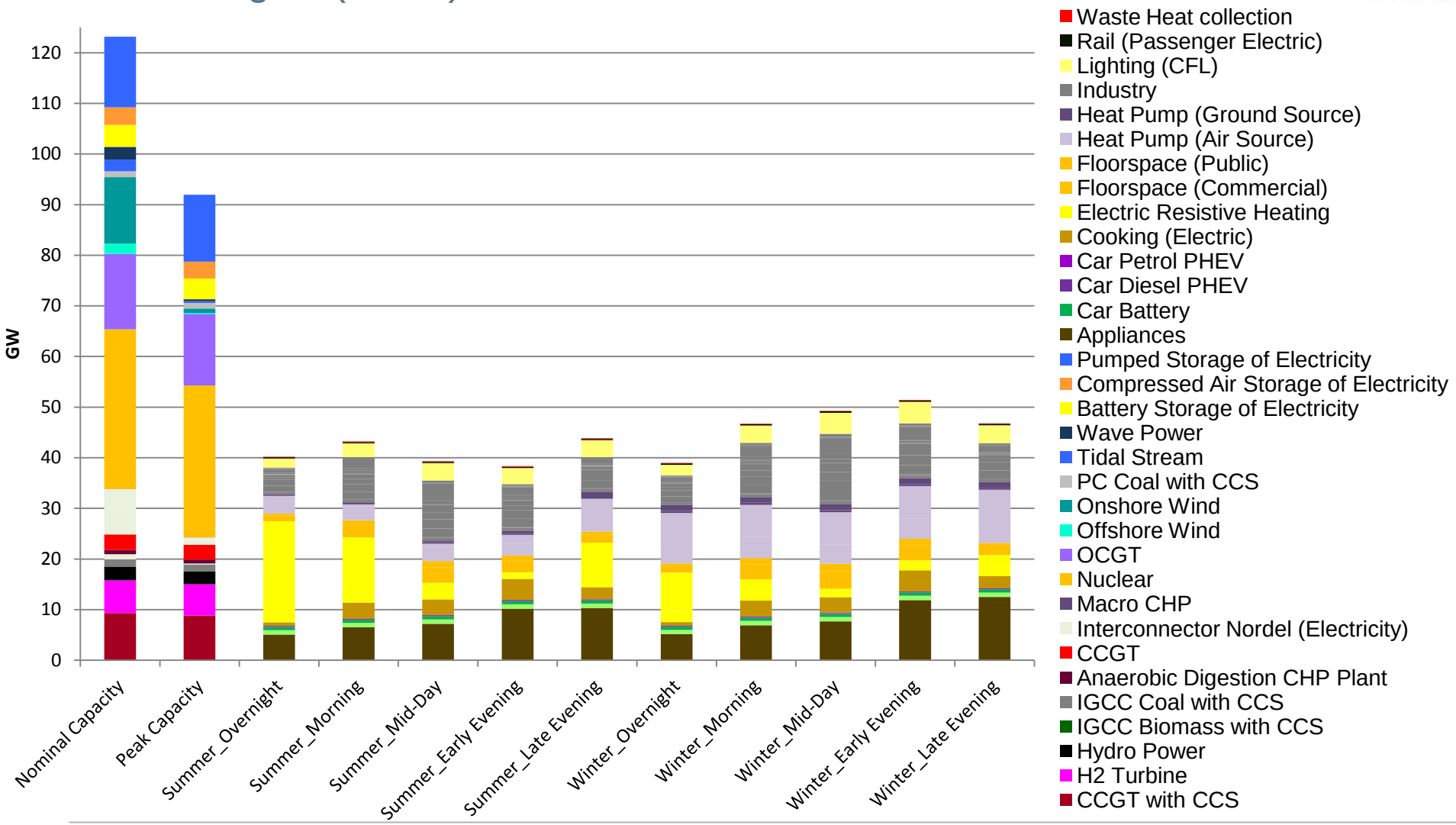




ESME
Energy System Modelling Environment

New Peak Energy Model: Electricity

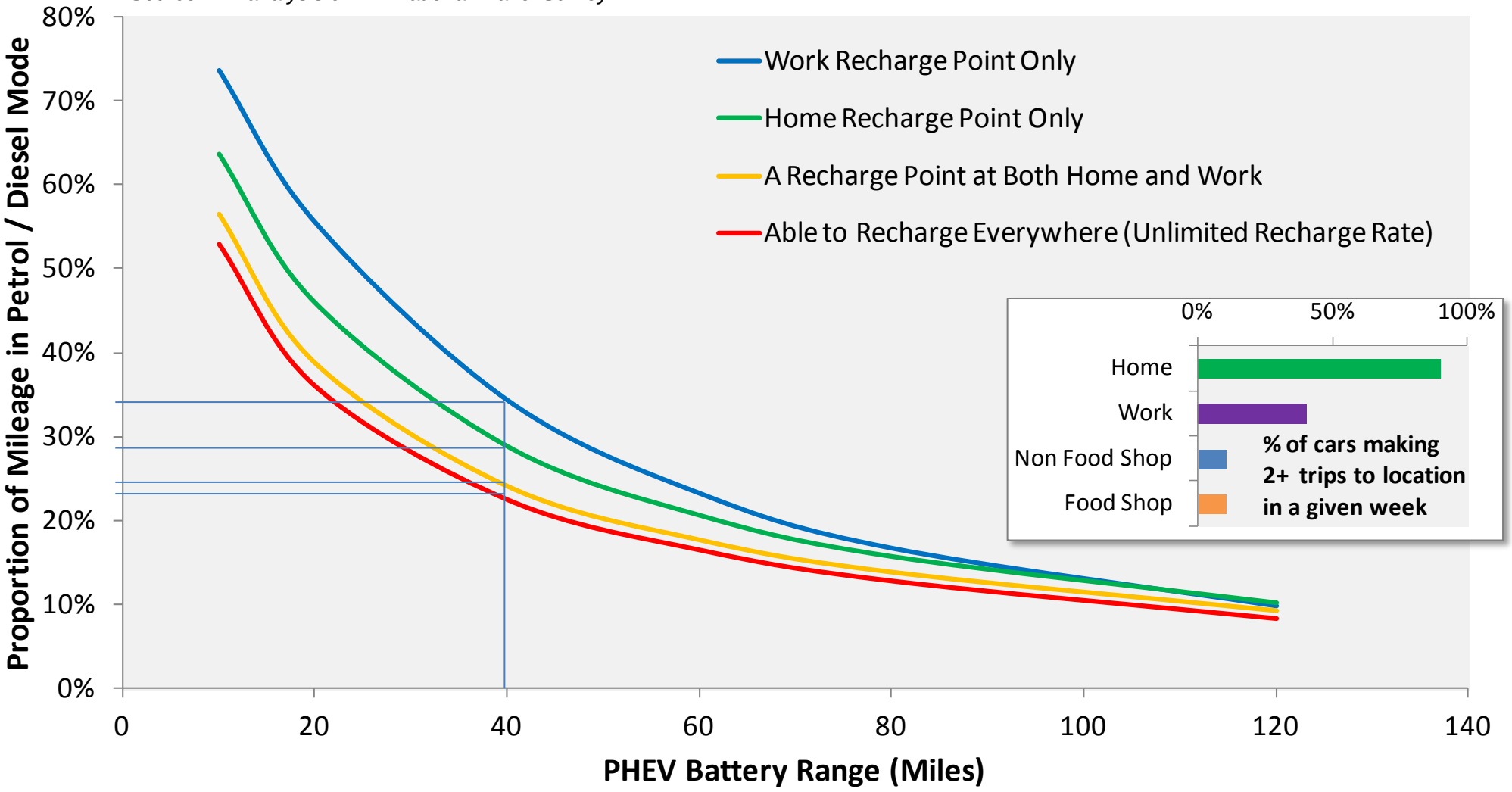
Peak Reserve Margin vs Typical Demand by Technologies (mean)



ESME results shown from development model:
ESME v2 + peak energy modules, ESME v2 data

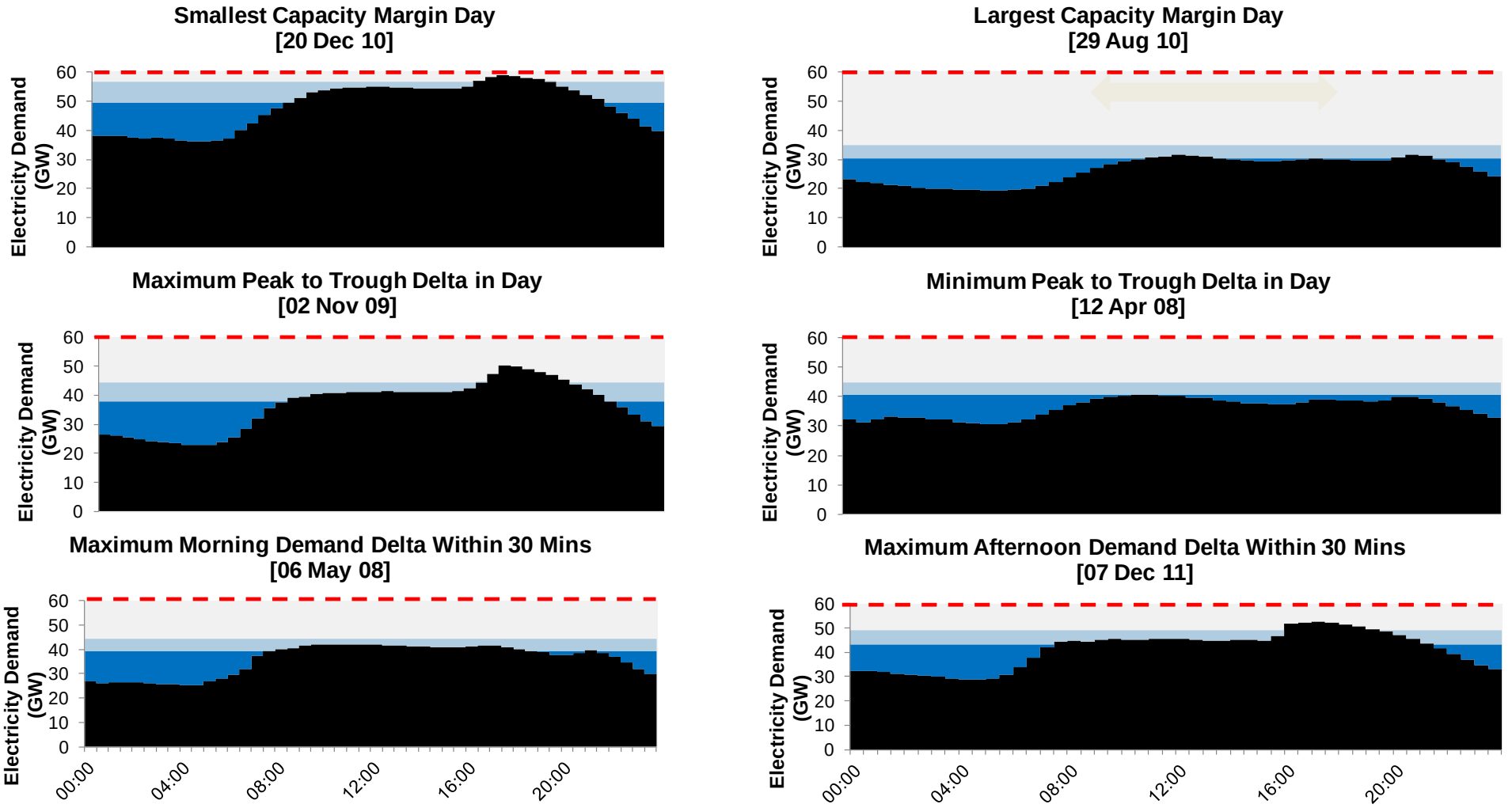
Electric Vehicles - Home is the best recharge point location; duplicate or public recharge points add little

Source: ETI analysis of DfT National Travel Survey



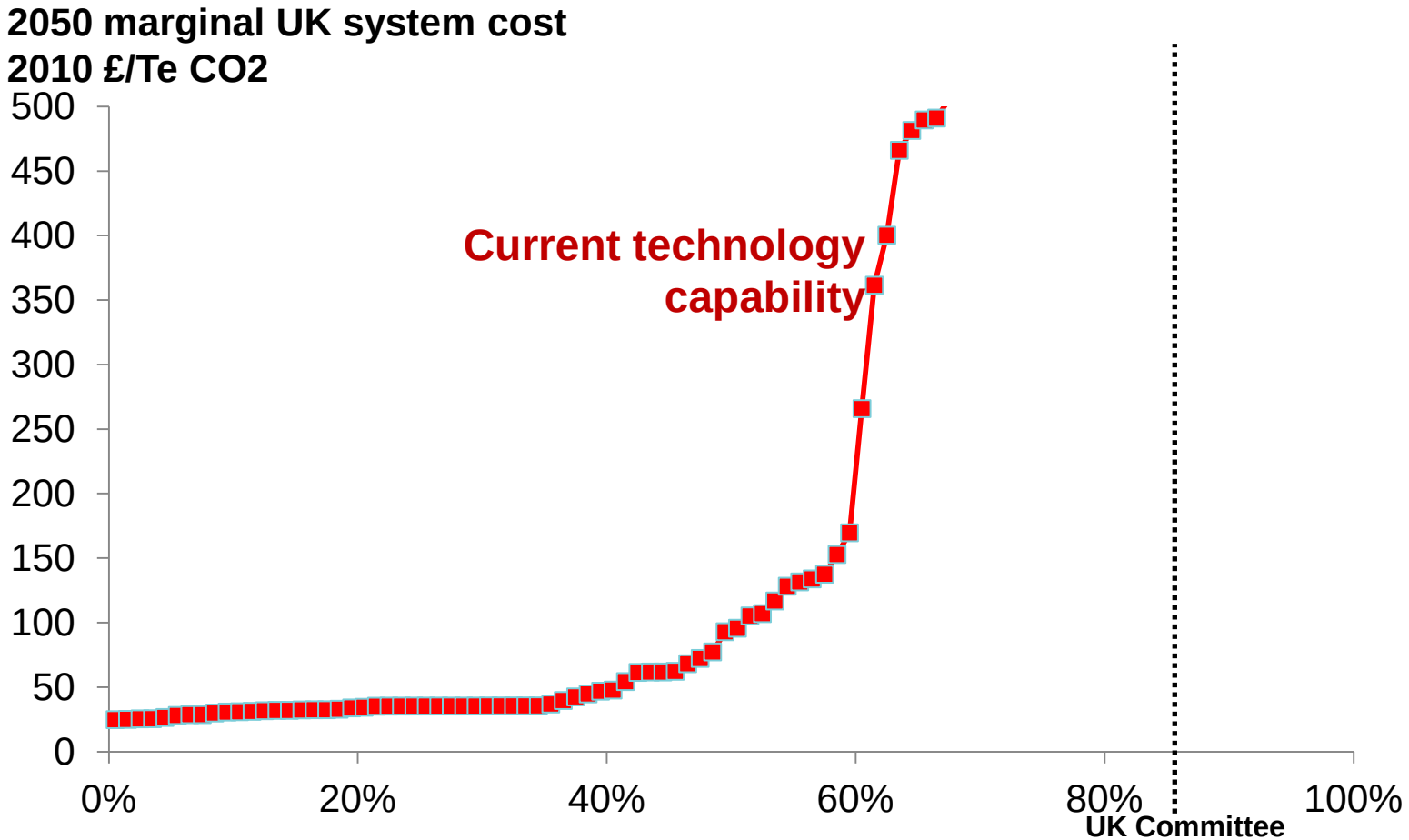
Dynamic demand control will be needed to fit vehicle recharging around variable national electricity demand

Design target: (1) don't add new peaks; and (2) improve system efficiency by levelling demand



Source: ETI analysis of National Grid demand data [Jan 2008 to Dec 2011]

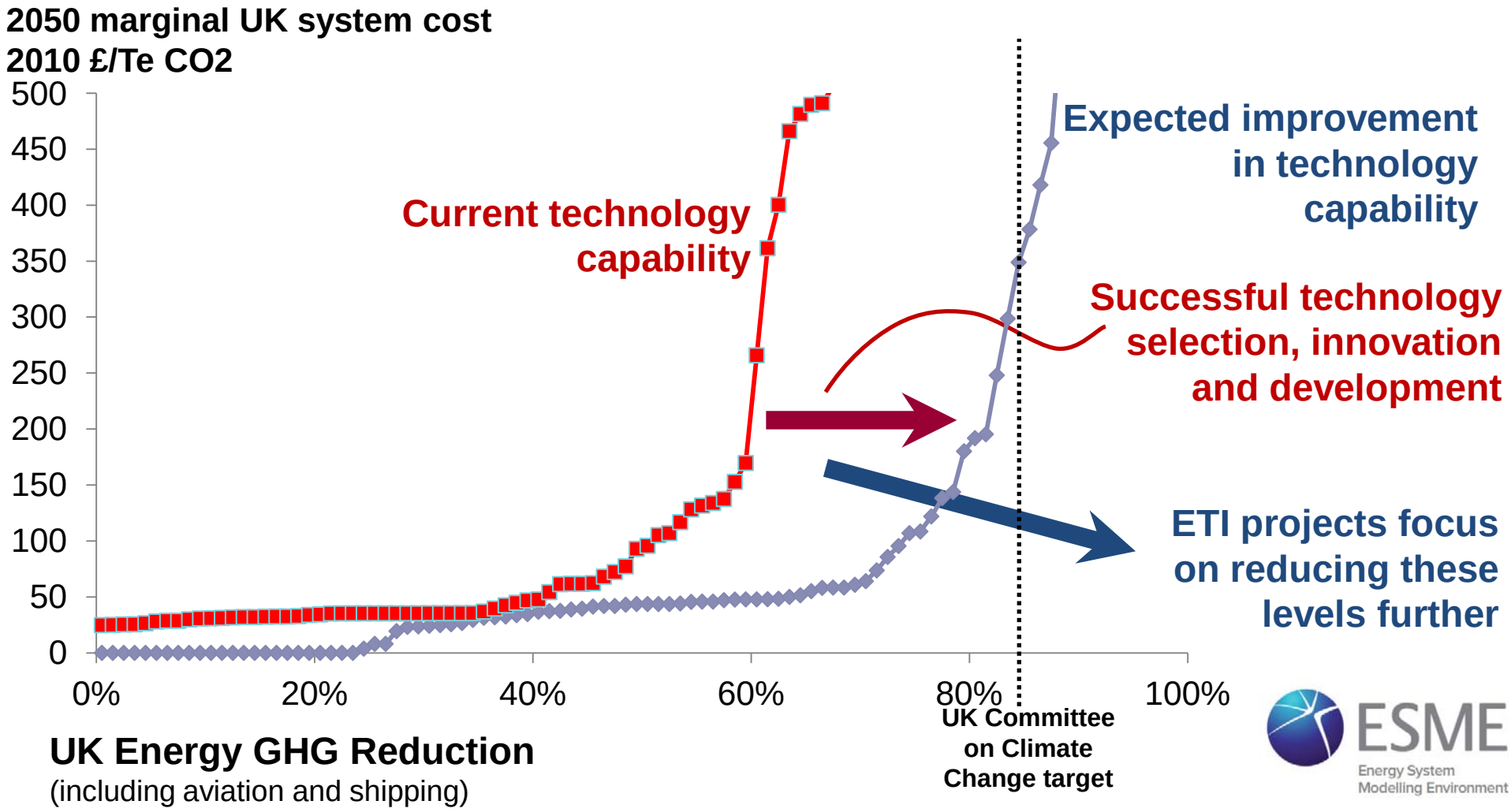
2050 CO_2 target is unaffordable with today's technologies



UK Energy GHG Reduction
(including aviation and shipping)

2050 abatement costs can be acceptable

if...we **develop** and **apply** the optimum technologies



Potential implications and development priorities for the UK

Efficiency measures

Waste heat recovery, building insulation, and efficient vehicles make a contribution under all emission reduction scenarios.

ETI targeting through 'Smart', (including vehicle electrification infrastructure) and HDV projects

Nuclear

Mature technology and appears economic under most emission reduction scenarios - primarily an issue of deployment (planning / licensing, supply-chain, finance etc)

Cost impacts post-Fukushima need clarification – international approach needed

ETI contributed to Nuclear roadmap & TINA

CCS

A key technology lever given potential wide application in power, hydrogen and SNG (gas) production, and in industry sector

ETI investing in separation, storage and system design – for coal, gas and biomass, also hydrogen turbine limits

ETI developing business models and commercial frameworks to enable deployment

Bioenergy

Major potential for negative emissions via CCS through a range of conversion routes – H2, SNG, process heat

ETI investing in science, logistics and value models

Offshore Renewables

Offshore Wind is the marginal power technology and an important hedging option

ETI developing over £30m in next generation, low cost, deepwater platform and turbine demonstrations

ETI developing marine modelling tools and technology

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