# Efficiently demanding energy?

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Executive Director
UK Energy Research Centre

Energy Efficiency & Demand Reduction:
Realising the potential of the West Midlands knowledge base
Birmingham 11 December 2009

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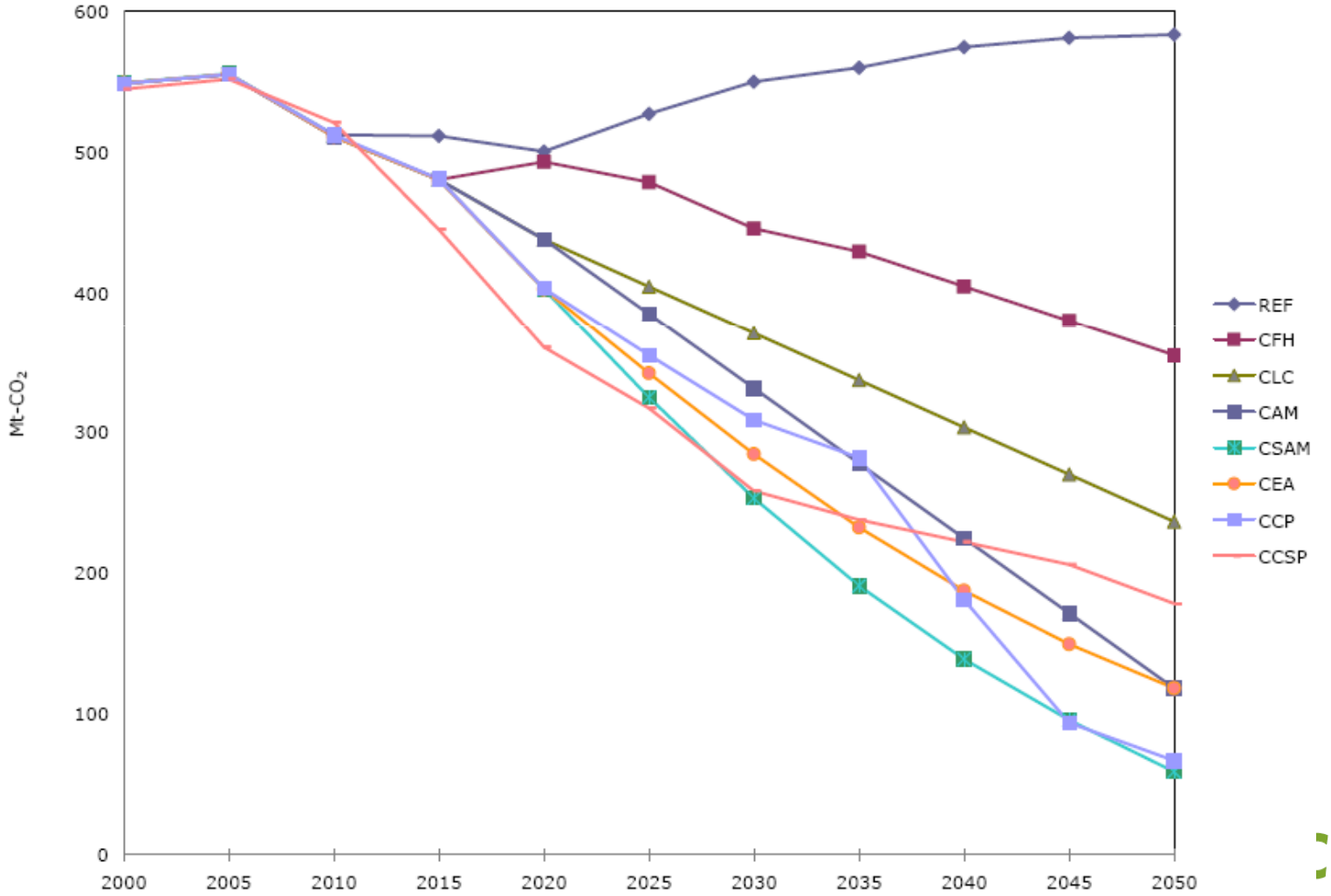
# The Scale of the Challenge: Climate Change Mitigation

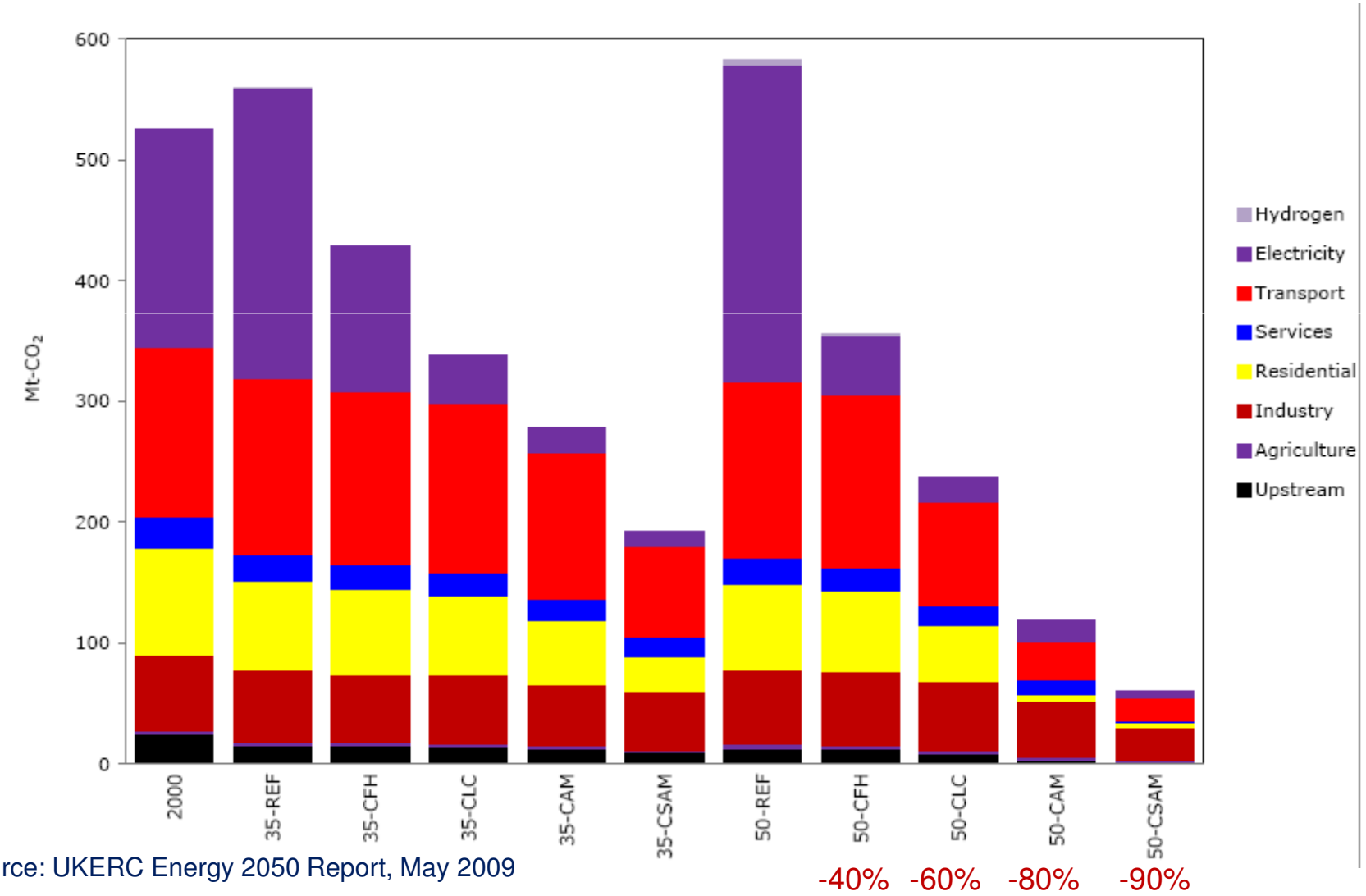
- The UK Government has committed to
  - A 34% reduction in GHG emissions by 2020 (110 $MTCO_2e$ cf 1990)
  - an aspiration of an 80% reduction in GHG emissions by 2050

# UK $CO_2$ emissions under different scenarios



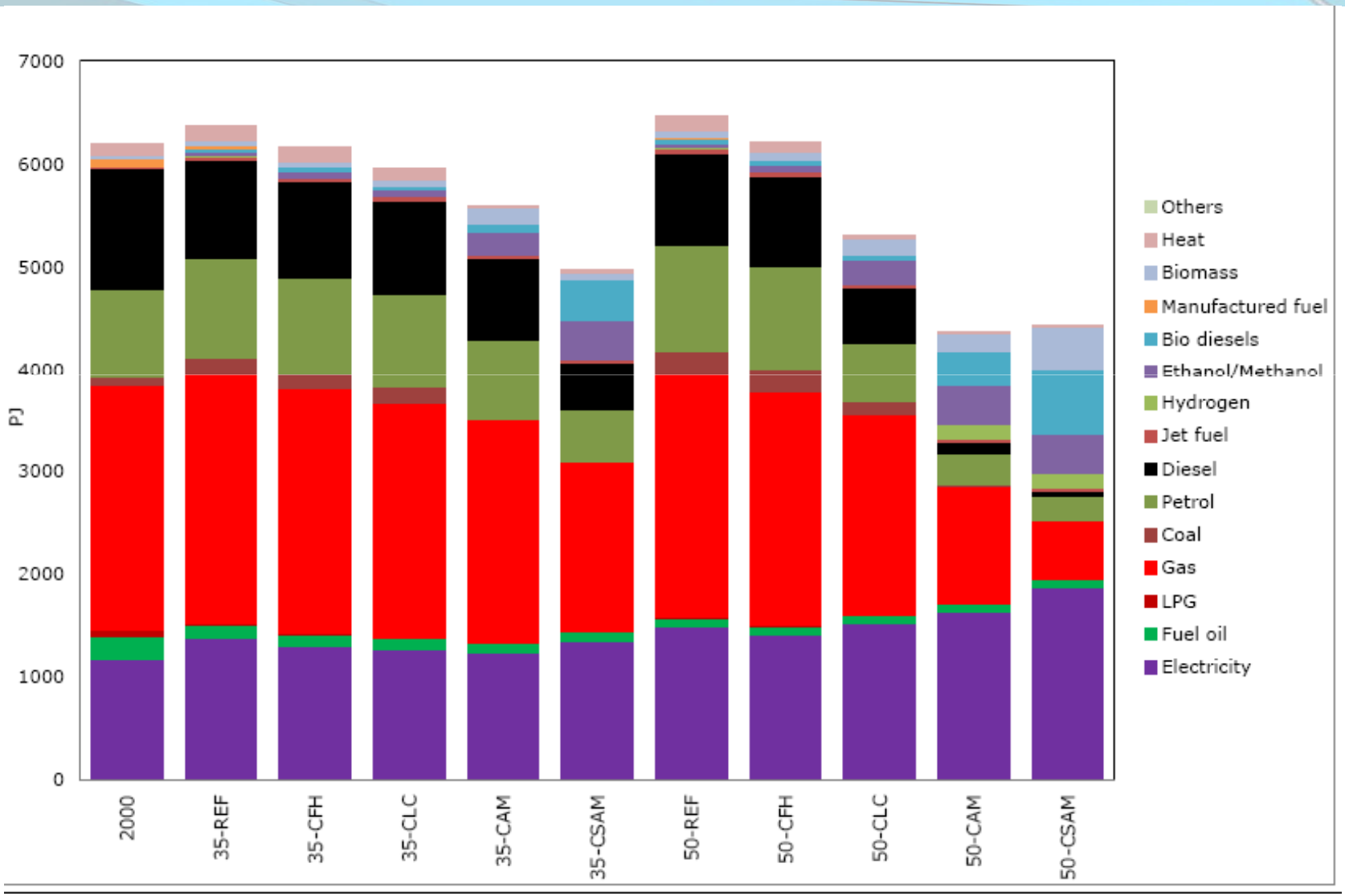

Source: UKERC Energy 2050 Report, May 2009

# Sectoral emissions for 2000, 2035, 2050




Source: UKERC Energy 2050 Report, May 2009

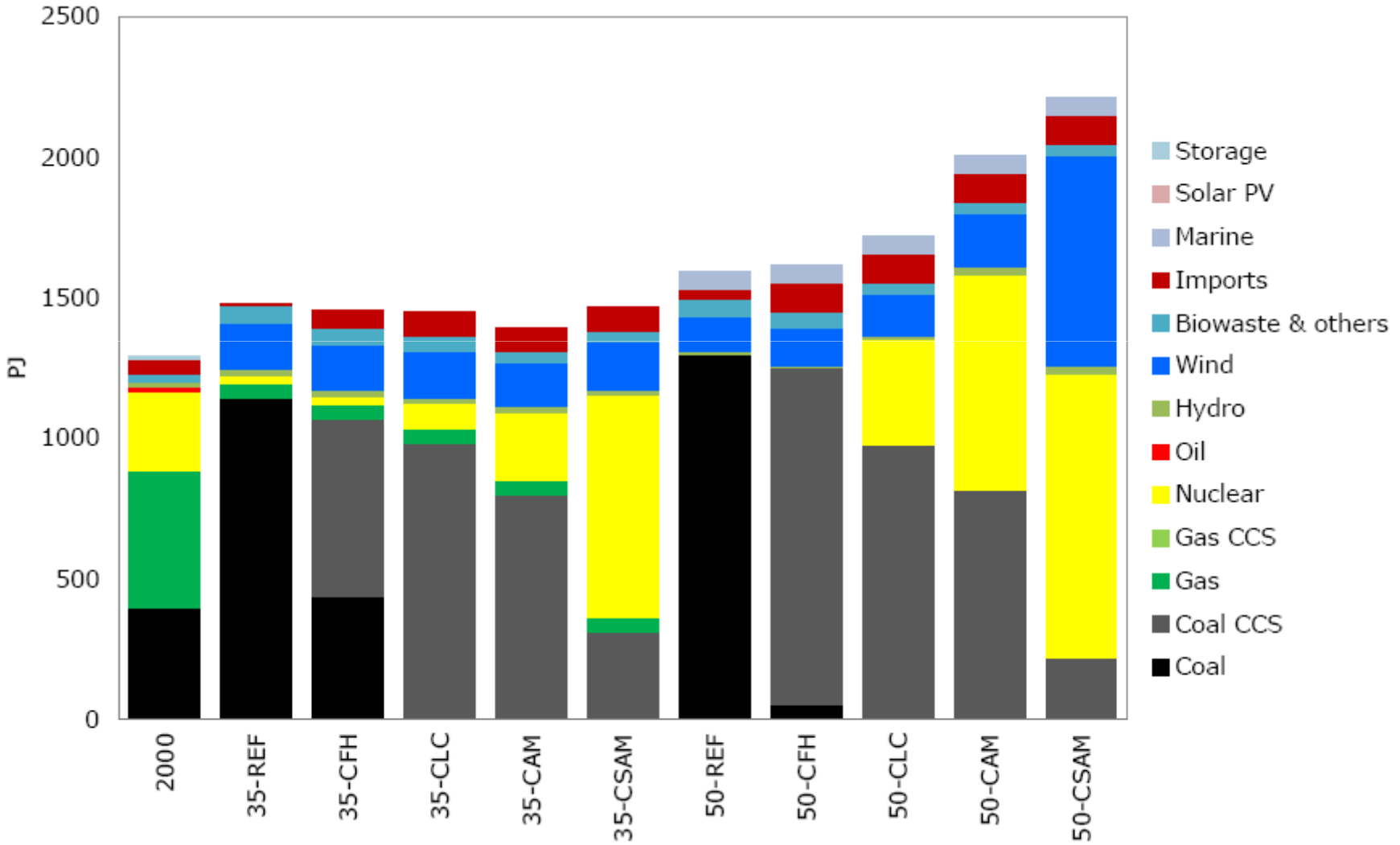
# Final energy demand by fuel 2035 & 2050




-40% -60% -80% -90%

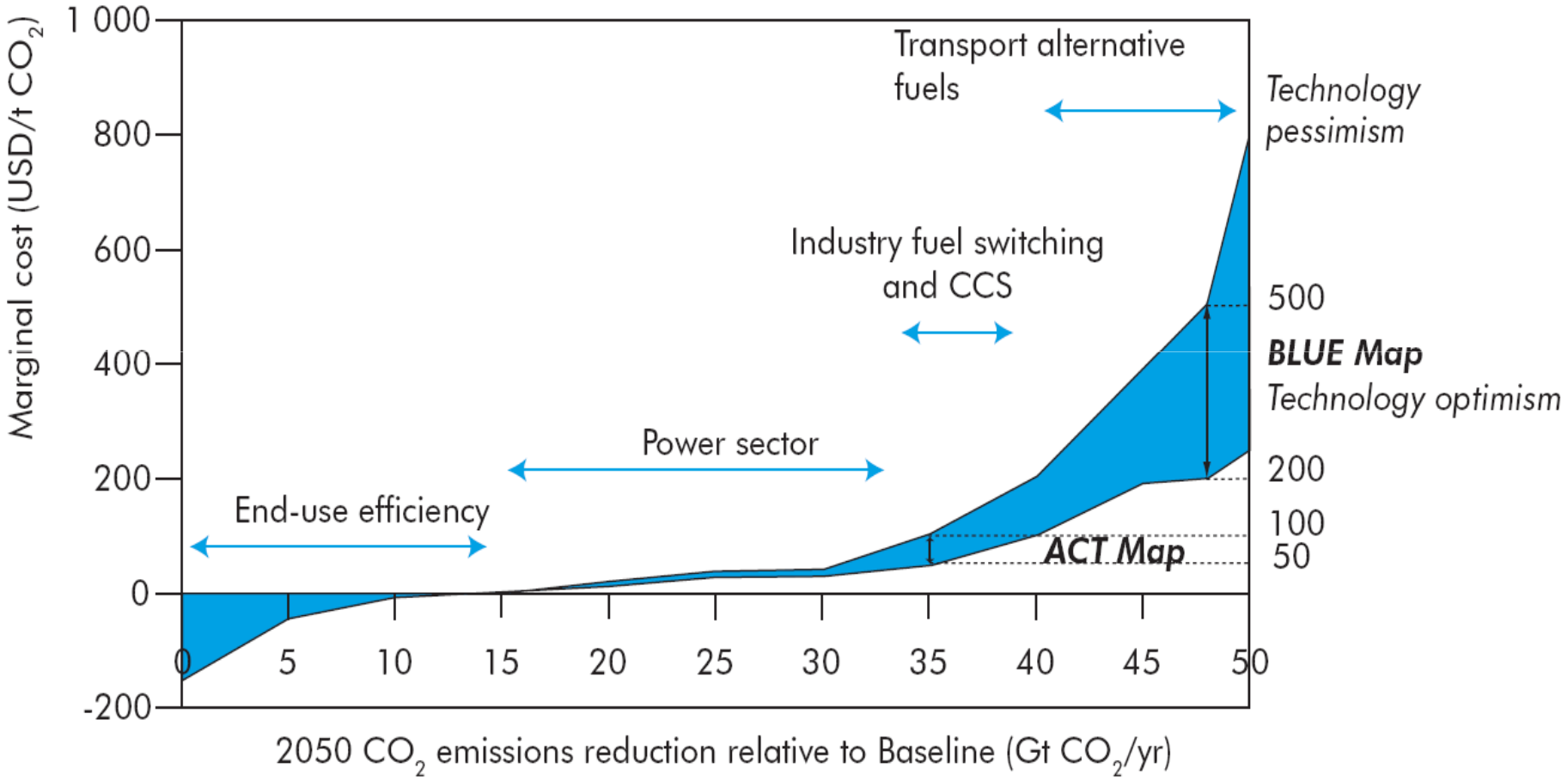
Source: UKERC Energy 2050 Report, May 2009

# Electricity generation mix 2035 & 2050




Source: UKERC Energy 2050 Report, May 2009

# Marginal Abatement Cost Curve for $CO_2$ Reduction




Source: International Energy Agency

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# We have a plan!


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# European Roadmap

By 2020:

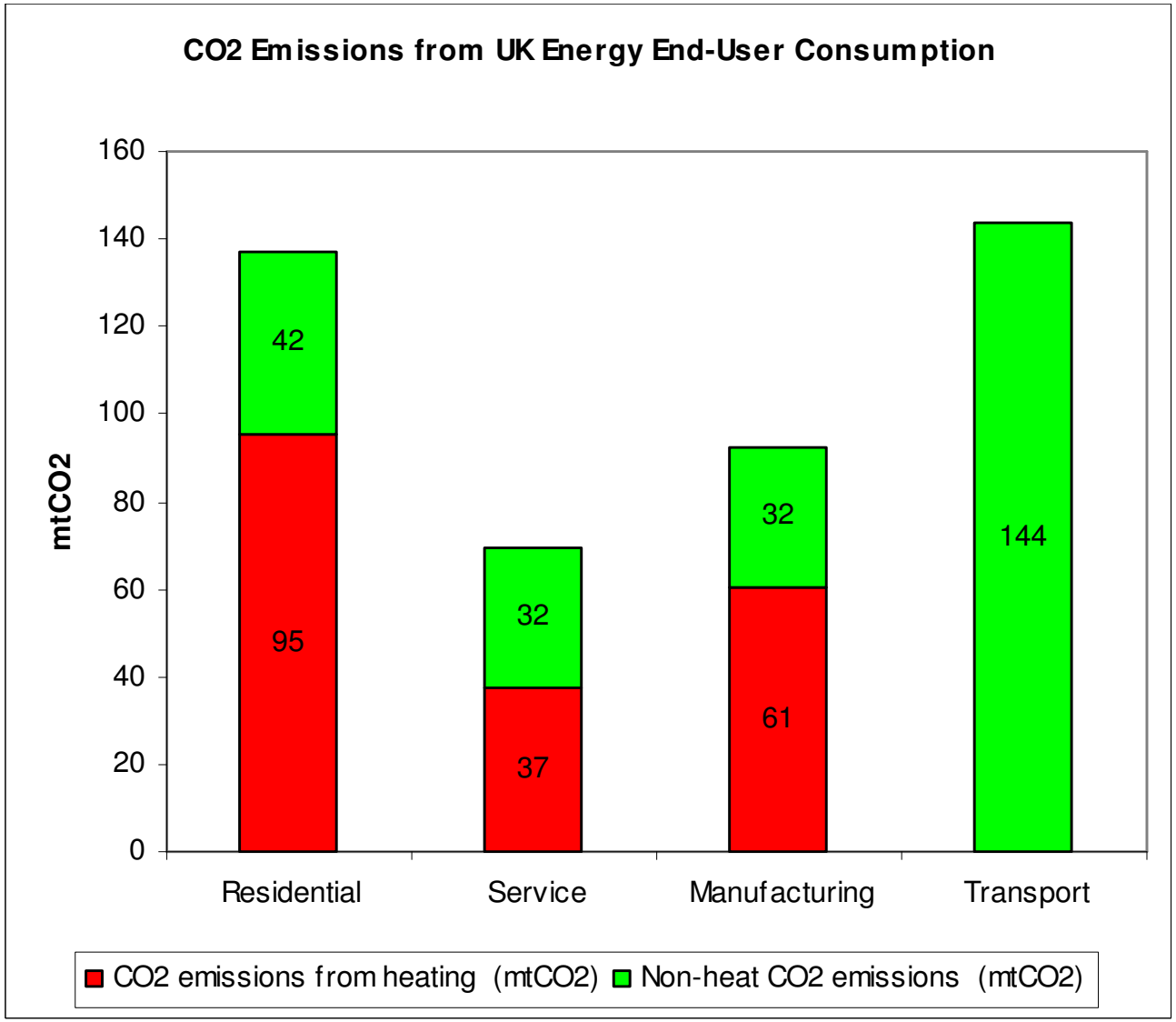
- 20% electricity from wind
- 15% electricity from solar PV
- Grid can seamlessly integrate 35% stochastic renewables
- 14%  EU energy from sustainable bio-energy sources
- CCS on verge of commercial viability (assuming functioning carbon market
- First GEN IV nuclear fission prototype ready

# Planned European R&D Investments

2010 - 2020:

| Technology | Investment | Target |
|---|---|---|
| ▪Solar PV & CSP | €16Bn | 15% electricity |
| ▪CCS | €13Bn | Almost commercial |
| ▪Energy Efficiency | €11Bn | 25 smart cities |
| ▪Fuel cells & Hydrogen | €6Bn | Commercial |
| ▪Electricity networks | €2Bn | 50% smart |

# Importance of heat

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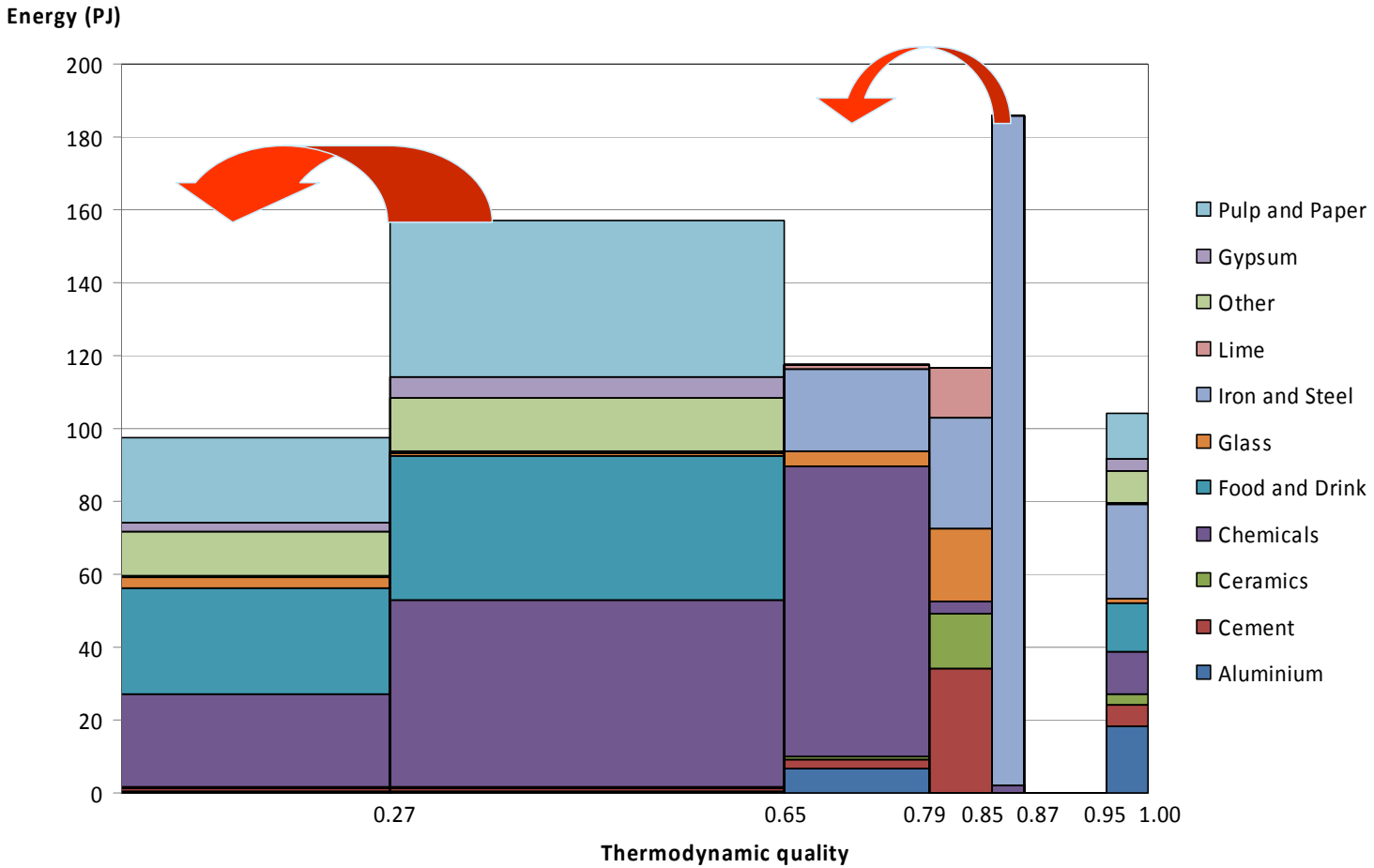
# UK industrial energy use by quality

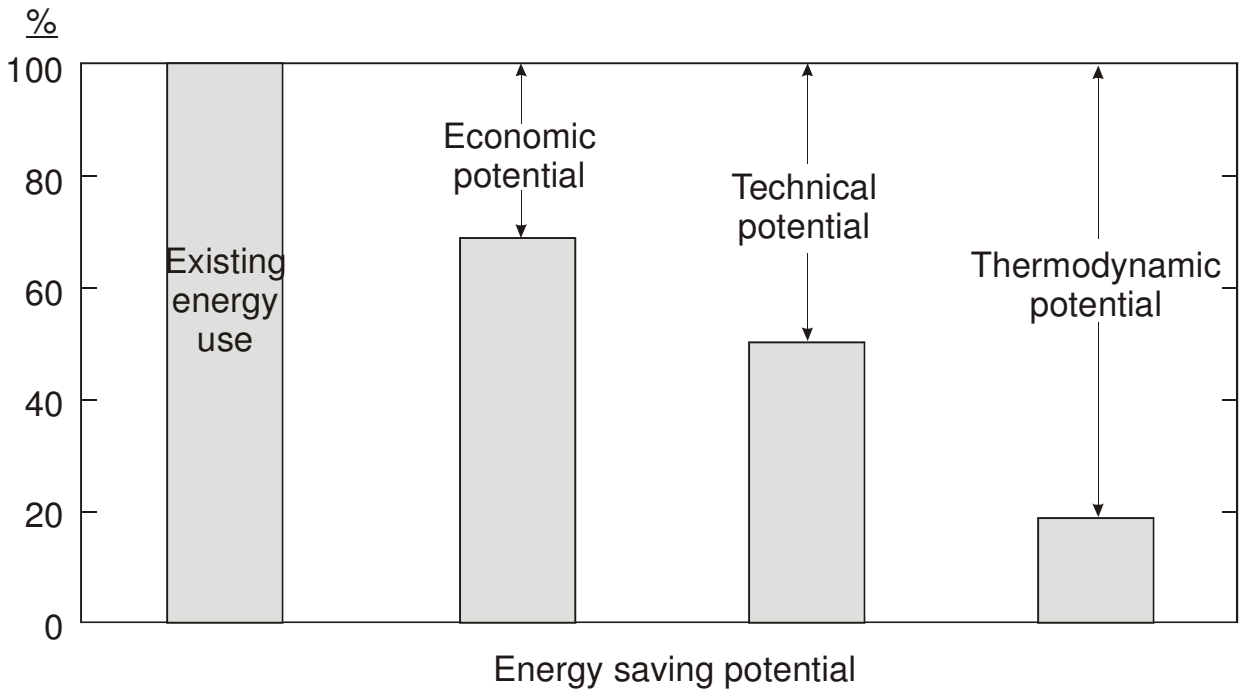



Source: Geoff Hammond, UKERC and Bath University

Heat

RC

# UK industrial energy saving potential




Heat

Source: Geoff Hammond, UKERC and Bath University

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# The Scale of the Challenge: Contribution of the Built Environment

- 45% of all present carbon emissions come from existing buildings, with 27% from homes
- 87% of existing buildings will still be here in 2050

# Market penetration trends, home energy efficiency measures

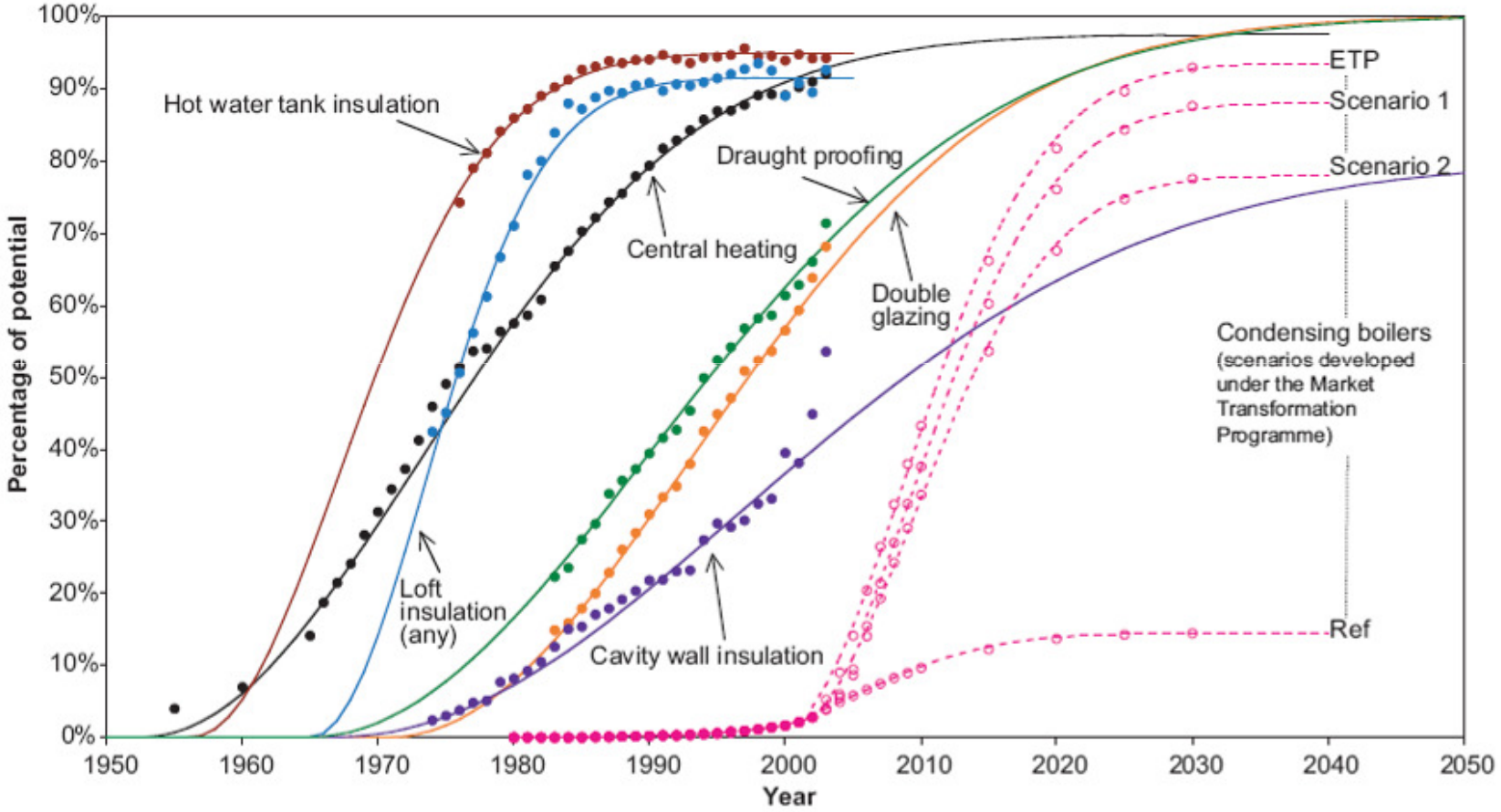


**Figure 1** Market penetration of home energy-efficiency related measures

Source: Prof Dennis Loveday, Loughborough University

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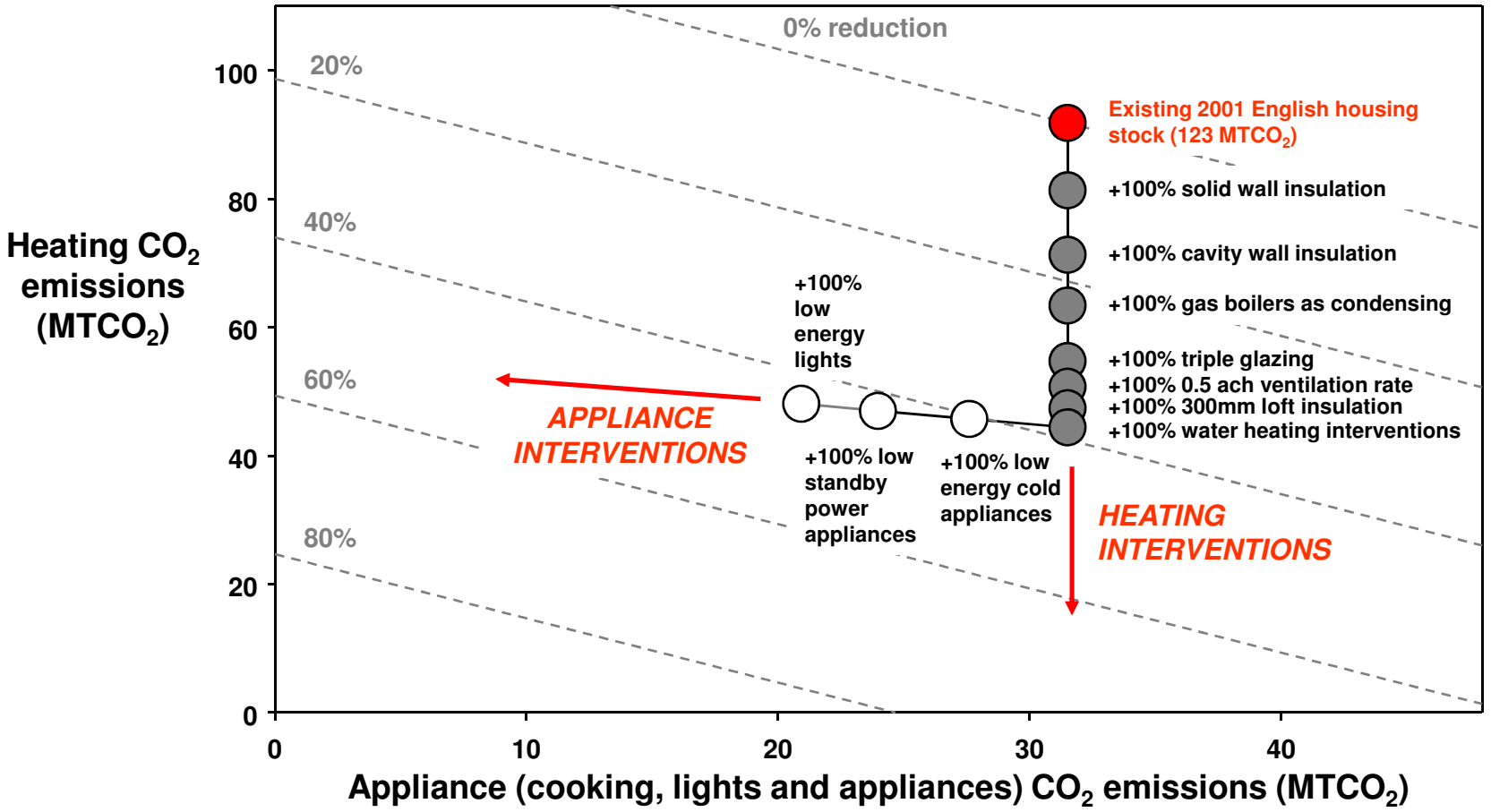
# Progress towards 80%...energy efficiency predictions: 2001 English housing stock




*-Based on 1971 to 2000 average climate data. Source: CaRB project, Carbon Vision Partnership, funded by EPSRC*

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Source: Prof Dennis Loveday, Loughborough University

# Recent progress: Hard data from recent times projected forward

- 1990#: 154MtCO$_2$ equivalent from housing
- 35% of energy saving interventions installed*

- 2005#: 147MtCO$_2$ equivalent from housing
- 65% of energy saving interventions installed*

2020 114MtCO$_2$, HMG's *target* for housing

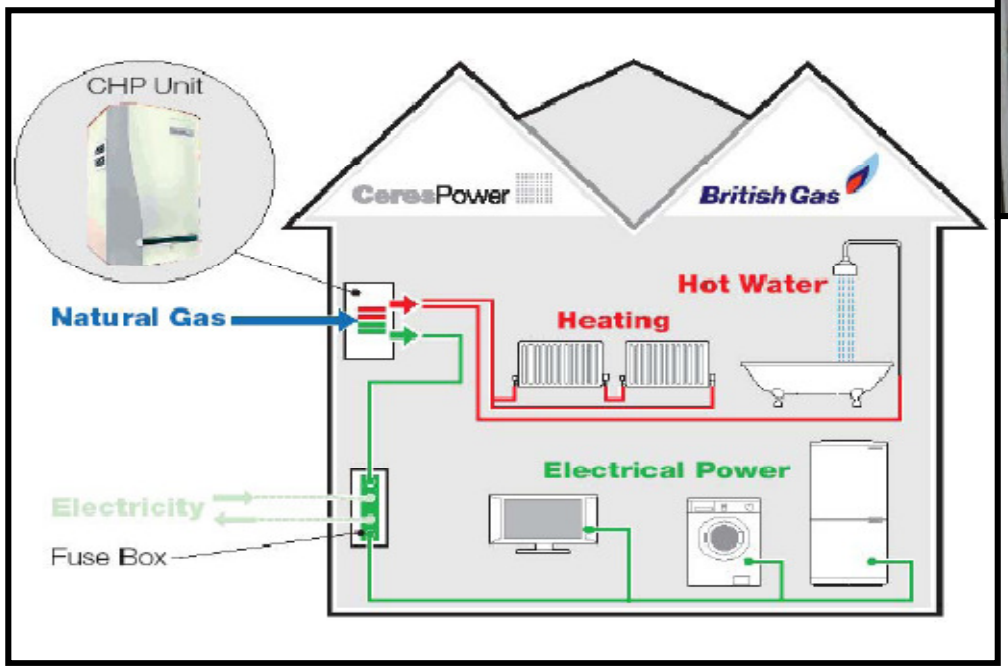
- Must achieve *net* savings at **six** times rate of recent history.

- 4% savings net of many factors
- At most a 20% further reduction via 100% reach of * above.

- # Measured data, incontrovertible
- * 3" loft insulation, >60% window double glazed, >60% rooms draught proofed, cavity wall insulation to modern standards

Source: Prof Mike Kelly, CLG

# Housing




MicroCHP: Fuel cell base
10 000 unit trial by 2010
36 000 for 2012

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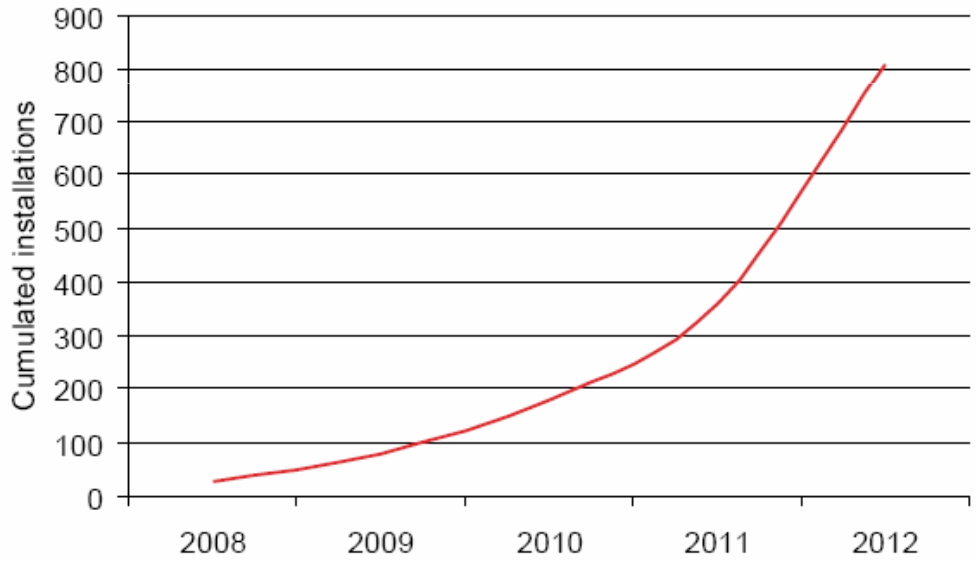
# German residential fuel cell propgramme

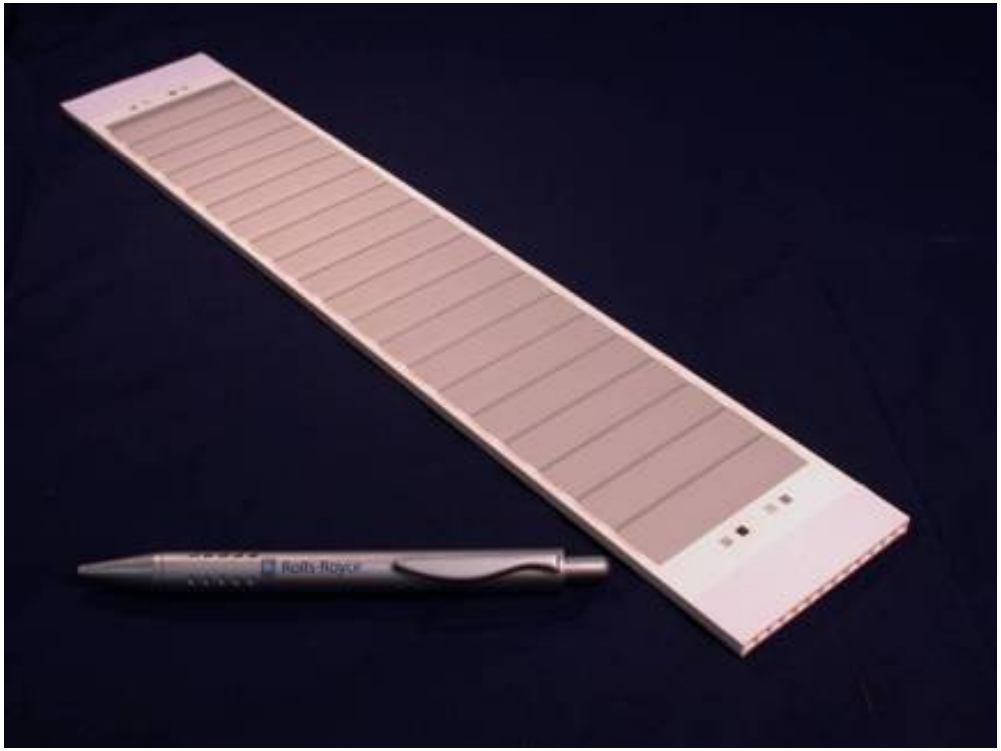
callux
Praxistest Brennstoffzelle fürs Eigenheim

## Planned numbers of appliances

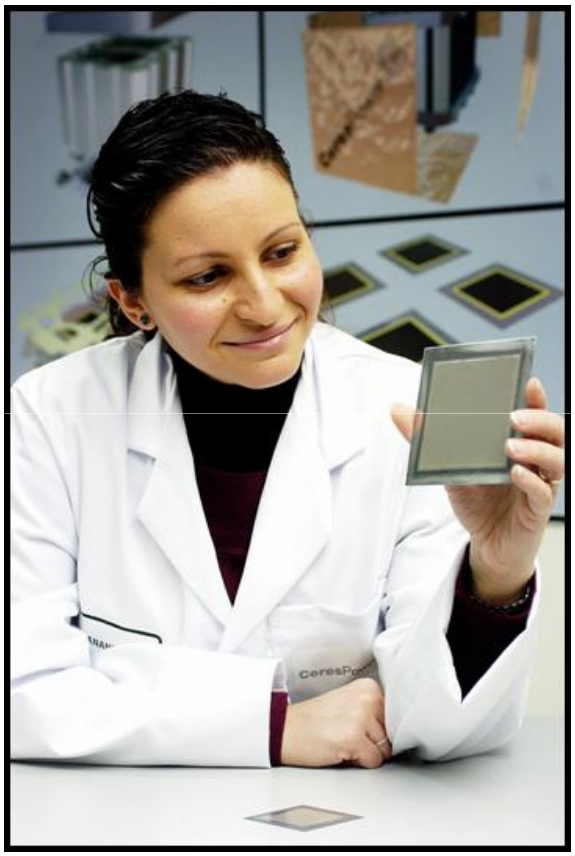



Approx. 800 fuel cell heating appliances are to be installed under the *callux* field test by 2012 and to be operated in some cases until 2015.

# SOFC technologies



Rolls Royce FCS



Ceres Power

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# Heat Pumps

- Can provide space / water heating, and space cooling
- Upgrades 'low grade' environmental heat
- Ground and air source
- Typical COPs in range 3-5
- Best with lower temp. / large area emitters
- Retrofit –some challenges (emitter and garden areas)
- Consumer barriers: unfamiliarity, maintenance availability, noise

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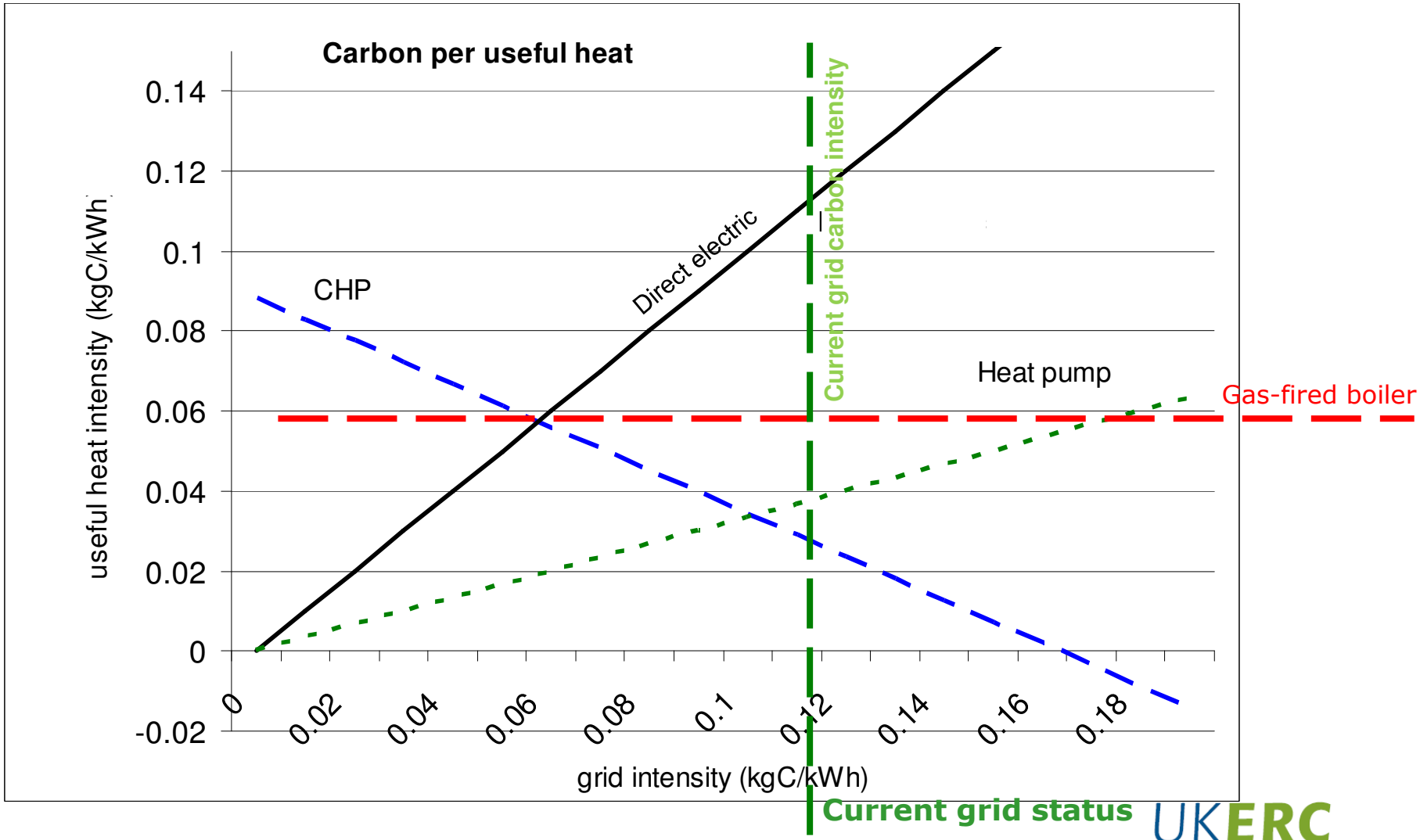
# Carbon intensity of heating




Source: Dr Nick Eyre, OUCE Oxford and UKERC

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# Transport: Hydrogen, Fuel Cells, Batteries, or Bikes




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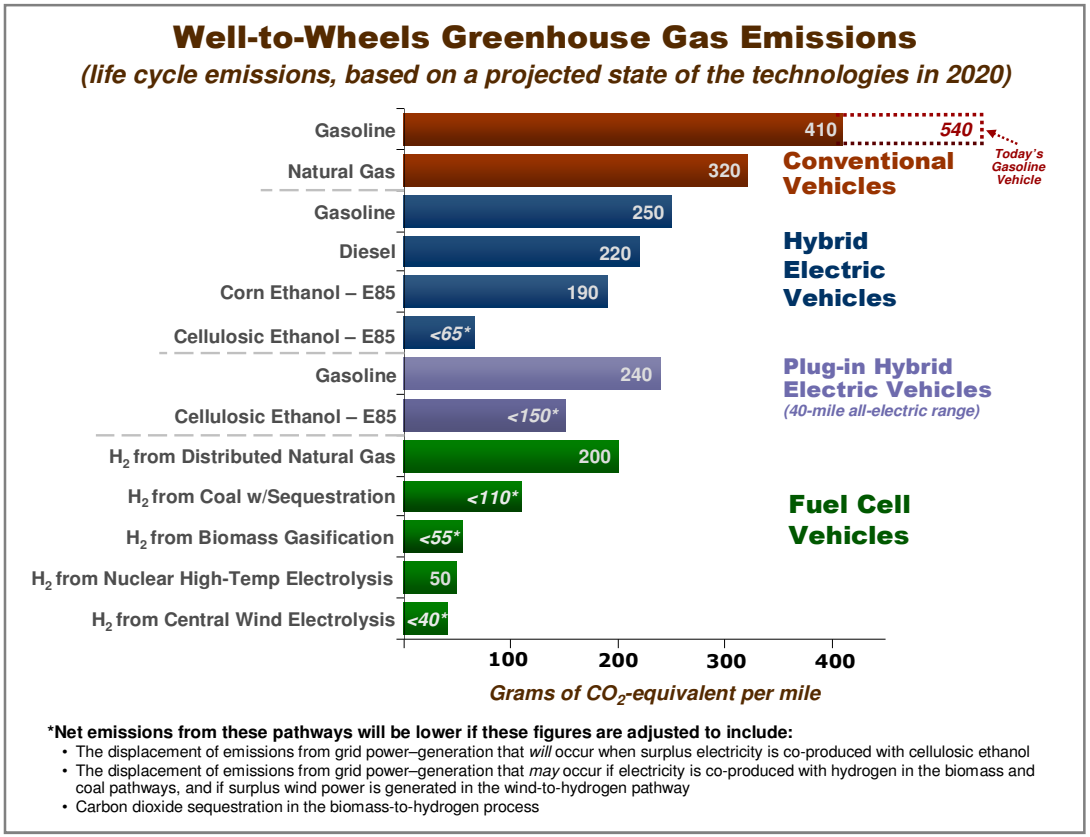
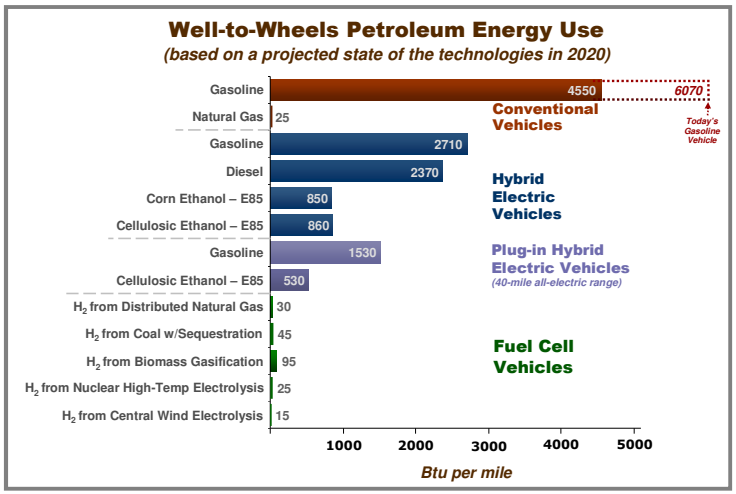
# Potential for fuel cell transport (doE)

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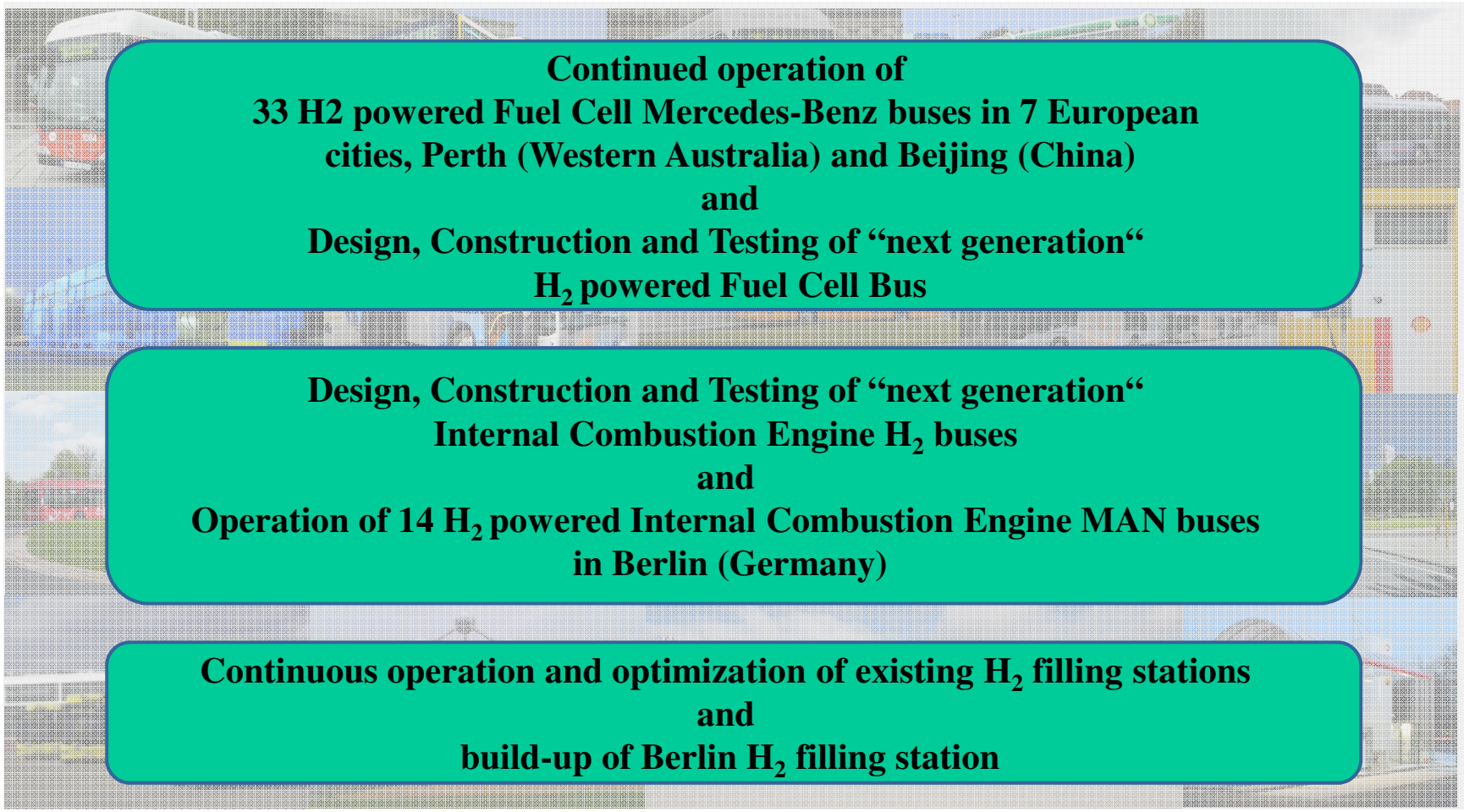
# What is HyFLEET:CUTE?

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# Achievements of the Worlds´ Largest Hydrogen Powered Bus Fleet

## Buses

- *More than 2.600.000 km in service**
- *More than 170.000 service hrs**
- *More than 8,5 Mio. passengers**
- *Vehicle Availability Ø 92% (79% to 96 %)*

** includes CUTE, ECTOS & STEP figures*

| FC Buses: | ICE Buses: |
|---|---|
| 2.200.000 km | 430.000 km |
| 140.000 hrs | 30.000 hrs |

## Infrastructure

- *Hydrogen Refuelling Units*
- *1 H2 Station Units Availability 89,5%*
- *13.149 Refuellings*
- *Hydrogen Refuelled > 555 thousand kg**

** includes CUTE, ECTOS & STEP figures*

Data as of September 2009

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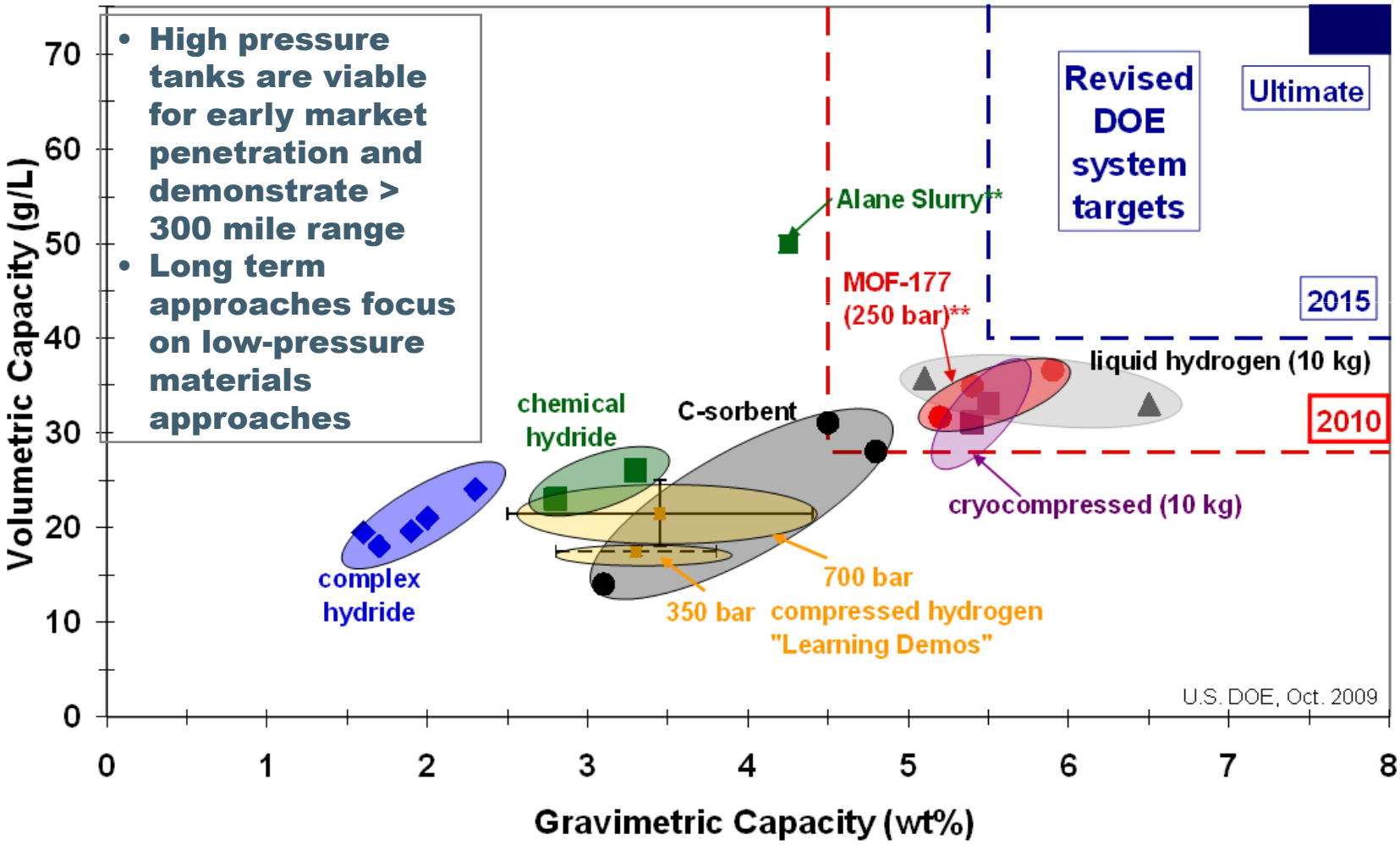
# Hydrogen storage

Storage System Capacities (weight vs. volume)



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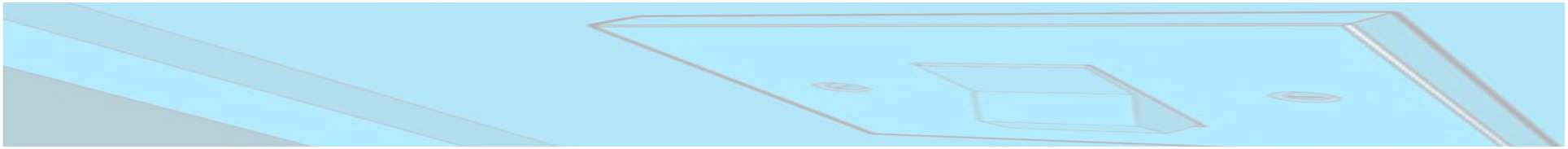

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