The Fourth Carbon Budget
Reducing emissions through the 2020s

Committee on Climate Change, December 2010

www.theccc.org.uk

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Considerations in the 2050 target

Science

Climate Objective

- Keep expected temperature change as little above 2°C as possible
- Keep risk of 4°C to very low levels (e.g. <1%)

International Circumstances

UK 2050 legislated target

- 80% reduction in greenhouse gases across all sources

-> 2050 emissions: 160 $MtCO_2e$, c. 2 tonnes per capita

Global emissions pathways

- Peak by 2020, halve by 2050

-> carbon costs rise to £100s / tCO_2e

-> limited credit availability

Expected Implementation of UK 2050 target

- 80% overall (160 $MtCO_2e$)
- 85% excluding IA&S (120 $MtCO_2e$)
- 90% reduction in CO_2 (60-70 $MtCO_2$)
- Delivered through domestic action

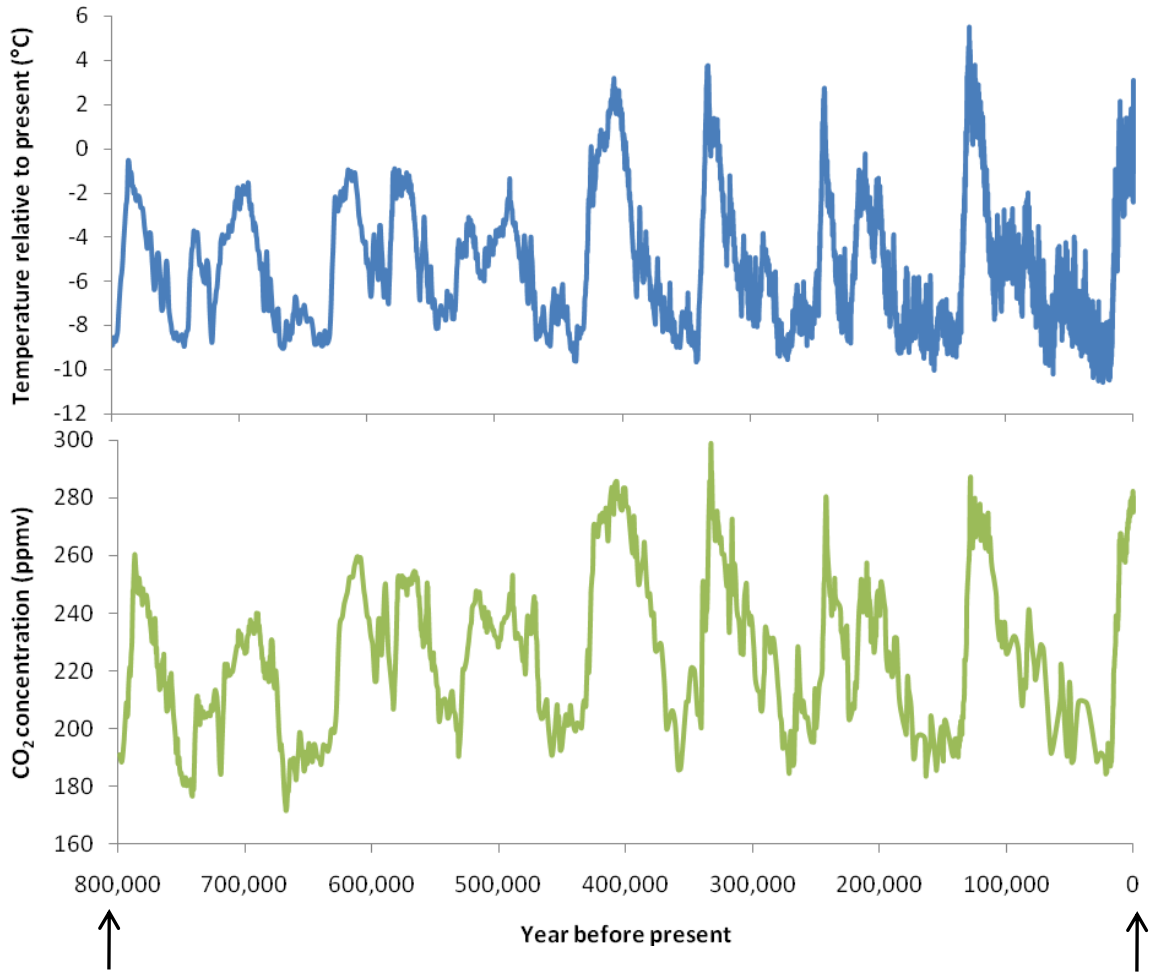
International Aviation and Shipping (IA&S) emissions

Non-CO_2 greenhouse gas emissions

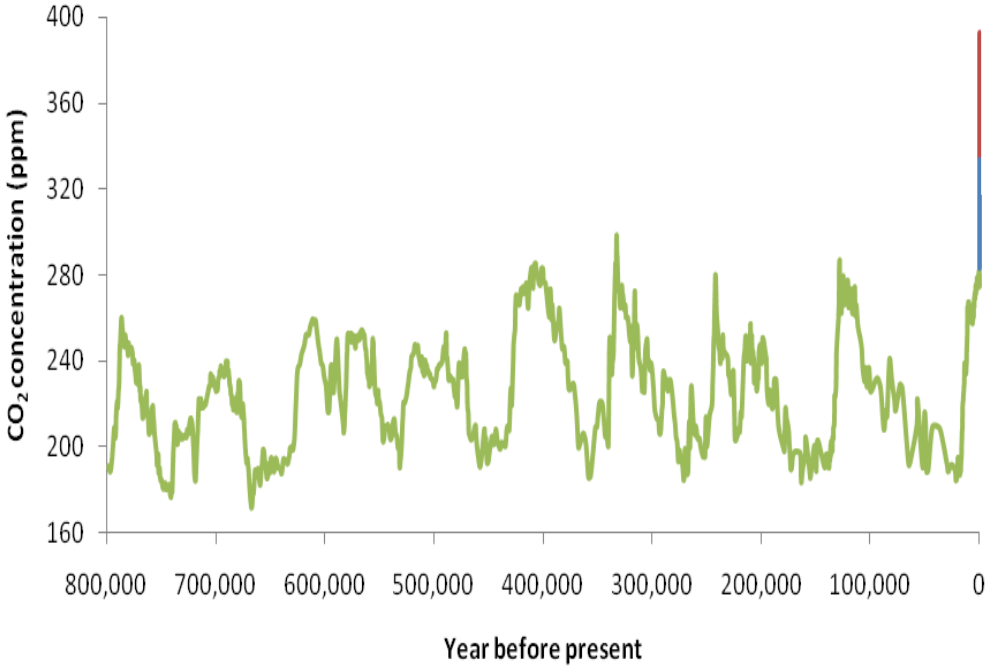
Fundamentals of climate science

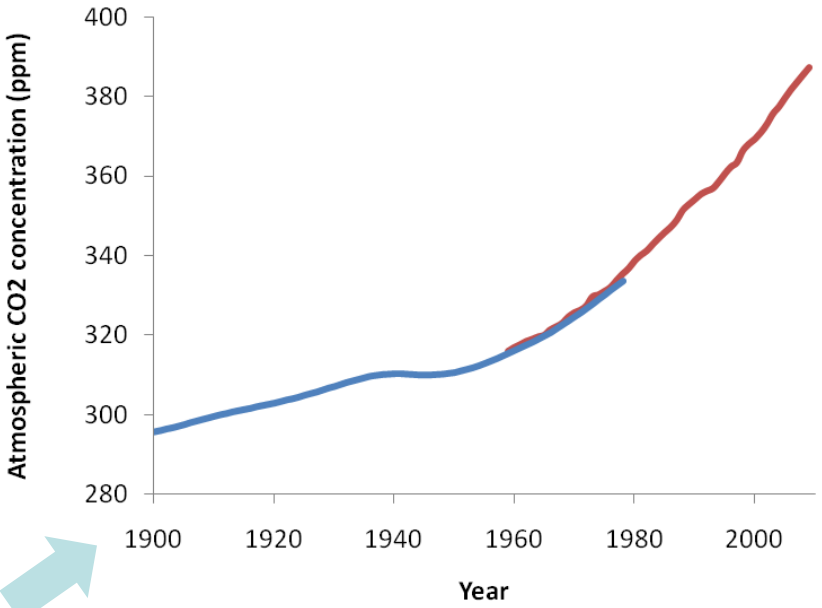
- Global climate change is already happening
- There is a high degree of confidence that this is largely a result of human activity
- Without action, there is a high risk of warming well beyond 2 degrees
- This would have significant consequences for human welfare and ecological systems

CO_2 and temperature are clearly linked in Earth's past



Our emissions have taken us out of this 'natural' cycle

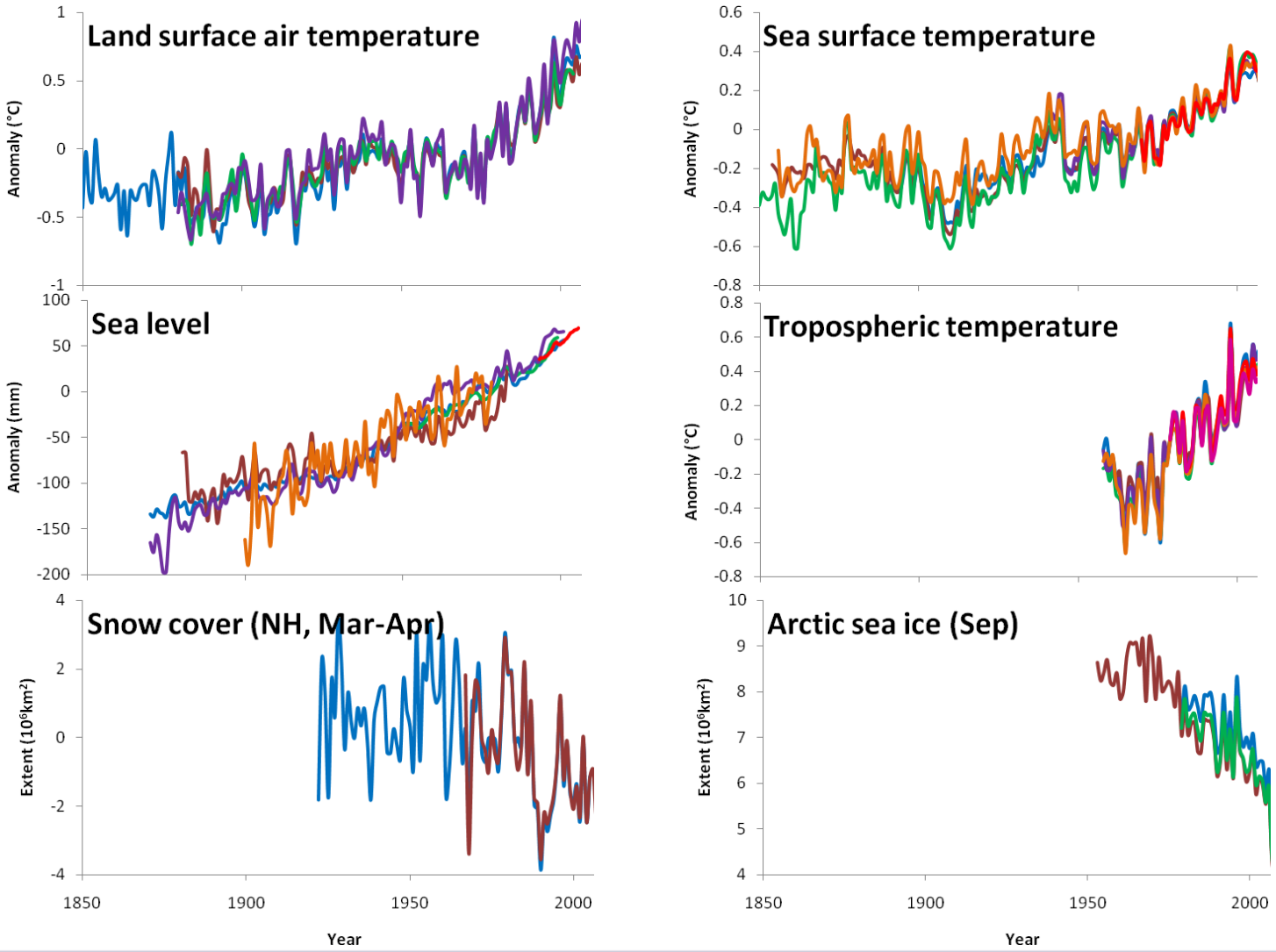




Ice core data, CDIAC

Direct air sampling, NOAA/ESRL

The world is warming in response



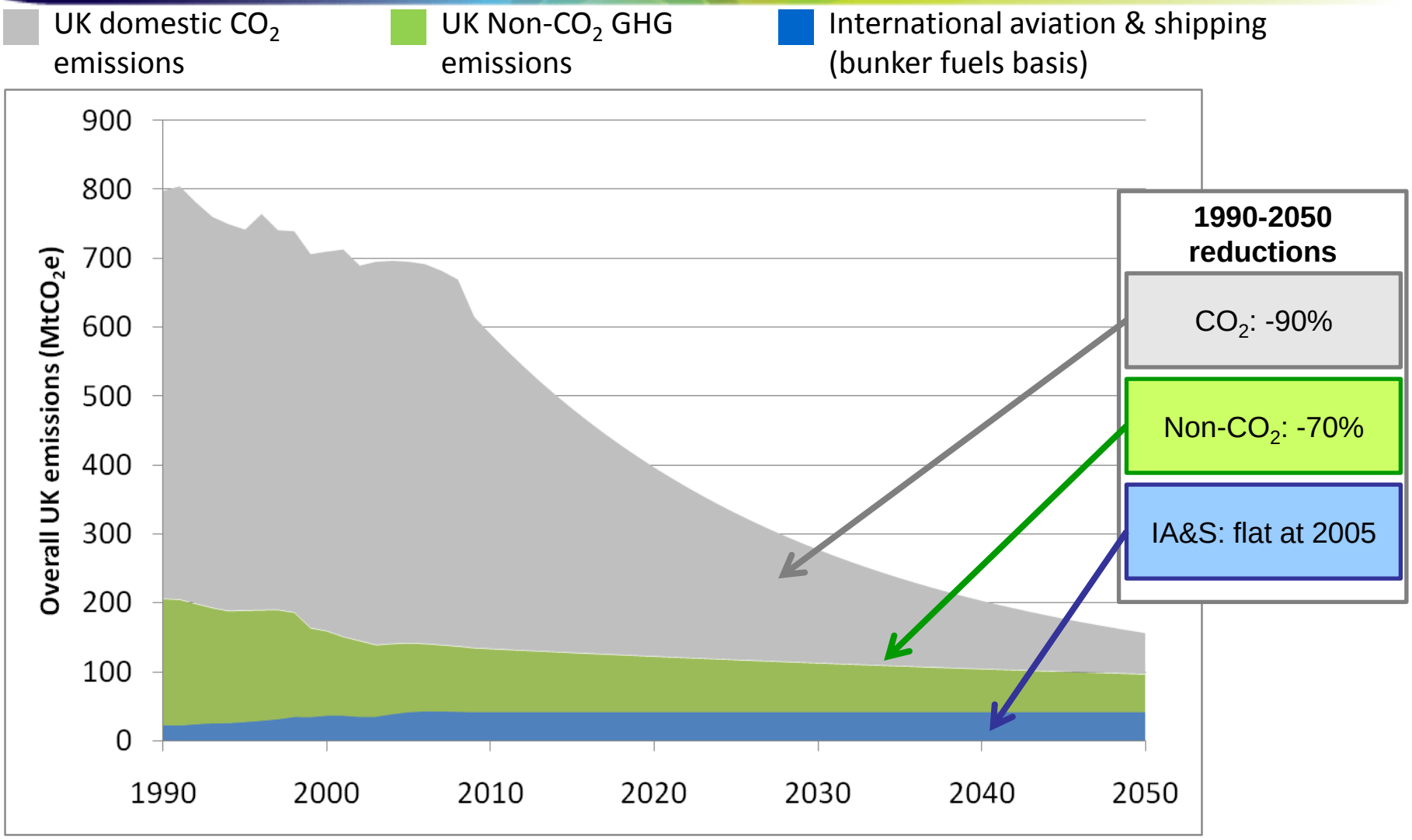
ARNDT ET AL. (2010) STATE OF THE CLIMATE IN 2009

Developments in climate science since our 2008 report

- Commissioned survey from experts at Met Office, Tyndall Centre & Walker Institute **(>500 studies reviewed**)
- Latest studies **broadly confirm our results** on global emissions required to keep 50/50 likelihood of staying close to 2°C
- **No major changes in risk** for given temperatures, but if anything a trend towards worse impacts in some sectors (e.g. agriculture, ecosystems, health)

- Scientific case for our 2008 targets remains robust:
  - **Keep central estimates of ΔT by 2100 close to 2°C, keep a very low chance of 4°C (e.g. 1%)**
  - **Global emissions peak by 2020, at least halved by 2050, fall further thereafter**
  - **UK emissions in 2050 at least 80% below 1990 levels**

80% target will require >80% reductions in some sectors



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Considerations for an indicative 2030 target

Expected Implementation of UK 2050 target

- 80% overall (160 $MtCO_2e$)
- 85% excluding IA&S (120 $MtCO_2e$)
- 90% reduction in CO_2 (60-70 $MtCO_2$)
- Delivered through domestic action

Likely/required emissions level in early 2020s

Feasible pathways during 2020s

Indicative target for 2030

- Around **60%** from domestic emissions reduction (310 $MtCO_2e$)
- Around **63%** as contribution to global emissions reduction

(all GHGs relative to 1990)

Feasible pathways from 2030-2050

Implied 2030-2050 path

- 5% reductions per annum
- Lower 2030 target would leave very challenging and expensive reductions beyond 2030

Recommendations on fourth budget period (2023-2027)

Recommendations on approach to first three budgets and international aviation and shipping

Domestic Action and Global Offer budgets

Awaiting global deal for 2020s

UK needs to:
- **develop options** for decarbonisation
- **avoid lock-in** to high-carbon assets
- **progress** towards 2050 target

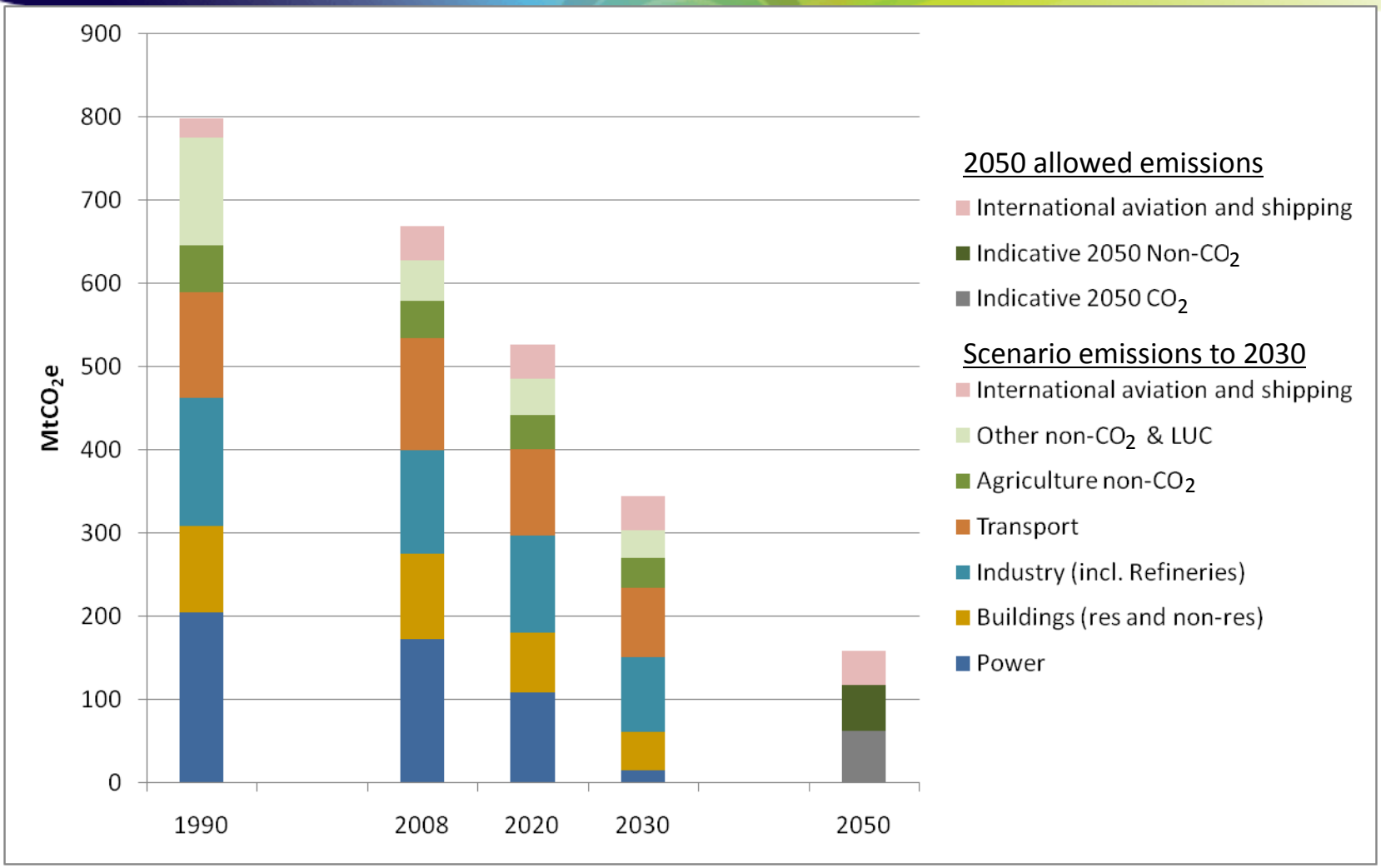
Domestic Action budget now

Global deal for 2020s

UK needs to make contribution to global emissions reduction

Global Offer budget in future

We have developed a feasible and cost-effective scenario for 2030 that is appropriate on the path to 2050



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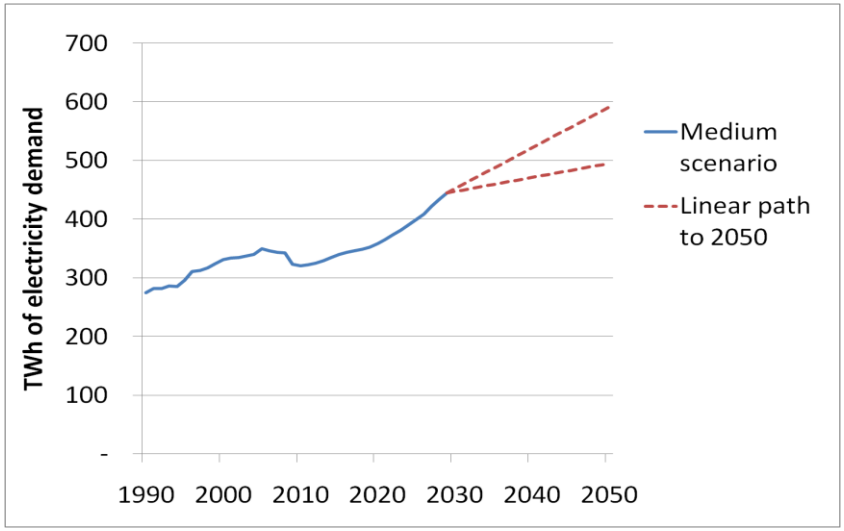
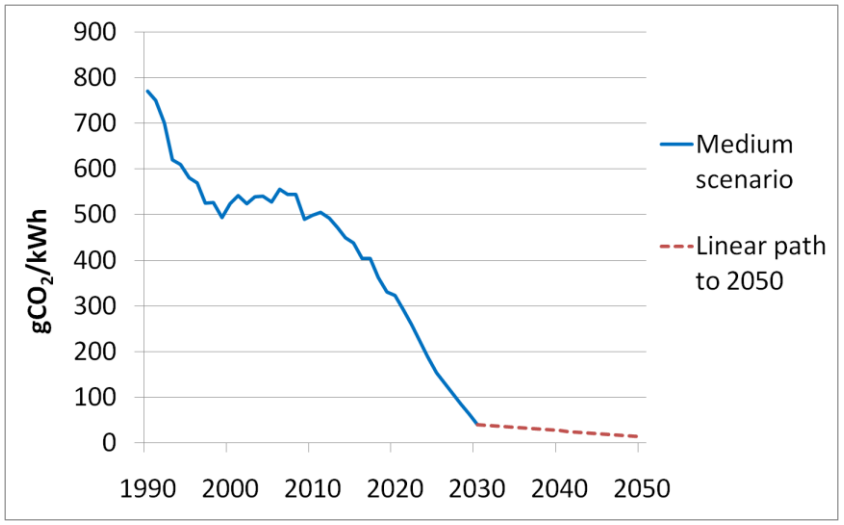
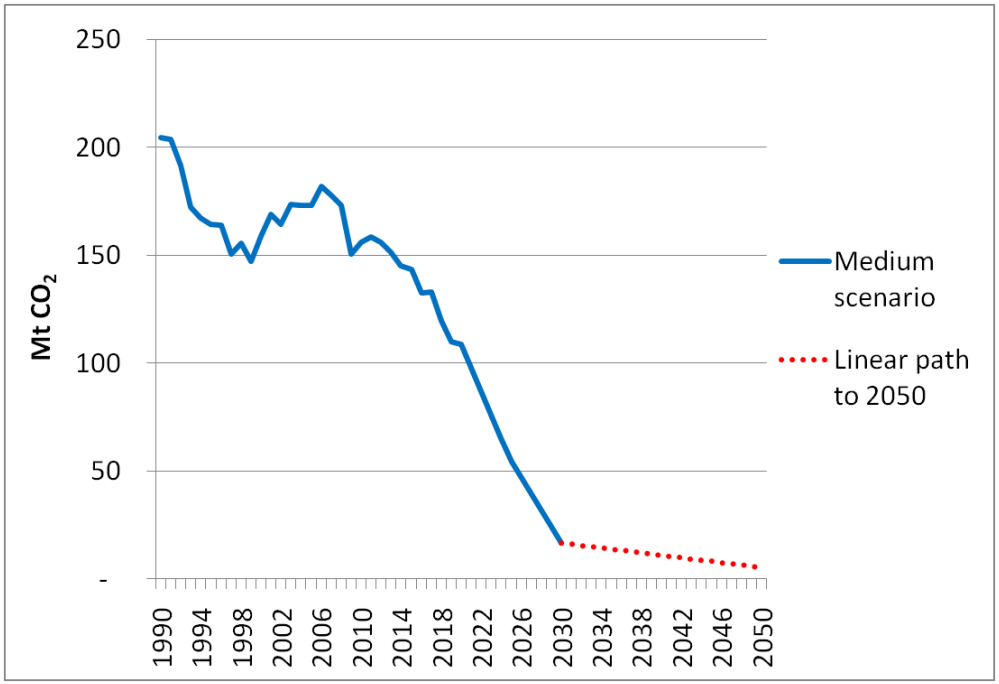
a) Power:
Emissions intensity will have to decrease, whilst demand is likely to increase

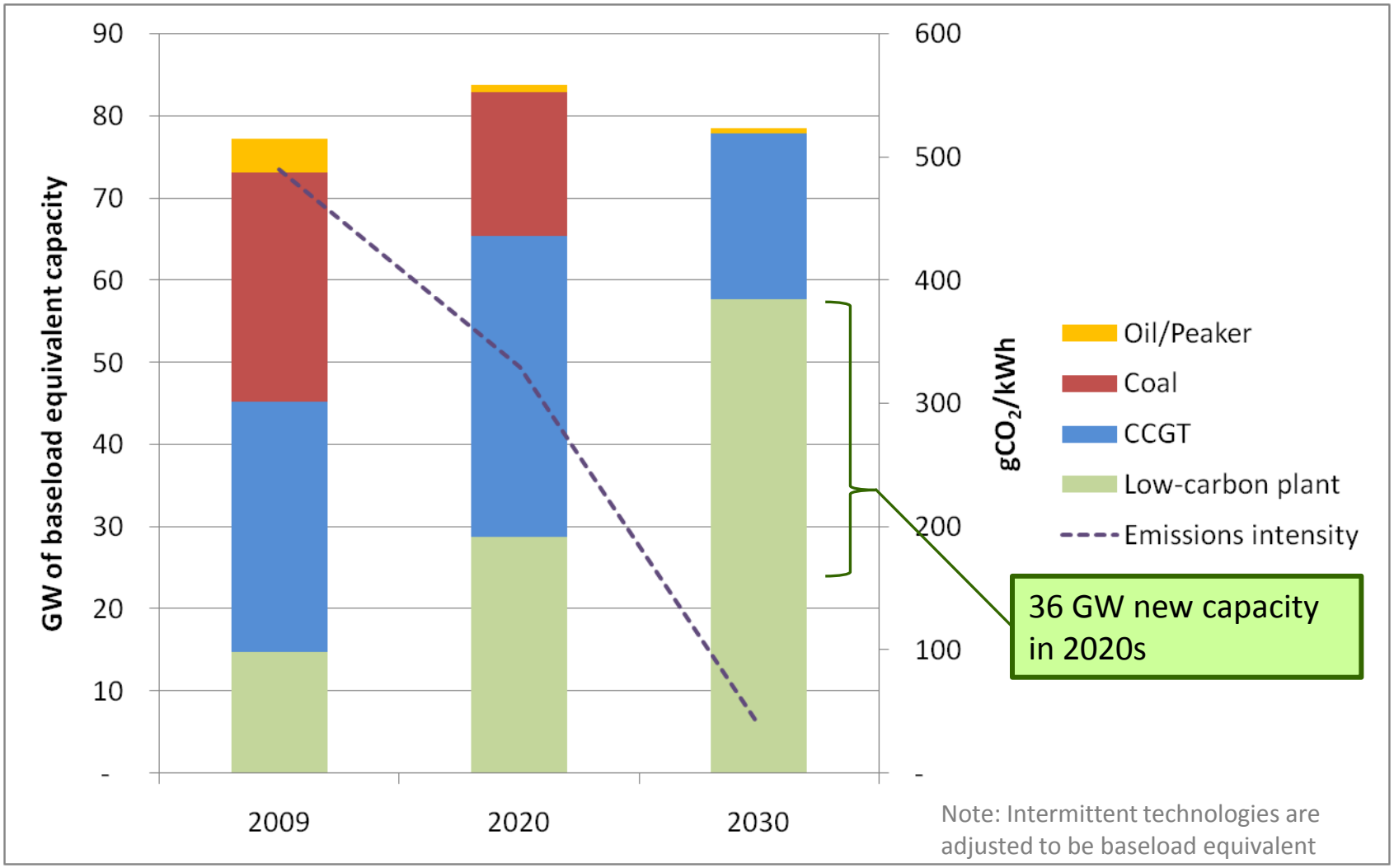






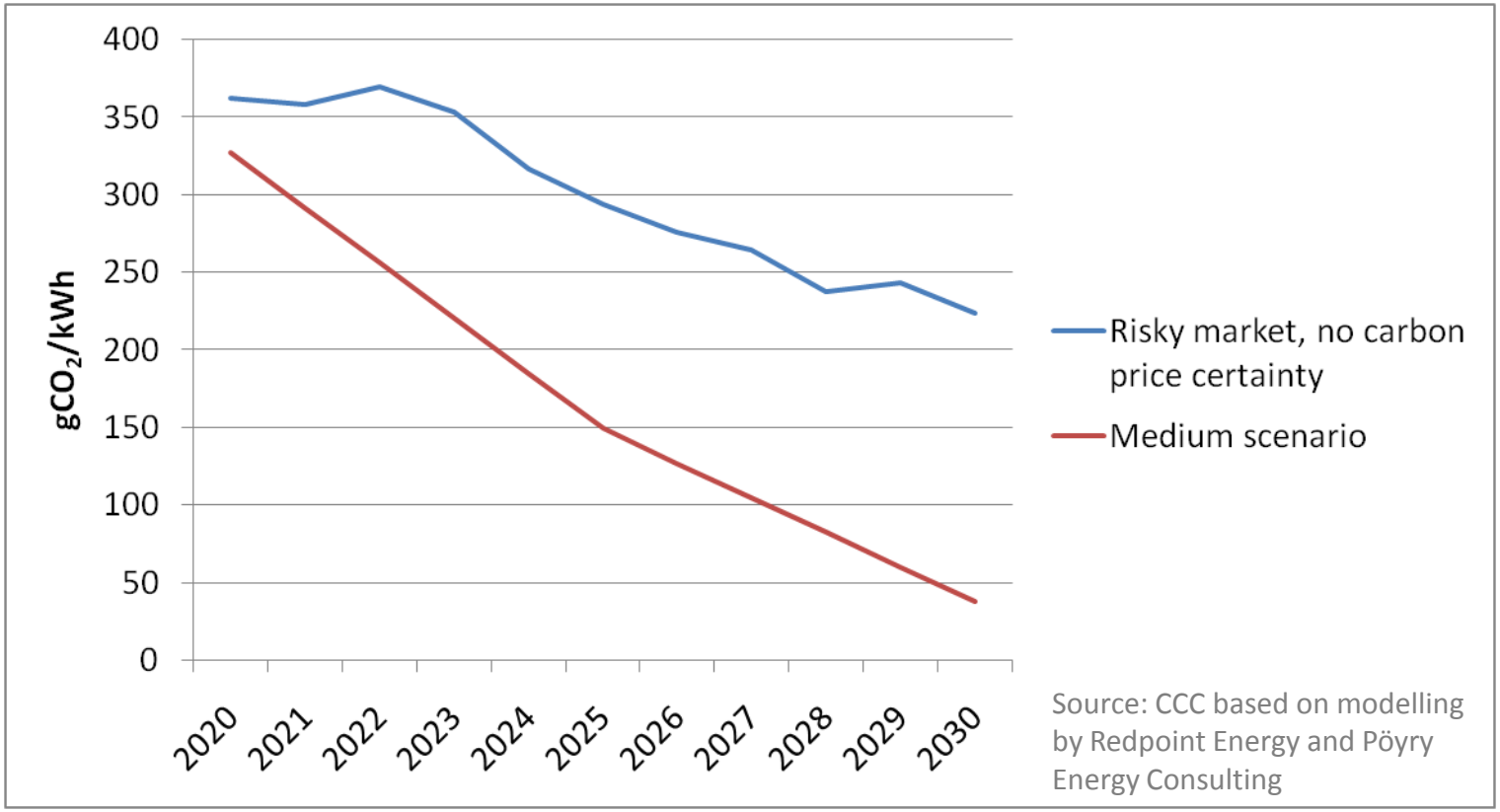
Source for 2050: range of MARKAL model runs for CCC (2010)

Power: This decarbonisation will require 30-40 GW new low-carbon capacity through the 2020s



Power: Current market arrangements won't deliver this decarbonisation

Emissions intensity trajectory under current market arrangements compared to required path

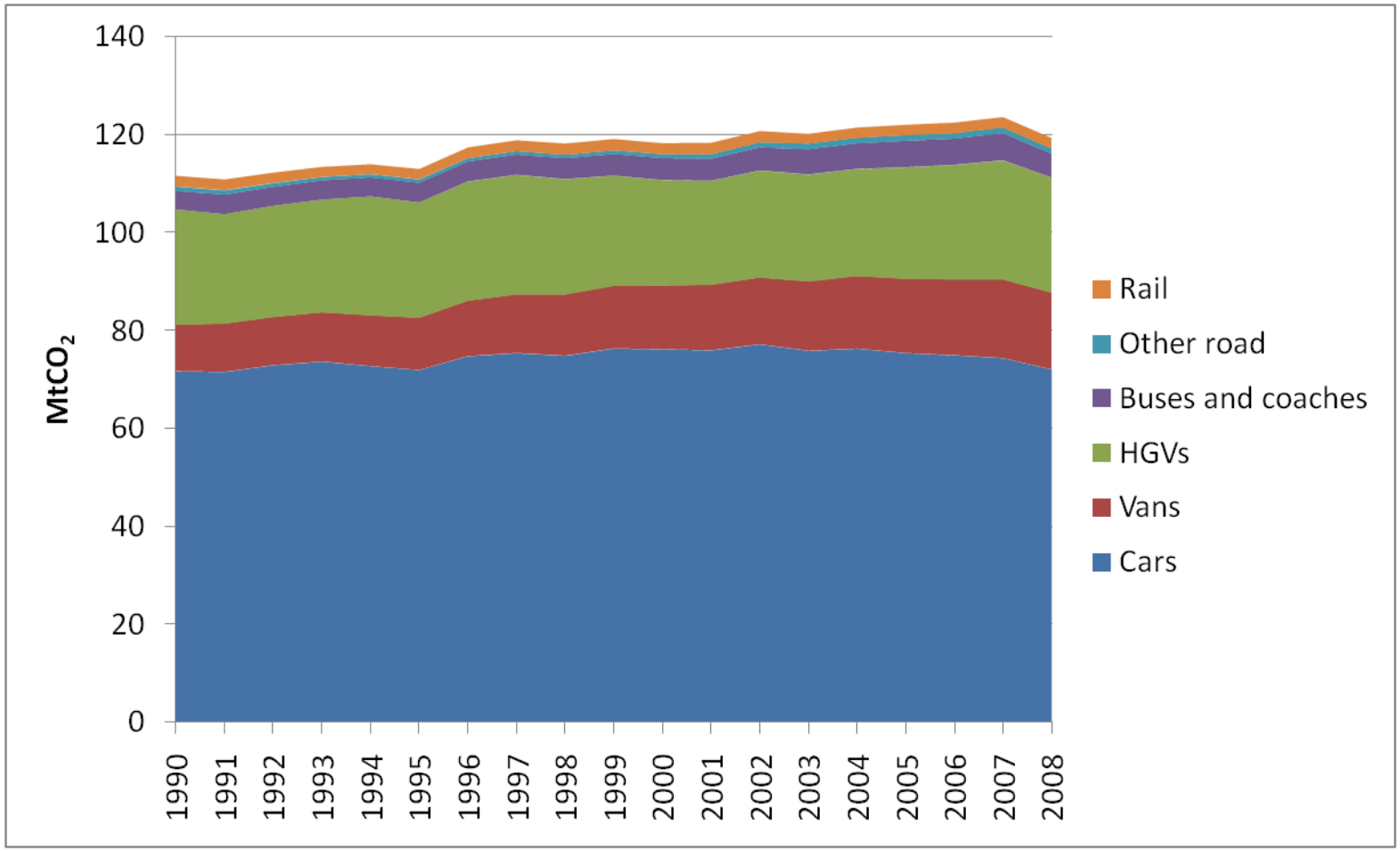


Source: CCC based on modelling by Redpoint Energy and Pöyry Energy Consulting

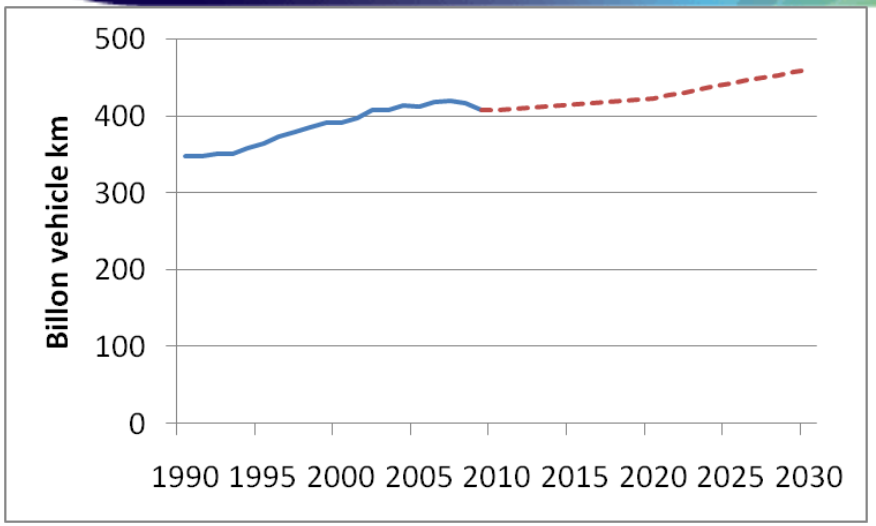
Power: Market reform is needed – tendering of long-term contracts the preferred mechanism

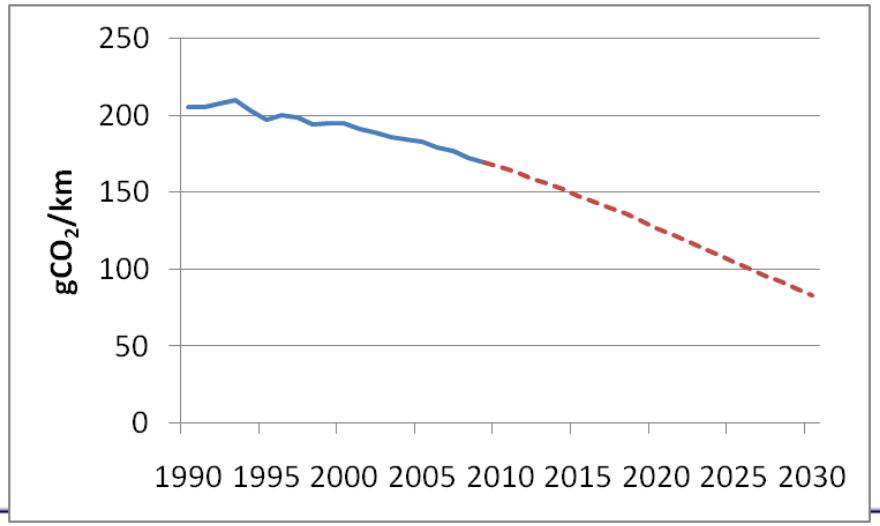
- Carbon price, gas price and demand risks will **limit investment** in low-carbon generation.
- Lowest cost strategy seeks to **reallocate risk**, not subsidise.
- Tendering of **long-term contracts** for low-carbon generation would:
  - allocate risks appropriately
  - provide price competition discipline
  - allow new entrants.
- Options include **Contracts for Differences** or **Power Purchase Agreements**.

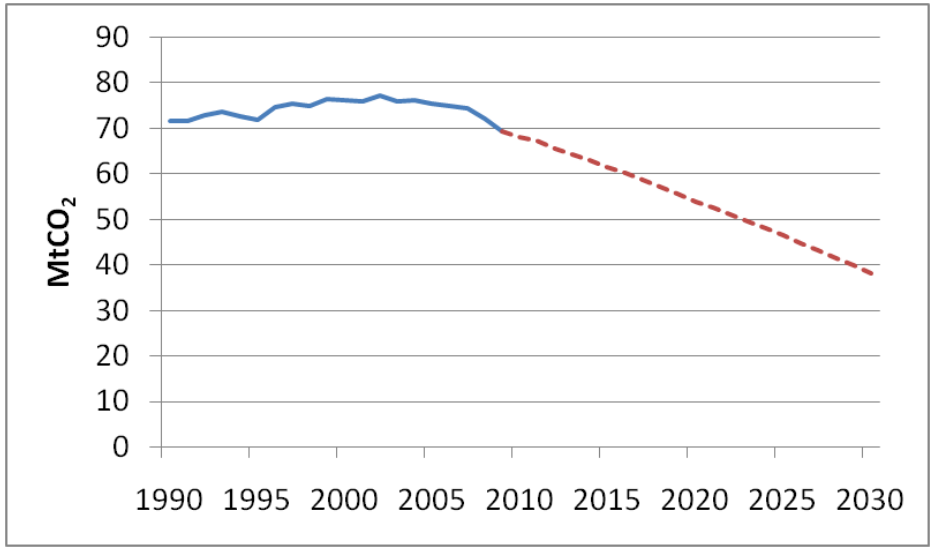
b) Transport:
Cars dominate emissions, with vans and HGVs also important



Cars: Emissions reduction will come from reducing g/km, while km likely to increase







Cars: Low-carbon vehicles need to be 60% of new sales in 2030

	2030		
	Share of new car sales	Share of miles	Emissions Intensity
Conventional cars	40%	70%	80-125 g/km
Plug-in hybrids	40%	20%	50 g/km
Pure electric vehicles	20%	10%	0 g/km

Average emissions intensity in 2030

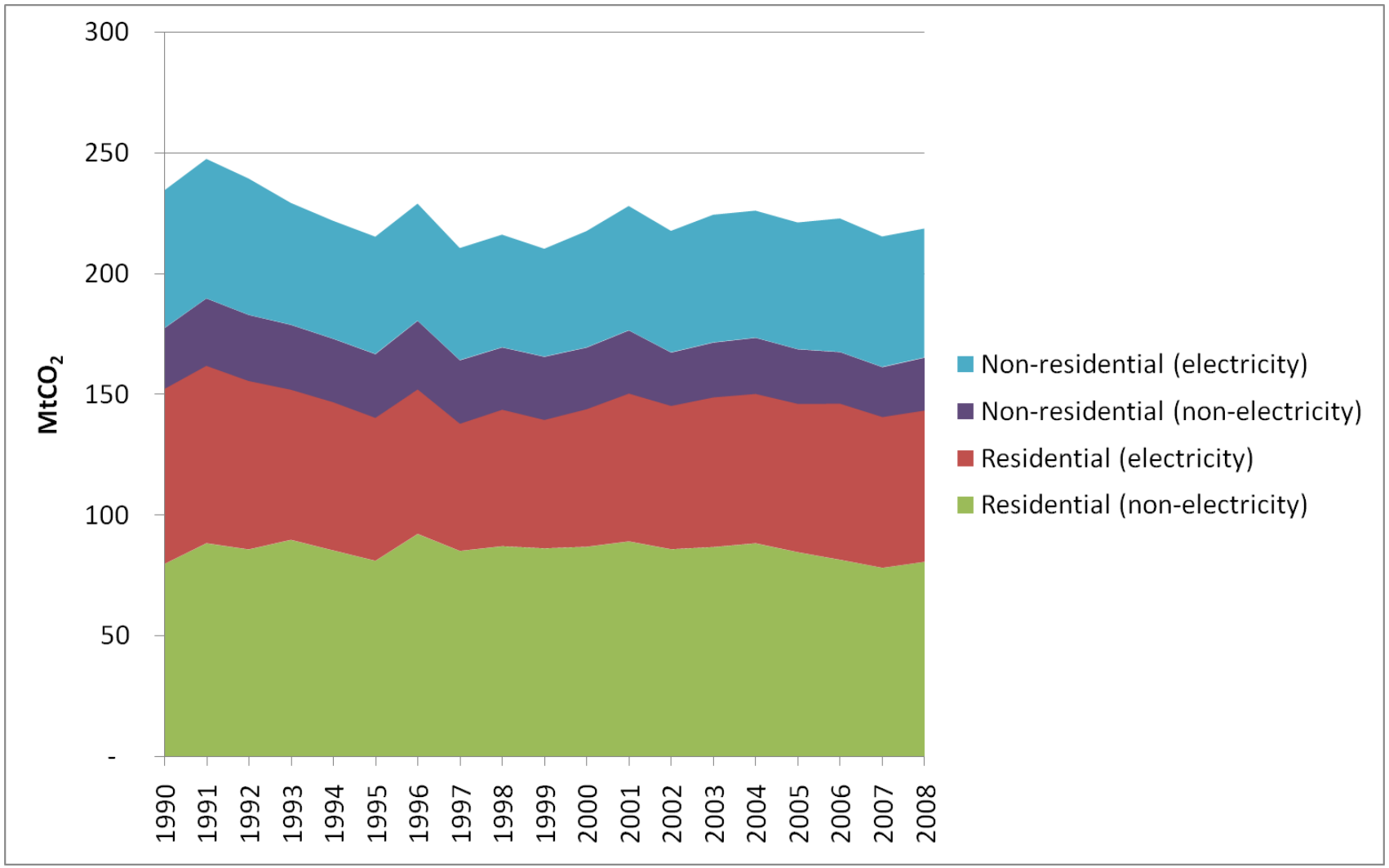
New cars purchased: 52g/km (versus 150g/km today)

All cars on road: 81 g/km (versus 173 g/km today)

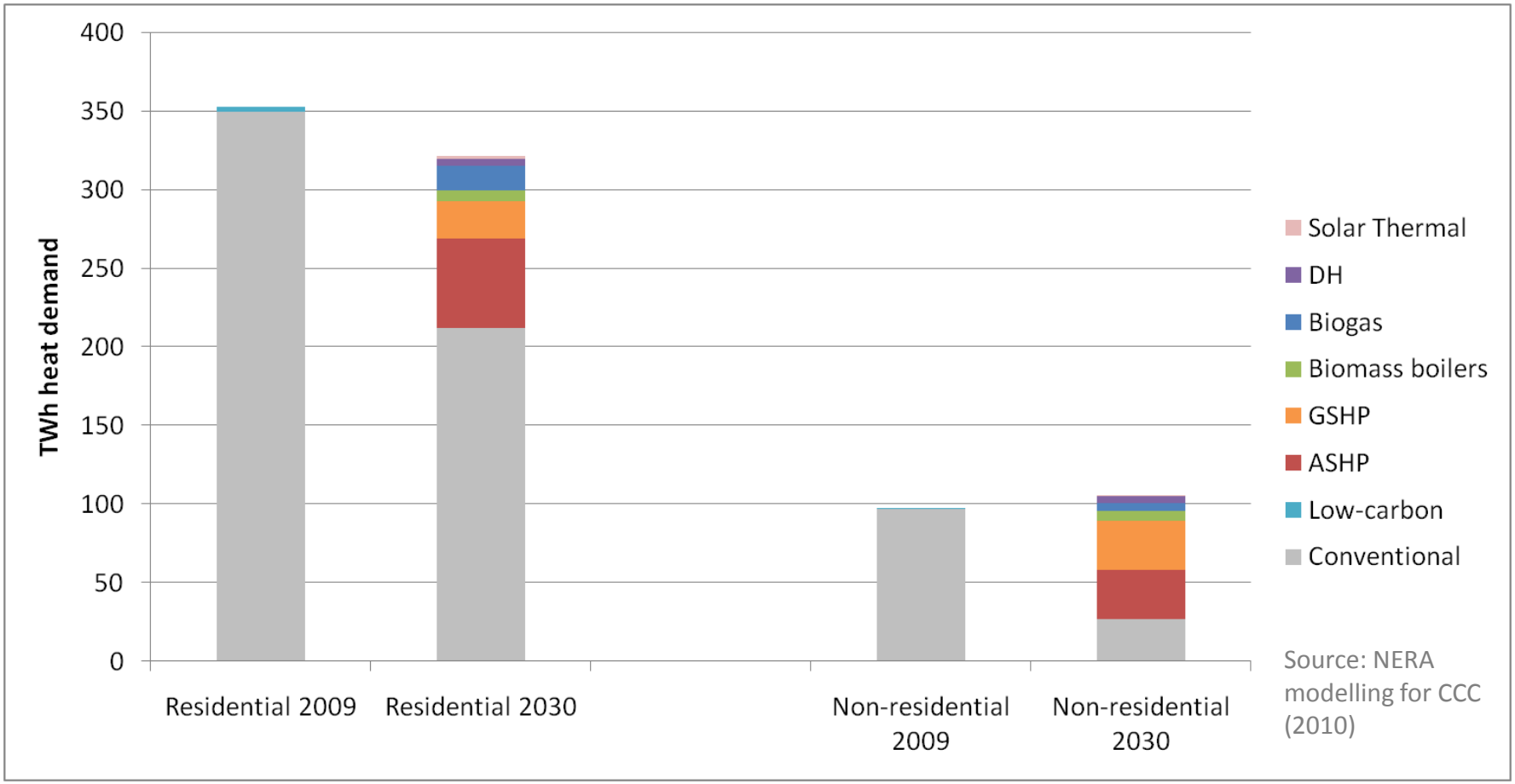
Transport: Policy support will be required to realise opportunities for emissions reduction

Improve **efficiency** of conventional vehicles	(e.g. more stringent new car CO_2 target-based regulation)
Encourage uptake of **electric**, plug-in hybrid and hydrogen vehicles	(e.g. taxes/subsidies on fuel/vehicles or very stringent new vehicle CO_2 regulation)
Manage additional **electricity demand**	(e.g. smart meters and time-of-day tariffs)
Encourage deployment of **hydrogen buses**	(e.g. regulation, economic instruments)
Continue to reduce **travel demand**	(e.g. Smarter Choices, incentives to improve logistics, land use planning)
Encourage **sustainable biofuels**	(e.g. regulation mandating minimum life-cycle emissions saving)

c) Buildings:
Direct and indirect emissions, from residential and non-residential (commercial and public) buildings



Heat in buildings: Significant opportunity to reduce emissions to 2030 with a major role for heat pumps



- Demand reductions from efficiency improvements, including 3.5 million solid walls by 2030 in residential buildings
- Low-carbon sources reach 33% of residential heat demand and 74% of non-residential heat demand in 2030

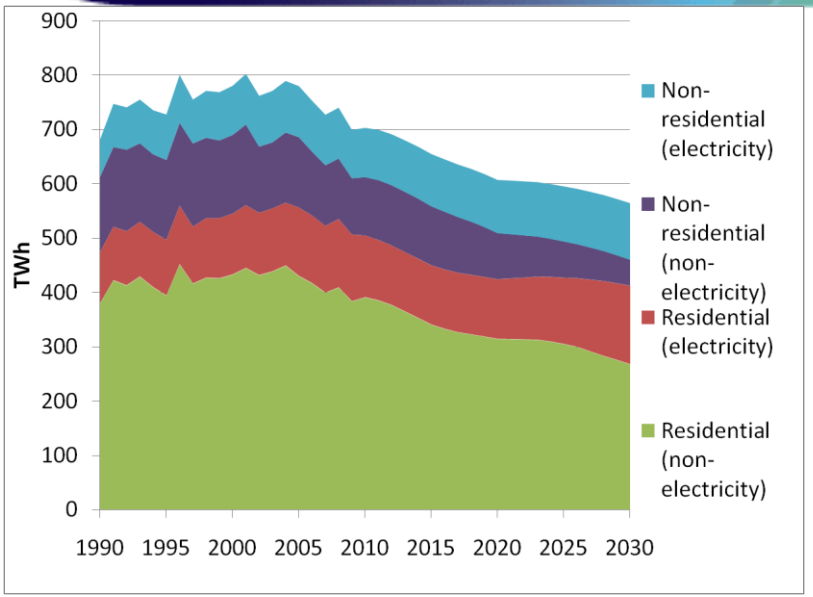
Electricity in buildings: Opportunity to improve efficiency of lights and appliances

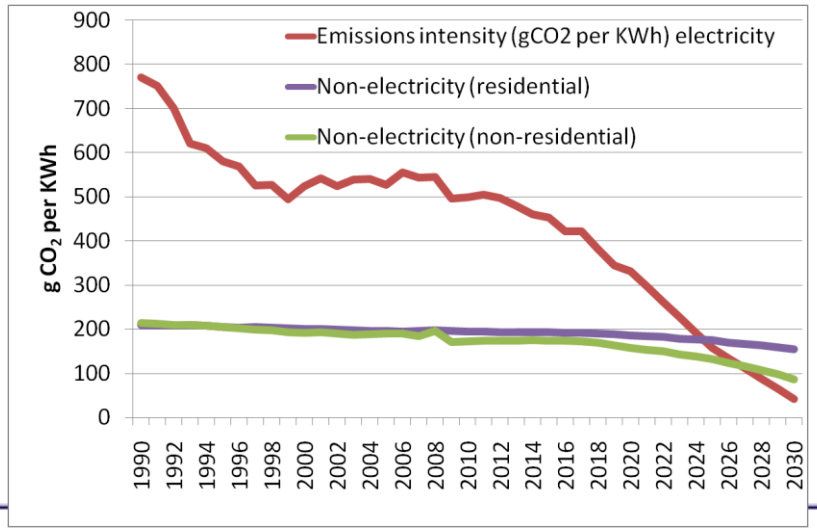
- **By 2020:** 19 TWh (14%) saving from increased share of efficient appliances in the residential sector
  - 33% A++ cold appliances
  - 50% A+ wet appliances
  - Significant increase in use of efficient ICT and electronic equipment
  - 100% of lighting efficient

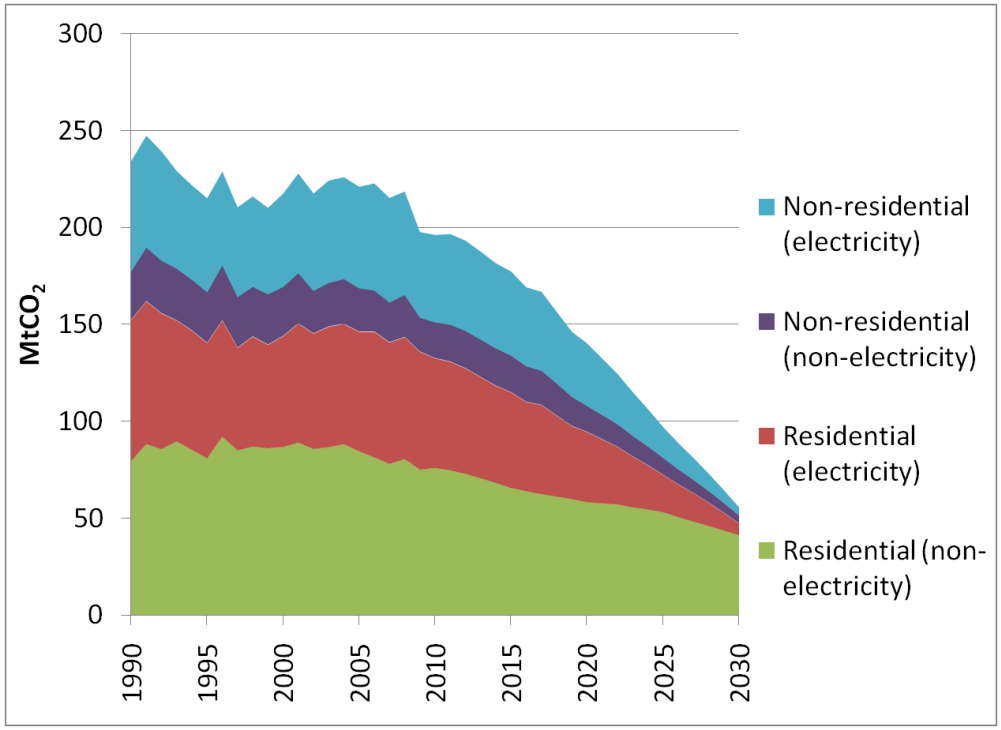
- **Beyond 2020:** scope to go further, given:
  - Stock turnover (e.g. 15 years for fridge-freezers, 12 years for washing machines and driers)
  - Further technology improvements will make this a low-cost measure

➢ Widespread take-up up of the most efficient appliances through the 2020s, together with more efficient lighting in households could save 10 TWh (7%) in 2030

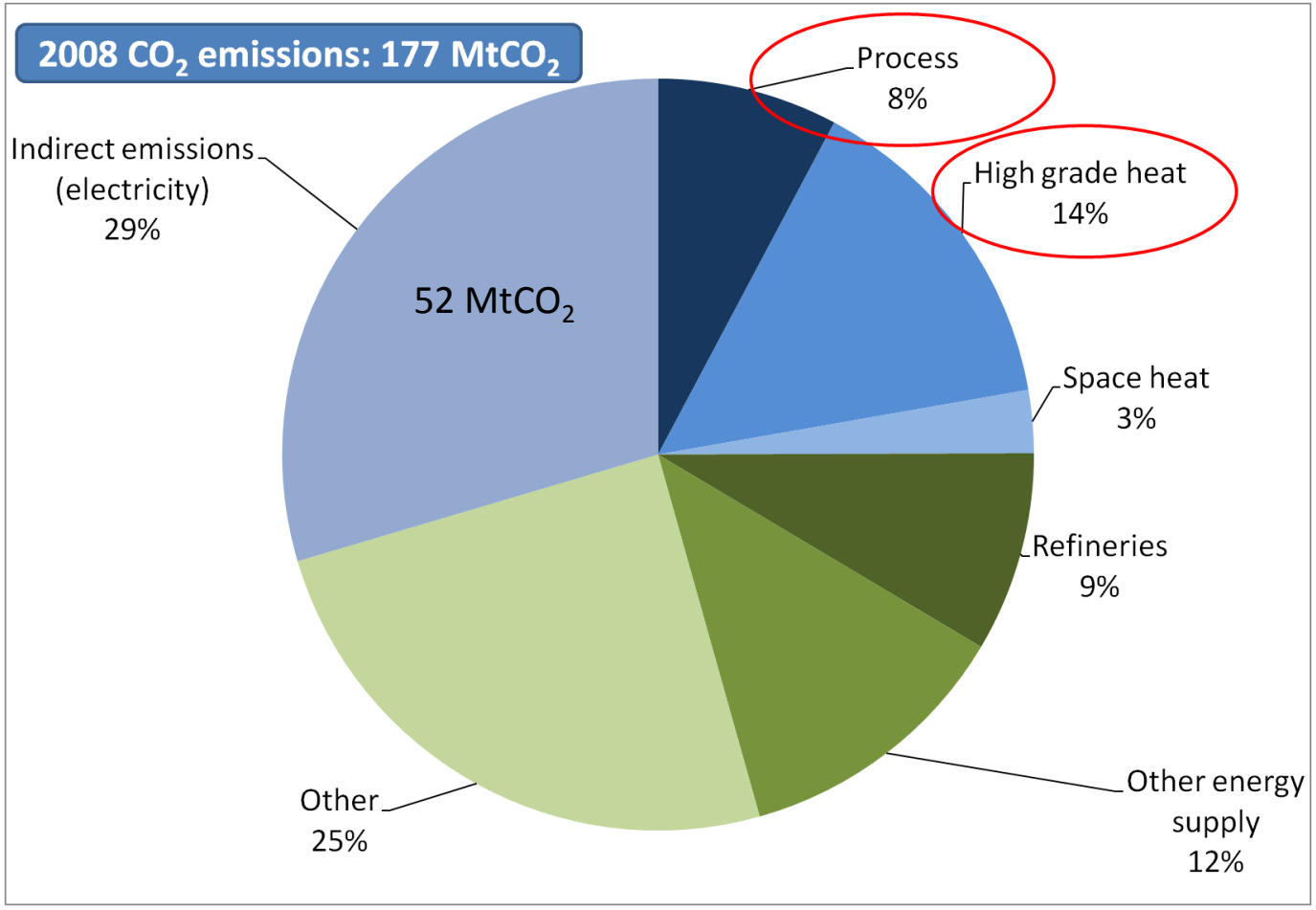
Buildings: Emissions reduction to 2030 from improved efficiency and shift to use of (low-carbon) electricity



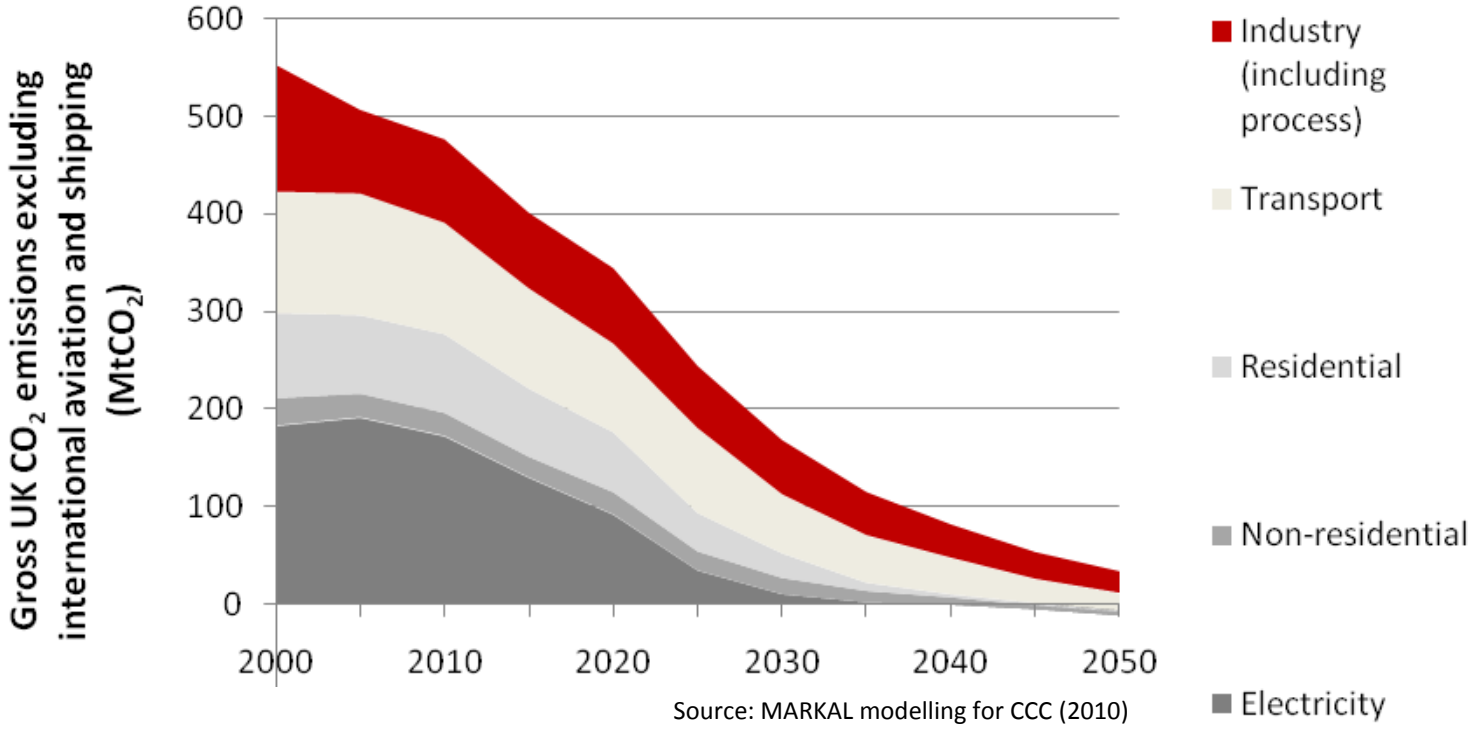




d) Industry:
Significant share of emissions from sources that are very hard to reduce



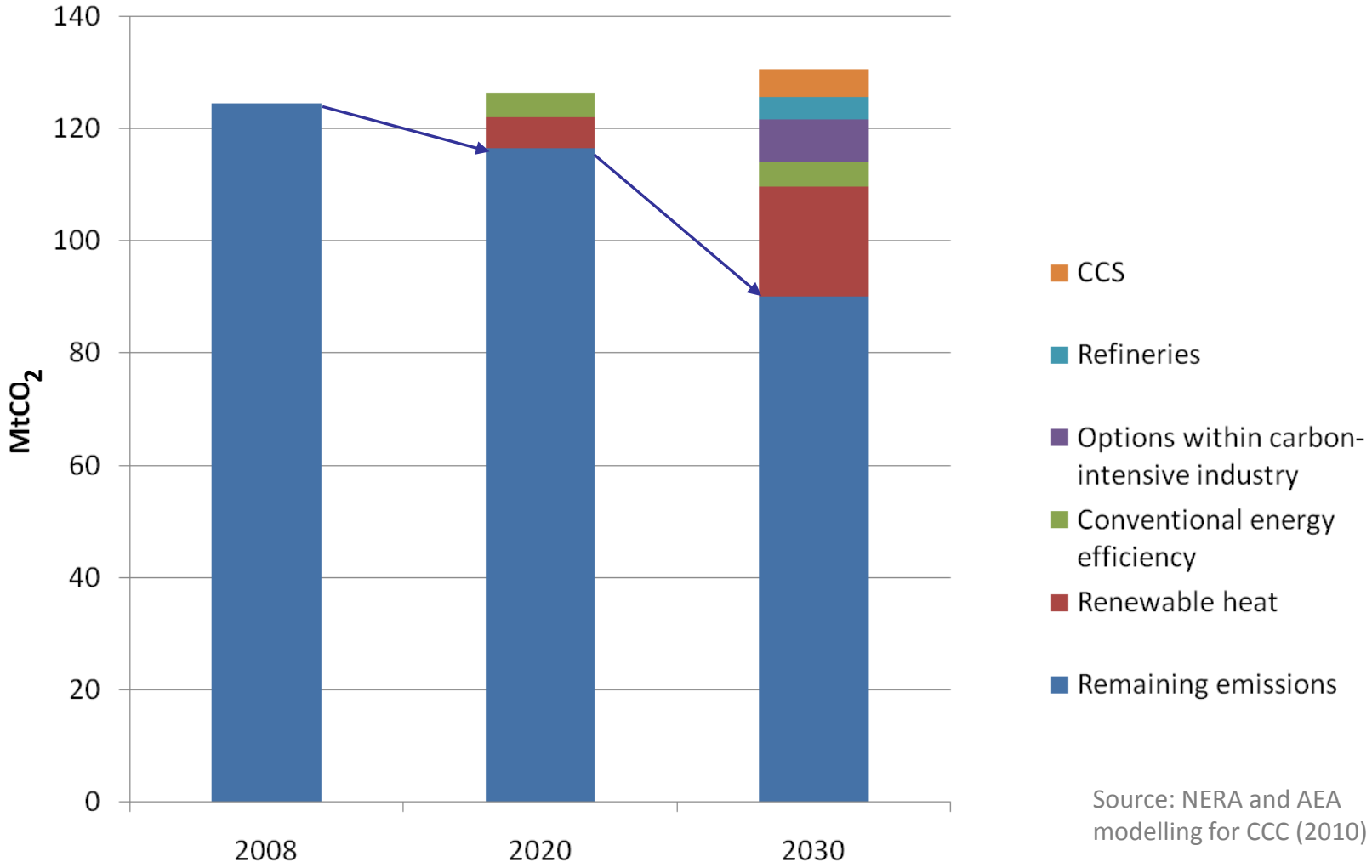
Industry:
Given limited abatement options, industry likely to be a large share of CO_2 emissions by 2050



Source: MARKAL modelling for CCC (2010)

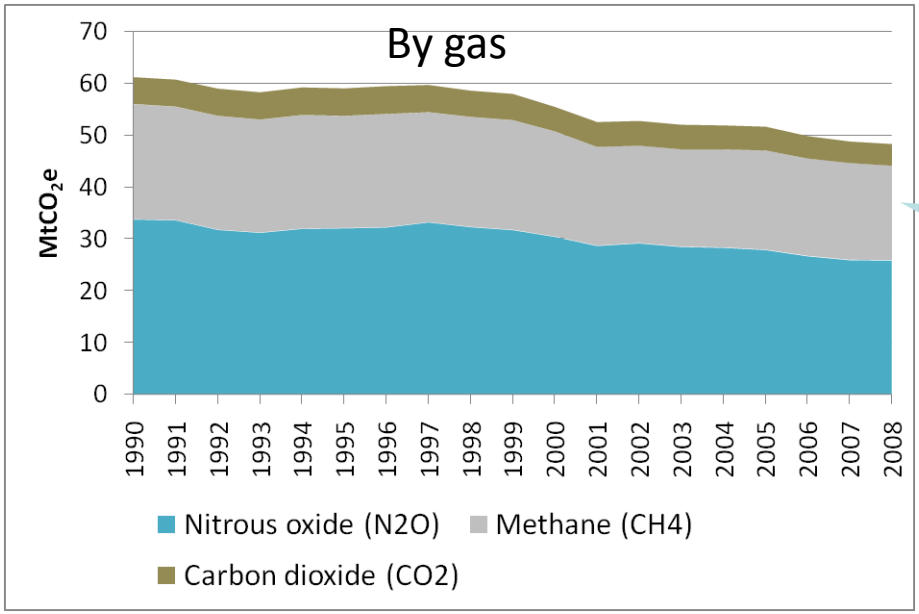
Full deployment of CCS at suitable sites, together with diversion of biogas and biomass from heating buildings (replaced by electrification) would still leave emissions at over 40 $MtCO_2$ (from a CO_2 pot of around 60-70 $MtCO_2$ for 2050)

Industry: Potential to reduce emissions to 2030 through CCS, process improvements and renewable heat (biogas/biomass)



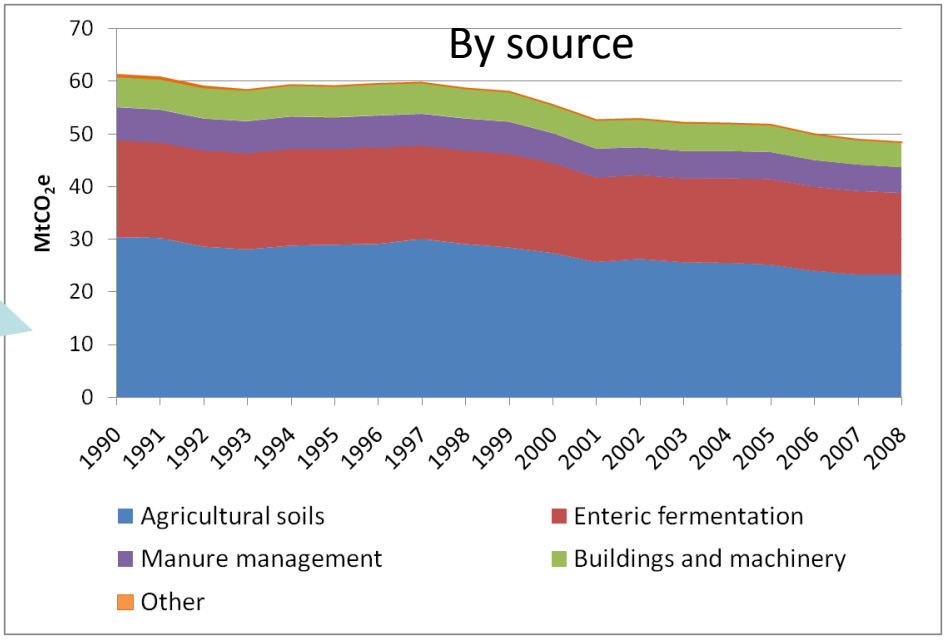
Source: NERA and AEA modelling for CCC (2010)

(e) Agriculture: Emissions mainly non-CO_2 from soils and livestock



Agriculture emissions mostly non-CO_2 arising from soils and livestock

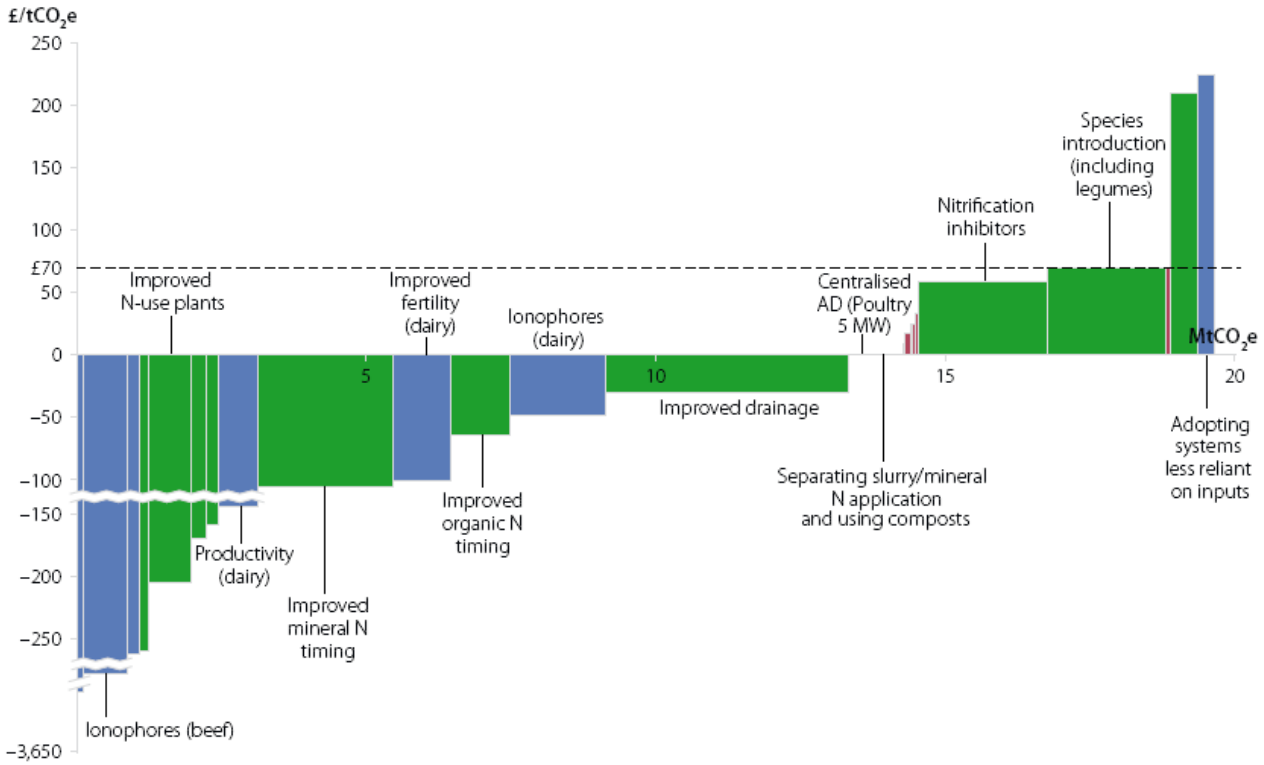
- **N_2O:** 54%
- **CH_4:** 38%
- **CO_2:** 9%



Agriculture emissions in 2008:

- **Soils (nitrogen fertilisers):** 48%
- **Enteric fermentation from livestock:** 32%
- **Manure management:** 10%
- **Energy use in buildings & machinery:** 10%

Agriculture: Opportunities to reduce emissions to 2030 by changed farm practices and technologies



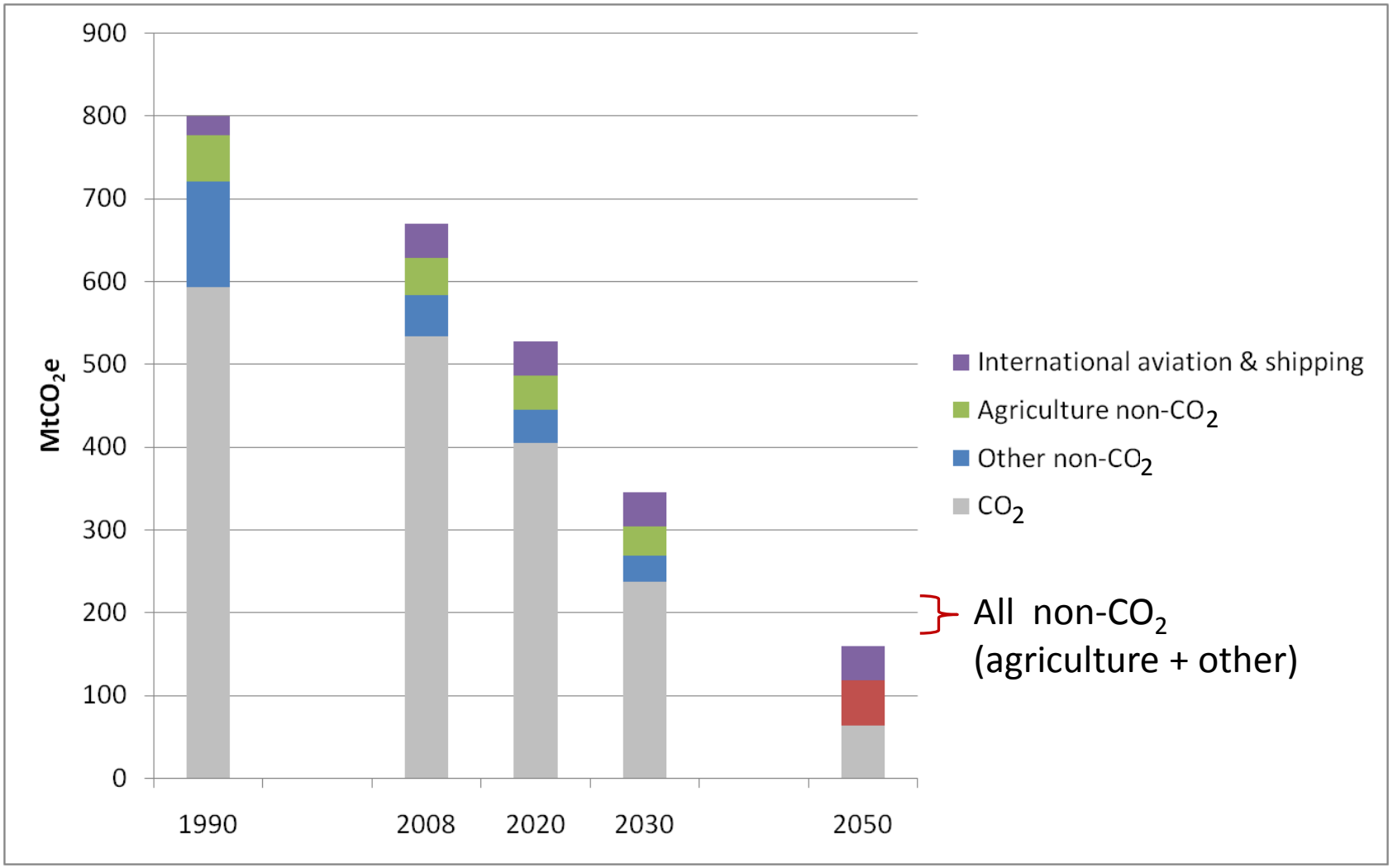
Source: SAC modelling for CCC

- 4-14 $MtCO_2e$ from known options in 2020

Less certain options

- **Additional soil and livestock management practices** (e.g. improved animal health)
- **More radical biotechnological options** (e.g. GM methods to improve nitrogen use efficiency for crops)
- **Changed agricultural systems**
- **Demand-side measures** (e.g. reducing food waste and rebalancing diets)

Agriculture: Emissions still remain significant by 2030, with considerable uncertainty how to reduce further



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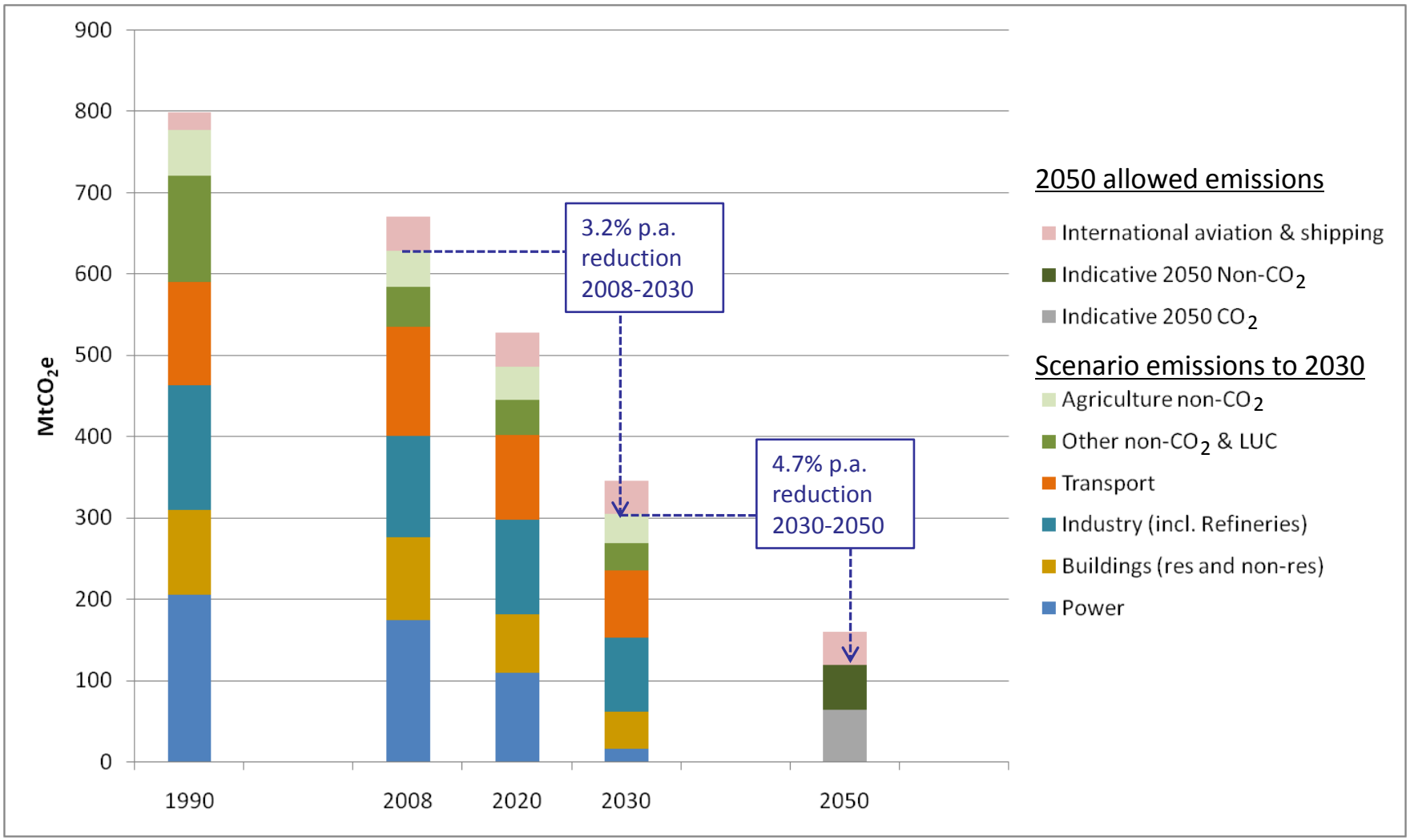
Emissions reductions will have to accelerate again from 2030 to 2050



2030 to 2050 – detailed assessment of opportunities suggests 'back-ending' is feasible

Power	Maintain annual low-carbon build rate (3-4 GW) through 2030s and 2040s	Zero-carbon power sector serving much higher demand
Buildings	• Further deploy heat pumps • District heating for built-up areas • Some resistive electric	Could be close to zero-carbon by 2050
Industry	• CCS where suitable • Biogas / biomass in high-grade heat	May also need product substitution, refinery restructuring, resource efficiency
Transport	• All cars and vans electric by 2050 • Hydrogen for HGVs and buses	May also need some biofuels to be zero-carbon Aviation hard to reduce
Agriculture	Reaching limits of known options by 2030	May need demand-side changes or radical supply-side options

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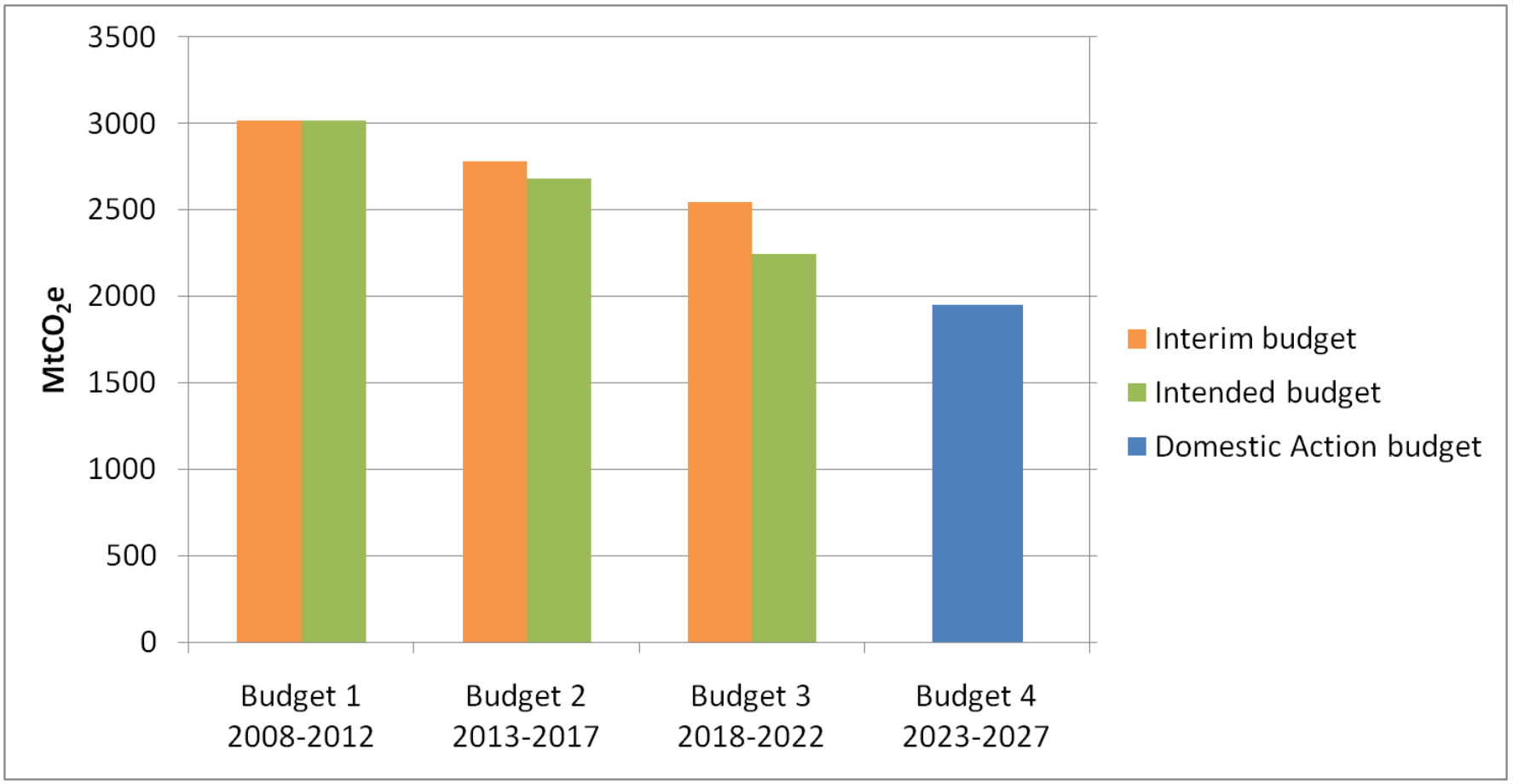
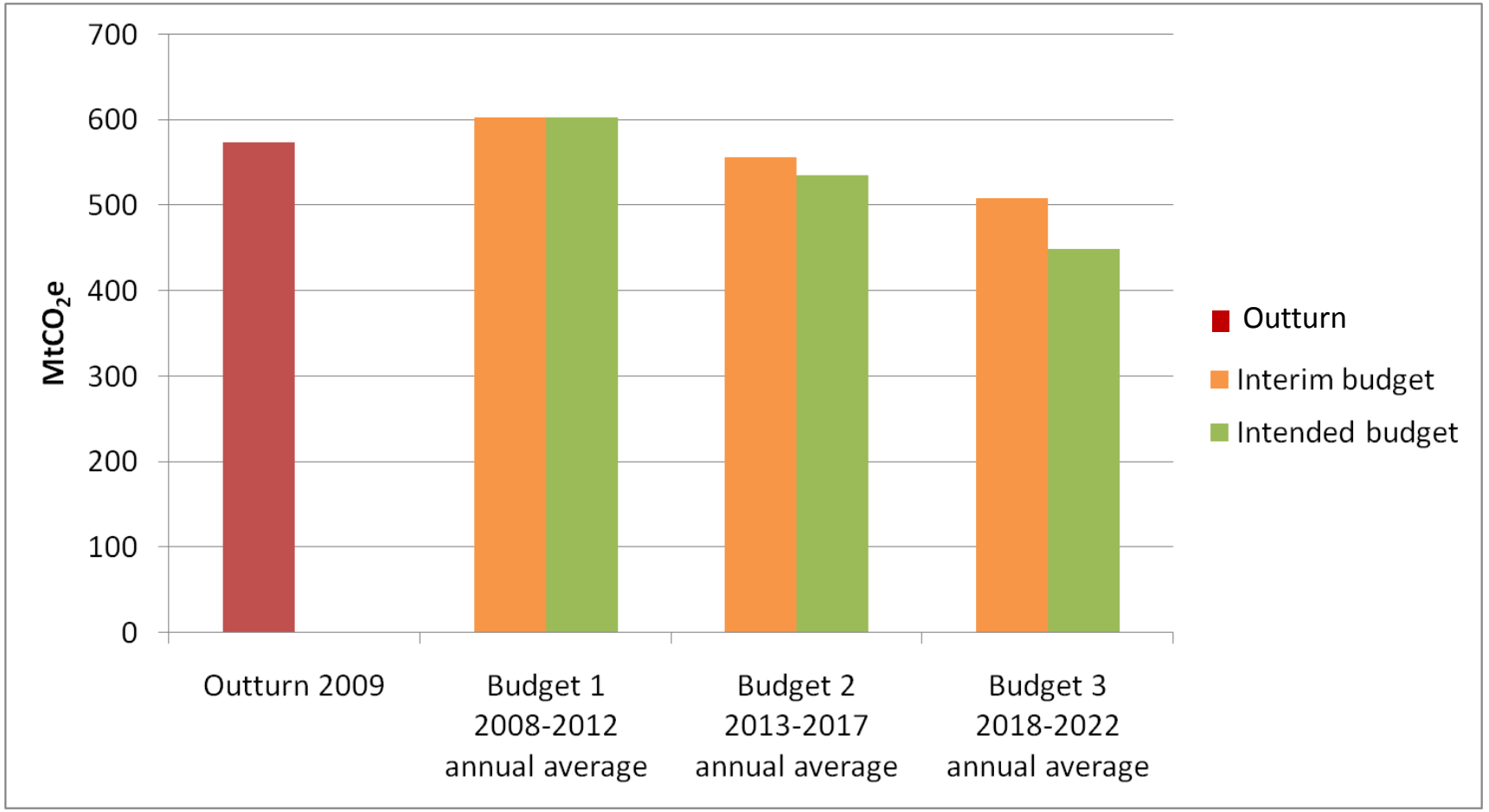
Interim, Intended and Domestic Action budgets



2009 emissions are already below required levels for the first budget



Emissions fell by 8.6% in 2009 during the recession

We therefore recommend that the second and third budgets are tightened

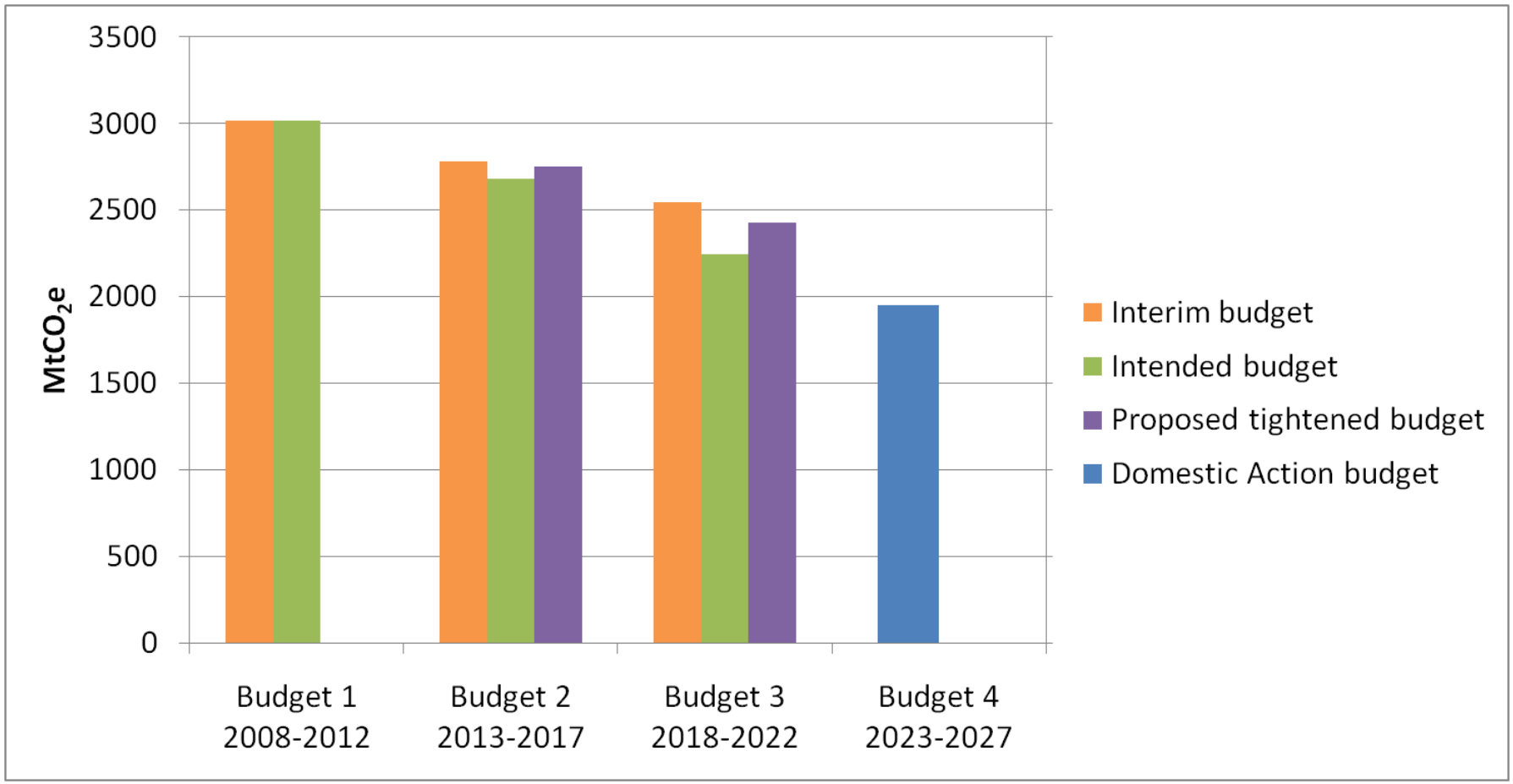
- Commit **not to bank** outperformance of first carbon budget.

- **Tighten second and third carbon budgets** to reflect allowed non-traded sector emissions under Intended budget.

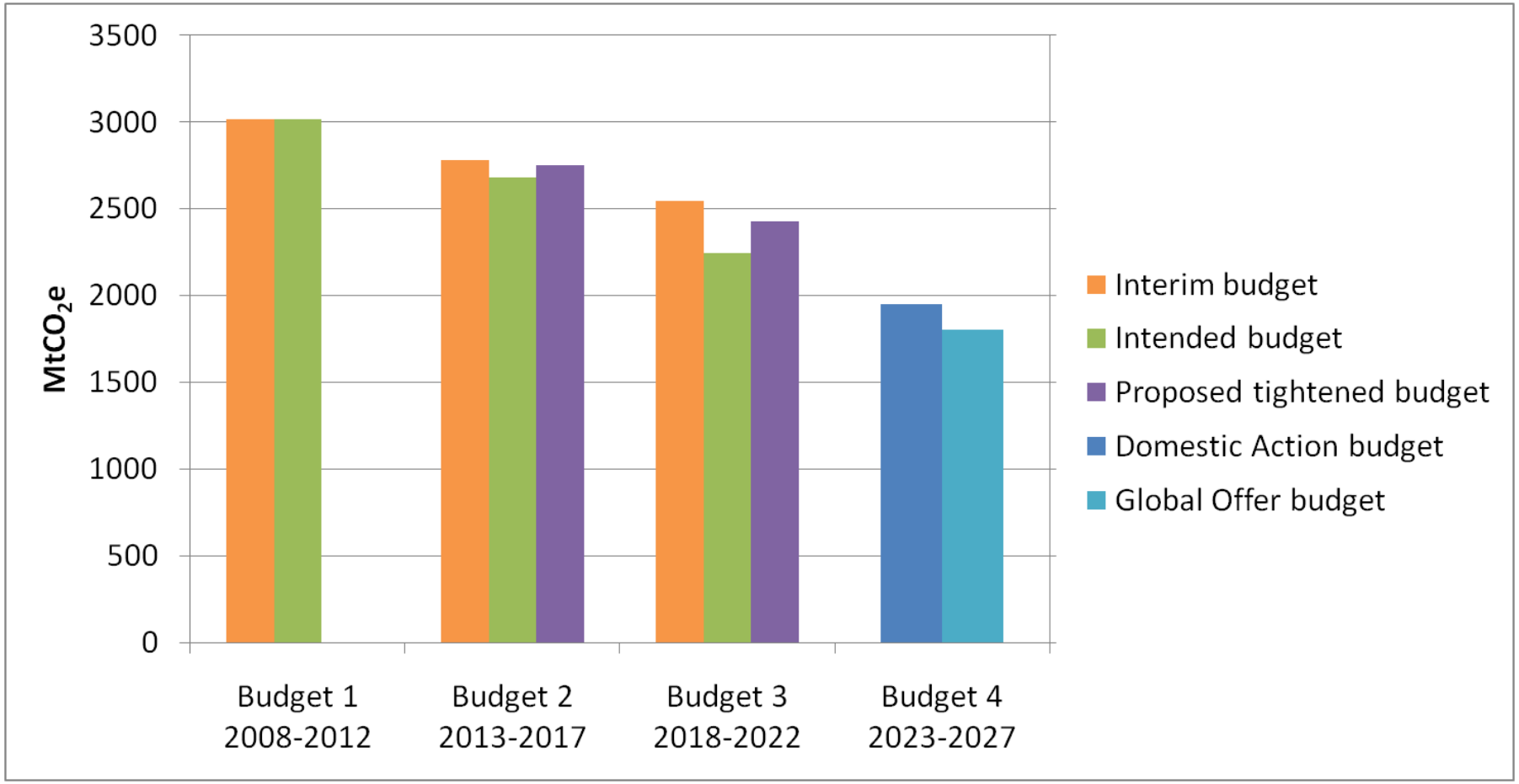
- Requires a **37%** emissions reduction in 2020 relative to 1990
  (versus 42% under the pure Intended budget and 34% under the pure Interim budget).

- A full move to the **Intended budget** should be legislated as EU ETS cap tightens.

Proposed tightened budgets



We also propose a Global Offer budget, that the UK should be willing to move to as part of a global deal to reduce emissions



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Costs and investment requirements

- Fourth budget and indicative 2030 target can be met at **under 1%** of GDP.
- Main **investments** are low-carbon capacity in power
  - Investment in generation £10 billion per annum
  - Compared to £2 billion in power / £200 billion economy-wide in recent years.

- Potential implications for the fiscal balance, fuel poverty, and competitiveness are **foreseeable** and **manageable** given appropriate policy response.
- Potential benefits for security of supply, from reduced reliance on volatile energy commodities.

Contents

Summary of recommendations

- The UK's **2050 target** of an 80% emissions reduction on 1990 remains appropriate.

- By **2030** the UK should aim for a 60% reduction on 1990
  = a 46% reduction from today, leaving a 63% reduction to 2050.

- Legislate the **Domestic Action** budget (1950 $MtCO_2e$) now
  - Aim to deliver this through domestic abatement (without credits)
  - Be willing to go further (possibly with credits) – indicative minimum **Global Offer** (1800 $MtCO_2e$).

- Move to the **Intended budget** for the non-traded sector for second and third budgets.

- **Policy implications**:
  - Electricity market reform & carbon price underpin
  - Support development of new technologies & markets
  - Make the step change to deliver the first three budgets.