

Buildings, Embodied Carbon and the Time Value of Carbon Emissions

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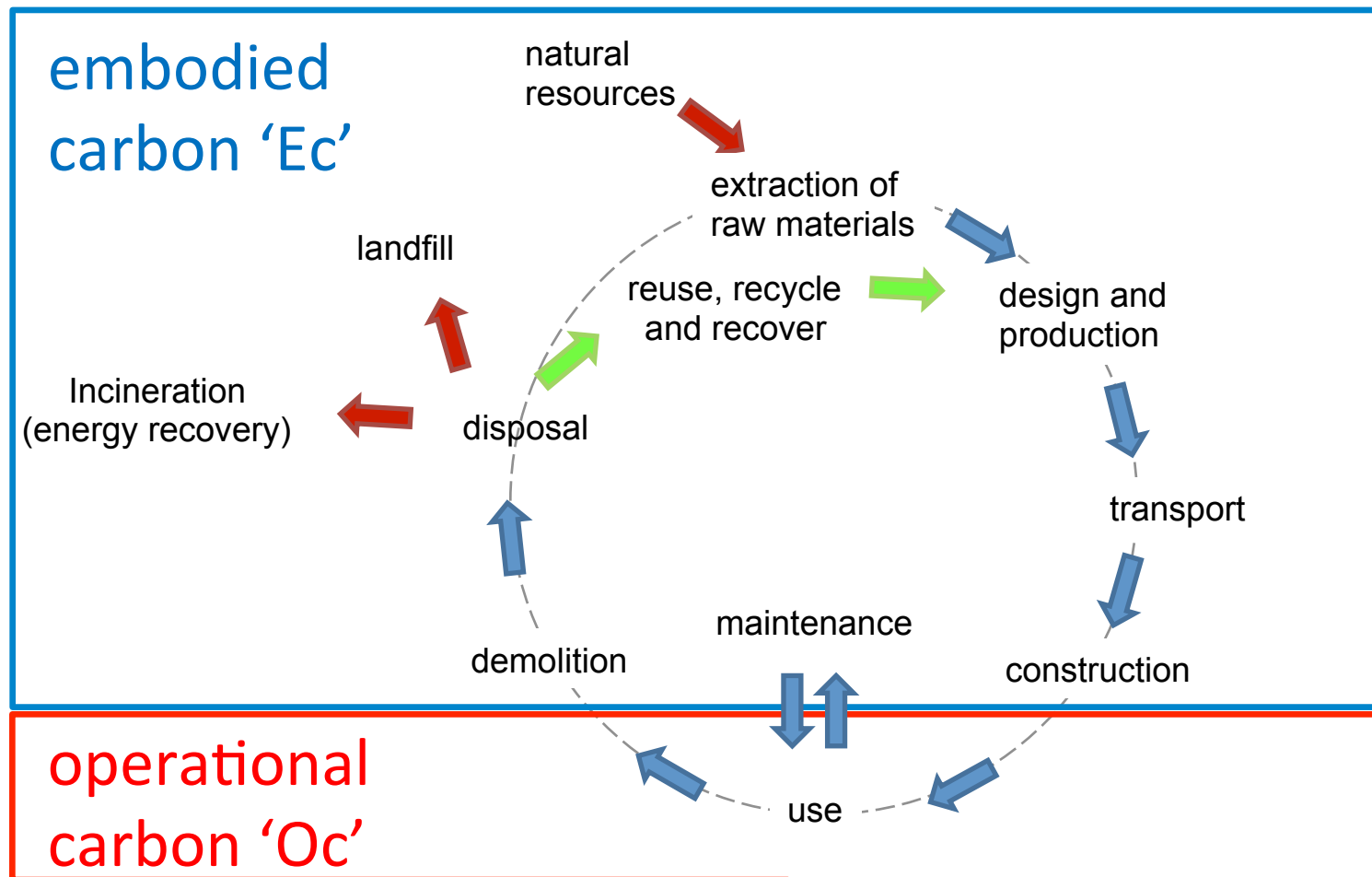
Contents:

- Context – climate change, UK policy and buildings
- Embodied and operational emissions from buildings
- Two key questions
 - Do we need to reduce embodied emissions?
 - Do emission savings have a time value?

Climate change and UK Policy

- UK policy accepts the need to limit the rise in global temperatures to no more than 2°C
- This requires global GHG emissions to peak by 2020, be cut by 50% by 2050 and approach zero before 2100
- And requires cuts in the UK of more than 80% (measured against the 1990 baseline) before 2050
- Therefore the UK has adopted legally binding carbon reduction targets of 34% by 2020 and 80% by 2050
- Buildings are estimated to be responsible for more than 50% of GHG emissions in the UK, made up of operational emissions (Oc) and embodied emissions (Ec)

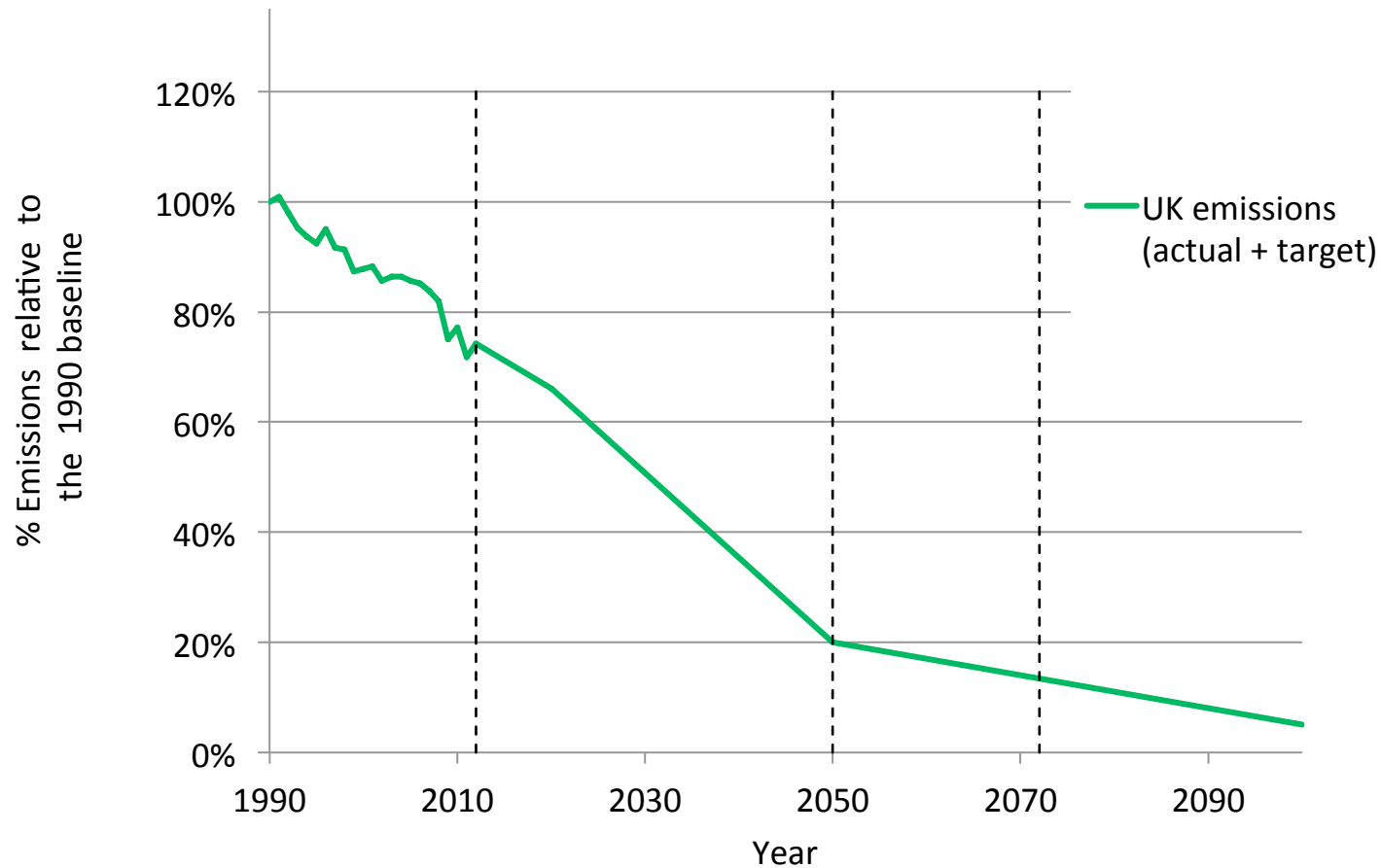
Embodied and operational emissions from buildings



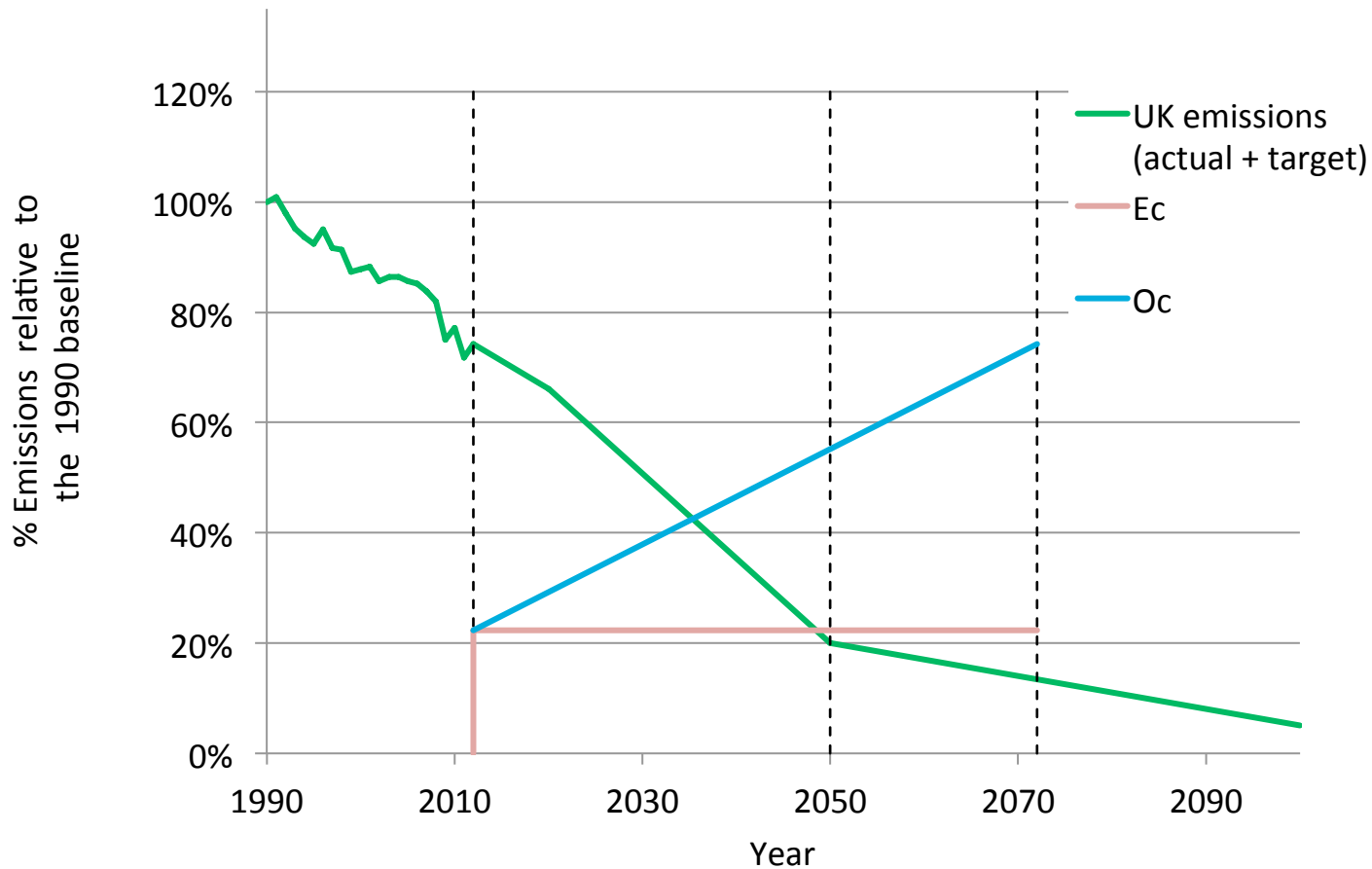
First key question

Can we reach our emission targets by just
reducing O_c or do we also need to reduce E_c ?

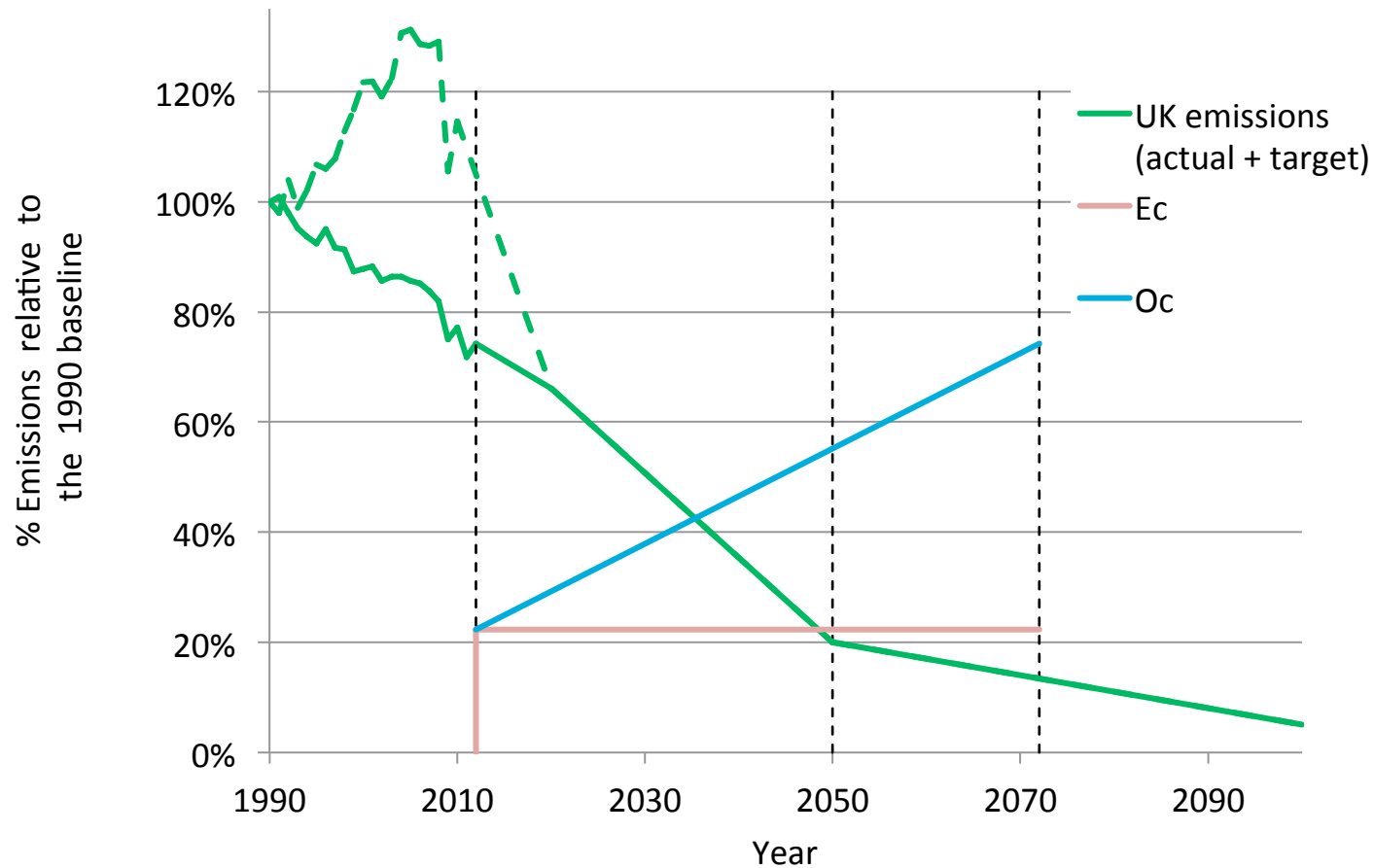
Required reductions in Oc and Ec



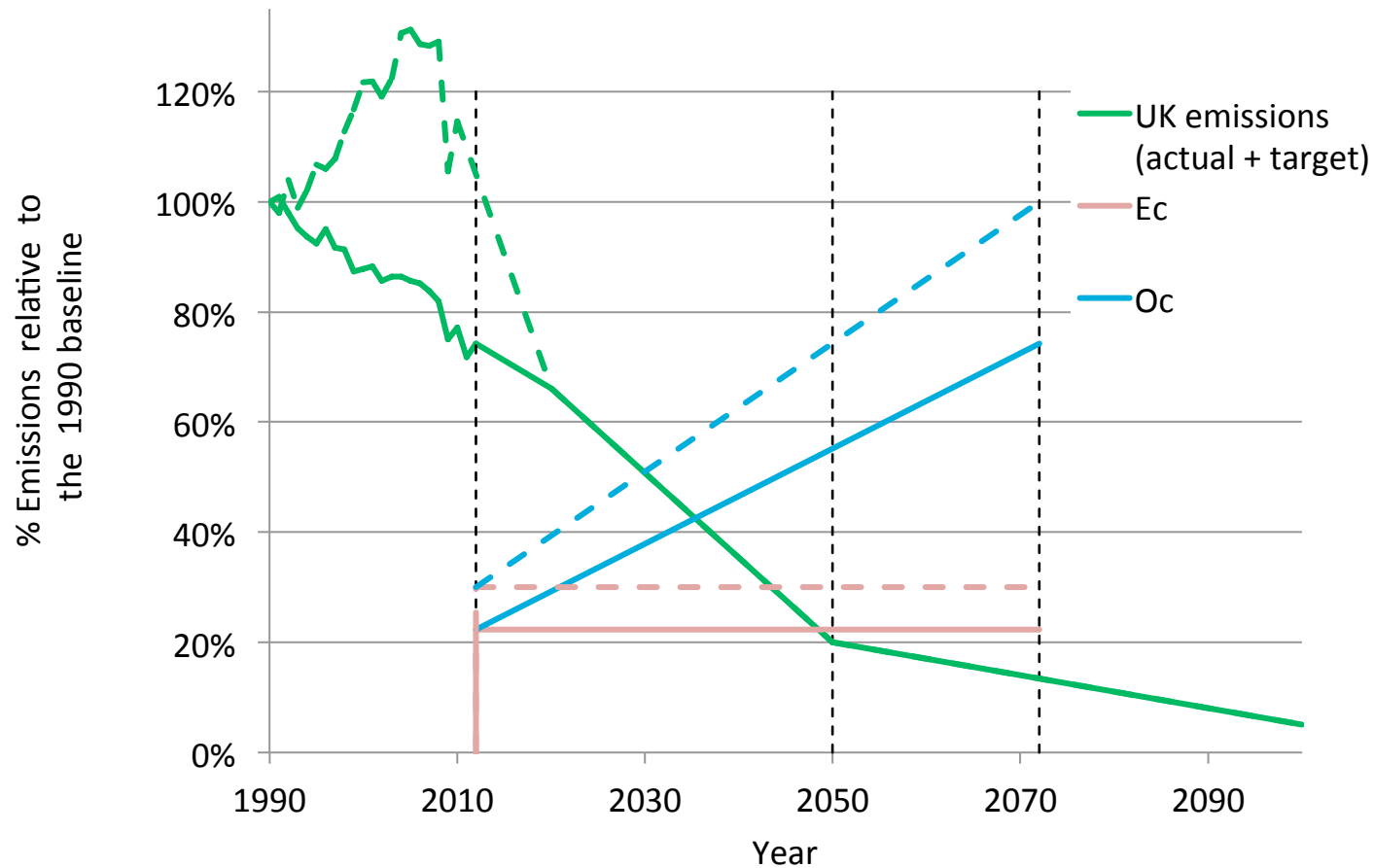
Required reductions in Oc and Ec



Required reductions in Oc and Ec



Required reductions in Oc and Ec



Second key question

Do emission savings occurring at
different times have the same value?

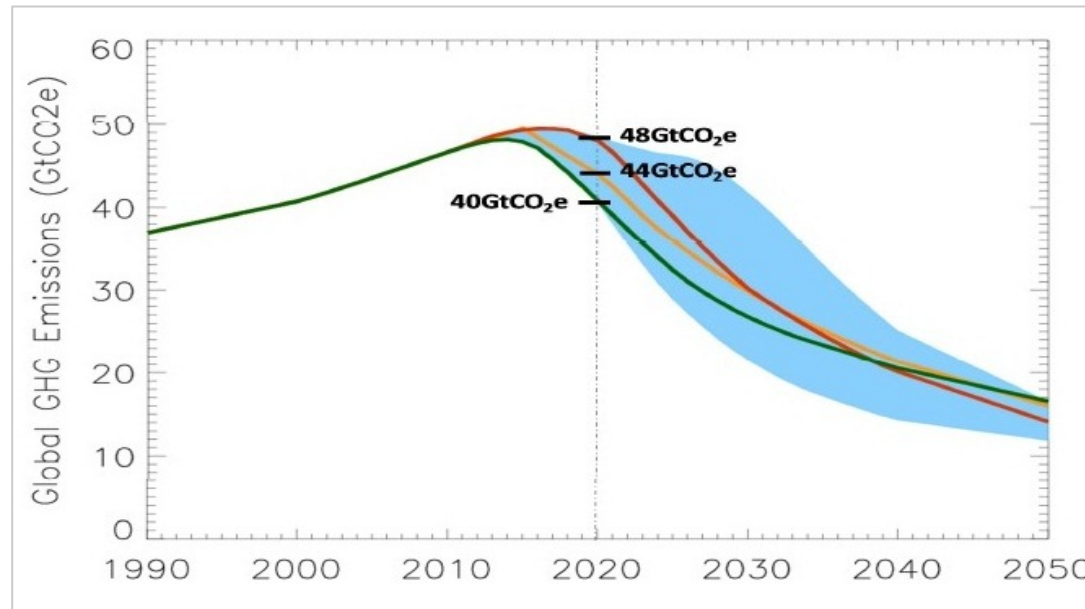
Timing of emissions

- Oc occurs throughout the service life of a building
- majority of Ec occurs just before the start of the service life

Issues affecting the time value of emissions:

- The urgency for emissions to peak before 2020
- Early effective action to reduce emissions is less costly
- Likely future reductions in O_c from buildings built today
- Delayed emissions are present in the atmosphere for a shorter time during the assessment period

The urgency for emissions to peak before 2020



(Source Bowen and Ranger (2009) in Stern Review)

- If emissions continue to rise after 2020 the chance of keeping global temperature below 2°C will probably have been missed
- emission reductions after this date will not help to keep temperatures below this threshold

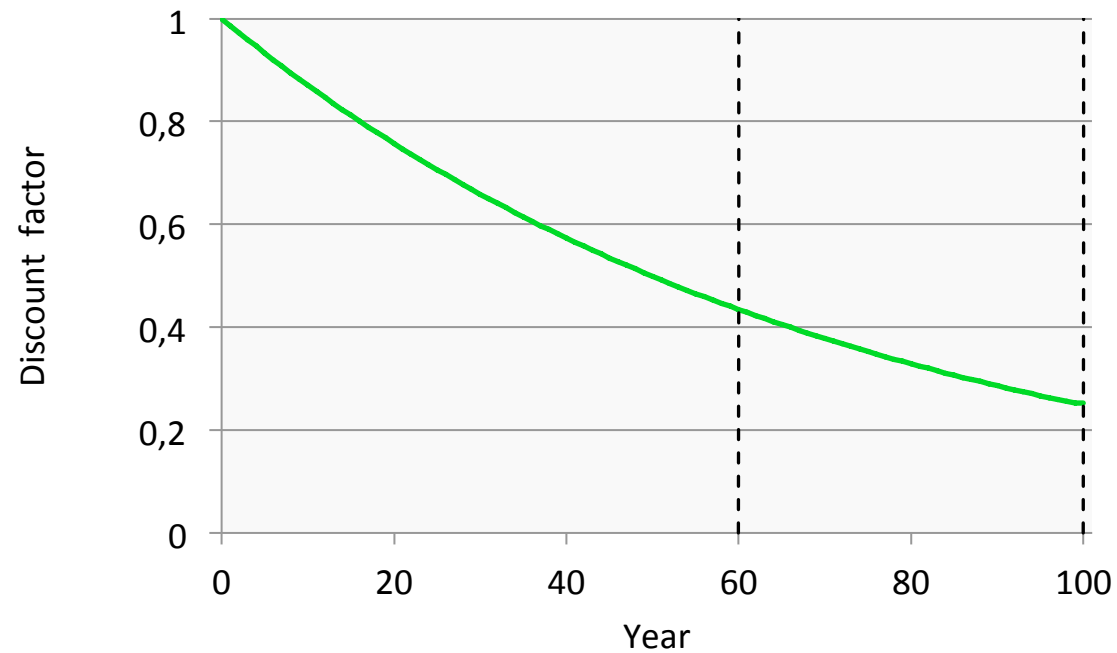
Early effective action is less costly

Sir Nicholas Stern (author of *'The Stern Review; The economics of climate change'*), has estimated:

- the cost of effective action to reduce GHG emissions over the next 10-20 years is around 2% of global GDP per year
- the cost if no action is taken is equivalent to losing between 5% and 20% of global GDP each year from now and into the future

A discount factor for urgency and cost

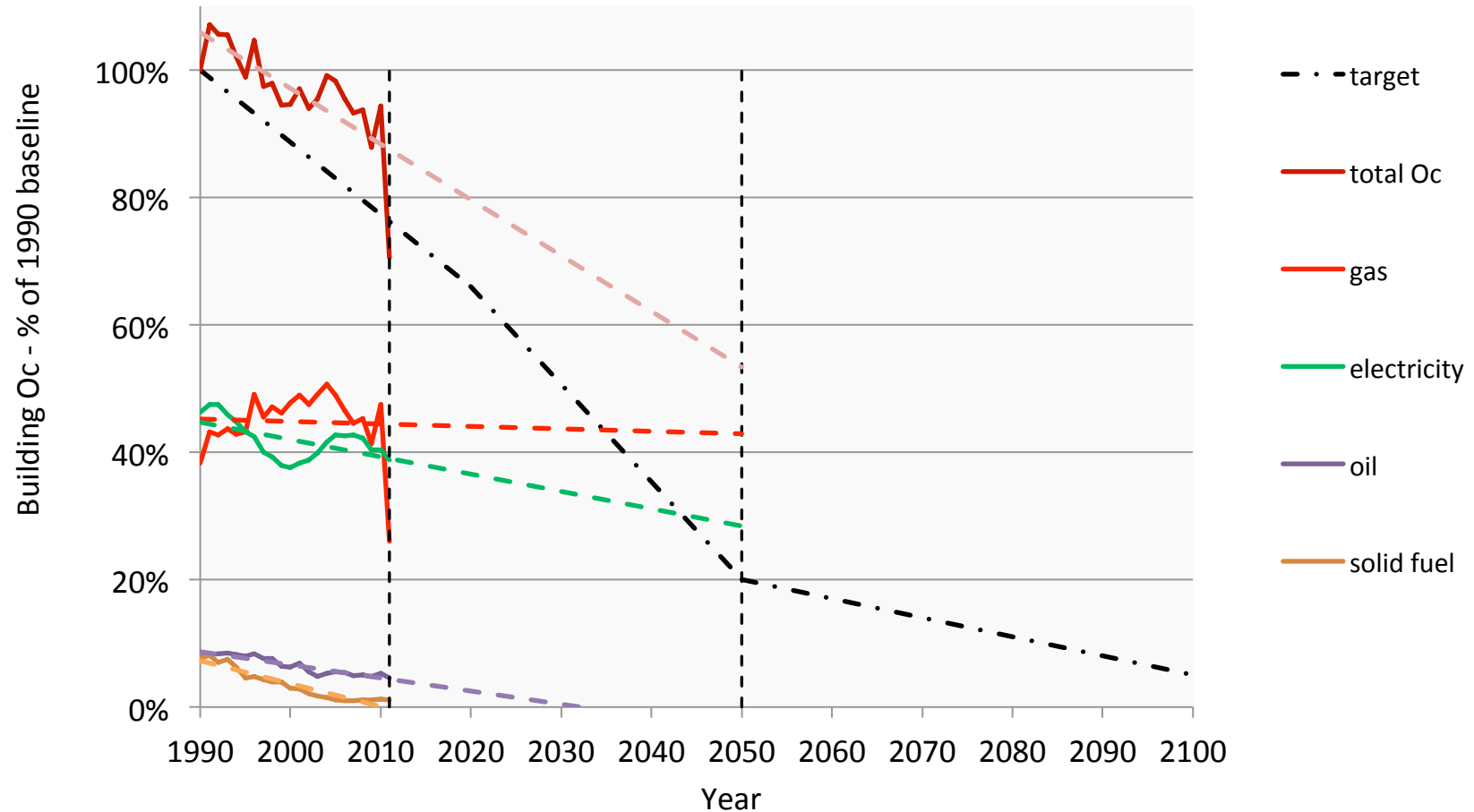
+1.4% discount rate based on the Stern Review



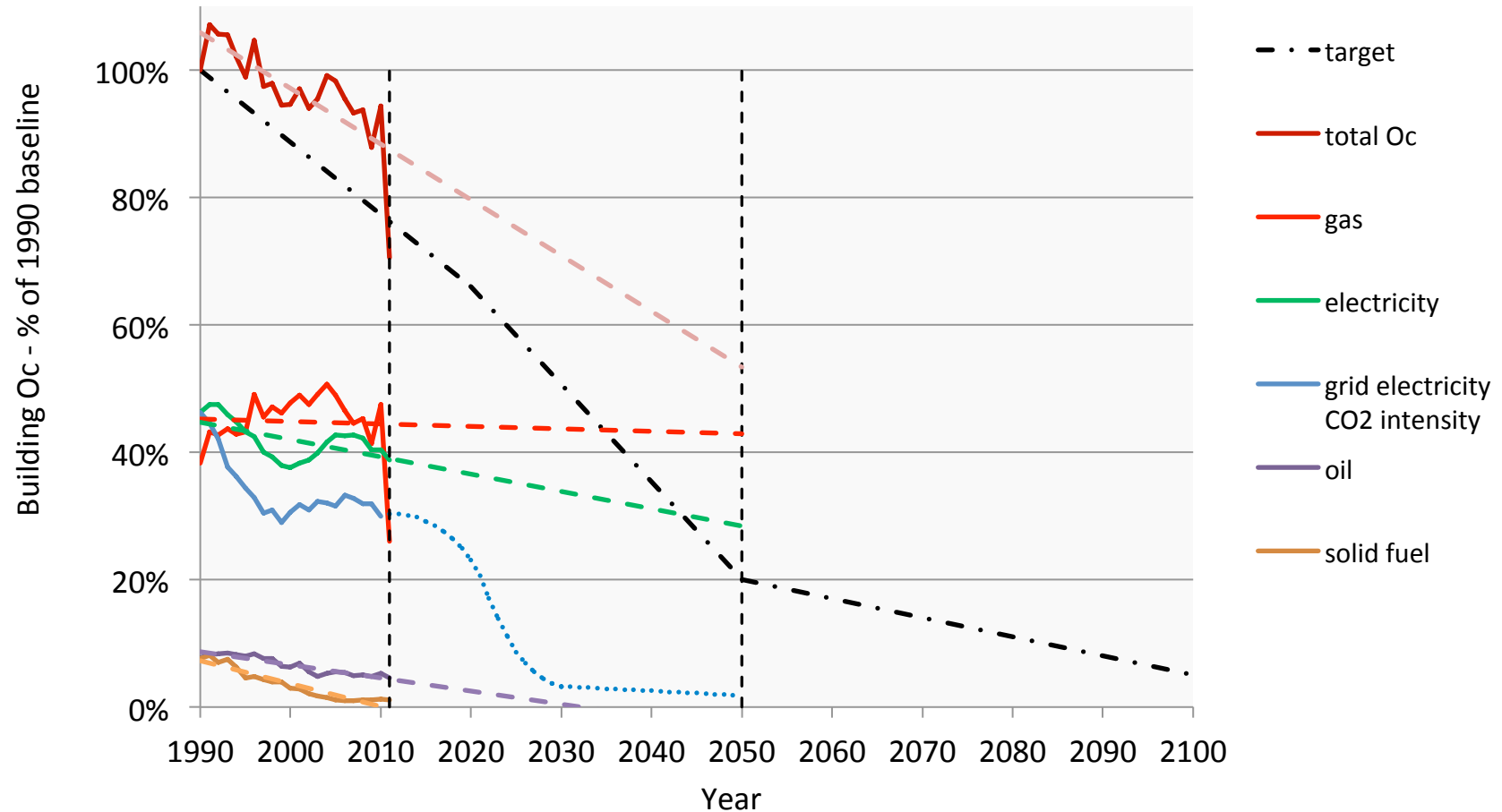
Future reductions in Oc from buildings built today

- decarbonisation of electricity supply
- future refitted building equipment with better energy efficiency
- reduced use of fossil gas and oil
- increased use of biogenic fuels
- consumer behaviour change

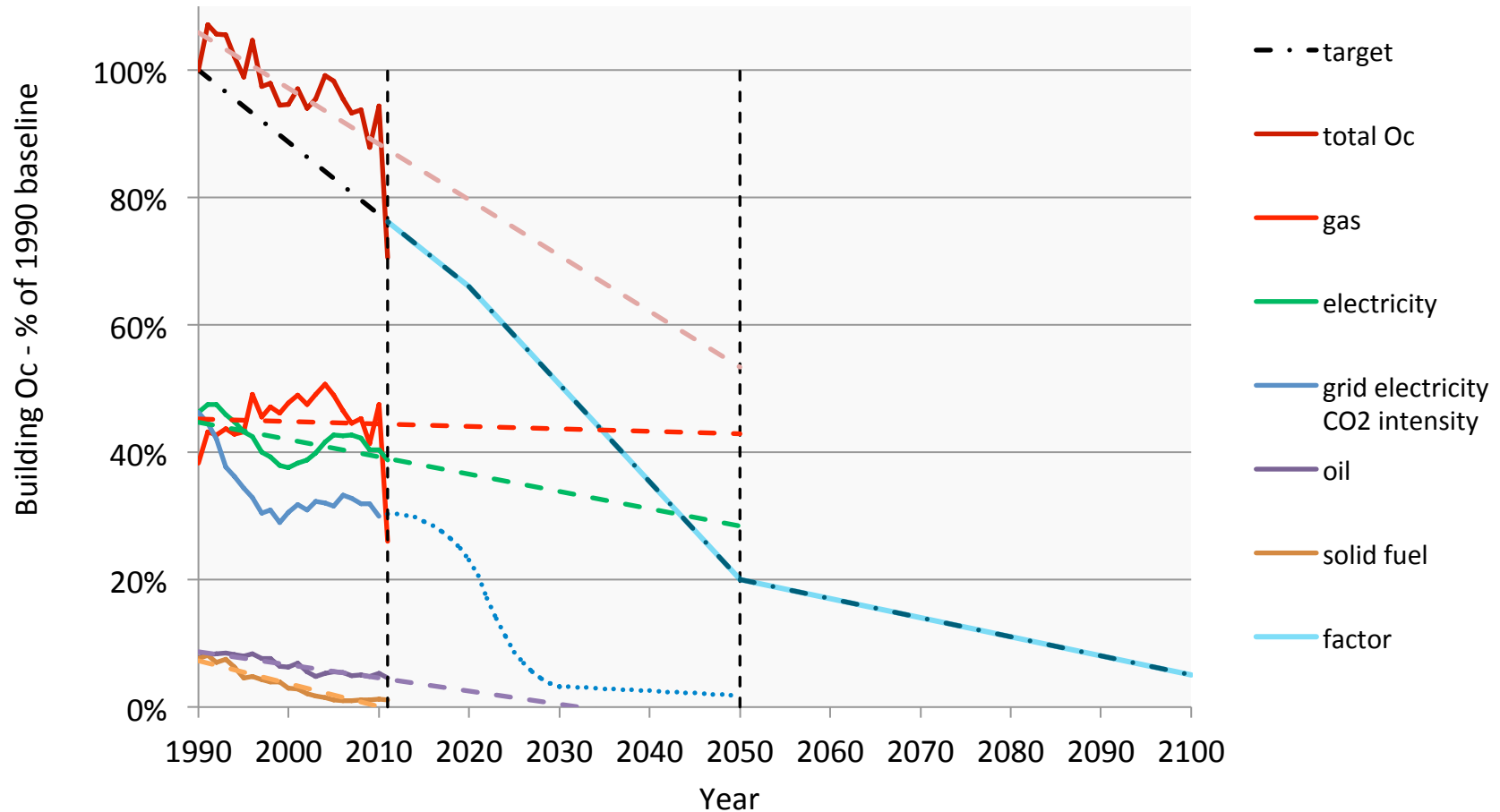
Future reductions in Oc from buildings built today



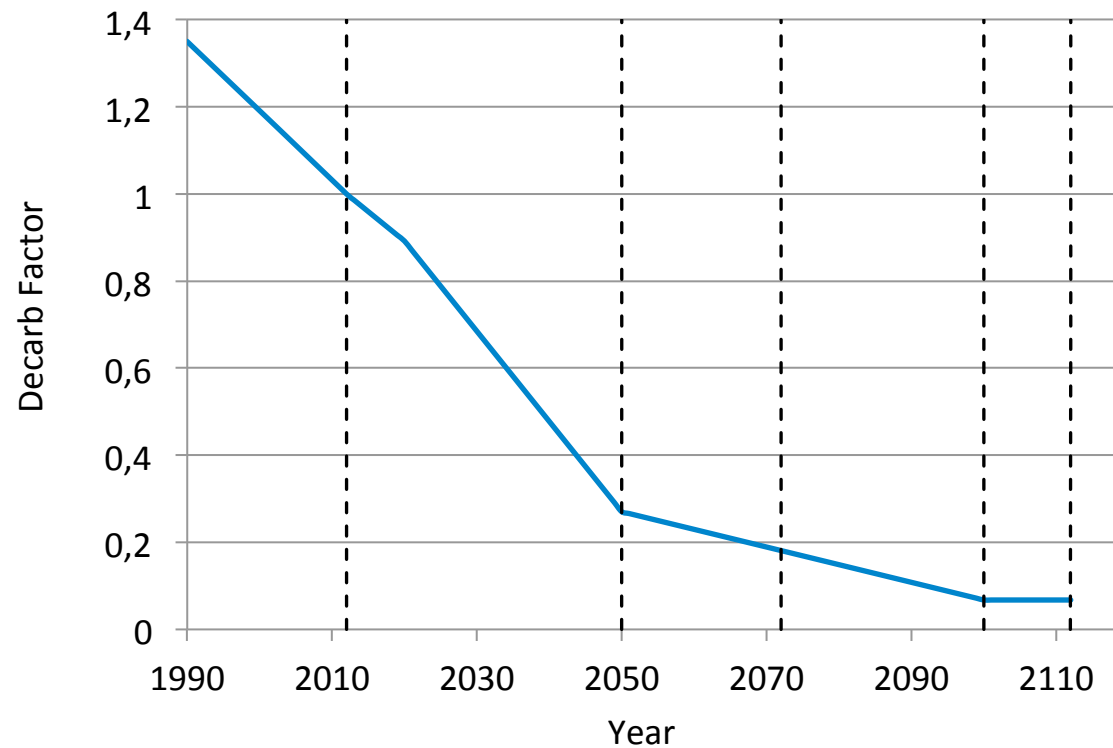
Future reductions in Oc from buildings built today



Future reductions in Oc from buildings built today



A 'decarb factor' for future reductions in Oc from buildings built today



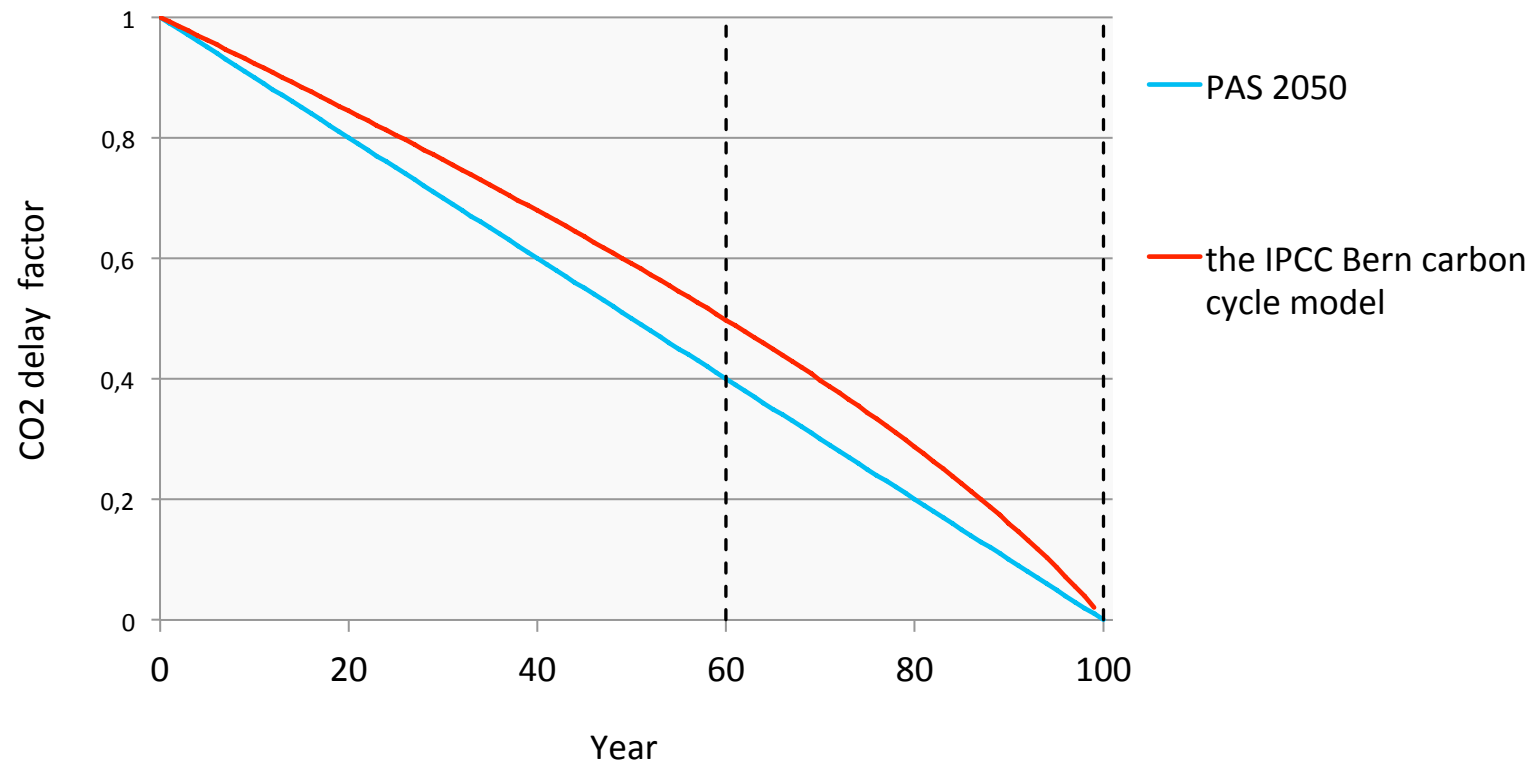
Delayed emissions

British Standard PAS 2050, *Specification for the assessment of the life cycle greenhouse gas emissions of goods and services*, states:

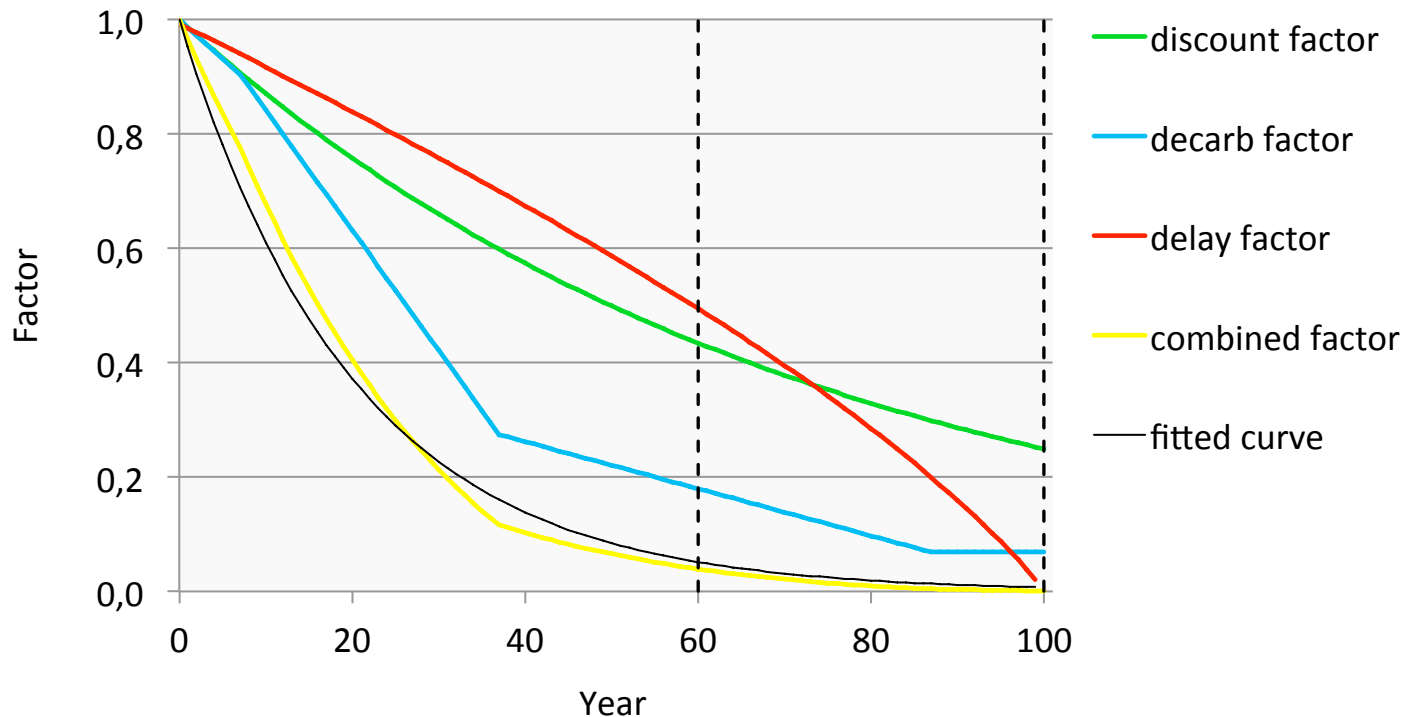
‘Emissions that are released over time through long use (e.g. light bulbs) or final disposal phases cannot be treated as a single release of emissions at the start of the 100-year assessment period. Therefore, these emissions must be calculated to represent the weighted average time in the atmosphere during the assessment period.’

- weightings are given to delayed emissions
- The emissions profile for a building are similar to those from a light bulb!

Delayed emissions factor



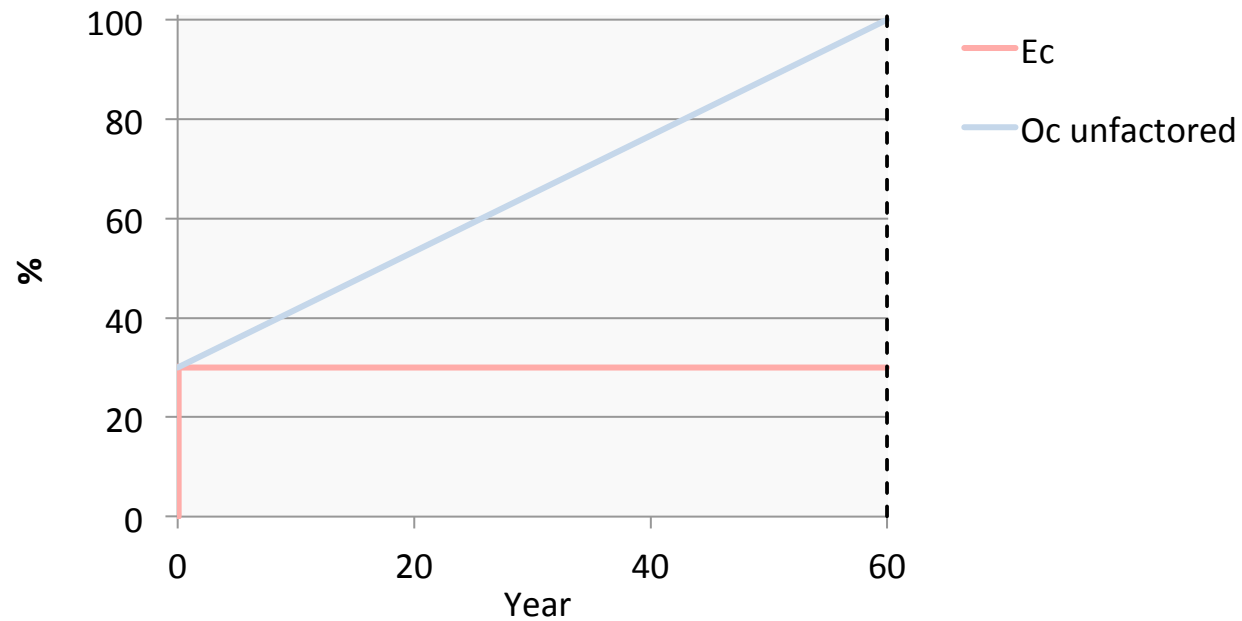
Combined 'time value factor'



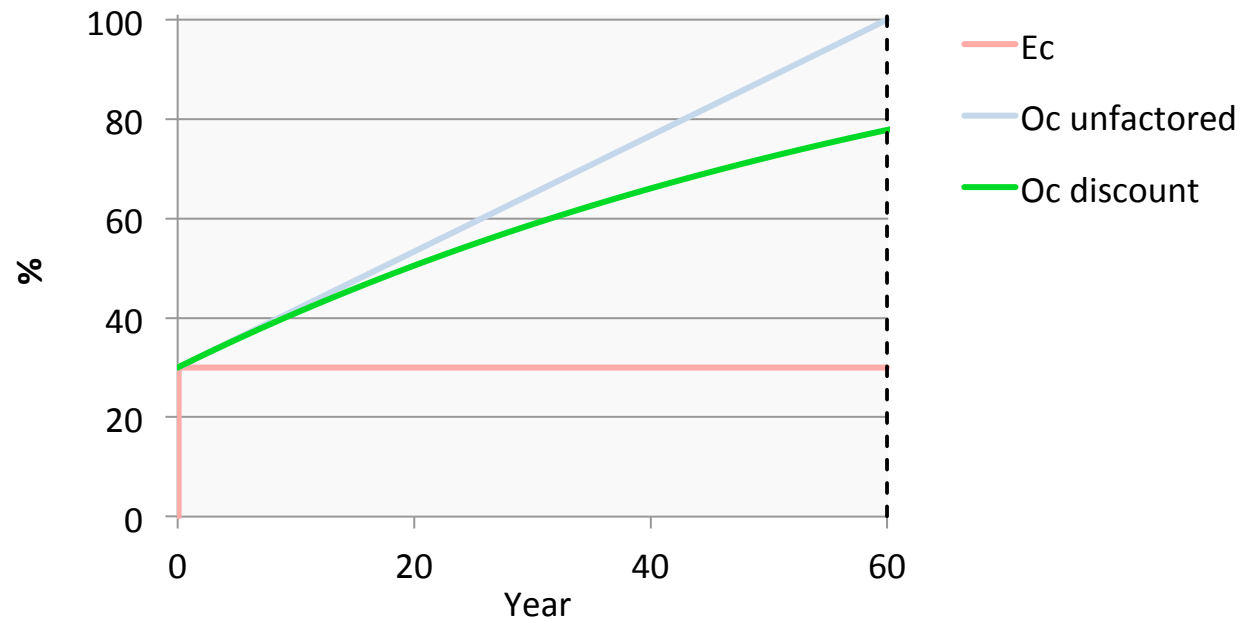
Proposed combined 'time value factor' = $e^{-0.0495n}$

'n' = the year emissions occur

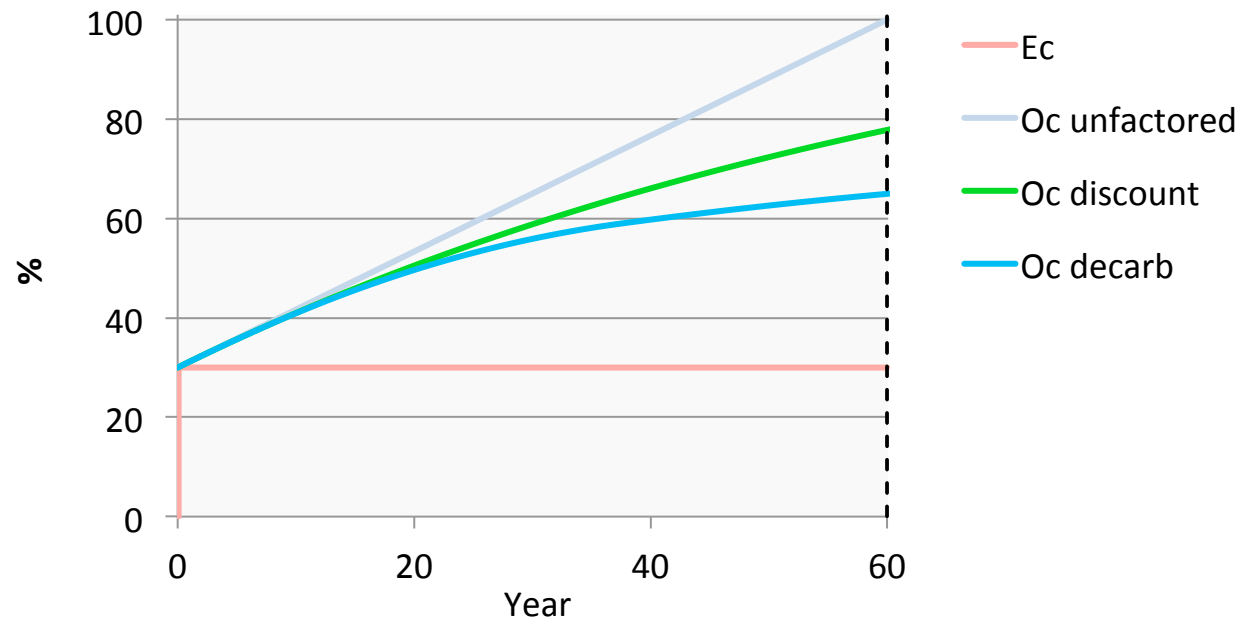
Results



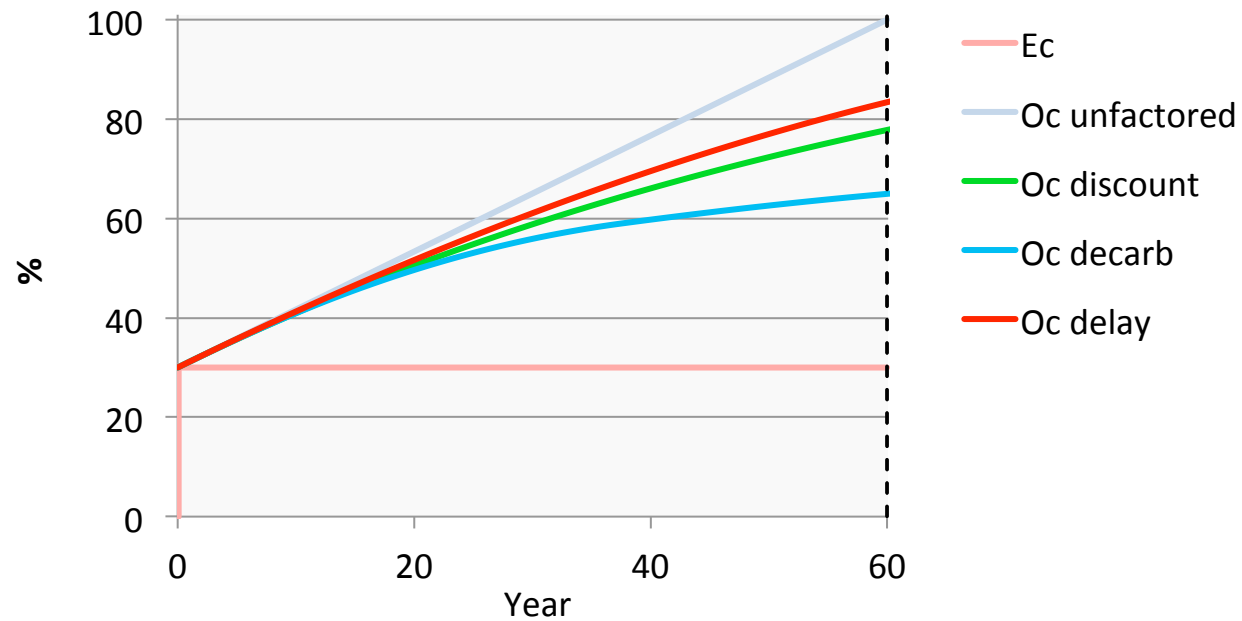
Results



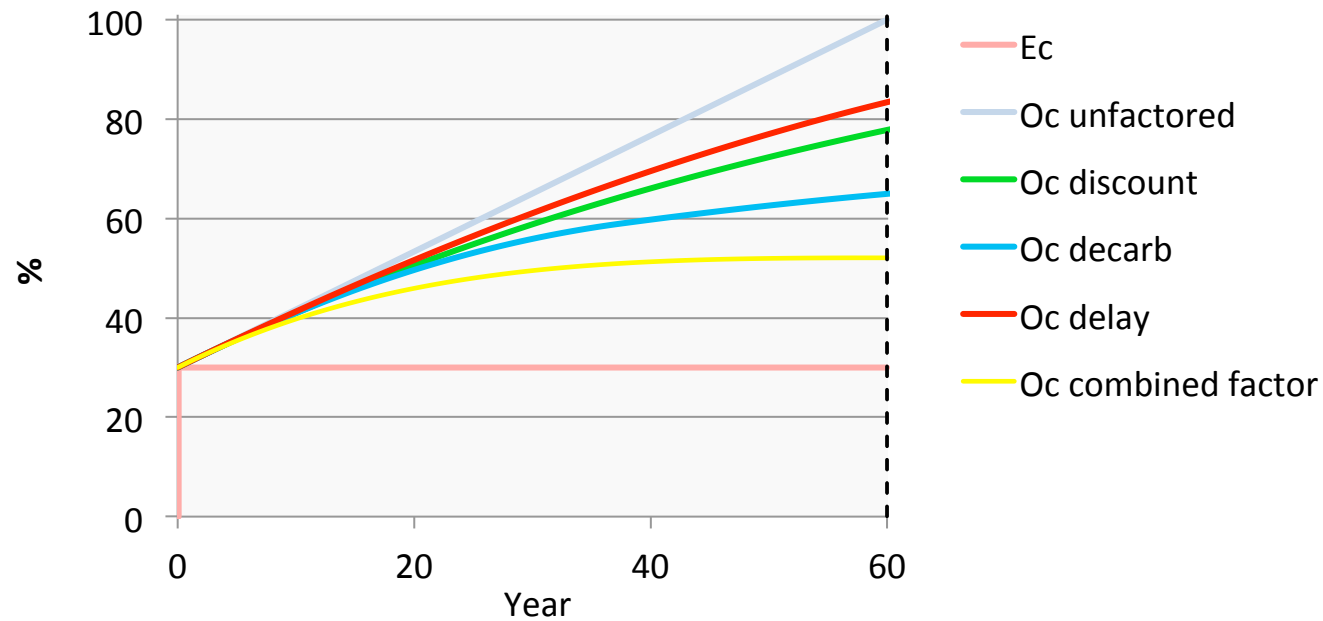
Results



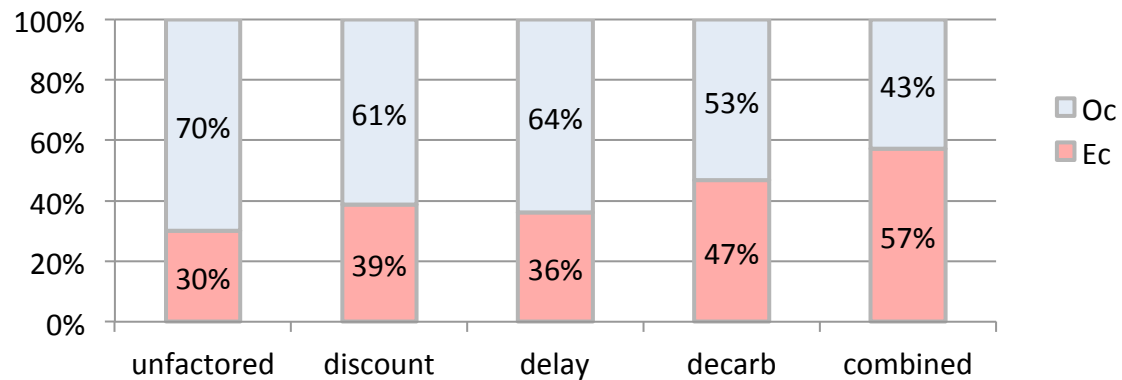
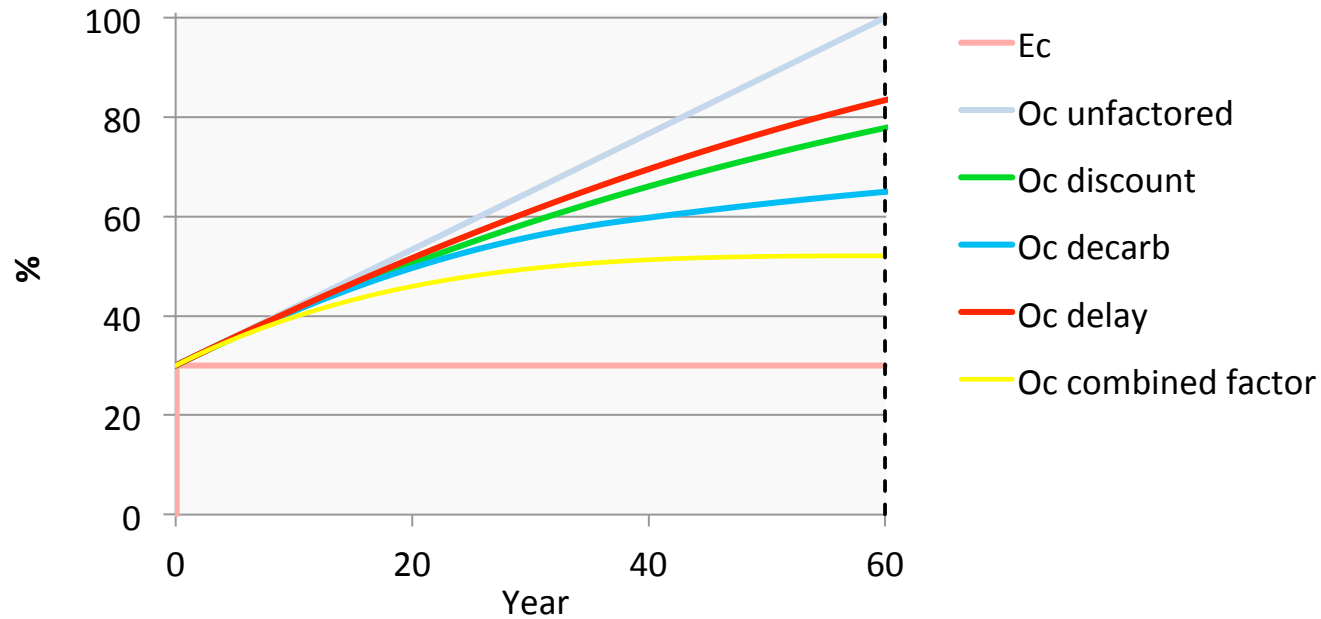
Results



Results



Results



Conclusions

- Reductions in both O_c and E_c from new buildings will be required to meet the UK emissions targets.
- Over the next 20 years, the earlier emission reductions can be made during the life of new buildings the more beneficial they are likely to be in terms of climate change
- E_c reductions early in a building lifecycle are likely to be the more beneficial than equivalent O_c reductions over the service life of a building
- Applying the 'time value' factor to building emissions, shows that E_c is likely to be, effectively, a higher proportion of life cycle emissions than O_c , for most new buildings.
- A 'time value factor' could be useful for comparing the true value of different mitigation options giving benefits at different times, e.g., when comparing E_c and O_c

Many thanks
to everyone for listening

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