KING'S College LONDON

University of London

Achieving a Low-Carbon Economy; The Policy Challenge

Presentation to the Workshop

'The Challenge of Climate Change'

By

Professor Paul Ekins

Professor of Energy and Environment Policy, King's College London

University of Warwick

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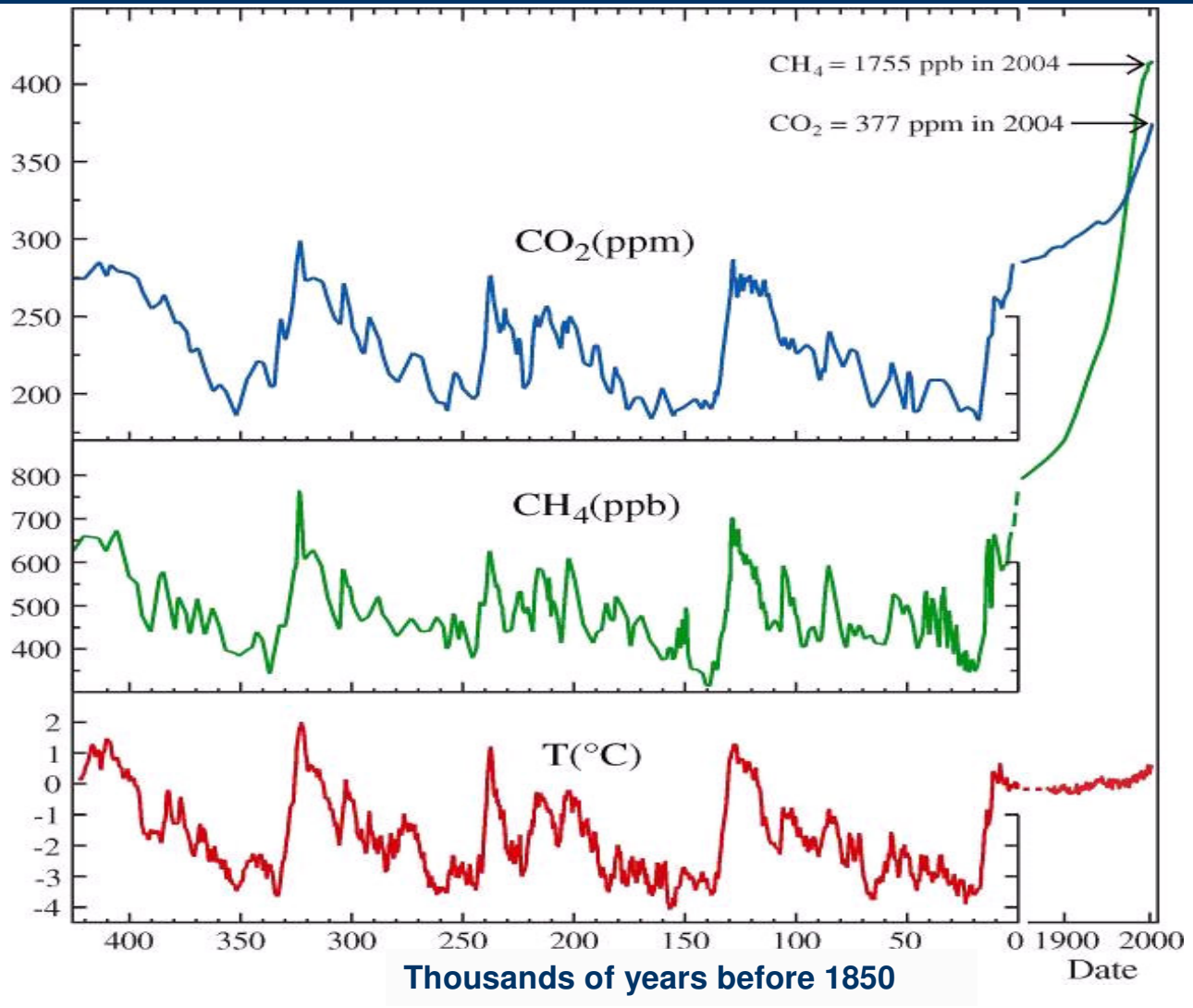
The last 450,000 years of natural change compared to the last century

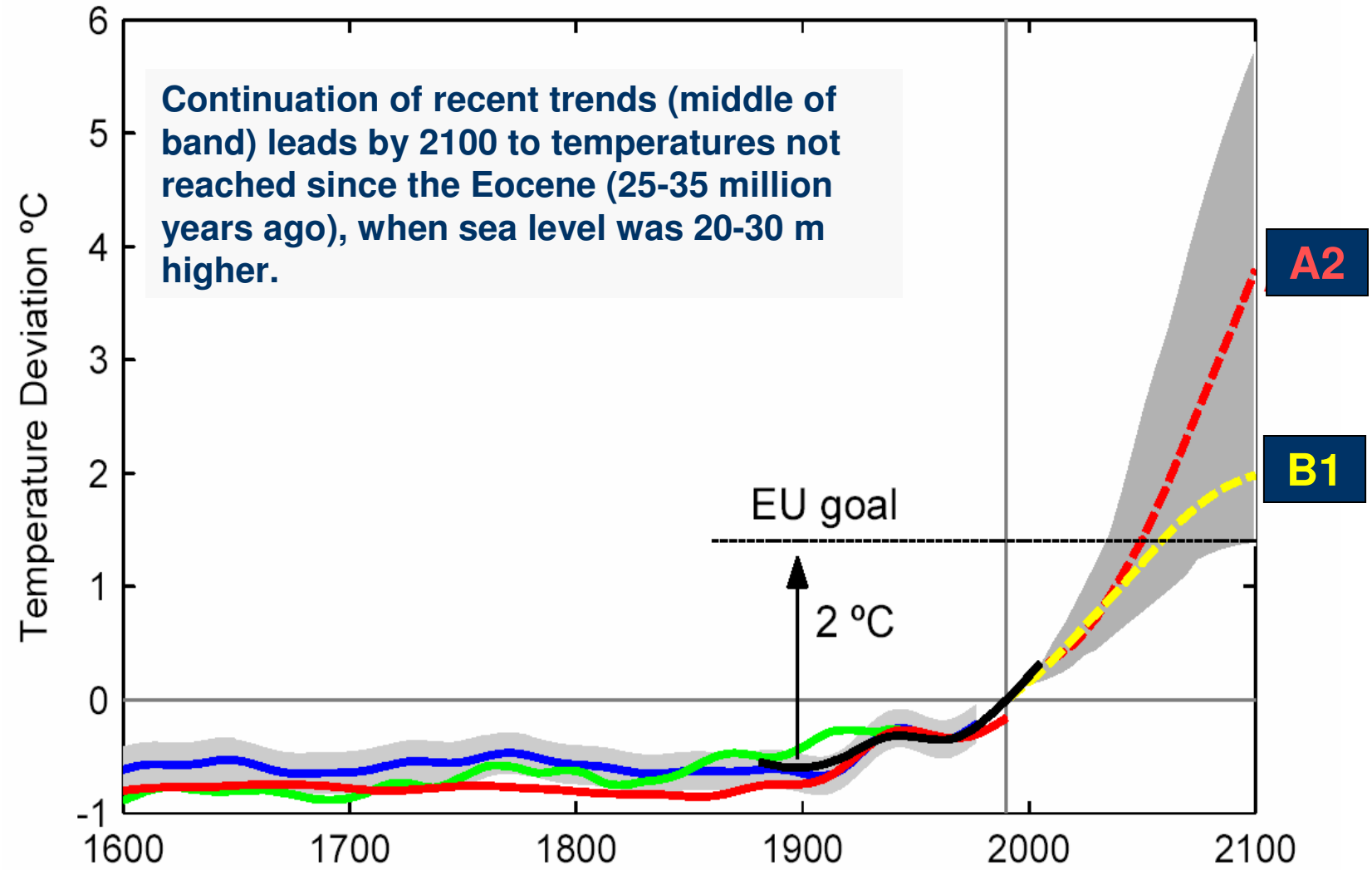


Source: Hansen, Clim. Change 68, 2005

‘Dangerous anthropogenic climate change’

- **Pre-industrial CO2 concentrations : 280 ppm**
- **Current CO2 concentrations: 380 ppm**
- **Current GHG (CO2e) concentrations: 430 ppm**
- **Rate of GHG concentration increase: 2.5 ppm p.a.**
- **Current global average temperature increase since 1900: 0.7ºC**
- **Target temperature increase for ‘acceptable’ climate change: 2ºC**
- **Probability that this will be exceeded at 450ppm: 80%**

The climate implications of where we‘re headed: The next 100 years compared to the last 400



Source: Professor John Holdren, Harvard University

Probability of exceeding different temperature rises versus pre-industrial levels

2ºC Rise

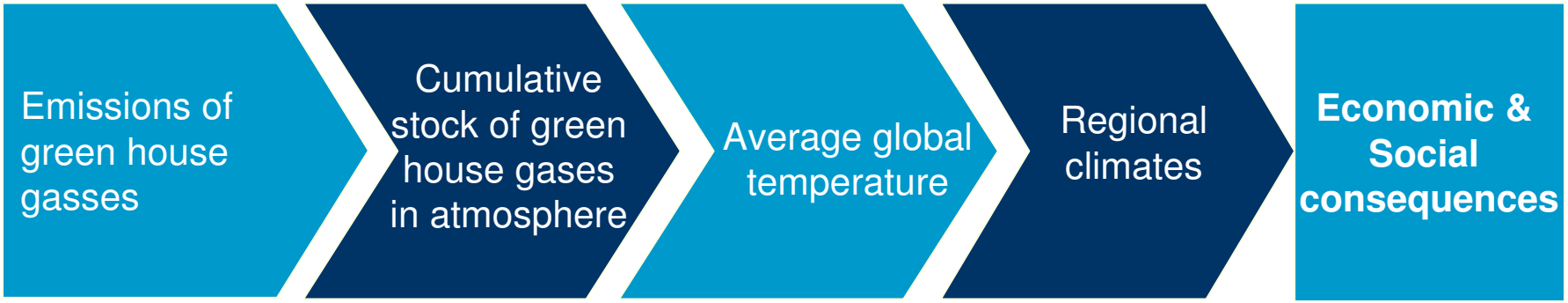
Stabilisation Level (CO_2e)*	Hadley Centre ensemble	IPCC Third Assessment
450	78%	38%
550	99%	77%
650	100%	97%

4ºC Rise

Stabilisation Level (CO_2e)*	Hadley Centre ensemble	IPCC Third Assessment
450	3%	1%
550	24%	9%
650	58%	25%

>50%

* Stabilisation level expressed in parts per million of CO_2 equivalent, allowing for the relative forcing effect of the non-CO_2 green house gases



- GDP growth
- Energy intensity of GDP
- Carbon intensity of energy

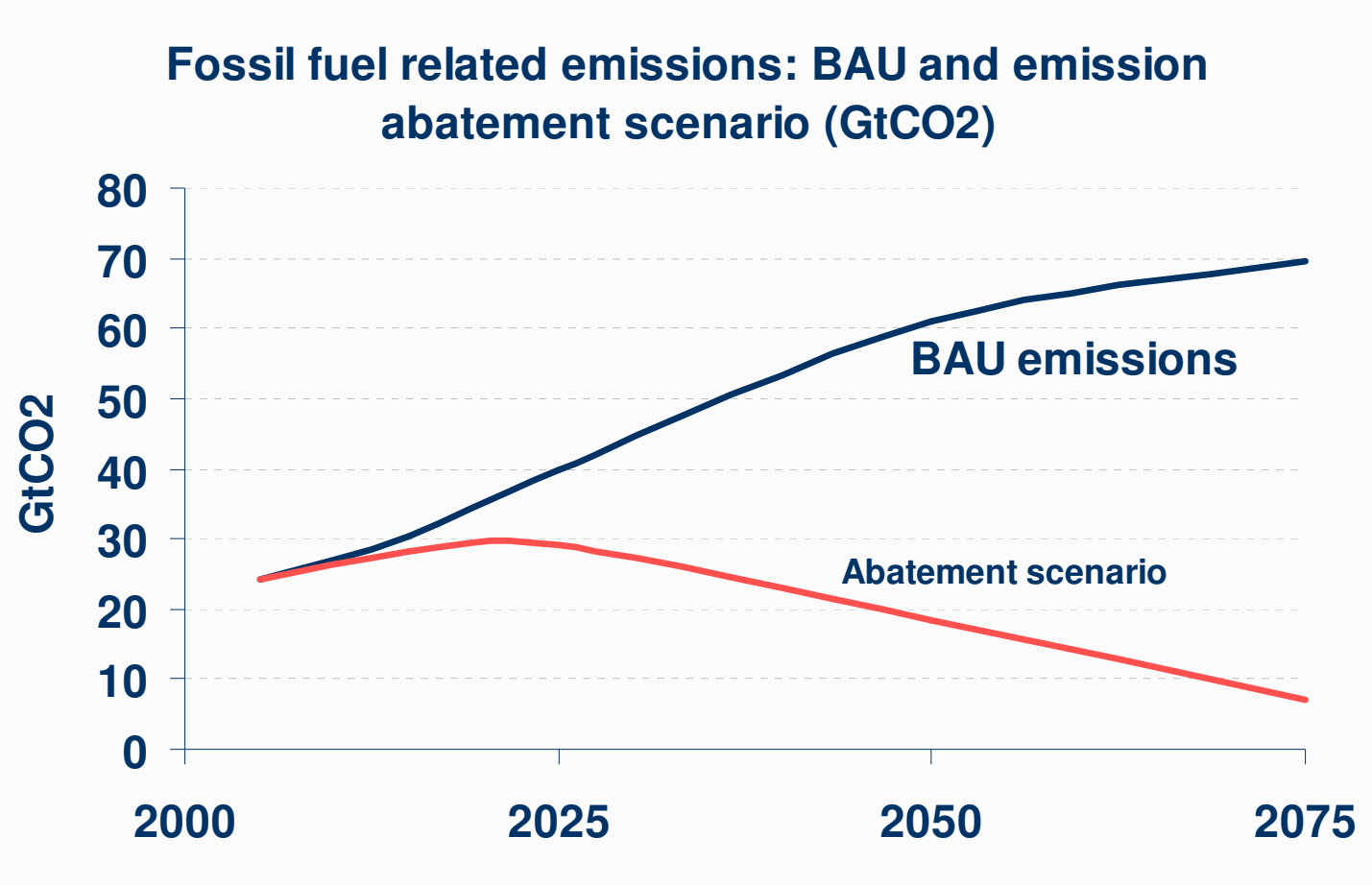
- Rate of dissipation

- Direct effects
- Feed-back loops
  - Amplifying
  - Dampening

- Complex climate models

- Non-linear relationship to temperature increase

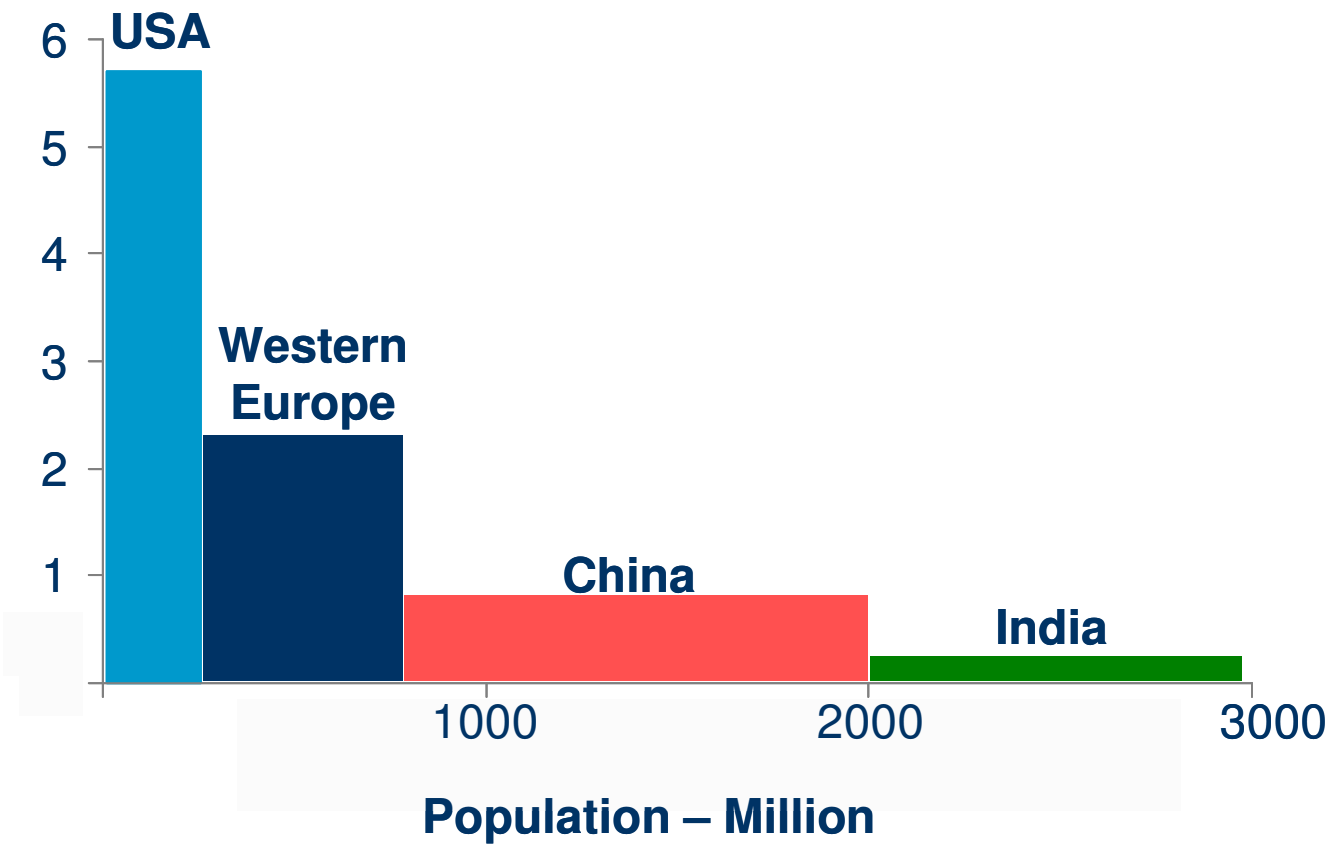
Emissions scenario to limit temperature change



Source: Stern Review, Part III, Chapter 9

CO_2 Emissions per capita

Tonnes of Carbon

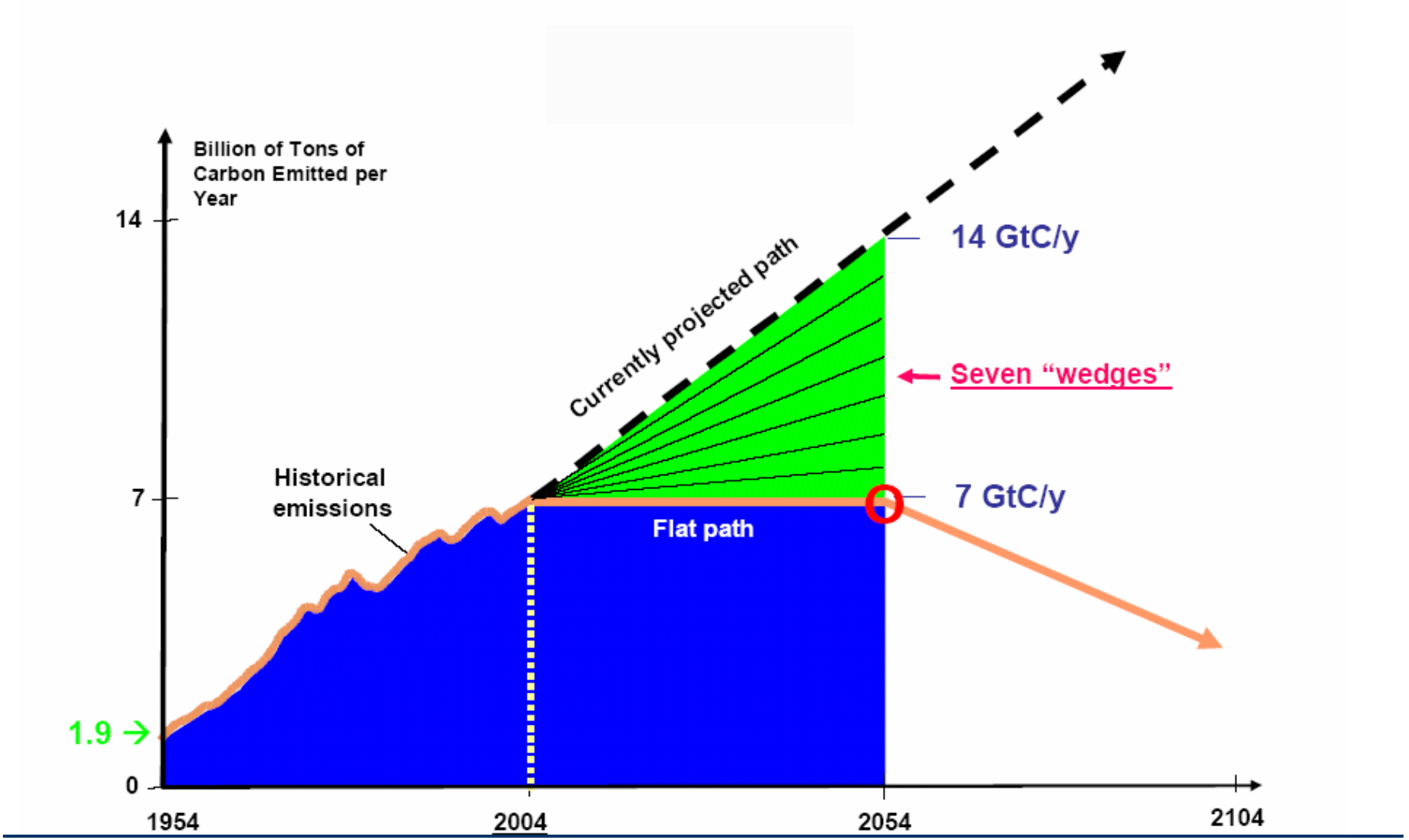


Source: Carbon Trust "The Climate Change Challenge", March 2005

The Stern Review Policy Prescription

- **Carbon pricing: carbon taxes; emission trading; (regulation?)**
- **Technology policy: low-carbon energy sources; high-efficiency end-use appliances/buildings**
- **Remove other barriers and promote behaviour change: take-up of new technologies and high-efficiency end-use options; low-energy (carbon) behaviours**

Technological Potential: the Socolow Wedges



Source: Professor Robert Socolow "Stabilisation Wedges", Met Office Symposium, 3rd February 2005

Potential “Wedges”: cuts of 1gt of carbon per year in 2054

1. **Efficient vehicles** *Increase fuel economy for 2 billion autos from 30 to 60 mpg.*

2. **Reduced use of vehicles** *Decrease auto travel for 2 billion 30 mpg autos from 10000 to 5000 miles per year*

4. **Nuclear** *Tripling of capacity to 1050 Gwatts.*

5. **Gas for coal substitution** *1400 G watts of electricity generation switched from coal to gas.*

6. **Carbon capture and storage** *Introduce CCS at 800 G watt coal stations*

10. **Wind power** *50 times as much wind power as at present.*

11. **Solar PV** *700 times 2004 capacity*

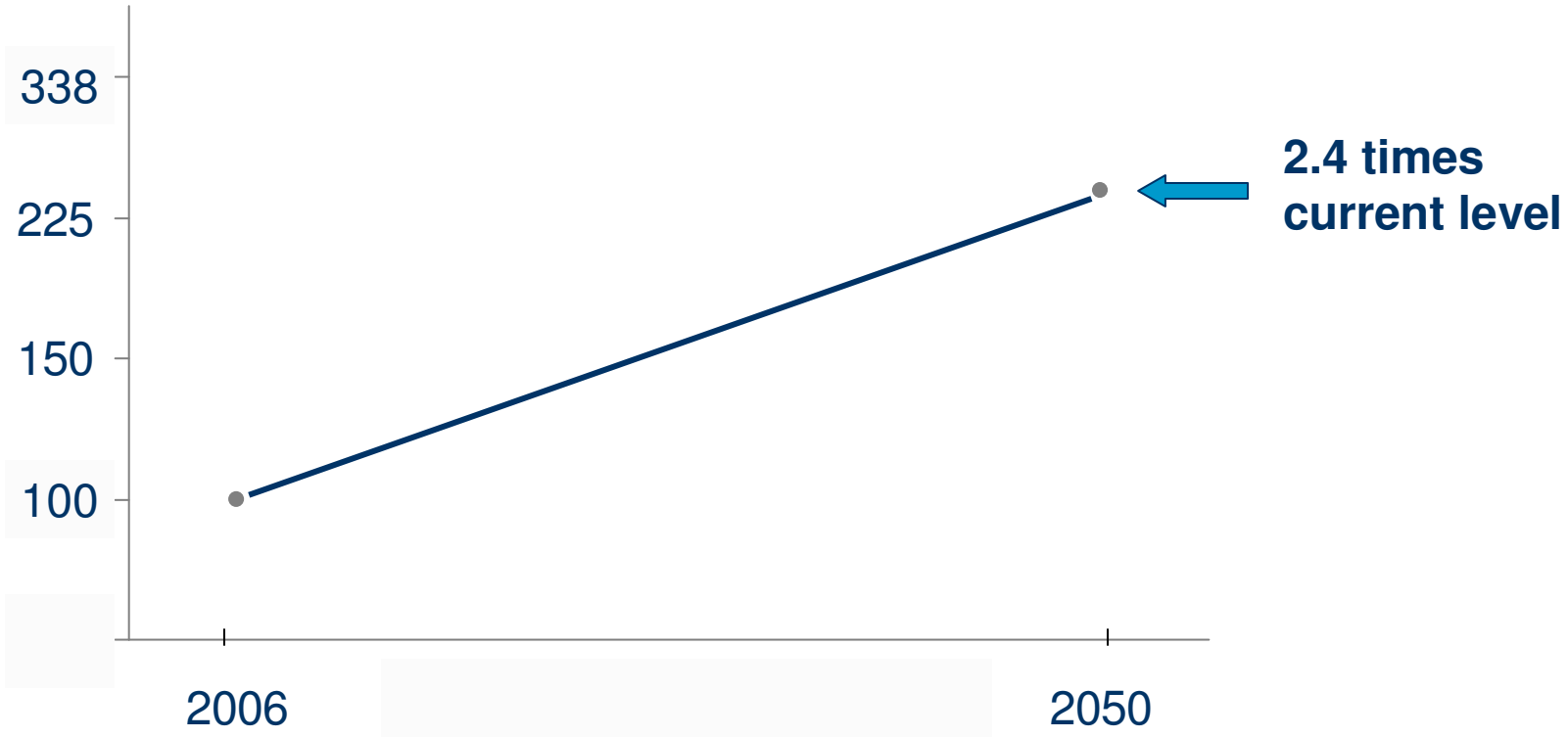
12. **Hydrogen** *Additional 4000 Gwatts of wind capacity or additional CCS capacity*

13. **Biomass fuel** *100 times the current Brazilian ethanol production*

Source: Professor Robert Socolow “Stabilisation Wedges”

Growth in UK living standards: business as usual

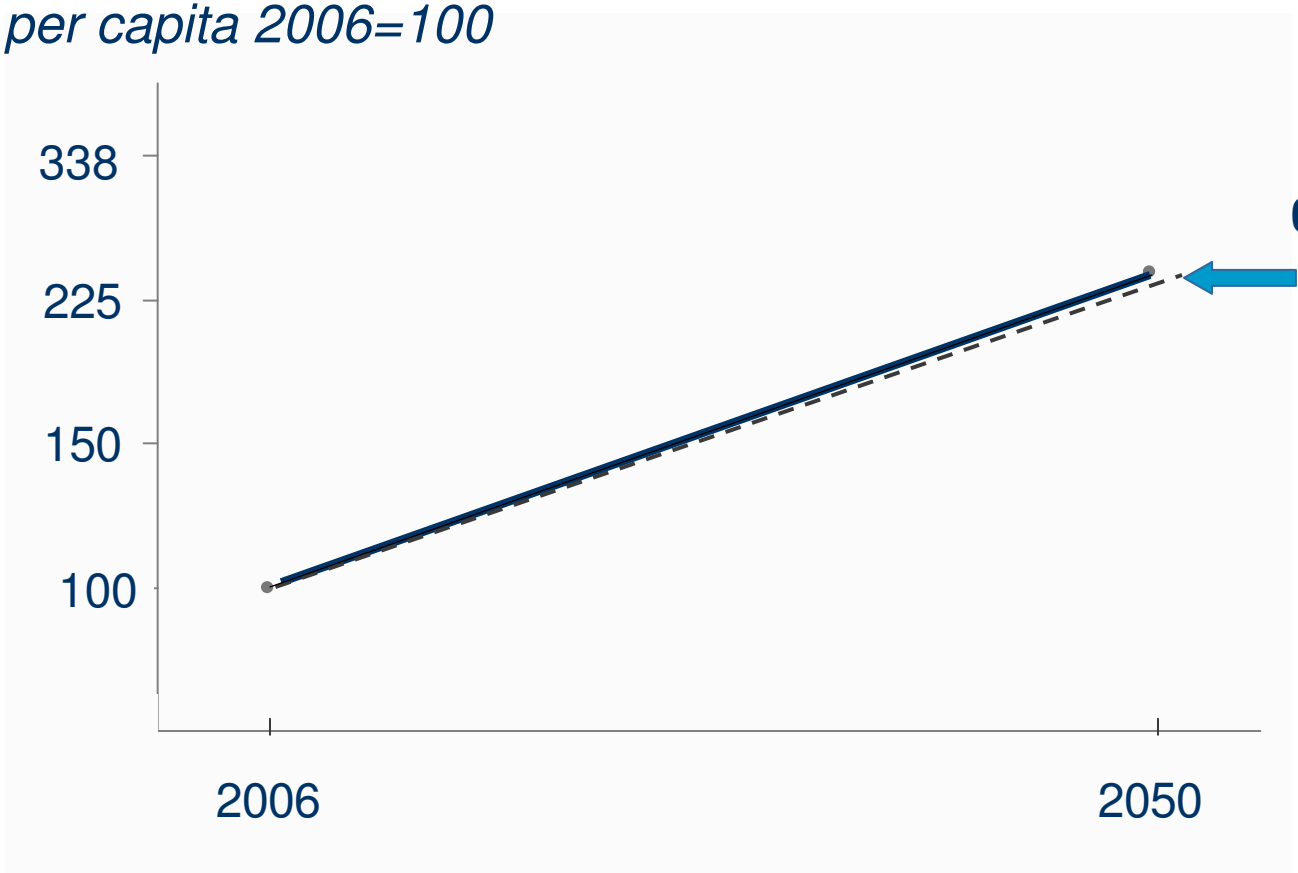
GDP per capita 2006=100



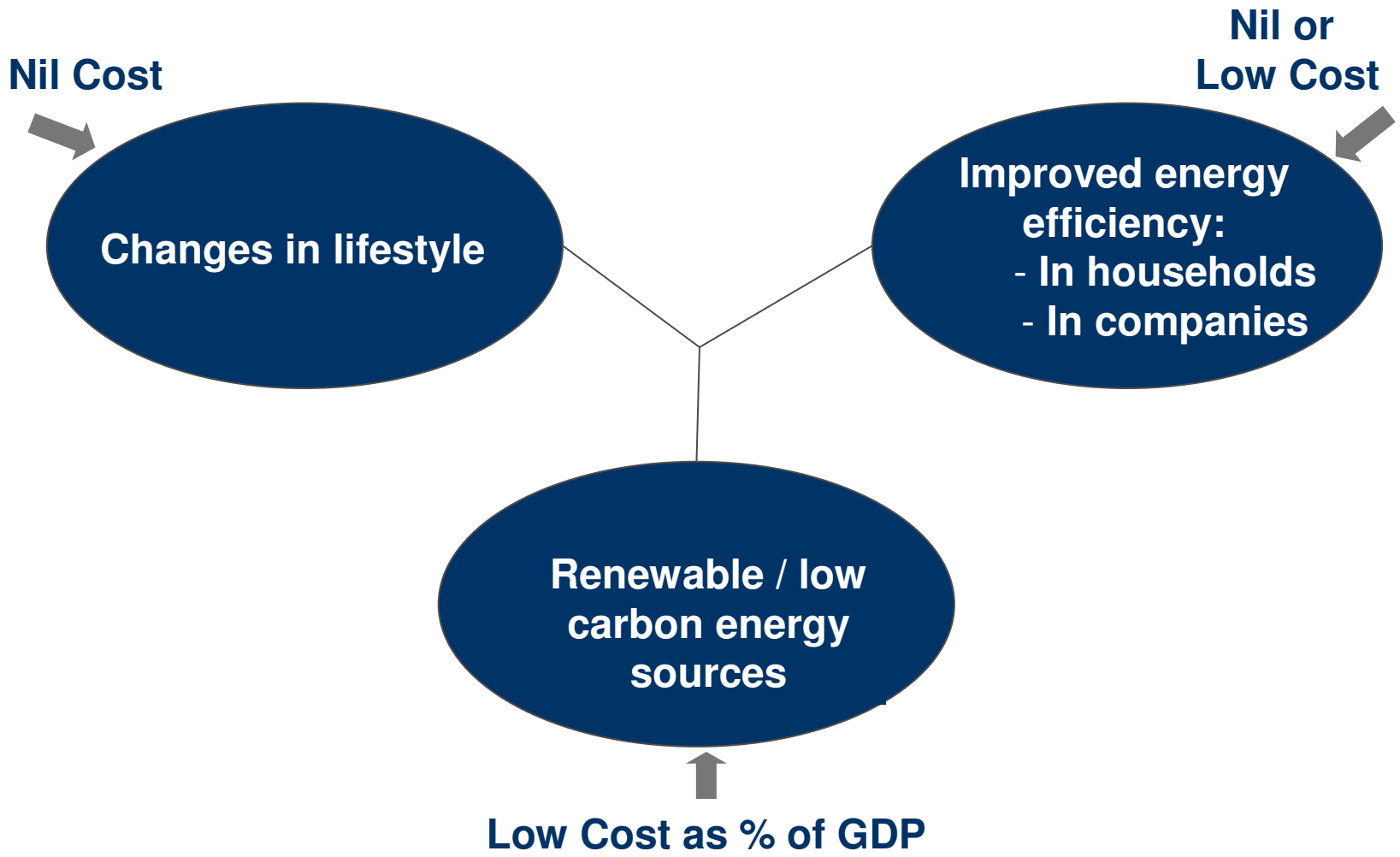
Source: HM Treasury Assumption of 2% per annum productivity growth, Long-term Public Finance Report, December 2005

Growth in UK living standards: with 60% emissions cut

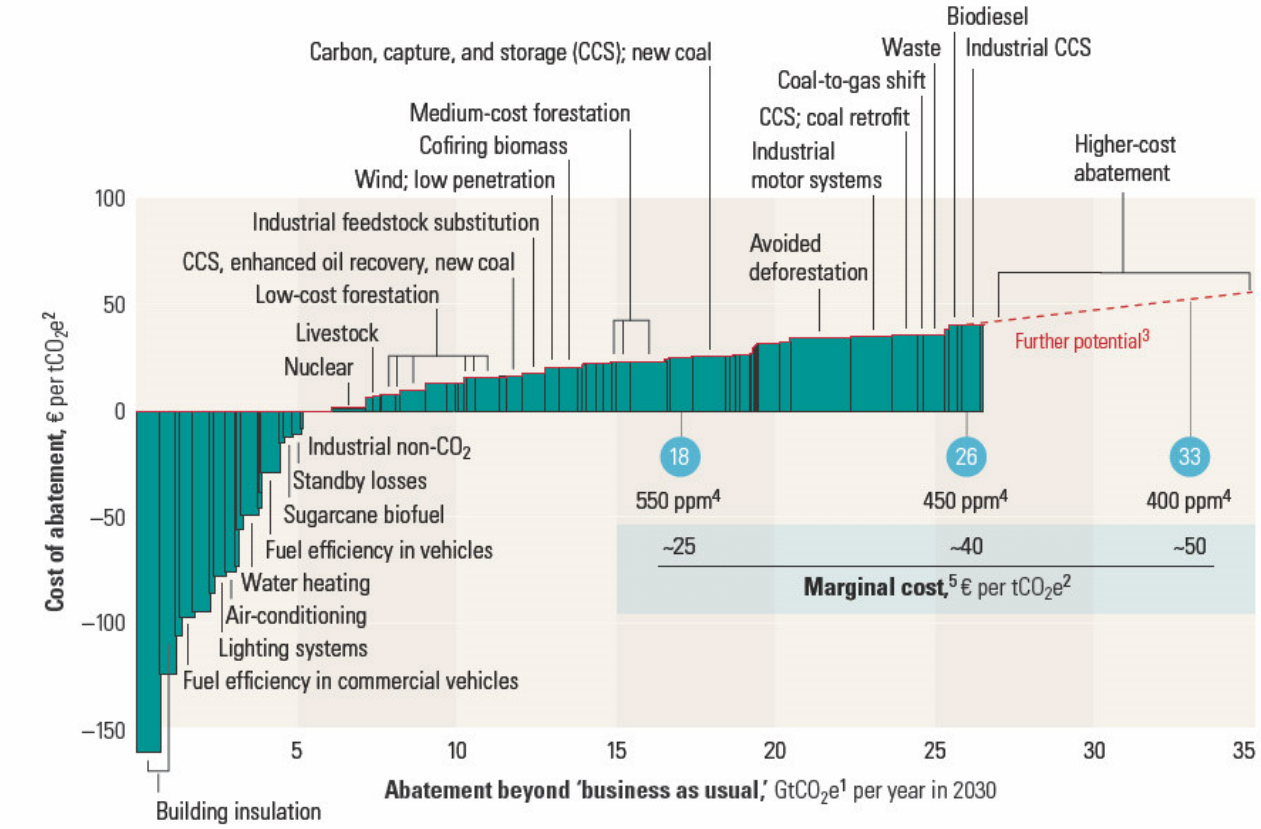
GDP per capita 2006=100



The economic cost of cutting emissions



Global cost curve for greenhouse gas abatement

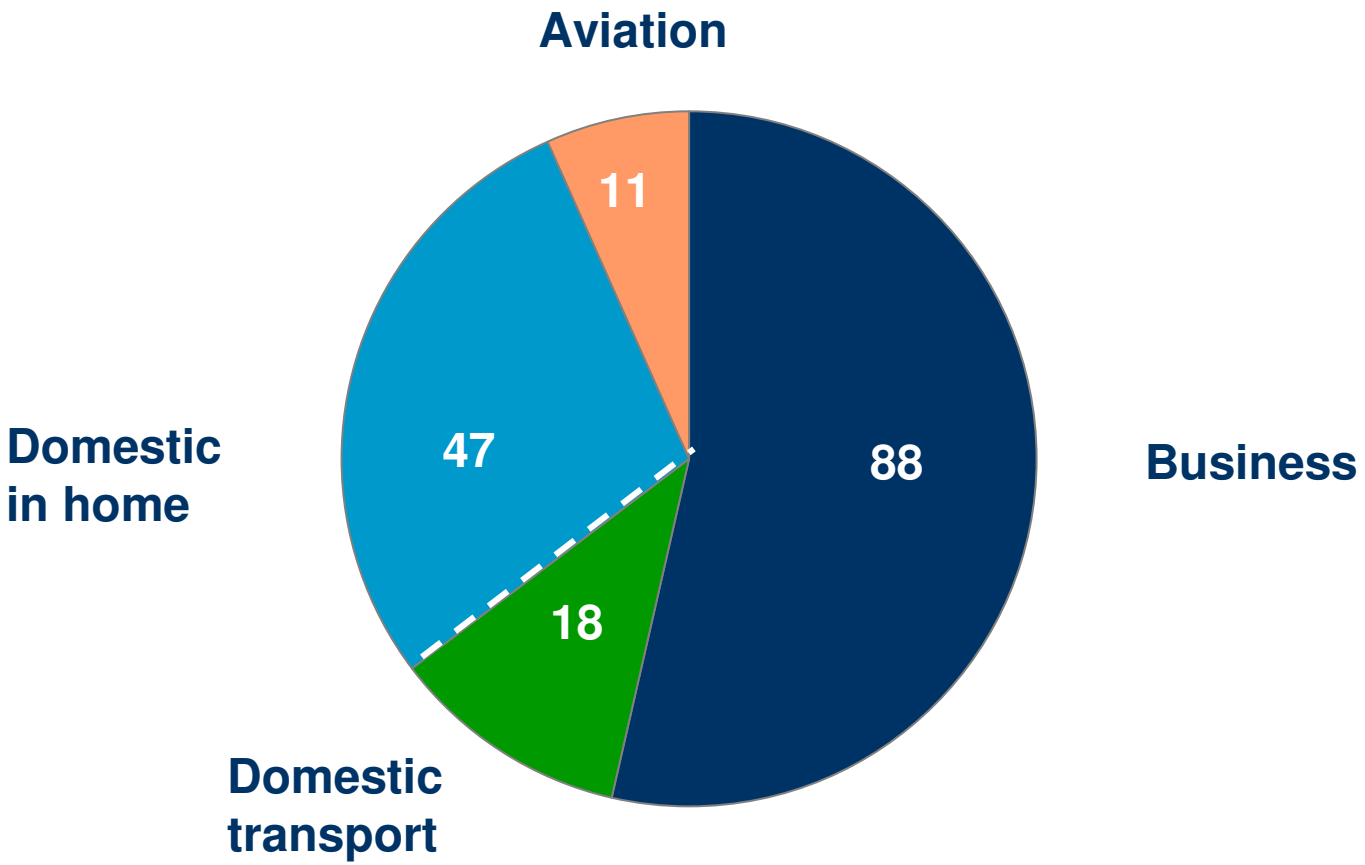


[1]$GtCO_2e$ = gigaton of carbon dioxide equivalent; "business as usual" based on emissions growth driven mainly, by increasing demand for energy and transport around the world, and by tropical deforestation.
[2]tCO_2e = ton of carbon dioxide equivalent.
[3]Measures costing more than €40 a ton were not the focus of this study.
[4]Atmospheric concentration of all greenhouse gases recalculated into CO_2 equivalents; ppm = parts per million.
[5]Marginal cost of avoiding emissions of 1 ton of CO_2 equivalents in each abatement demand scenario.

Source: A cost curve for greenhouse gas reductions, The Mckinsey Quarterly, January 2007

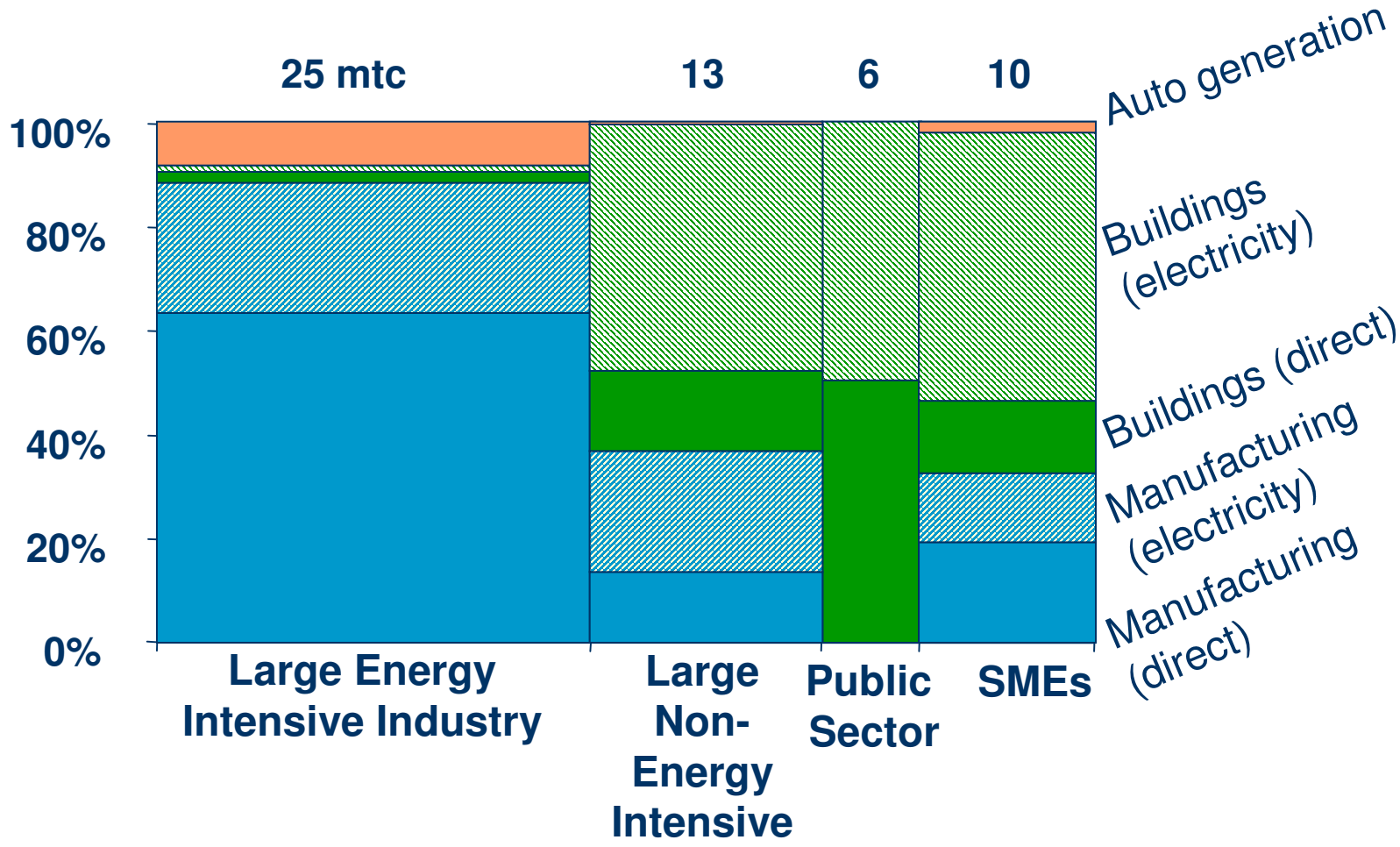
UK Carbon Emissions – 2002

Total = 165 mtc



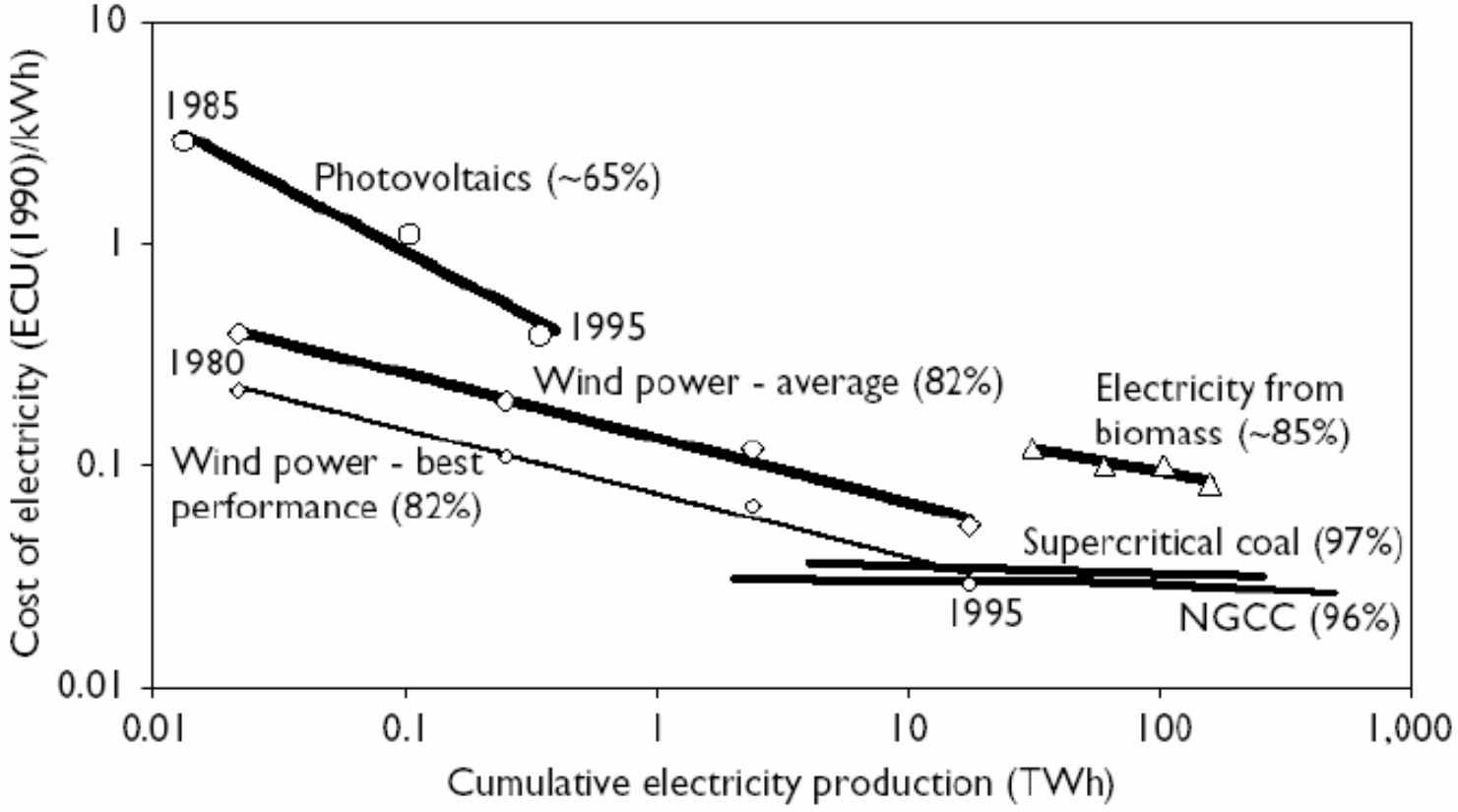
Source: "The carbon emissions in all that we consume", Carbon Trust, 2006

Business and public sector emissions
(excluding transport, distribution and supply industries)



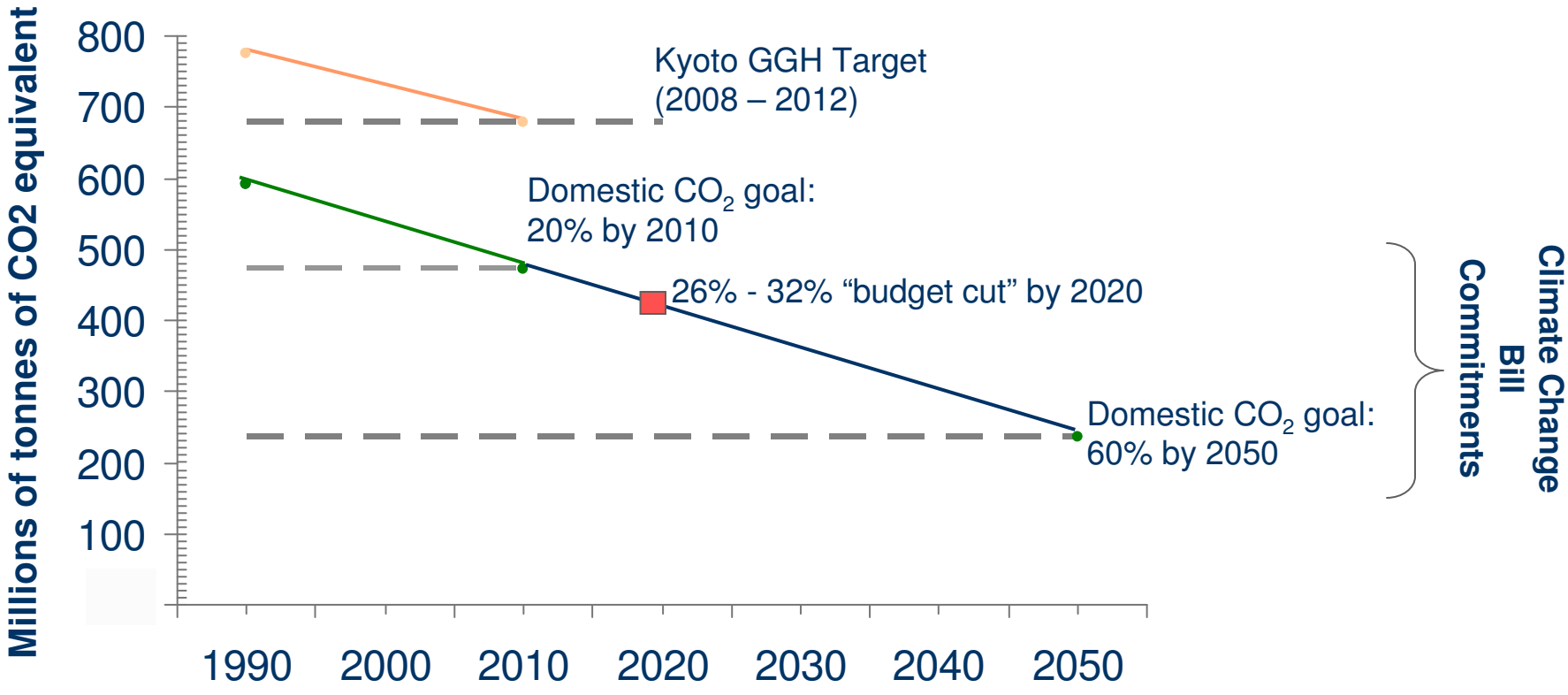
Source: "The UK Climate Change Programme: Carbon Trust, 2005

Cost evolution and learning rates for selected technologies



Source: IEA, 2000, Stern Review, Chapter 9

UK emissions targets



Instruments and objectives

Carbon Price

- Trading schemes
- Taxes

Regulation & Information

- E.g. building standards
- E.g. appliances
- E.g. automotive emissions

Technology Support & Subsidy

- Energy efficiency in energy intensive sectors
- Transport demand and energy efficiency
- Renewable energy development

- Energy efficiency across the economy

- Renewable energy development
- (Energy efficiency)

UK Climate change programme: past measures

Taxes

- Fuel duty escalator
- Climate change levy

Trading schemes

- EU – ETS phase I
- Carbon Reduction Commitment
- Renewables Obligation Certificates

Regulation & voluntary commitments

- Building regulations
- Supplier obligation: Energy Efficiency Commitment/Carbon Emissions Reduction Target
- European appliance labelling
- European automotive voluntary commitments

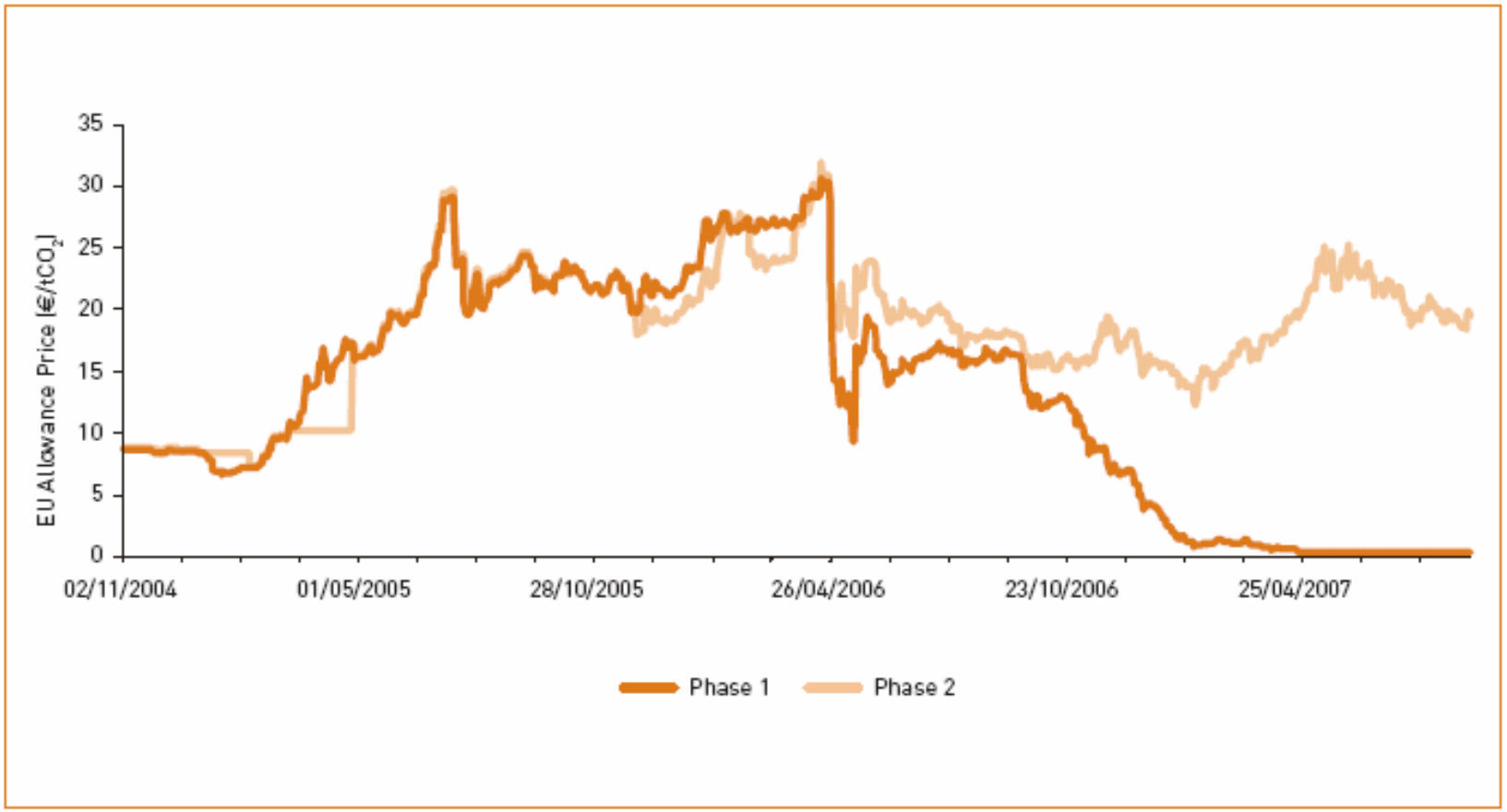
UK Climate change measures: planned impact by 2020

		Million tonnes of carbon abated	
Taxes & trading schemes	▪ EUETS with aviation included	13.9 – 14.1	**15.3 – 17.2**
	▪ Renewable transport fuel obligation	0.8 – 1.0	
	▪ Reformed (banded) ROCs	0.4 – 1.1	
	▪ Carbon Reduction Commitment	1.0	
Appliance & building regulation	▪ Energy performance in building directive	0.6 – 1.6	**4.5 – 9.9**
	▪ Zero carbon new homes	1.1 – 1.2	
	▪ Successor to EU voluntary automotive commitments	1.8 – 4.1	
	▪ More energy efficient products	1.0 – 3.0	
Information & support	▪ Better billing, smart metering, real time displays	0.1 – 0.7	**3.1 – 4.7**
	▪ Continuation of supplier obligation	3.0 – 4.0	
Technology support	▪ CCS demonstration projects	0.3 – 1.0	**0.3 – 1.0**
			23.4 – 33.0*

(*) Including also 0.2 other

Source: Energy White Paper, 2007

The price of CO_2 under the EU ETS



Source: Climate Change Capital

Policy commitments – the international context

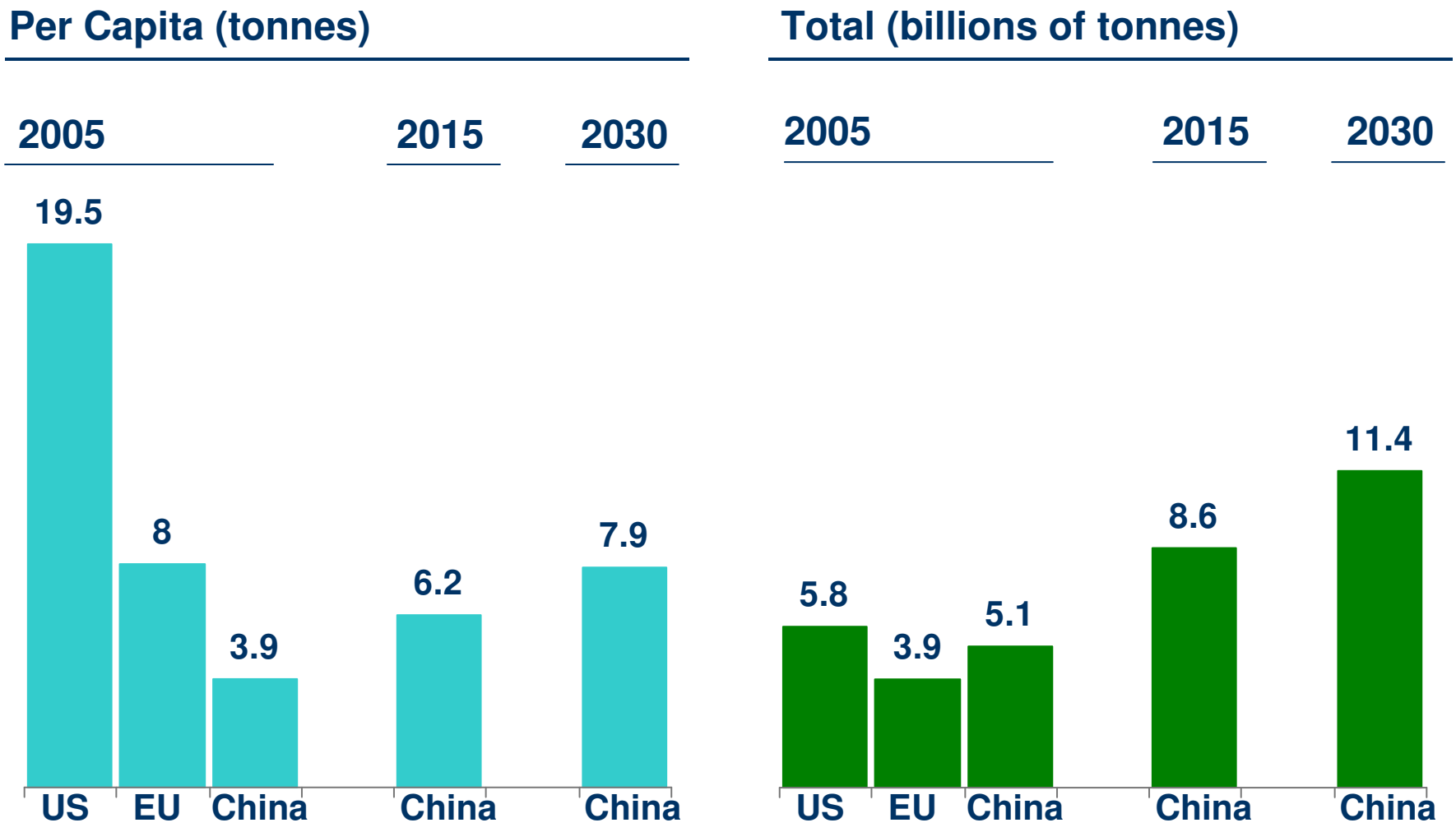
- EU Post-2010 policy:
  - 30% cut by 2020 if all developed countries agree
  - 20% unilateral cut
  - 20% renewable energy
- US:
  - Leading presidential candidates committed to cap and trade systems
  - “AB 32” Californian Global Solutions Act 2006
    - » 25% cut by 2020
    - » 80% aspiration by 2050 (executive order)
- Kyoto next steps: Bali agreement to negotiate follow on commitments

Reality check (1)

"The number and strength of policies under consideration continues to grow faster than the number and strength of policies actually adopted, reflecting a general pattern of growing concern, but more talk than action."

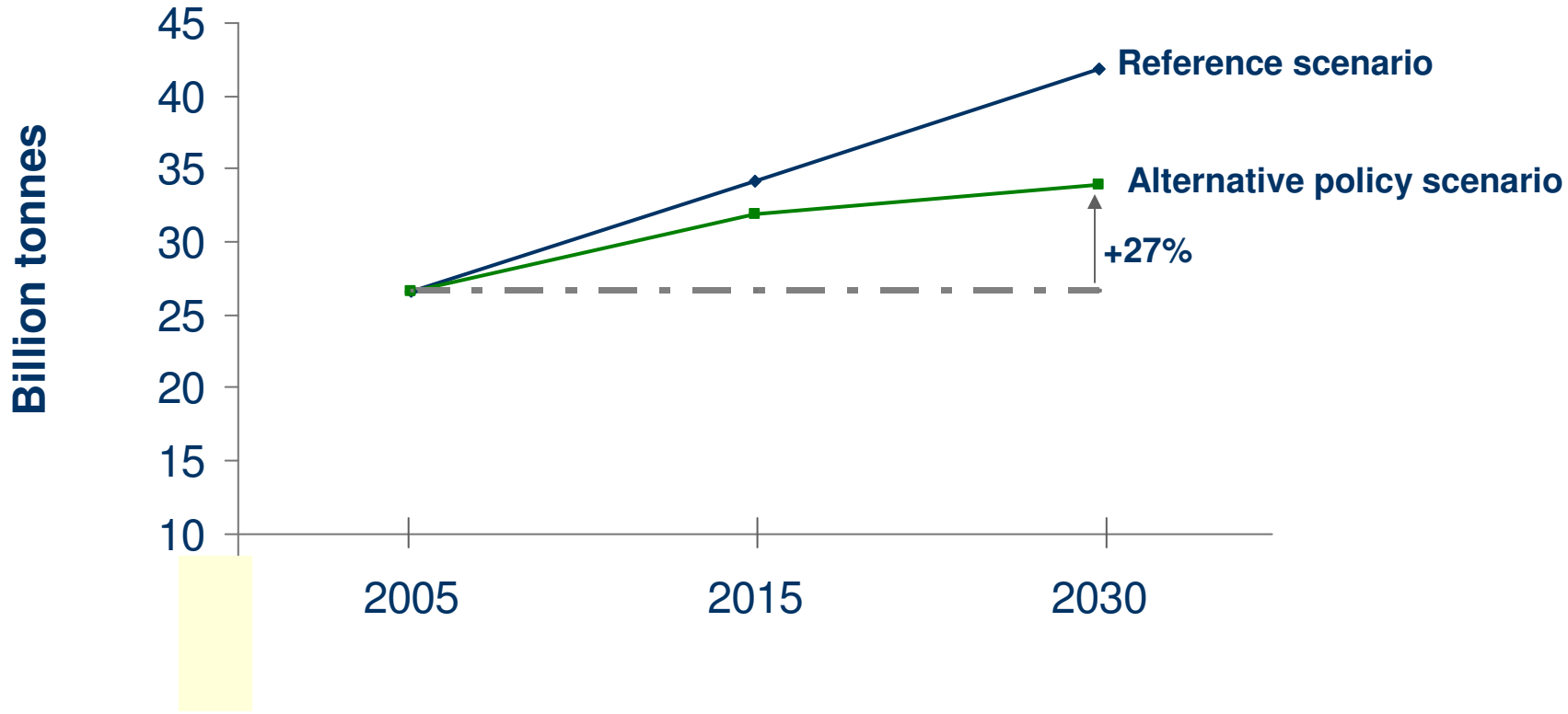
(International Energy Agency, World Energy Outlook, 2007)

Chinese energy-related CO_2 emissions: W.E.O. Reference scenario



Source: International Energy Agency, World Energy Outlook 2007, Reference Scenario

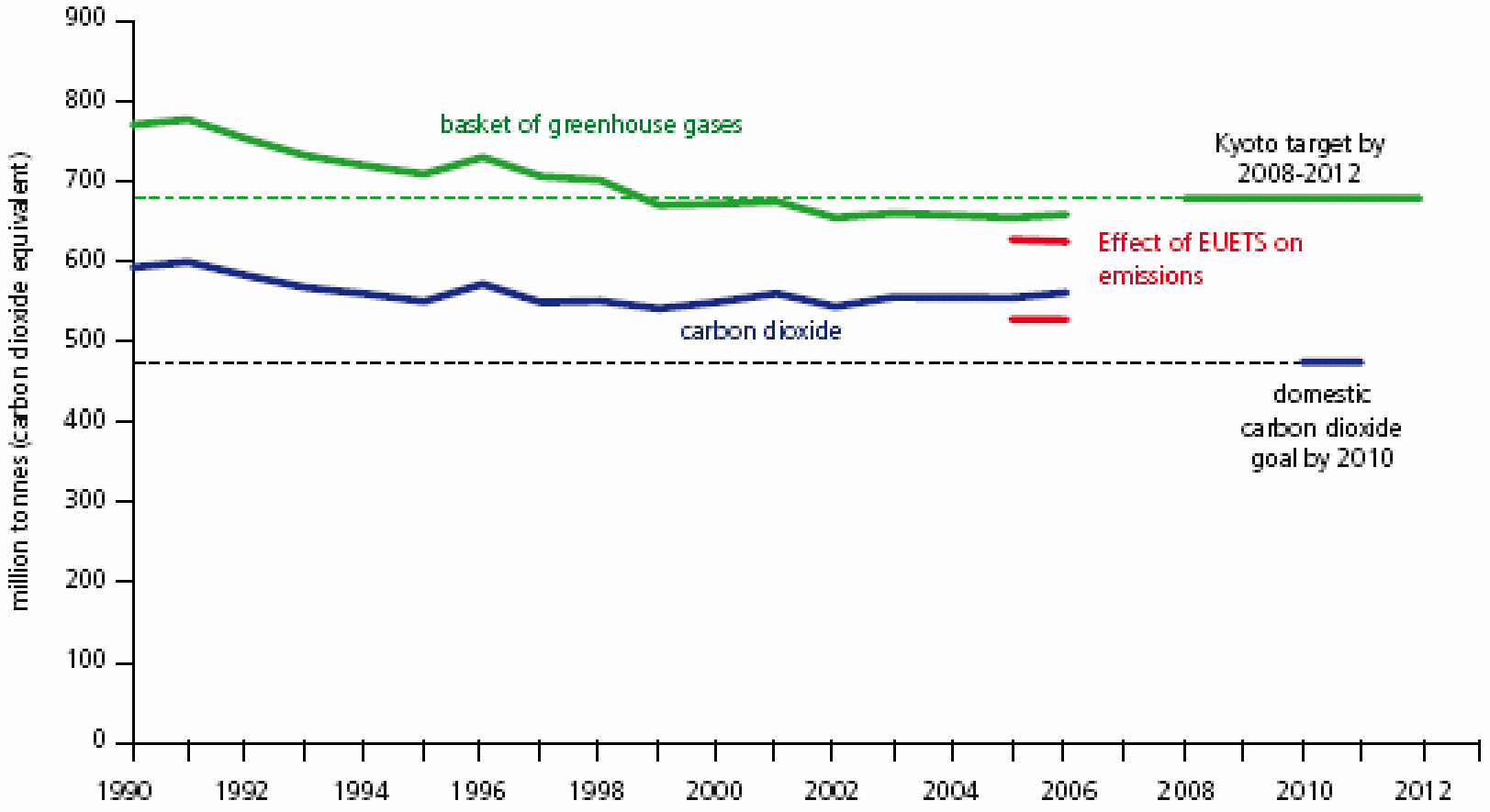
Energy-related CO_2 emissions by IEA scenario



Source: IEA, World Energy Outlook 2007, Chapter ???

Effects of EU ETS on UK greenhouse gas emissions

1990 – 2006



Reality check (2)

- **Much actual innovation is going in the wrong direction ....**
  - **Air-conditioning, plasma TVs, patio heaters**
  - **Indoor ski slopes, outdoor skating rinks**
  - **Cars of choice are getting larger and heavier (SUVs, not 60mpg, is the main vehicular development of the last 10 years)**
  - **Aviation is exploding globally**
- **Because many high-energy activities are very attractive to consumers.**
- **To choke them off will require very high prices or draconian regulation or both. Problems of political feasibility.**

Reality check (3)

- **At £280/tc Shadow Price of Carbon could drive low-carbon innovation**
- **At £70/tc Shadow Price of Carbon will permit e.g. UK aviation expansion**
- **DfT Consultation Paper chooses latter because Govt. assumes world is on an emissions trajectory to stabilise at 450-550 ppm**
- **Actually we are on an emissions trajectory of 650-750 ppm**
- **Using an SPC of £70/tc will ensure that we stay that way**

Conclusions

Potential & Progress

- Cutting emissions dramatically (e.g. 60-80%) by 2050 is possible at relatively small economic cost
- Multiple technologies available and required
- Low cost short-term potential is energy efficiency

… longer term renewable energy

- Increasing rhetorical commitment but
  - UK not on target
  - World not on target
- Failure to learn from and follow up on social innovations
- And we are running out of time (global emissions to peak and start falling well before 2020)

Policy levers

- High carbon price essential but not sufficient
- Trading schemes may need tax underpin (price floor)
- Regulation important
- Substantial technology support important for technology 'wedges' to be realised
- Europe and UK policy levers will have to get much stronger for 450 ppm stabilisation
- Will require much stronger political leadership