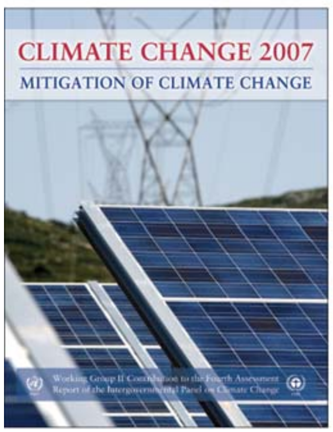
Implications of stabilisation of greenhouse gas concentrations

Findings from the IPCC

Fourth Assessment Report

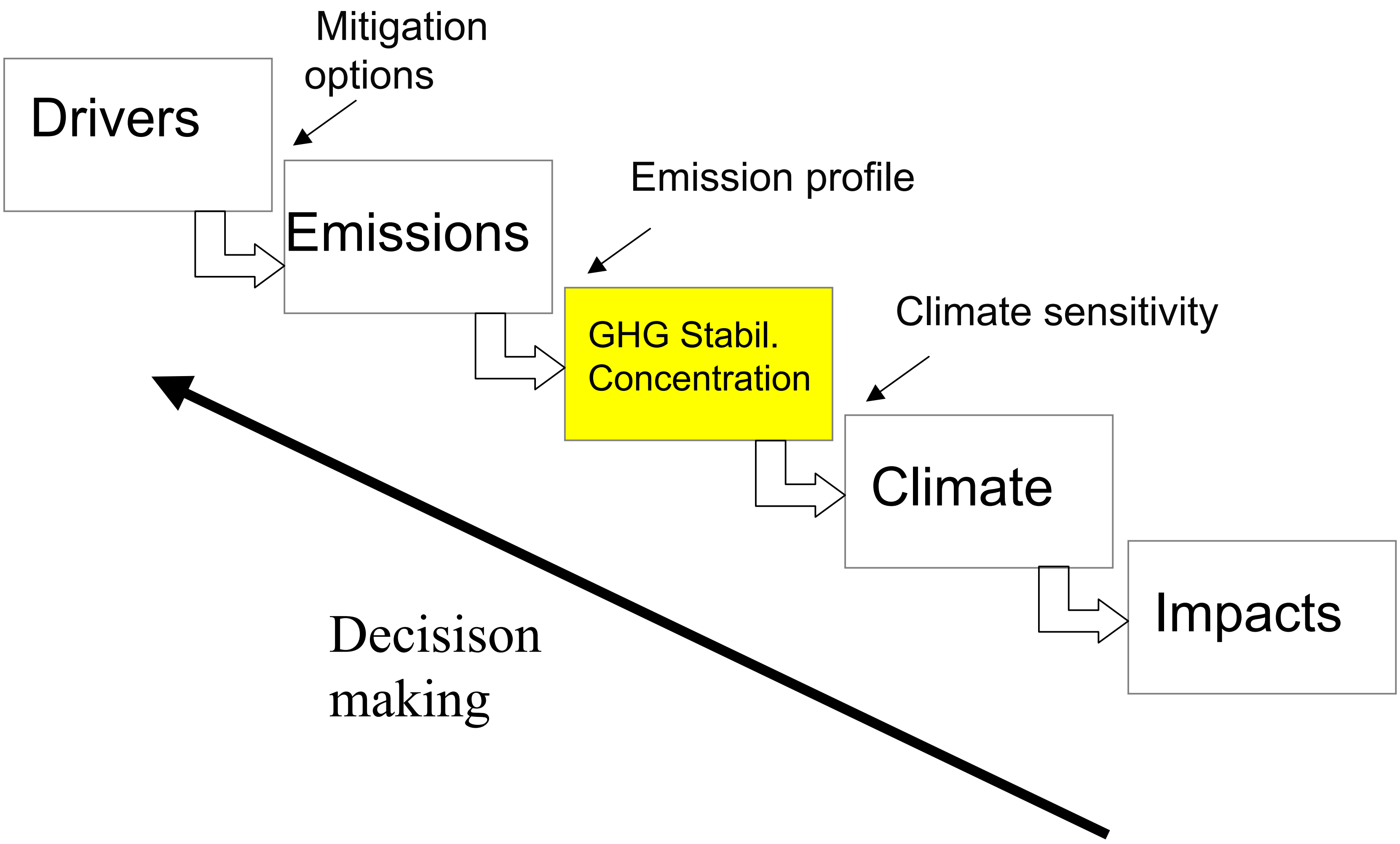


Bert Metz

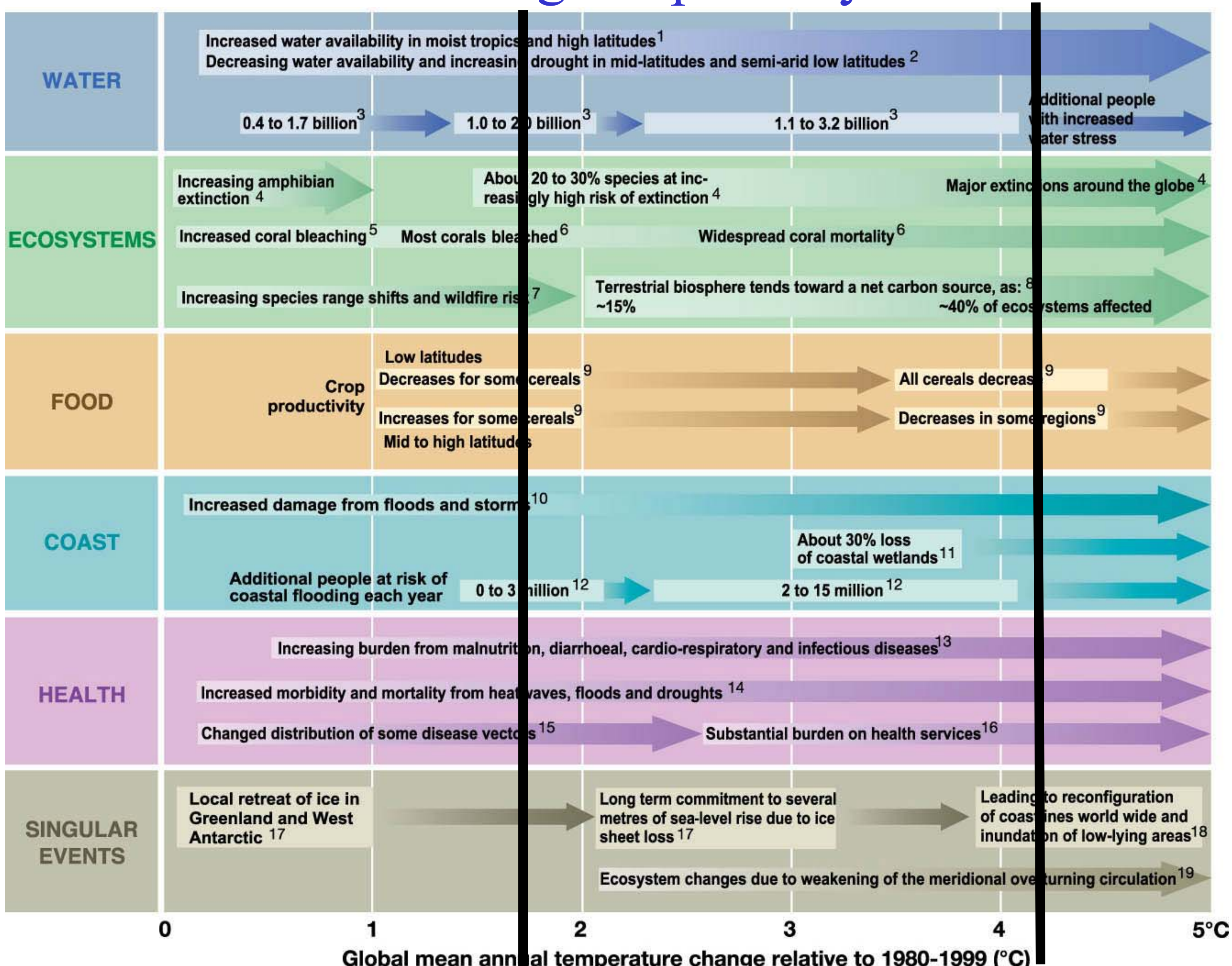
Co-chair IPCC WG III

SBSTA Workshop on IPCC AR4, June 6, 2008

Stabilisation and its implications



Climate change impacts by sector



2100 impacts for 50% reduction of global emissions by 2050

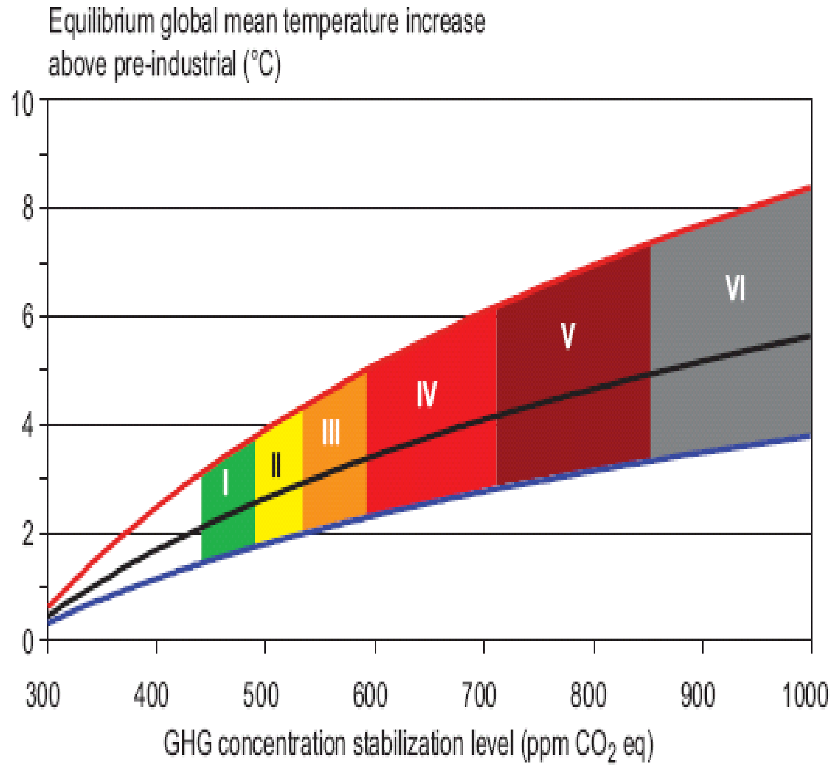
2100 impacts for unmitigated emissions

Source IPCC AR4 and Parry et al, Nature reviews, May 2008

IPCC

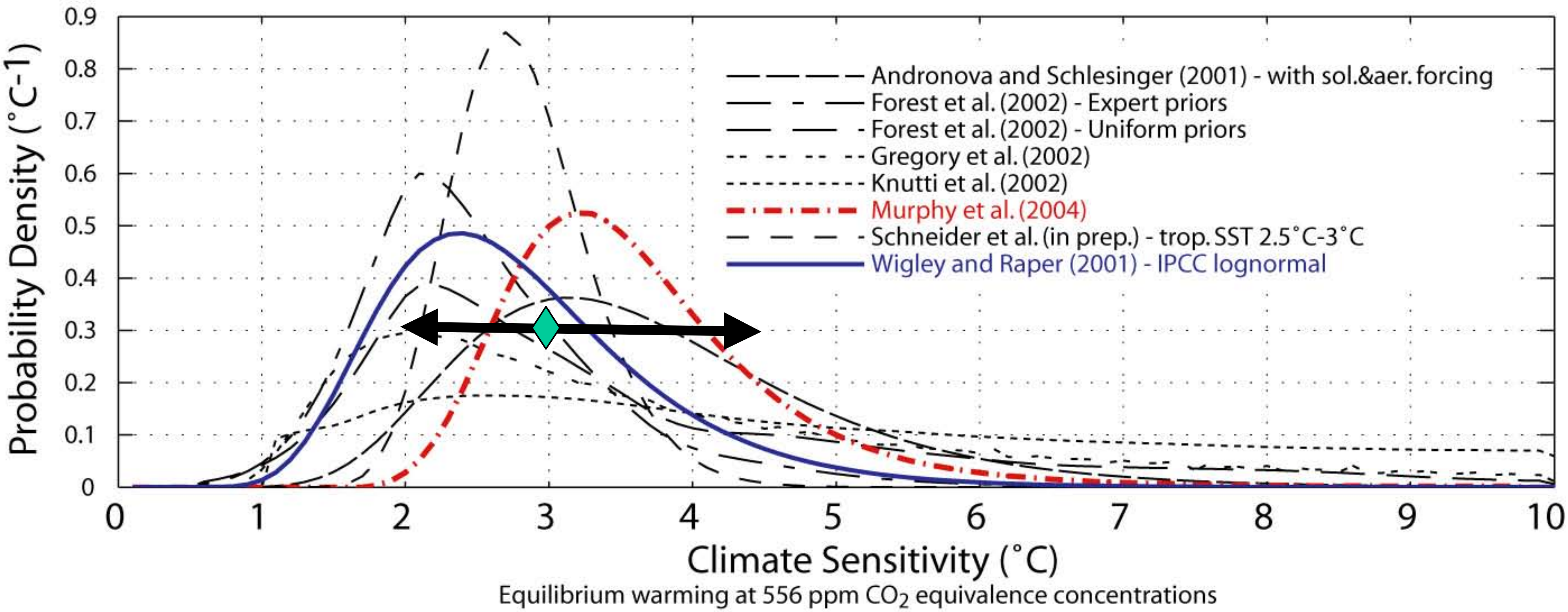
Global average temperature and greenhouse gas concentrations

Temperature range is caused by uncertainty about climate sensitivity

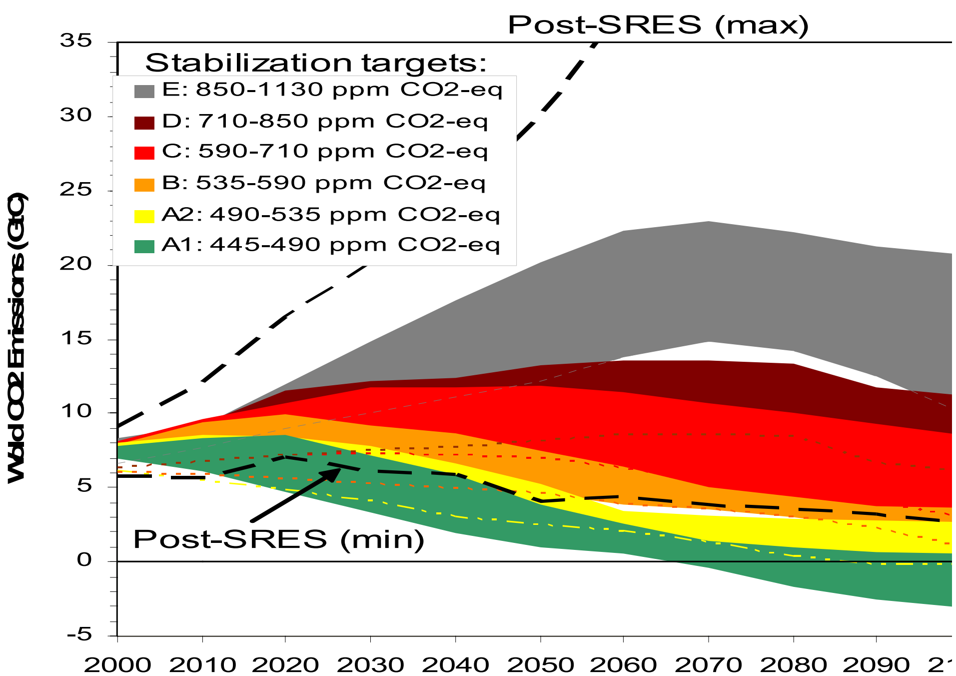


Climate sensitivity: 2-4.5 with likely value of 3 (from 2.5)

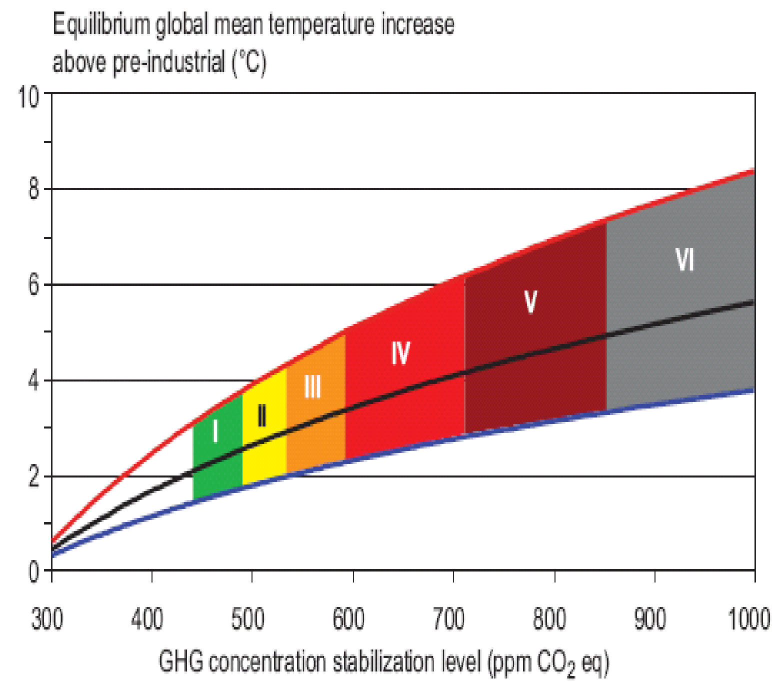
(Hare & Meinshausen, 2004)



The lower the stabilisation level the earlier global emissions have to go down



Multigas and CO2 only studies combined



Mitigation efforts over the next two to three decades will have a large impact on opportunities to achieve lower stabilization levels

Stababilization level (ppm CO_2-eq)	**Global Mean temperature increase at equilibrium (°C)**	**Year global CO_2 needs to peak**	**Year global CO_2 emissions back at 2000 level**	**Reduction in 2050 global CO_2 emissions compared to 2000**
445 – 490	2.0 – 2.4	2000 - 2015	2000- 2030	-85 to -50
490 – 535	2.4 – 2.8	2000 - 2020	2000- 2040	-60 to -30
535 – 590	2.8 – 3.2	2010 - 2030	2020- 2060	-30 to +5
590 – 710	3.2 – 4.0	2020 - 2060	2050- 2100	+10 to +60
710 – 855	4.0 – 4.9	2050 - 2080		+25 to +85
855 – 1130	4.9 – 6.1	2060 - 2090		+90 to +140

Time windows for peaking and returning to 2000 emissions levels

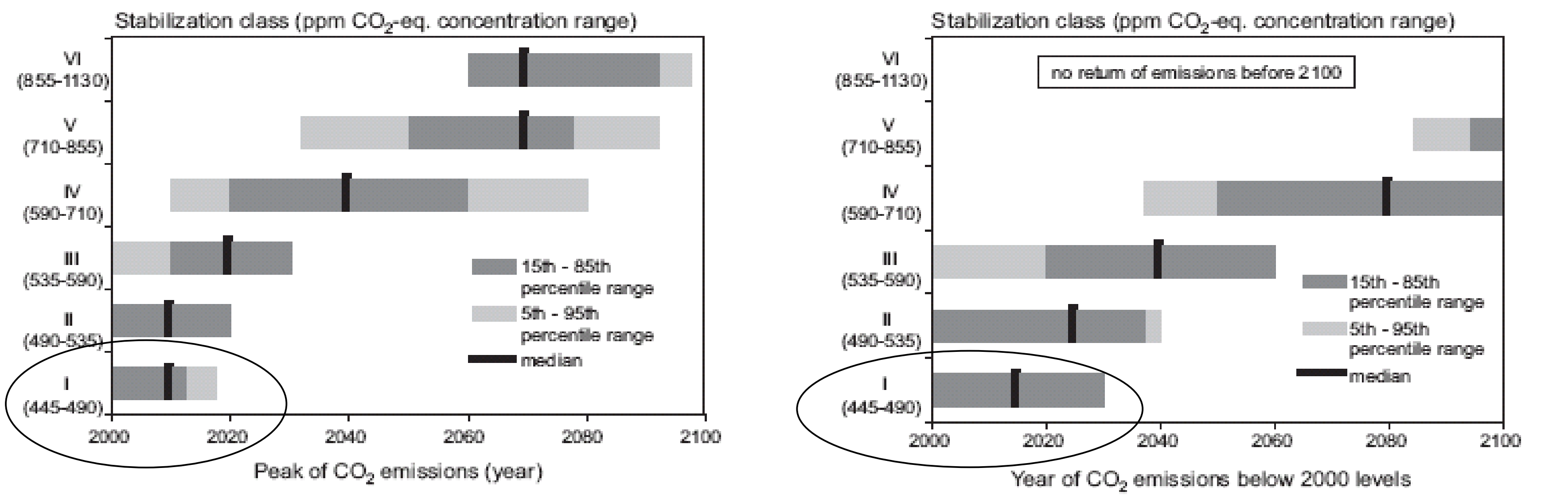
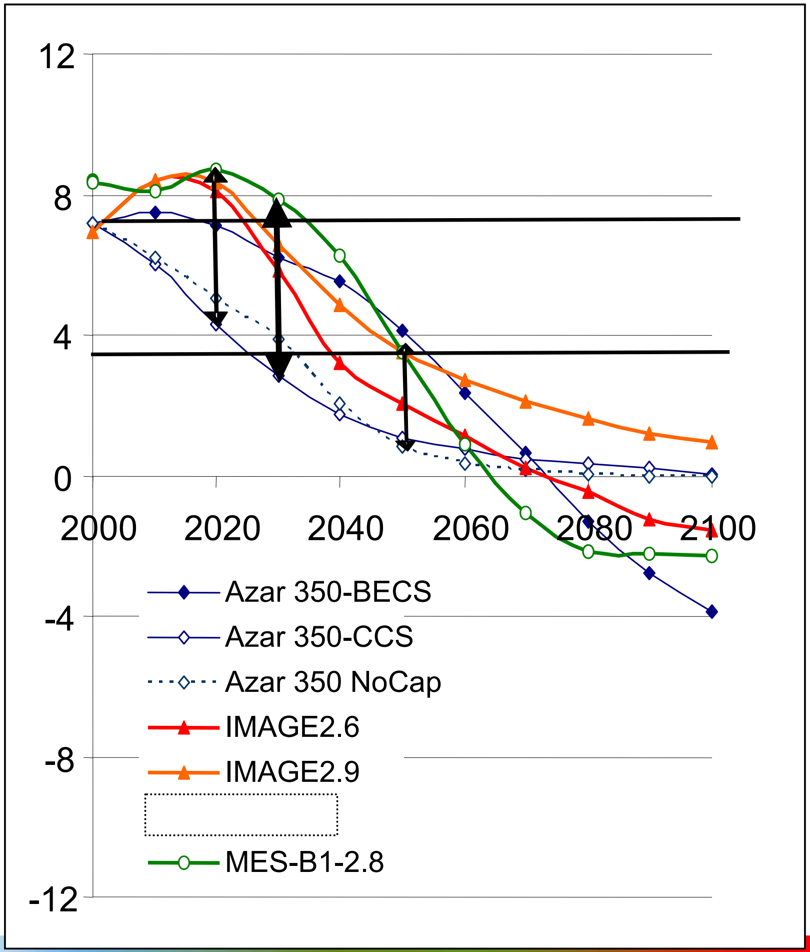


Figure 3.19: *Relationship between the stringency of the stabilization target (category I to VI) and 1) the time at which CO_2 emissions have to peak (left-hand panel), and 2) the year when emissions return to present (2000) levels.*

Data source: After Nakicenovic et al., 2006, and Hanaoka et al., 2006.

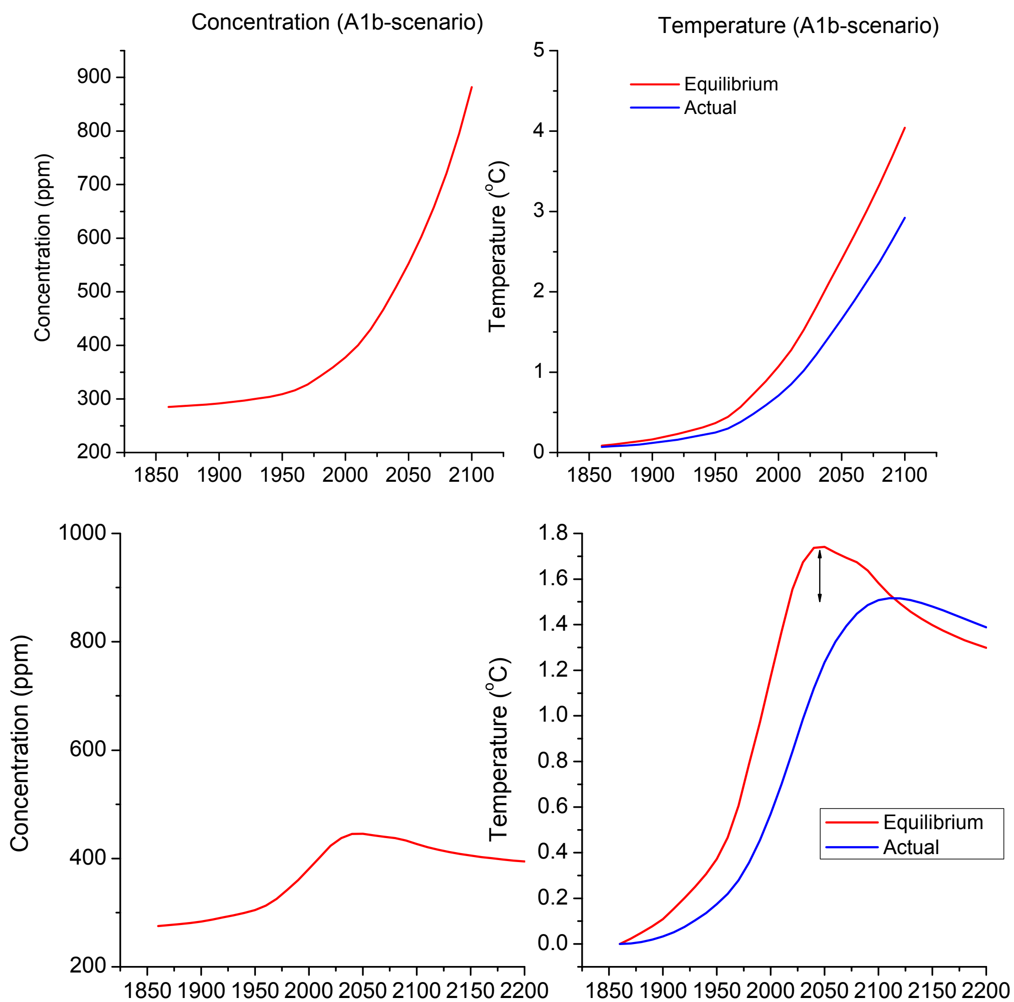
Category I stabilisation studies

Energy-related CO_2 (GtC)



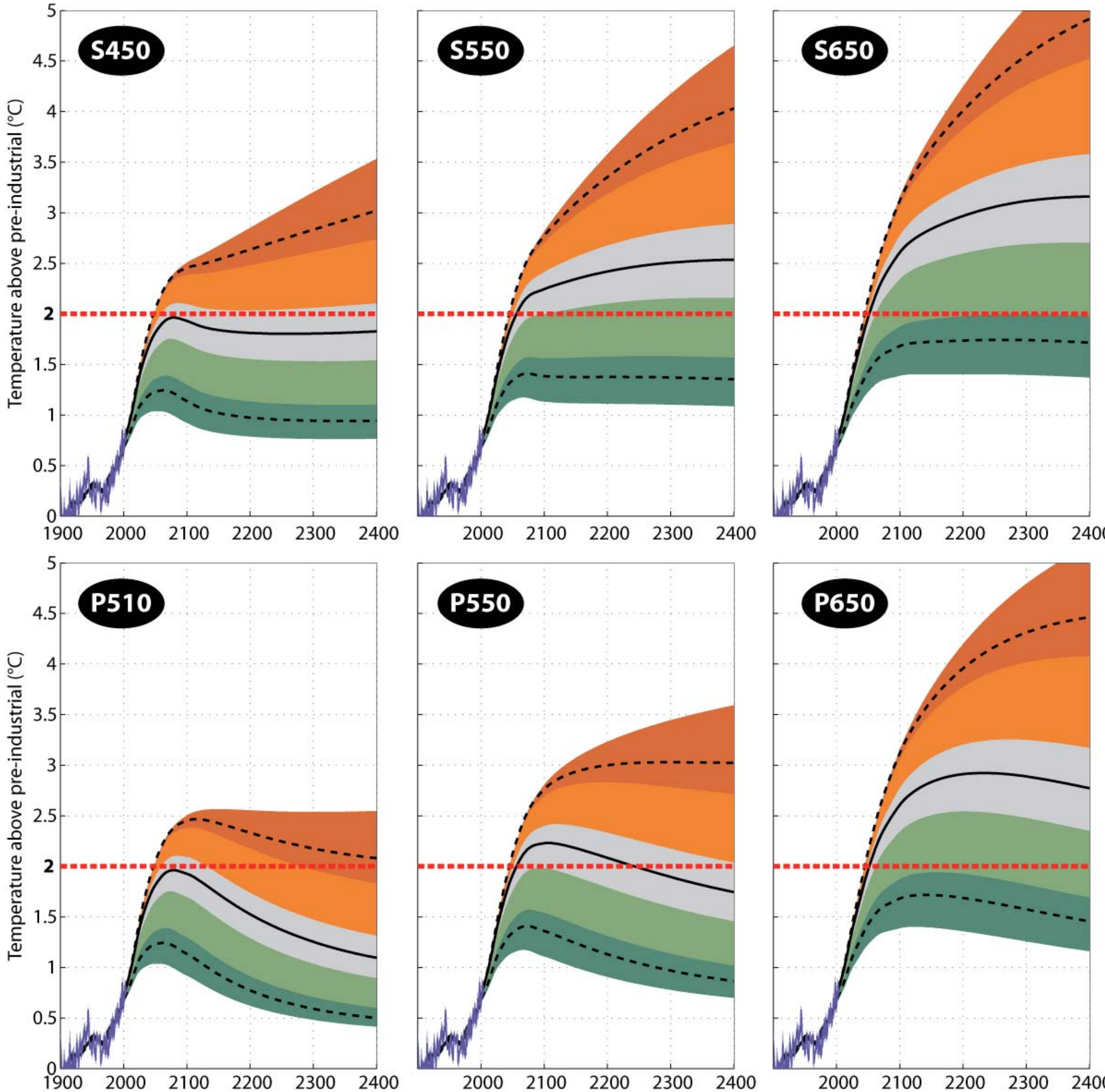
- ➢Global emissions:
  - ➢2020: not more than 20%% above 2000
  - ➢2030: not more than 2000 emissions
  - ➢2050: -50 to -80% compared to 2000

Current studies: low level stabilisation requires overshoot



Actual temperature always lags behind equilibrium temperature

Allows for using the lag time by returning quickly enough to lower concentration before equilibrium is reached.



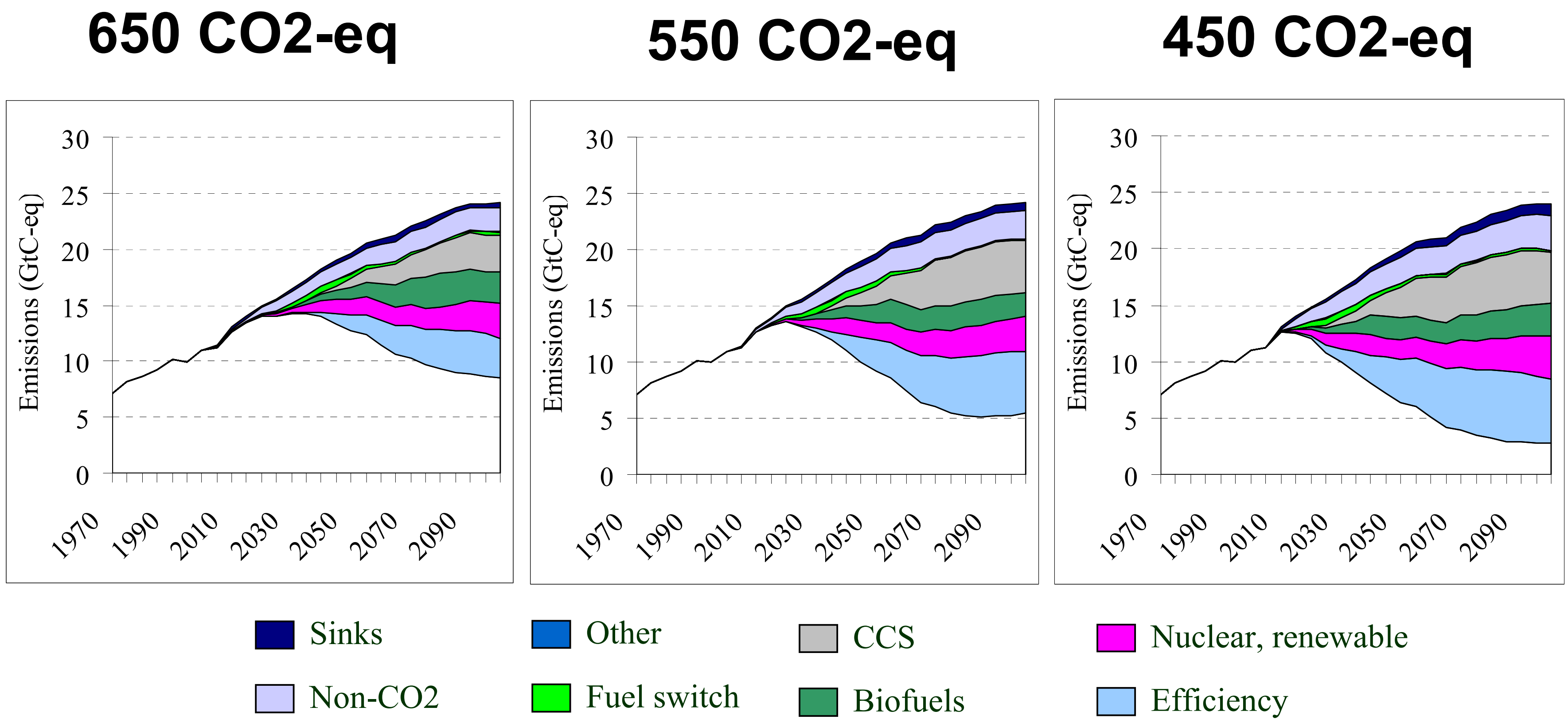
- 550 ppm is “unlikely” to meet the 2°C target
- 450 ppm: fifty: fifty chance to meet 2°C
- Peaking increases the likelihood

IPCC

den Elzen, Meinshausen and van Vuuren, 2006, Multi-gas emission envelopes, GEC

How to get to low emissions?

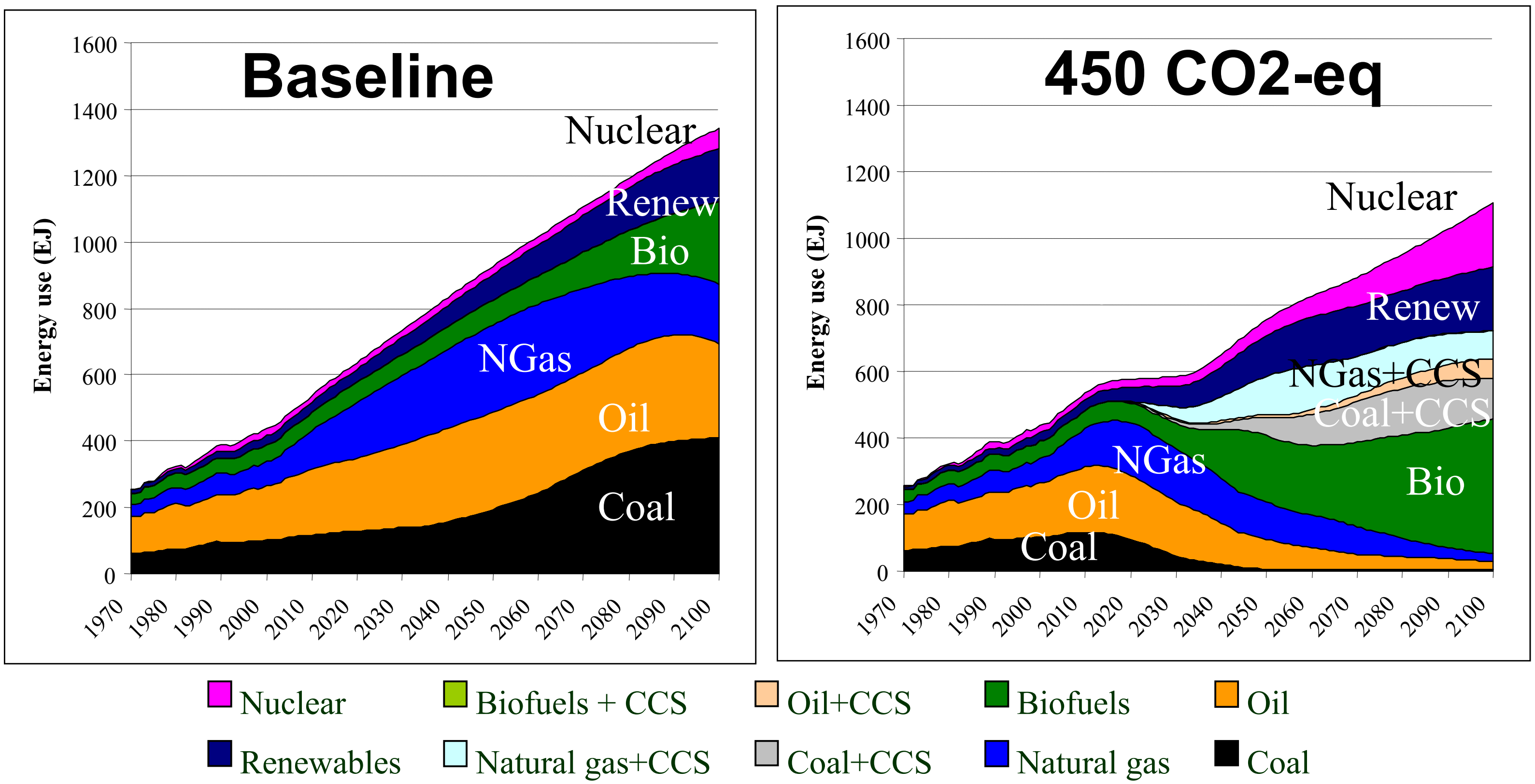
Indicative distribution of options



Van Vuuren et al. Stabilising GHG emissions.

How to get to low emissions?

Indicative energy system changes



Source: Van Vuuren et al. Stabilising GHG emissions.

Limitations of current low level stabilisation studies

- Only few studies (6)
- No early retirement of existing installations
- Limited set of baselines
- Uncertainty about rate at which emissions can be brought down
- Net negative emissions from BECS+ forestry uncertain

Thank you

Technological learning

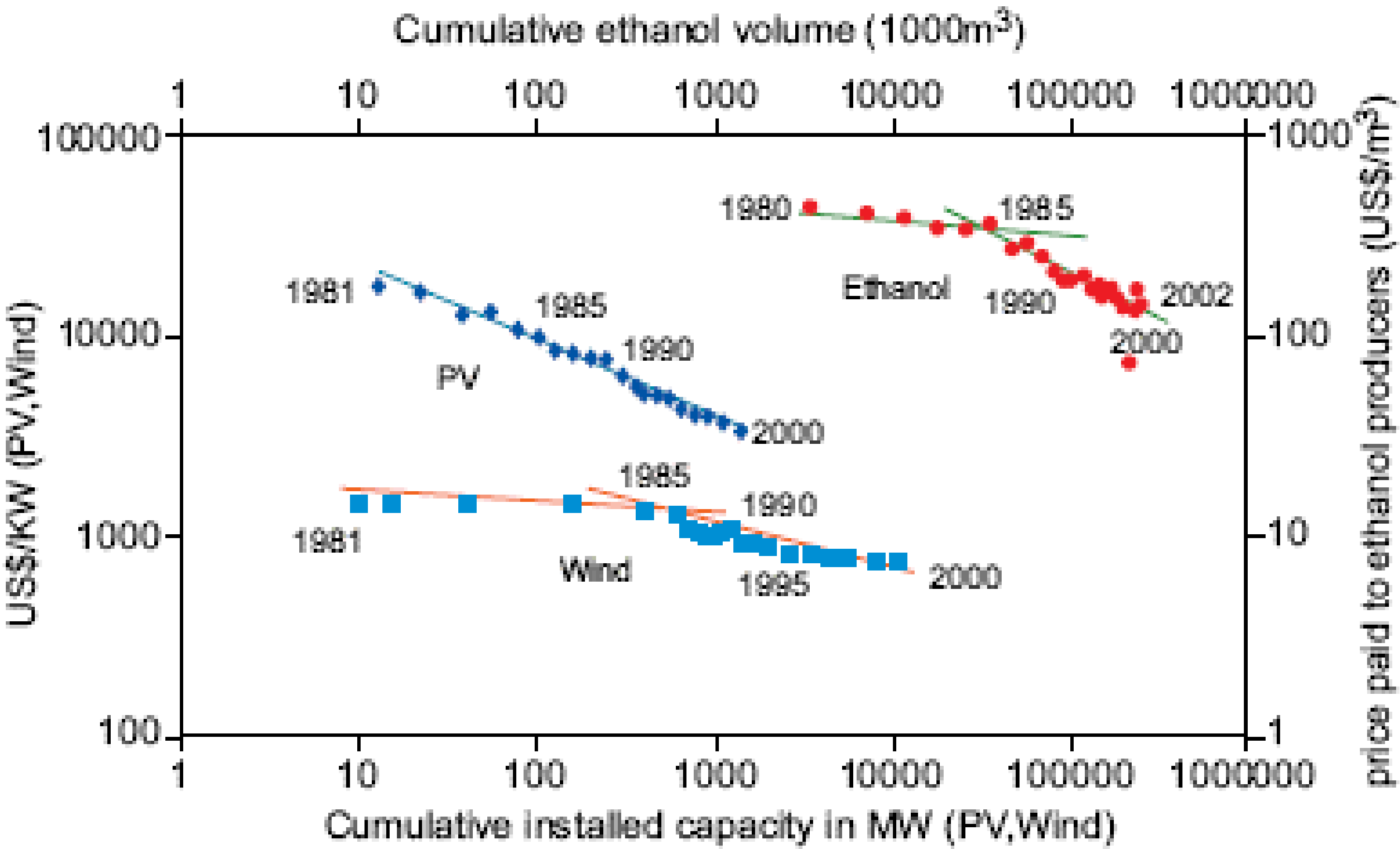
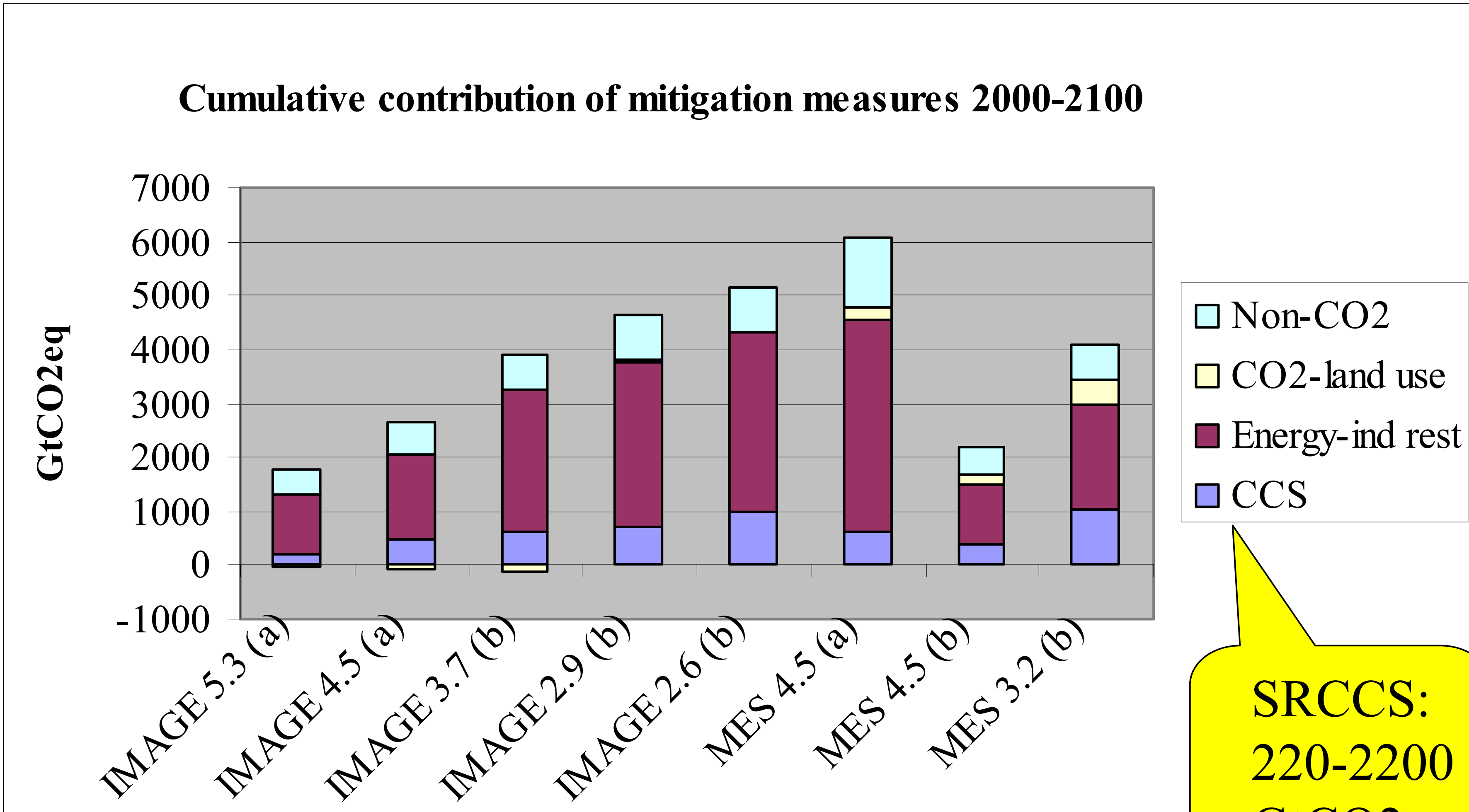


Figure 4.11: *Investment costs and penetration rates for PV, wind and bioethanol systems showing cost reductions of 20% due to technological development and learning experience for every doubling of capacity once the technology has matured.*

Source: Johansson et al., 2004.

The share of CCS



SRCCS:
220-2200
GtCO2

Table 3.5: *Classification of recent (post-TAR) stabilization scenarios according to different stabilization targets and alternative stabilization metrics. Groups of stabilization targets were defined using the relationship in Figure 3.16.*

Category	Additional radiative forcing	CO_2 concentration	CO_2-eq concentration	Peaking year for CO_2 emissions[a]	Change in global emissions in 2050 (% of 2000 emissions)[1]	No. of scenarios
	W/m^2	ppm	ppm	year	%	
I	2.5-3.0	350-400	445-490	2000-2015	-85 to -50	6
II	3.0-3.5	400-440	490-535	2000-2020	-60 to -30	18
III	3.5-4.0	440-485	535-590	2010-2030	-30 to +5	21
IV	4.0-5.0	485-570	590-710	2020-2060	+10 to +60	118
V	5.0-6.0	570-660	710-855	2050-2080	+25 to +85	9
VI	6.0-7.5	660-790	855-1130	2060-2090	+90 to +140	5
Total						177

Note: [a] Ranges correspond to the 15th to 85th percentile of the Post-TAR scenario distribution.
Note that the classification needs to be used with care. Each category includes a range of studies going from the upper to the lower boundary. The classification of studies was done on the basis of the reported targets (thus including modeling uncertainties). In addition, also the relationship, which was used to relate different stabilization metrics, is subject to uncertainty (see Figure 3.16).

Table 3.10: *Properties of emissions pathways for alternative ranges of CO_2 and CO_2-eq stabilization targets. Post-TAR stabilization scenarios in the scenario database (see also Sections 3.2 and 3.3); data source: after Nakicenovic et al., 2006 and Hanaoka et al., 2006)*

Class	Anthropogenic addition to radiative forcing at stabilization (W/m^2)	Multi-gas concentration level (ppmv CO_2-eq)	Stabilization level for CO_2 only, consistent with multi-gas level (ppmv CO_2)	Number of scenario studies	Global mean temperature C increase above pre-industrial at equilibrium, using best estimate of climate sensitivity[c)]	Likely range of global mean temperature C increase above pre-industrial at equilibrium[a)]	Peaking year for CO_2 emissions[b)]	Change in global emissions in 2050 (% of 2000 emissions)[b)]
I	2.5-3.0	445-490	350-400	6	2.0-2.4	1.4-3.6	2000-2015	-85 to -50
II	3.0-3.5	490-535	400-440	18	2.4-2.8	1.6-4.2	2000-2020	-60 to -30
III	3.5-4.0	535-590	440-485	21	2.8-3.2	1.9-4.9	2010-2030	-30 to +5
IV	4.0-5.0	590-710	485-570	118	3.2-4.0	2.2-6.1	2020-2060	+10 to +60
V	5.0-6.0	710-855	570-660	9	4.0-4.9	2.7-7.3	2050-2080	+25 to +85
VI	6.0-7.5	855-1130	660-790	5	4.9-6.1	3.2-8.5	2060-2090	+90 to +140

Notes:

a. Warming for each stabilization class is calculated based on the variation of climate sensitivity between 2°C –4.5°C, which corresponds to the likely range of climate sensitivity as defined by Meehl *et al.* (2007,Chapter 10).

b. Ranges correspond to the 70% percentile of the post-TAR scenario distribution.

c. 'Best estimate' refers to the most likely value of climate sensitivity, i.e. the mode (see Meehl *et al.* (2007,Chapter 10) and Table 3.9