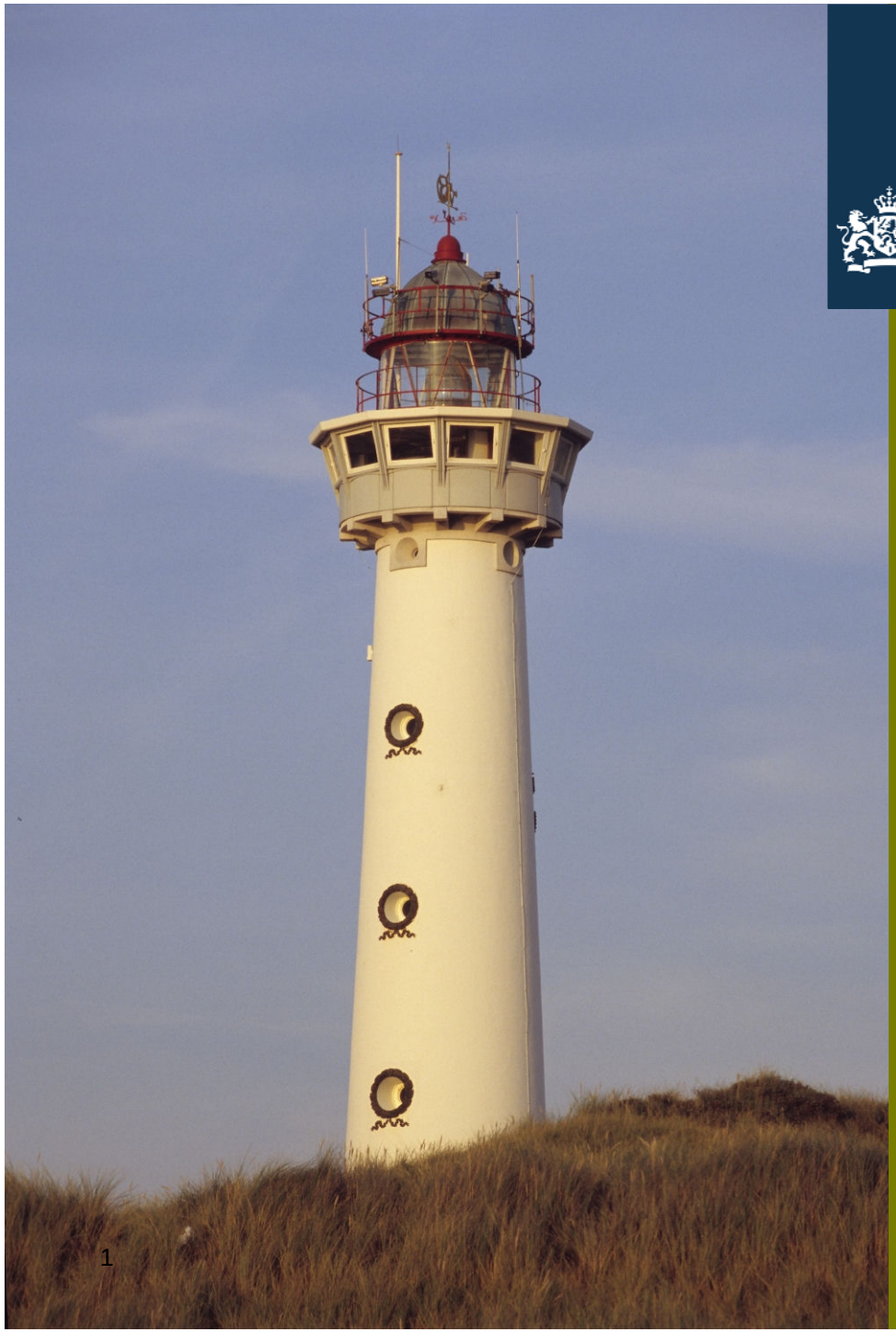

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AR5 scenario development and low concentration scenarios

Detlef van Vuuren

Reasons for new scenarios

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- Four important reasons to develop new community scenarios for climate assessment:
  - 1. Need to cover a wider range of GHG concentrations (SRES only included baseline scenarios)
  - 2. Need for a wider set of parameters (Climate models have become more complex; higher information need).
  - 3. Need for scenarios that cover mitigation & adaptation issues (need for more collaboration between "WGs")
  - 4. Use more recent insight into trends in scenario drivers (update)

However, scenario range has broadened and policy questions have changed scope (from baseline to mitigation)

Warming commitment = 1.3°C

Temperature increase range 1.8-7.1°C.

al (2010) The next generation of scenarios for climate change r
Nature 463:747-756.

New process

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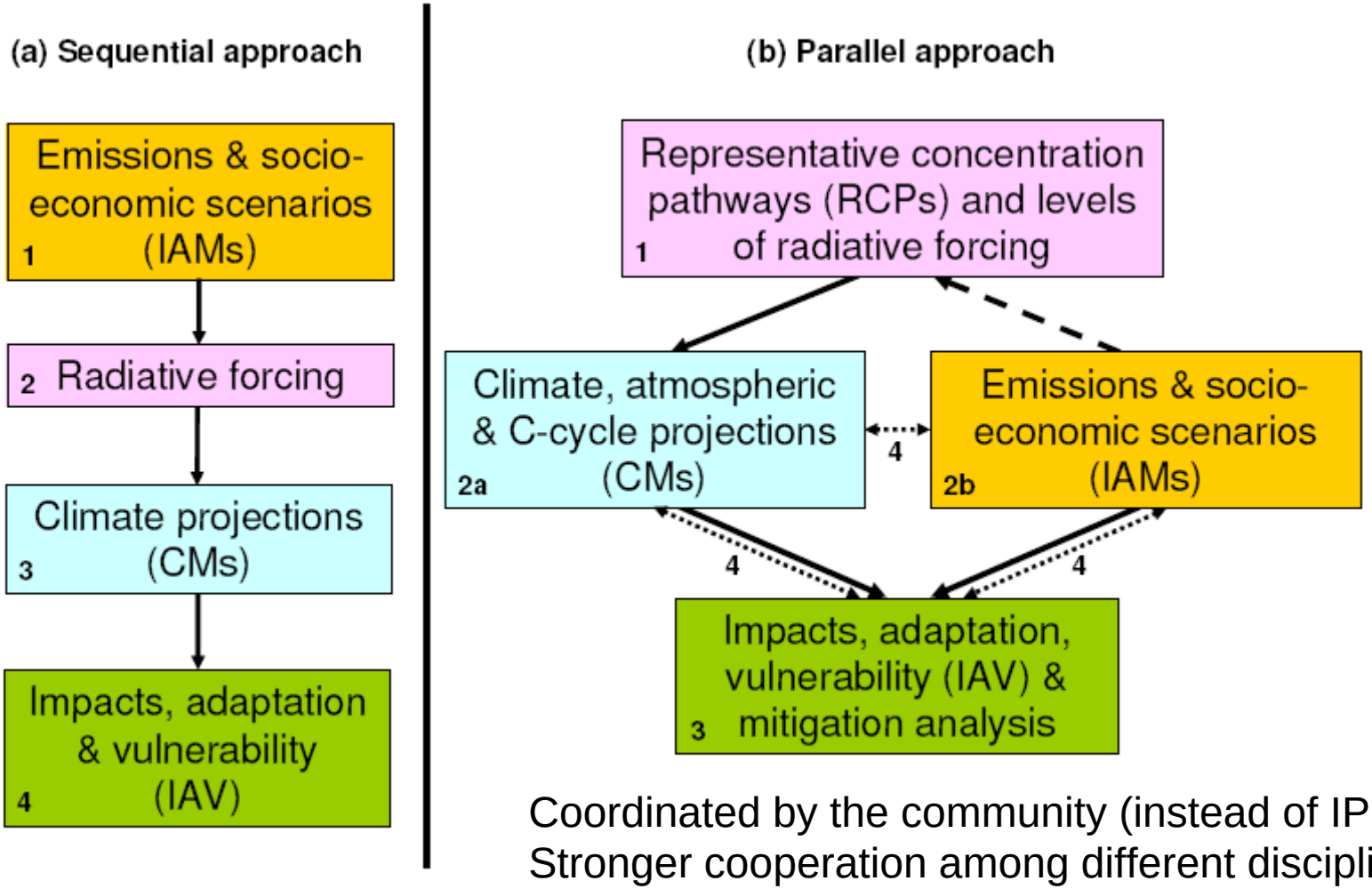

Coordinated by the community (instead of IPCC)
Stronger cooperation among different disciplines
Baseline and mitigation

Moss RH, et al (2010) The next generation of scenarios for climate change research and assessment. Nature 463:747-756.

Emission, land and concentration available

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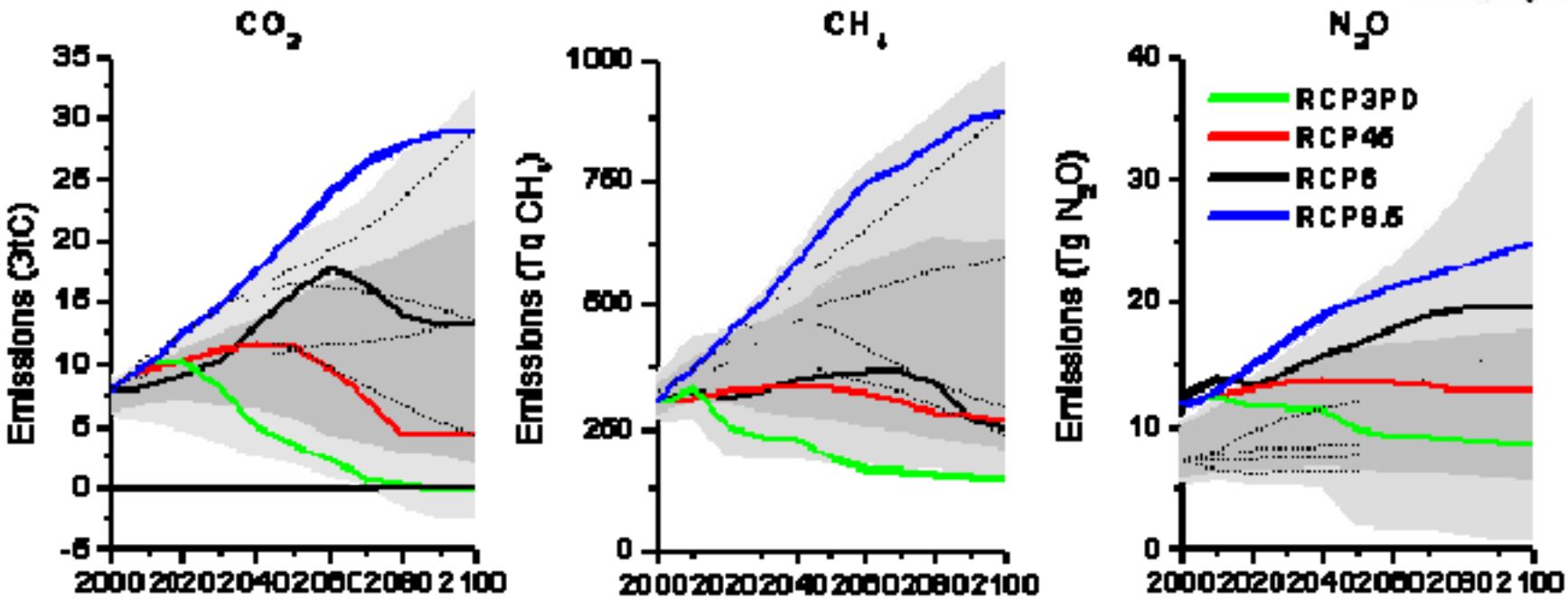

Table 1.1: Overview of Representative Concentration Pathways (RCPs)

	Description[1]	Publication – IA Model
RCP8.5	Rising radiative forcing pathway leading to 8.5 W/m^2 in 2100.	Riahi et al. (2007) – MESSAGE
RCP6	Stabilization without overshoot pathway to 6 W/m^2 at stabilization after 2100	Fujino et al. (2006) and Hijioka et al. (2008) – AIM
RCP4.5	Stabilization without overshoot pathway to 4.5 W/m^2 at stabilization after 2100	Clarke et al. (2007) – MiniCAM
RCP3-PD[2]	Peak in radiative forcing at ~ 3 W/m^2 before 2100 and decline	van Vuuren et al. (2006, 2007) – IMAGE

All selected from existing literature (but slightly updated)

Span a wide range of different possible futures and trajectory shapes.

Van Vuuren, D.P. et al 2011. Representative Concentration Pathways: An overview. Climatic Change.

Progress from here

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- Climate model runs now becoming available… What now?

  Mitigation modellers: Look into RCPs under different policy assumptions

  Check for consistency and inconsistency between IAMs ←→ESM (improve models and insights)

  Compare complex climate model (especially land use)

  Use results in Impact research

Zoom in on lowest scenarios

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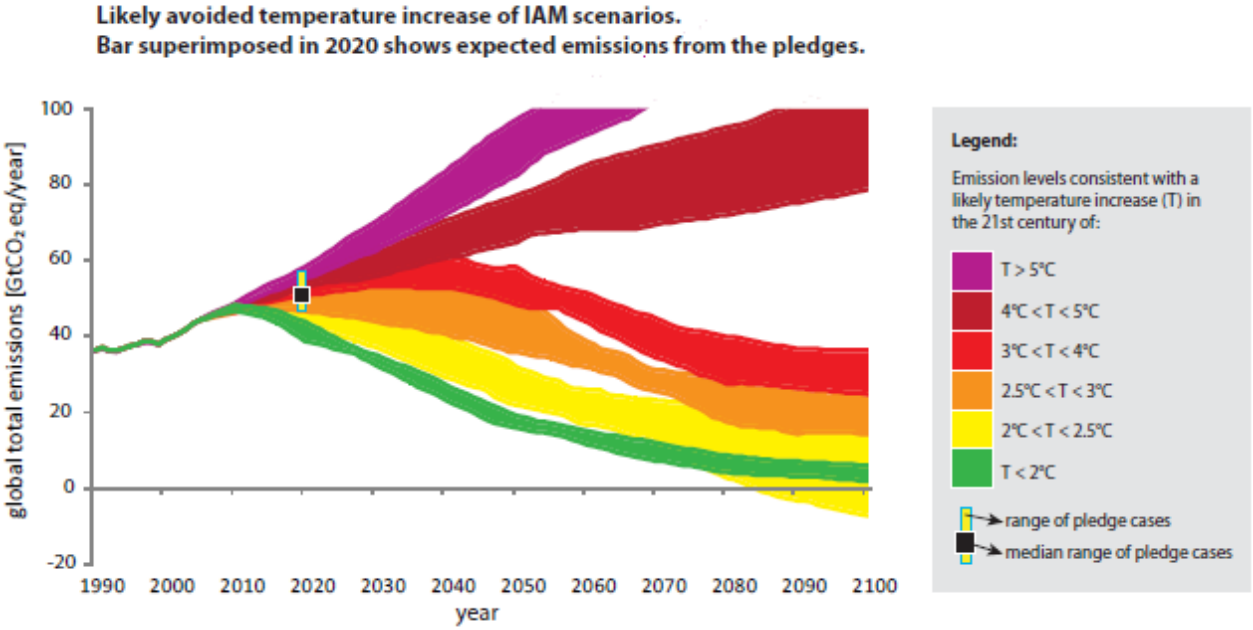


UN chief challenges world to agree tougher target for climate change

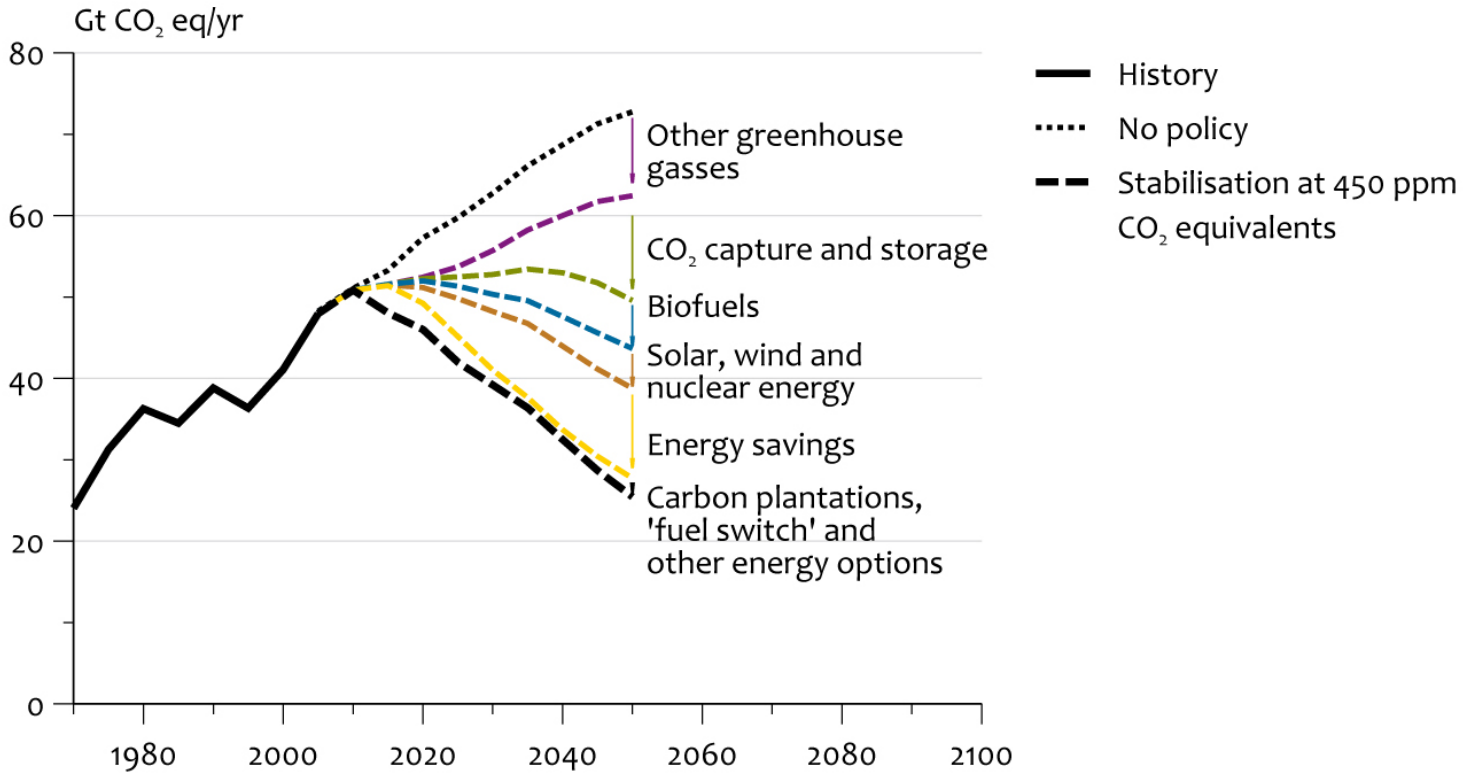
Global warming should be limited to 1.5C, not 2C, declares Christiana Figueres

Gaurdian, 1 June, 2011

- 2ºC scenarios. Some where around 44-46 $GtCO_2$-eq in 2020
- Copenhagen pledges 49-53 $GtCO_2$-eq (conditional, unconditional etc).
- Hardly any credible 1.5ºC scenarios in literature

UNEP (2010). The emission gap report. Nairobi.

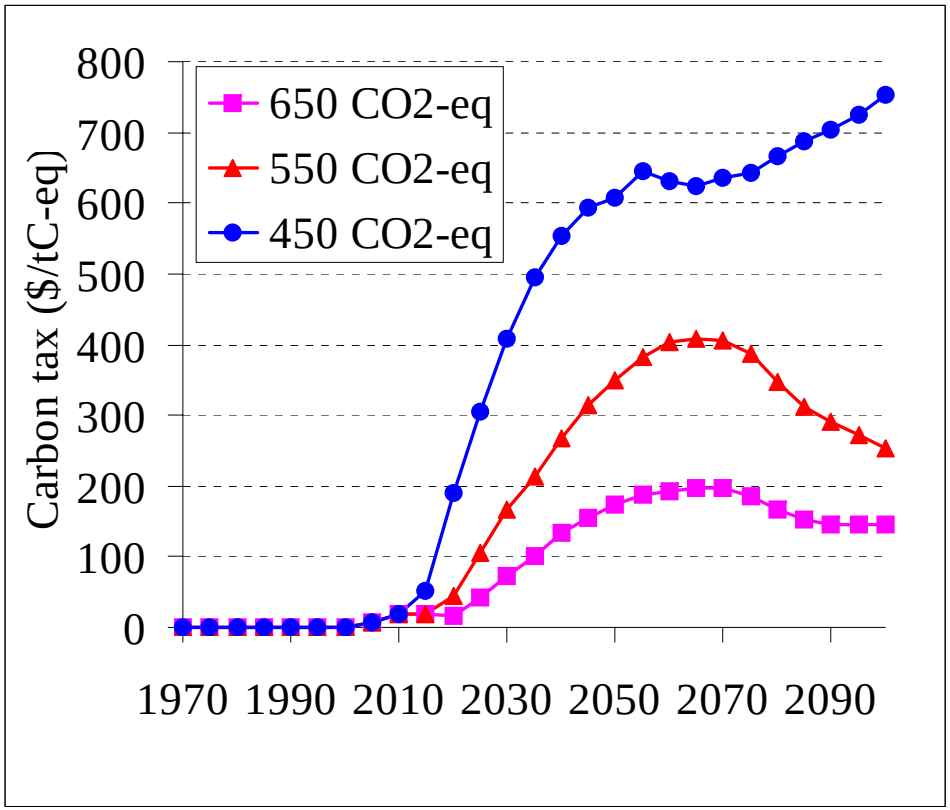
Contribution by reduction options to stabilise global greenhouse gas emissions



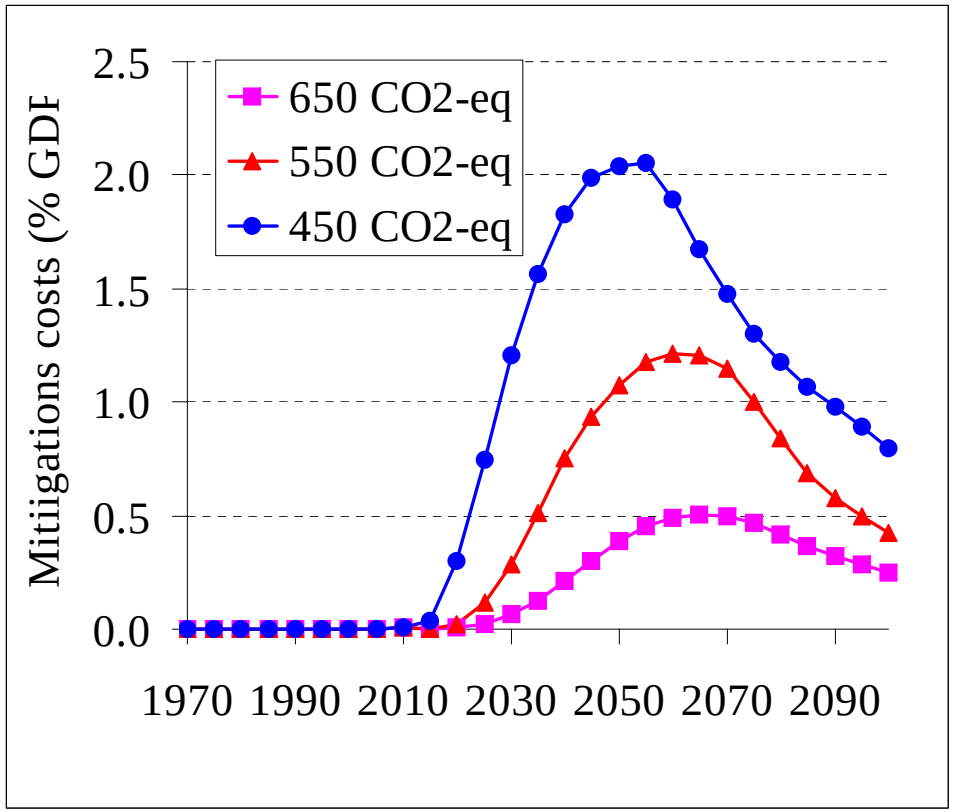
Still, many scenarios show 2ºC to be technically feasible

Van Vuuren et al. Stabilising GHG emissions at low concentration levels.*Climatic Change* 81: 119-159.

Carbon tax



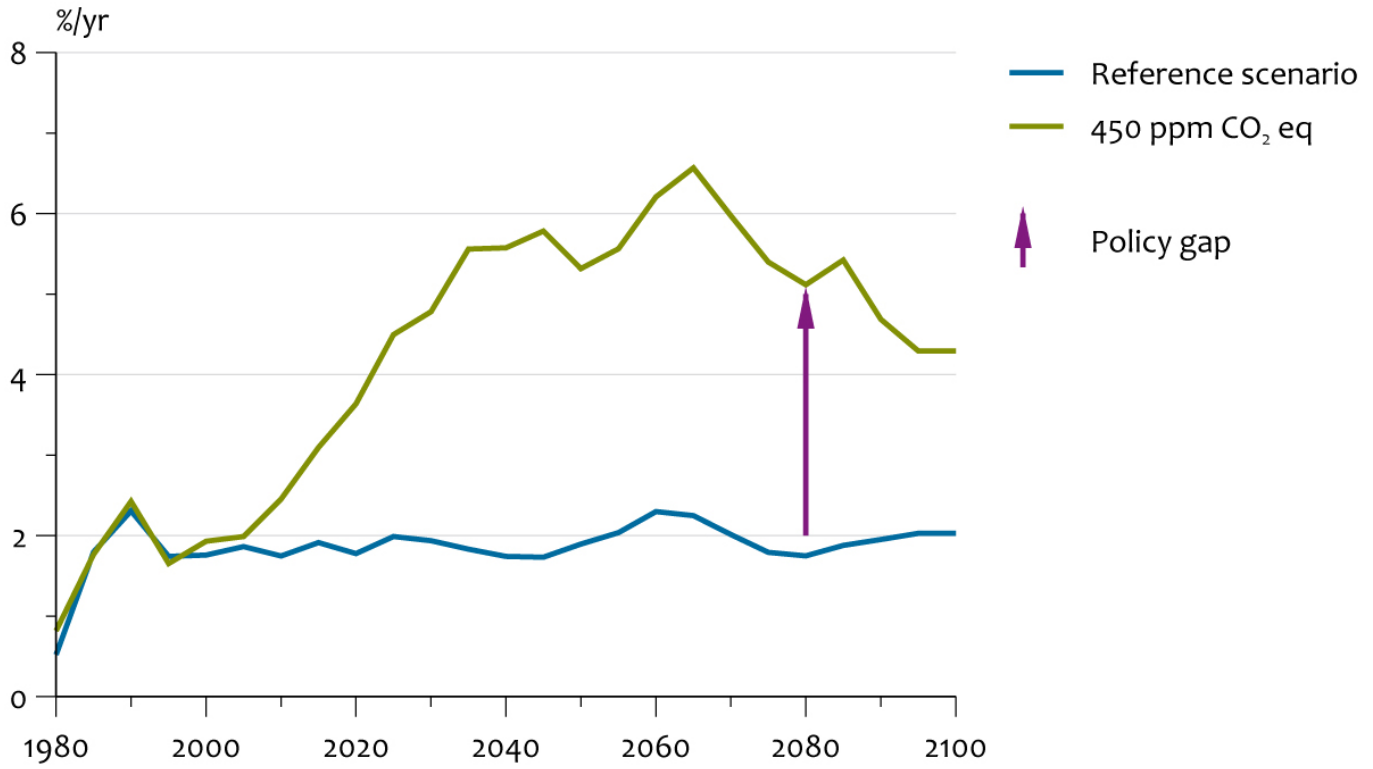
Abatement costs (%GDP)



- Substantial costs → But nothing to disrupt the economy

Van Vuuren et al. Stabilising GHG emissions at low concentration levels.*Climatic Change* 81: 119-159.

Rate of improvement of ratio between greenhouse gases and GDP



But quite a challenge!

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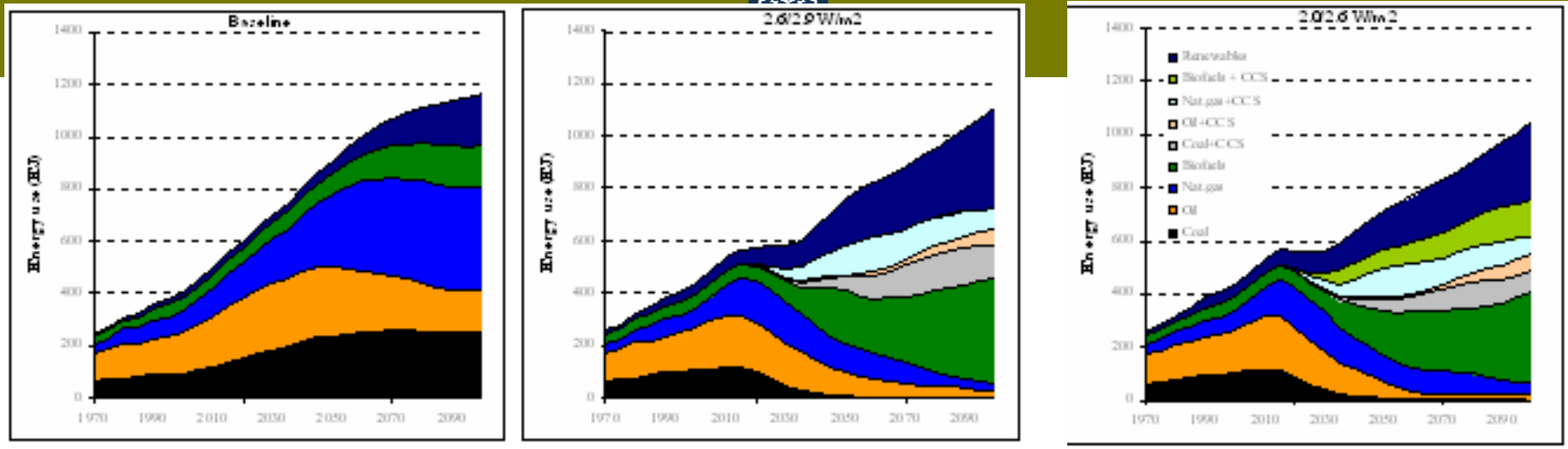


Nuclear | Biofuels + CCS | Oil+CCS | Biofuels | Oil

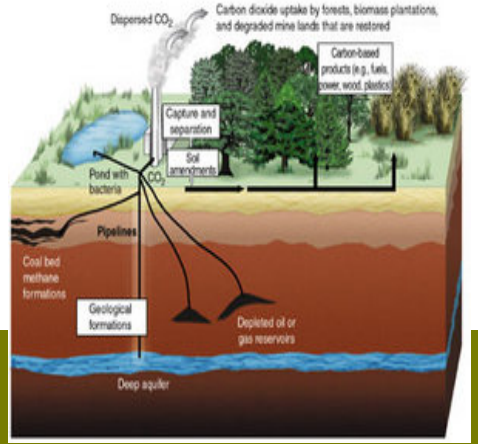
Renewables | Natural gas+CCS | Coal+CCS | Natural gas | Coal

- Major changes in the global energy system

Default

BioEnergy +

CCS (BECS



400 ppm:
Most models
need BECCS

Most scenarios still assume full participation

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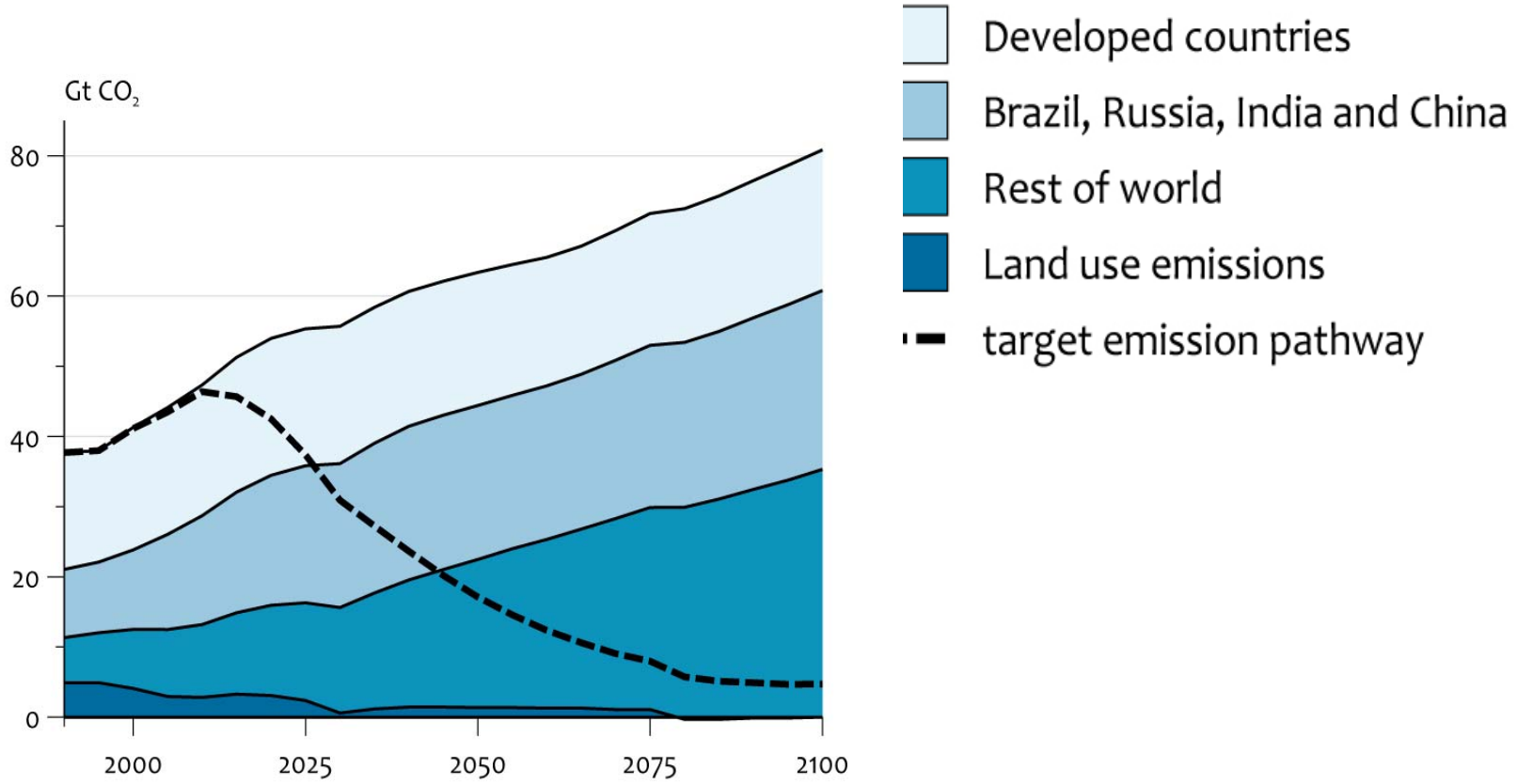
Reference emissions by world regions vs target emissions



Update of scenario table

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Old

CO2-eq conc.	Temp-Erature	No. of scenarios	Emission reduction	
			In 2020	in 2050
445-490	2.0-2.4	6	-	-85 to -50
490-535	2.4-2.8	18		-60 to -30

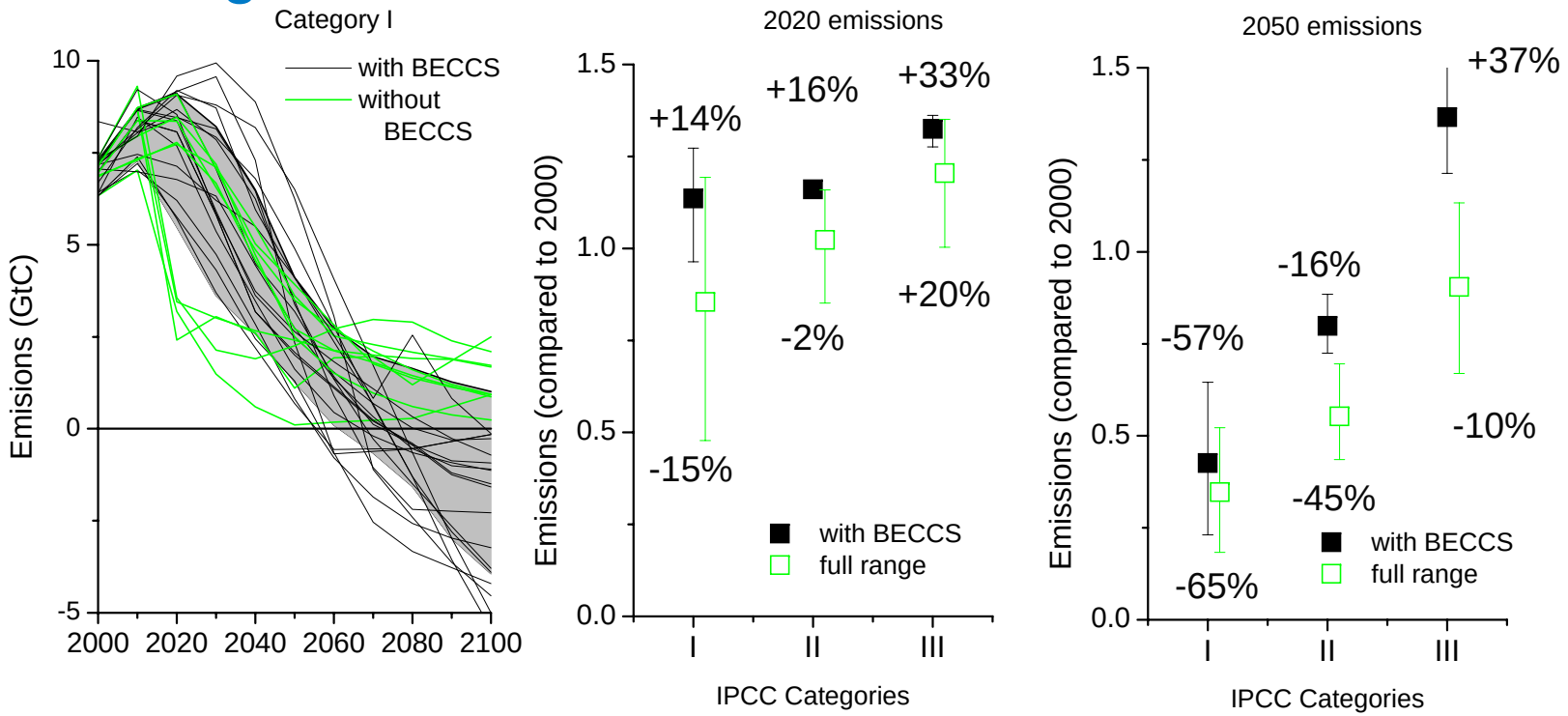
New

445-490	2.0-2.4	27	-14 to +25	-80 to -35
490-535	2.4-2.8	19	-14 to +18	-50 to -20

There is not a single number for 2ºC or 1.5ºC emissions; instead political trade-off betwee risks and trade-offs

Van Vuuren, D.P., Riahi, K., 2011. The relationship between short-term emissions and long-term concentration targets - A letter. Climatic Change 104, 793-801

Zooming in on the cat. I

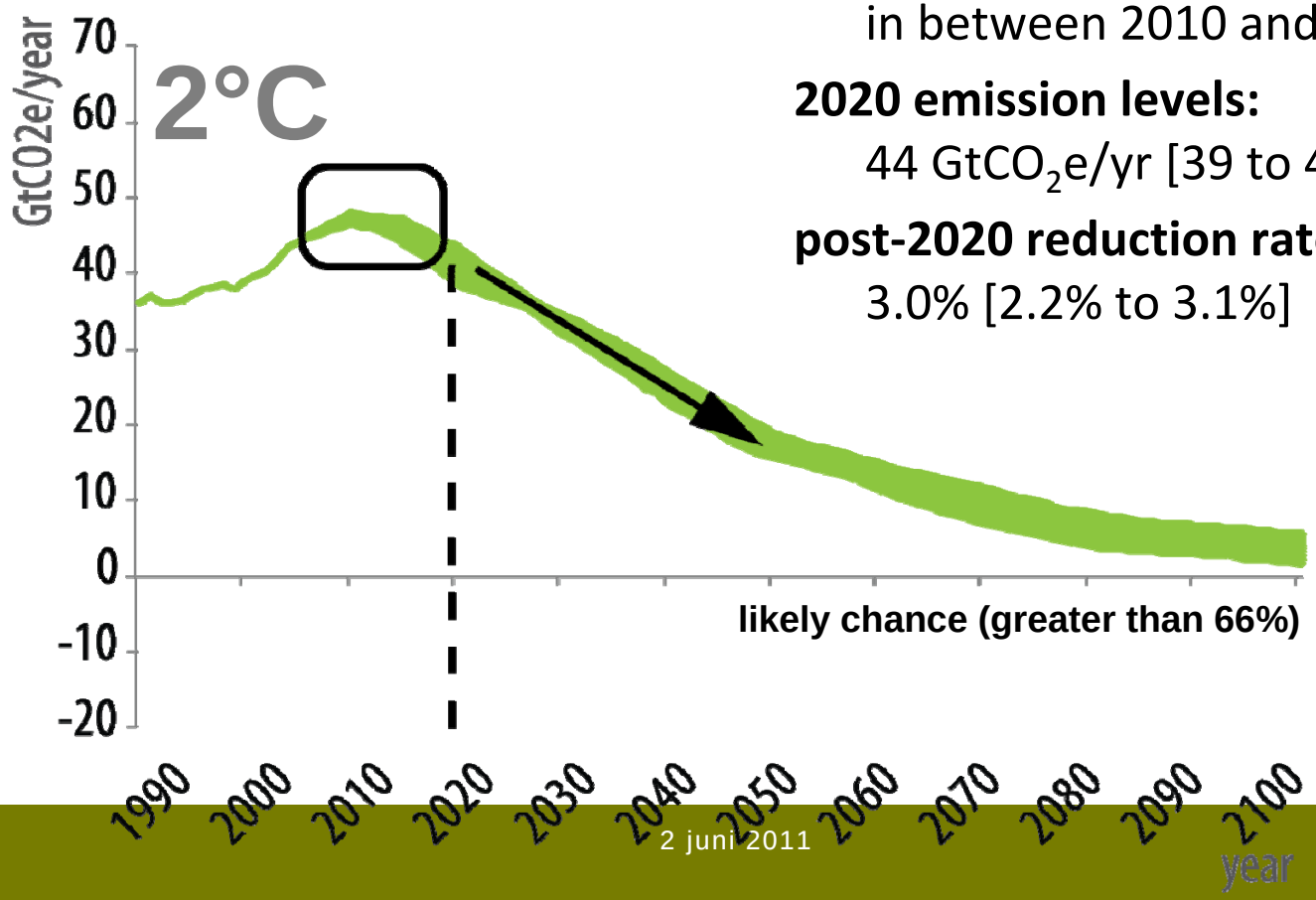


BECCS allows to avoid very stringent early emission reduction

Van Vuuren, D.P., Riahi, K., 2011. The relationship between short-term emissions and long-term concentration targets - A letter. Climatic Change 104, 793-801

KEY MESSAGES:

general characteristics (20th to 80th percentile)



peak:

in between 2010 and 2020

2020 emission levels:

44 $GtCO_2e/yr$ [39 to 44]

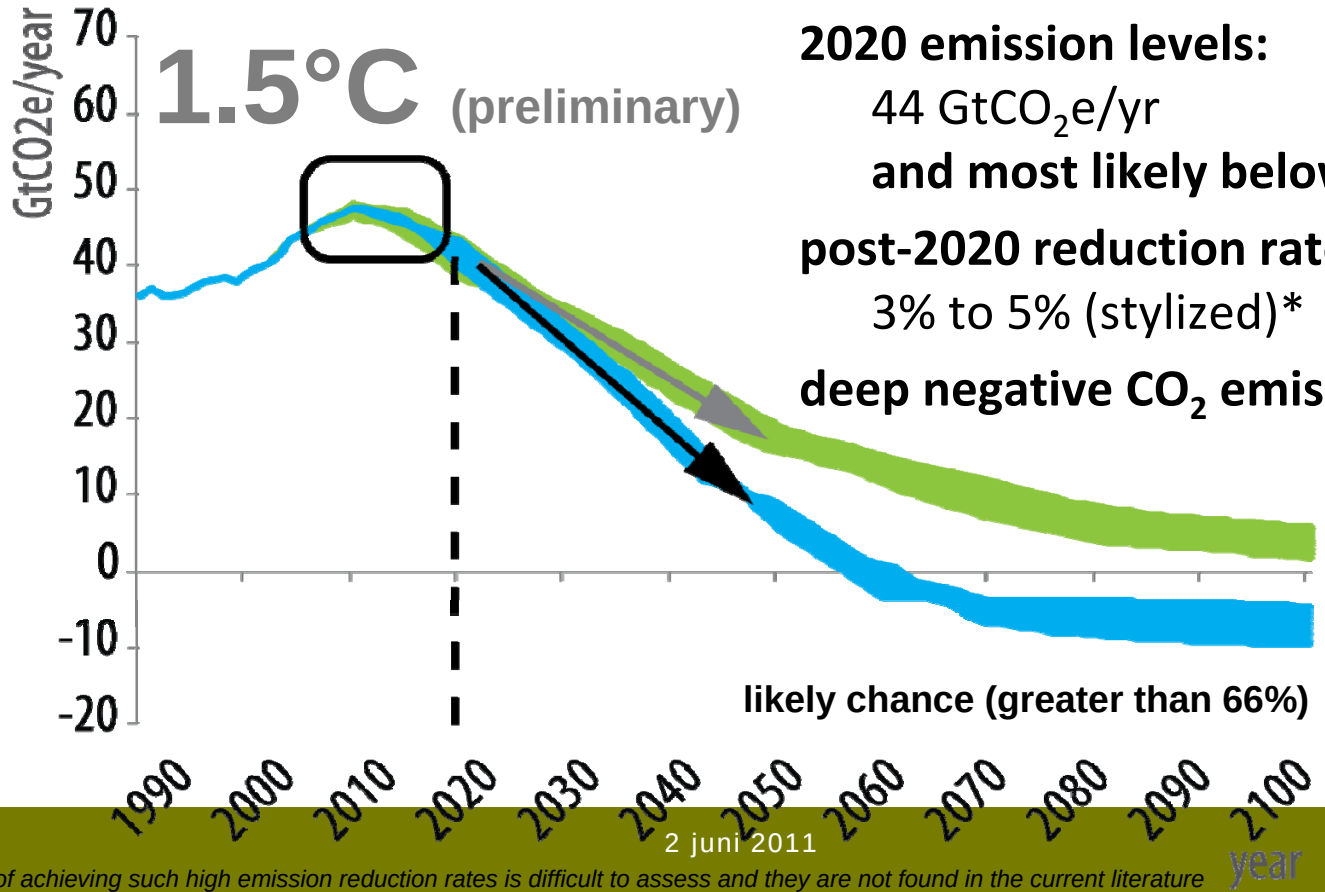
post-2020 reduction rate:

3.0% [2.2% to 3.1%]

UNEP thanks Joeri Rogelj (ETHZ) for graphics

KEY MESSAGES:

general characteristics (20th to 80th percentile)



peak:

in between 2010 and 2020

2020 emission levels:

44 $GtCO_2e/yr$

and most likely below

post-2020 reduction rate:

3% to 5% (stylized)*

deep negative CO_2 emissions

likely chance (greater than 66%)

UNEP thanks Joeri Rogelj (ETHZ) for graphics

** Note that the feasibility of achieving such high emission reduction rates is difficult to assess and they are not found in the current literature of IAM results (3.6% is the fastest rate found in our set)*

➢Thank you for your attention!

RCPs will form basis of new scenario research for AR5

More insight in low stabilisation levels (but keep pressure on climate science)

Increased insights into key technologies (efficiency, bio-energy, CCS, BECCS….)

Coming soon: Special Issue in Climatic Change on RCPs

1. Overview paper (van Vuuren et al.)
2. MESSAGE paper (Riahi et al.)
3. AIM paper (Matsui et al.)
4. GCAM paper (Thomson et al.)
5. IMAGE paper (van Vuuren et al.)
6. Land use paper (Hurtt et al.)
7. Emission inventory paper (Garnier et al.)
8. Atm. Chemistry paper (Lamarque et al.)
9. GHG conc.&extension (Meinshausen ea)

Land use pattern in 450 ppm mitigation scenario (2100)

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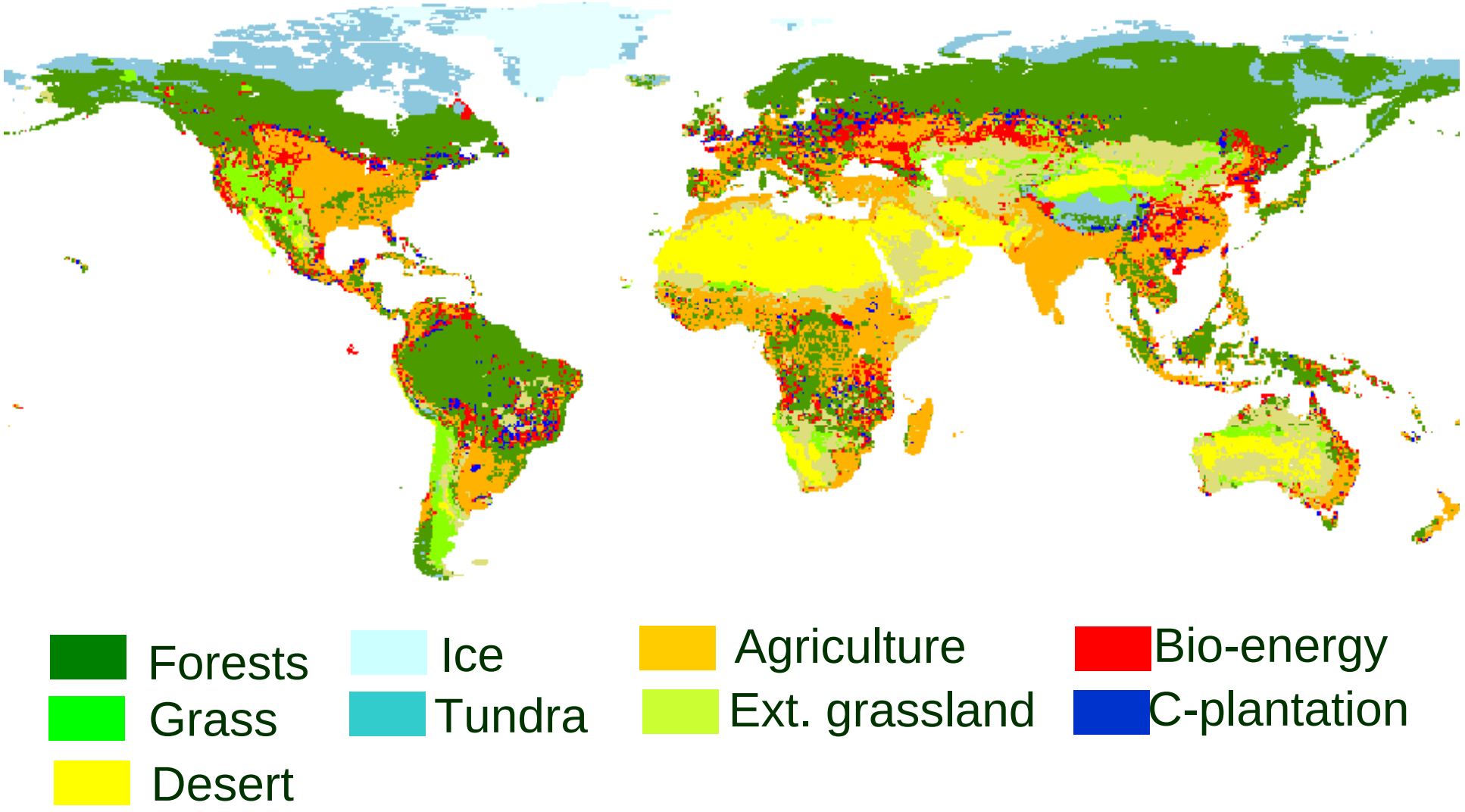
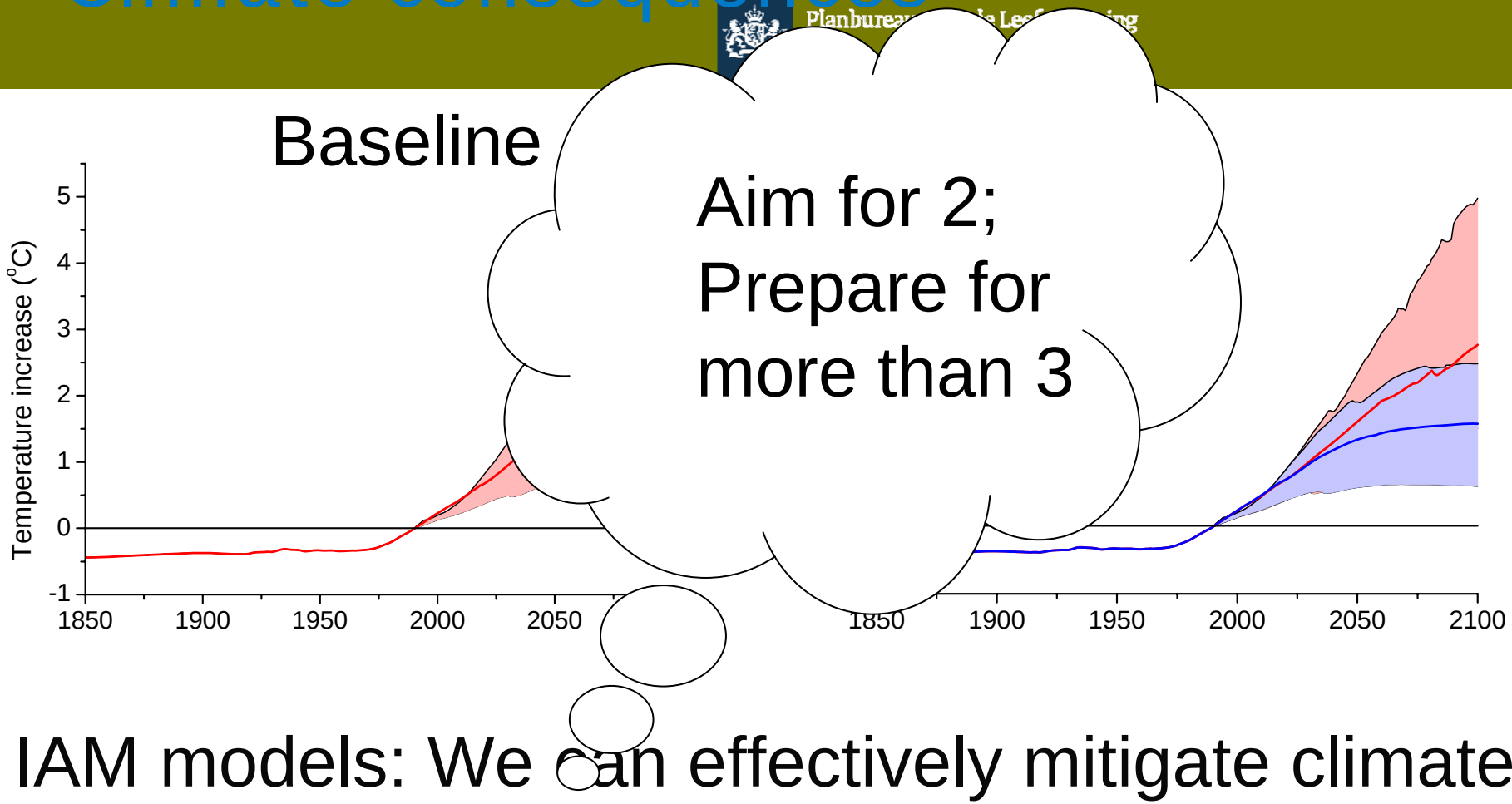


Van Vuuren et al. Stabilising GHG emissions at low concentration levels.*Climatic Change* 81: 119-159.

Climate consequences

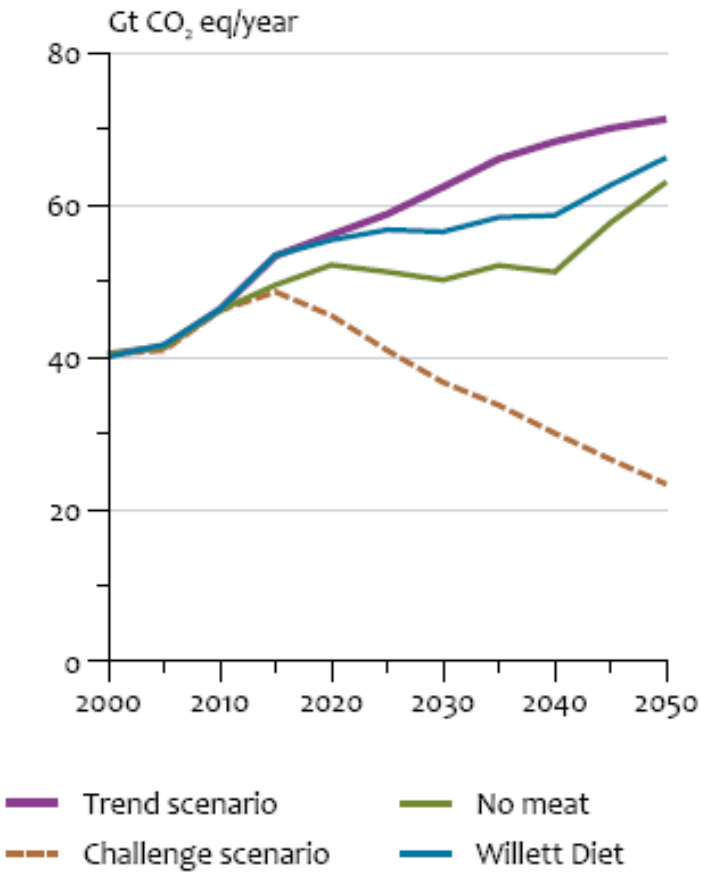


IAM models: We can effectively mitigate climate change – but not stop it

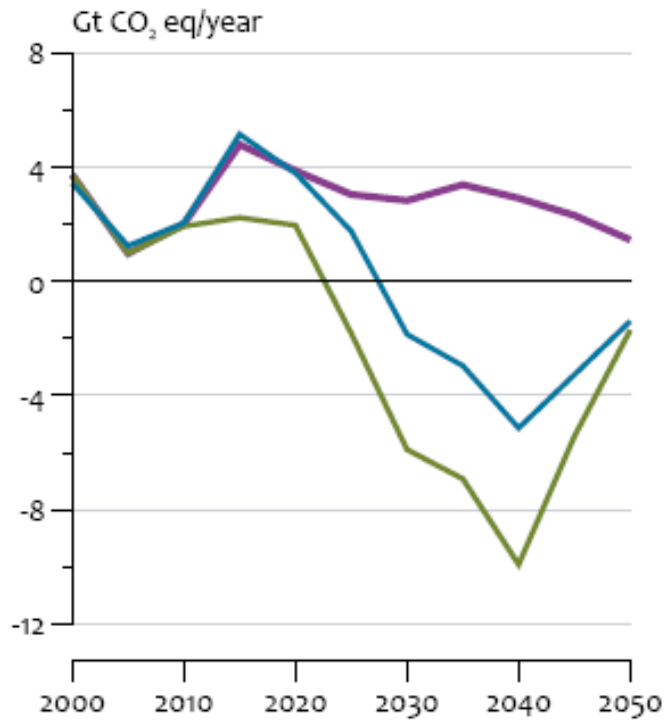
Van Vuuren et al. (2008). Temperature increase of 21st scenarios. PNAS. 105. 40. 15258–15262

C

All greenhouse gasses



From land use change



Trend scenario
Challenge scenario
No meat
Willett Diet