IPCC: towards AR5

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Credits: many slides borrowed with gratitude from IPCC colleagues: R. Christ, R. Moss, RK Pachauri, S. Solomon, J. Palutikof, J. Stone...

Talk at the Research dialogue, SBSTA, Bonn, 3-6--2009

Role of IPCC

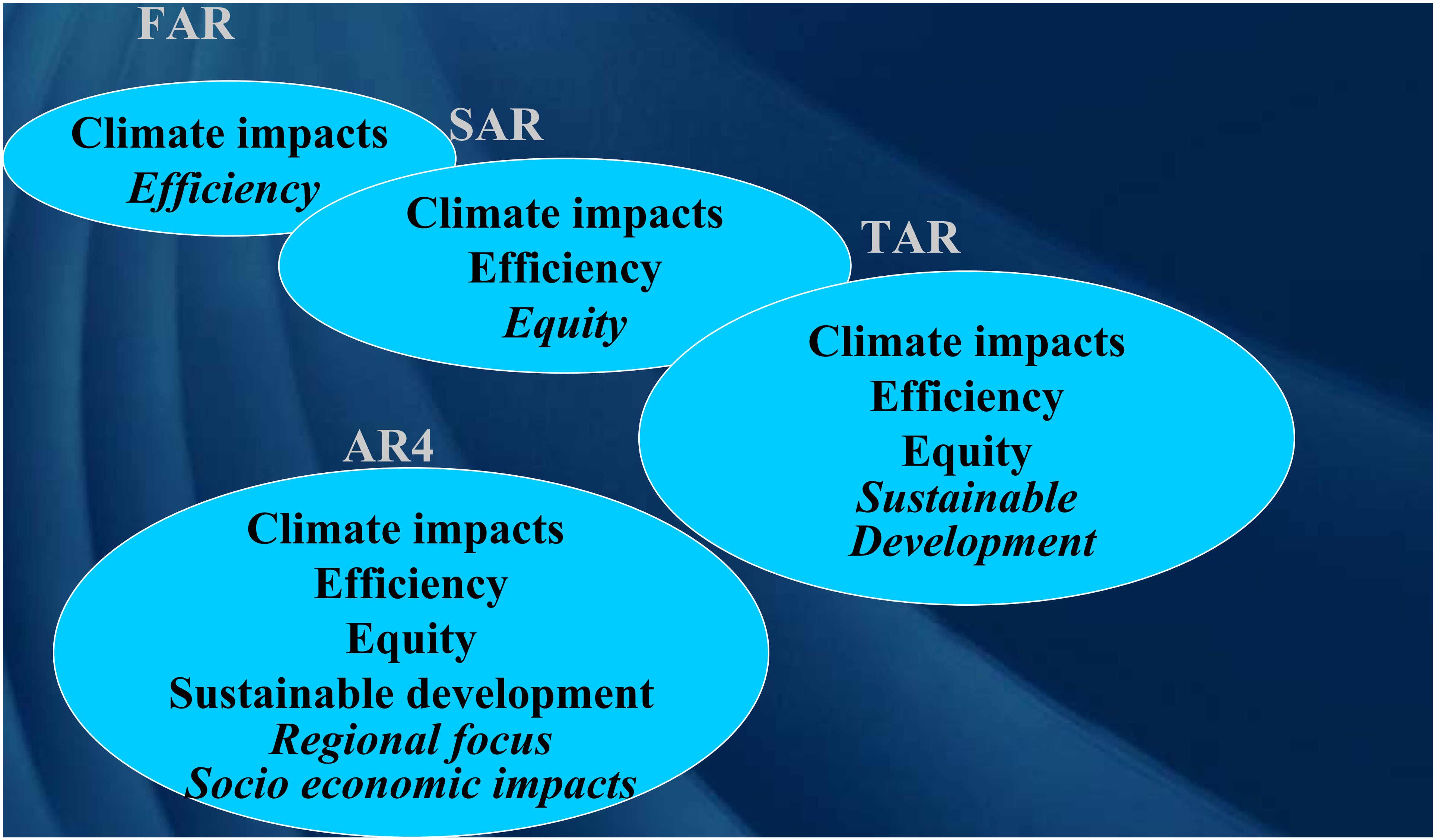
"The IPCC does not carry out research nor does it monitor climate related data or other relevant parameters. It bases its assessment mainly on peer reviewed and published scientific/technical literature."

(source: www.ipcc.ch)

Strengths of the IPCC

- ✓ Policy-relevant findings
- ✓ Assessments relying on peer reviewed literature
- ✓ Mobilisation of thousands of multi-disciplinary experts worldwide
- ✓ Rigorous Review process involving experts and Governments
- ✓ Widely used methodological reports
- ✓ Media attention and outreach activities

The evolving perspective - IPCC Assessments



⌘Latest science

Key messages from the IPCC WG1 Report (1)

- **Certain:**
  - Emissions resulting from **human activities are substantially increasing** the atmospheric concentrations of the **greenhouse gases**: CO2, CH4, CFC, and N2O
- Calculated **with confidence**:
  - Under the business as usual scenario, **temperature will increase by about 3°C by 2100** (uncertainty range: 2 to 5°C), and **sea level will increase by 60 cm** (uncertainty range: **30 to 100 cm**)

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Key messages from the IPCC WG1 Report (2)

- With an increase in the mean temperature, **episodes of high temperature** will most likely become **more frequent**
- Rapid changes in climate will change the composition of ecosystems; **some species** will be unable to adapt fast enough and **will become extinct**.
- Long-lived gases (**CO2**, N2O and CFCs) **would require immediate reduction** in emissions from human activities **of over 60% to stabilise their concentration at today's levels**.

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Oops…

- … this was from the IPCC **first** assessment report, published 19 years ago (1990)

- Was anybody really listening?

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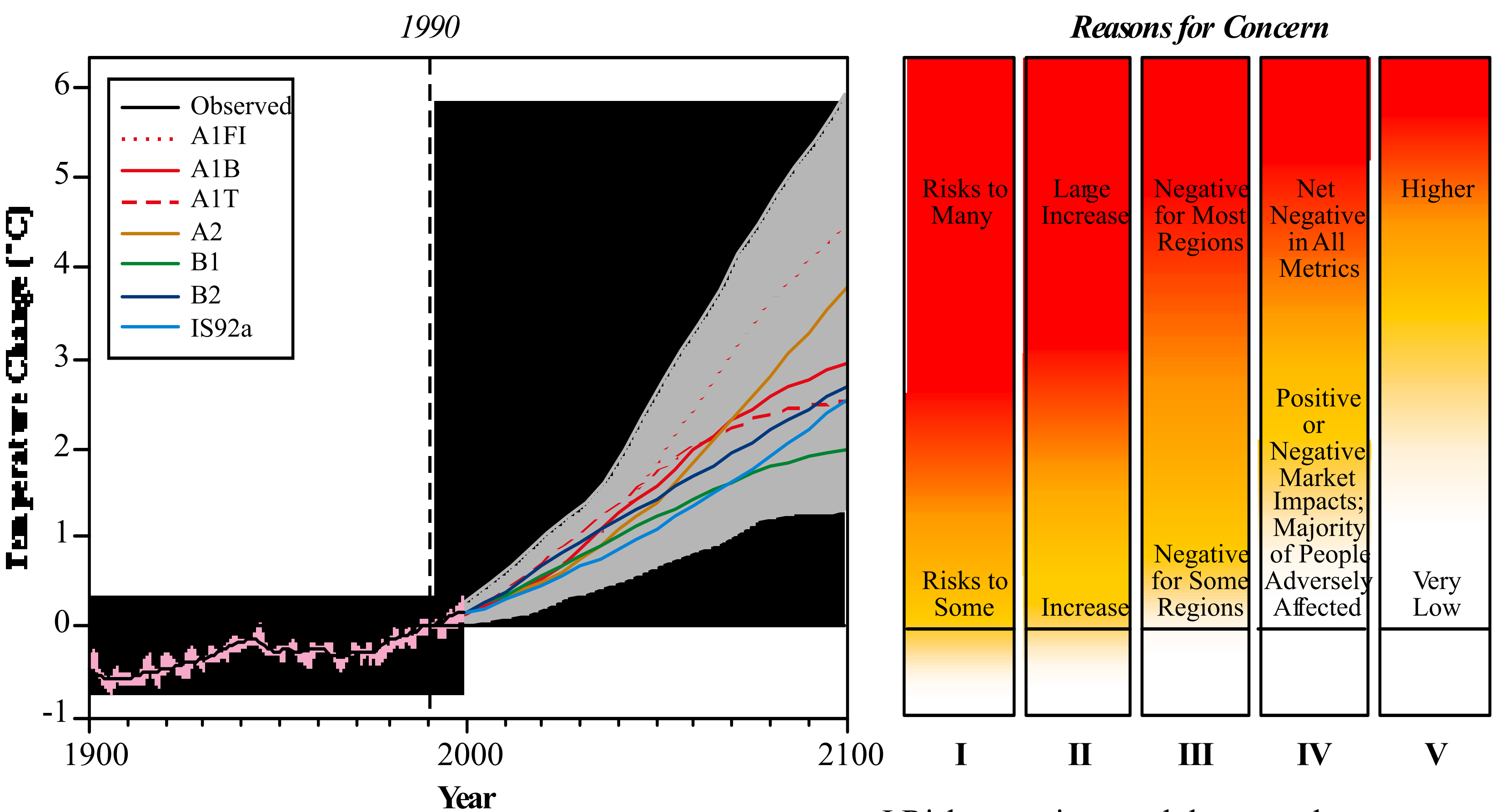
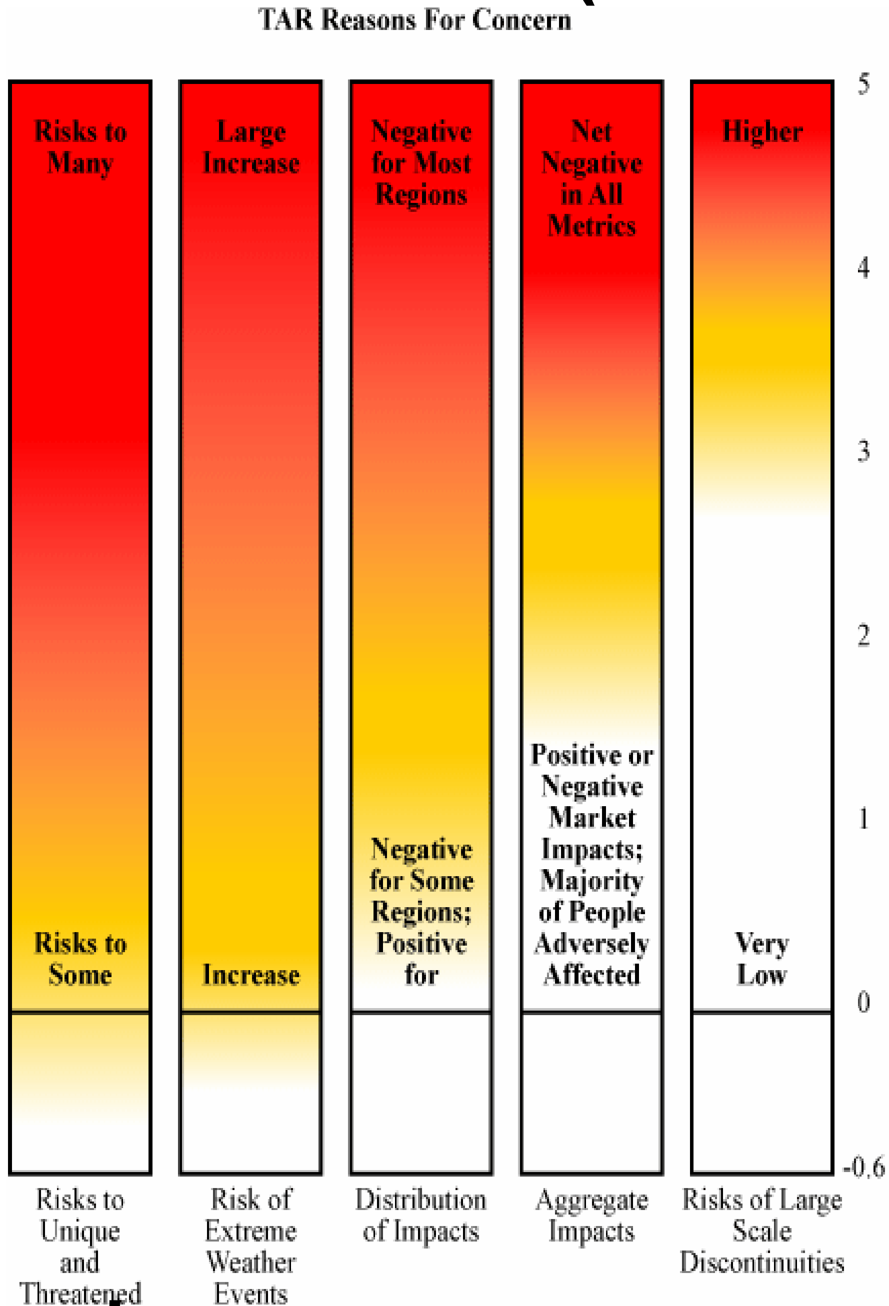
IPCC TAR Reasons for Concern



I Risks to unique and threatened systems
II Risks from extreme climate events
III Distribution of Impacts
IV Aggregate Impacts
V Risks from large-scale discontinuities

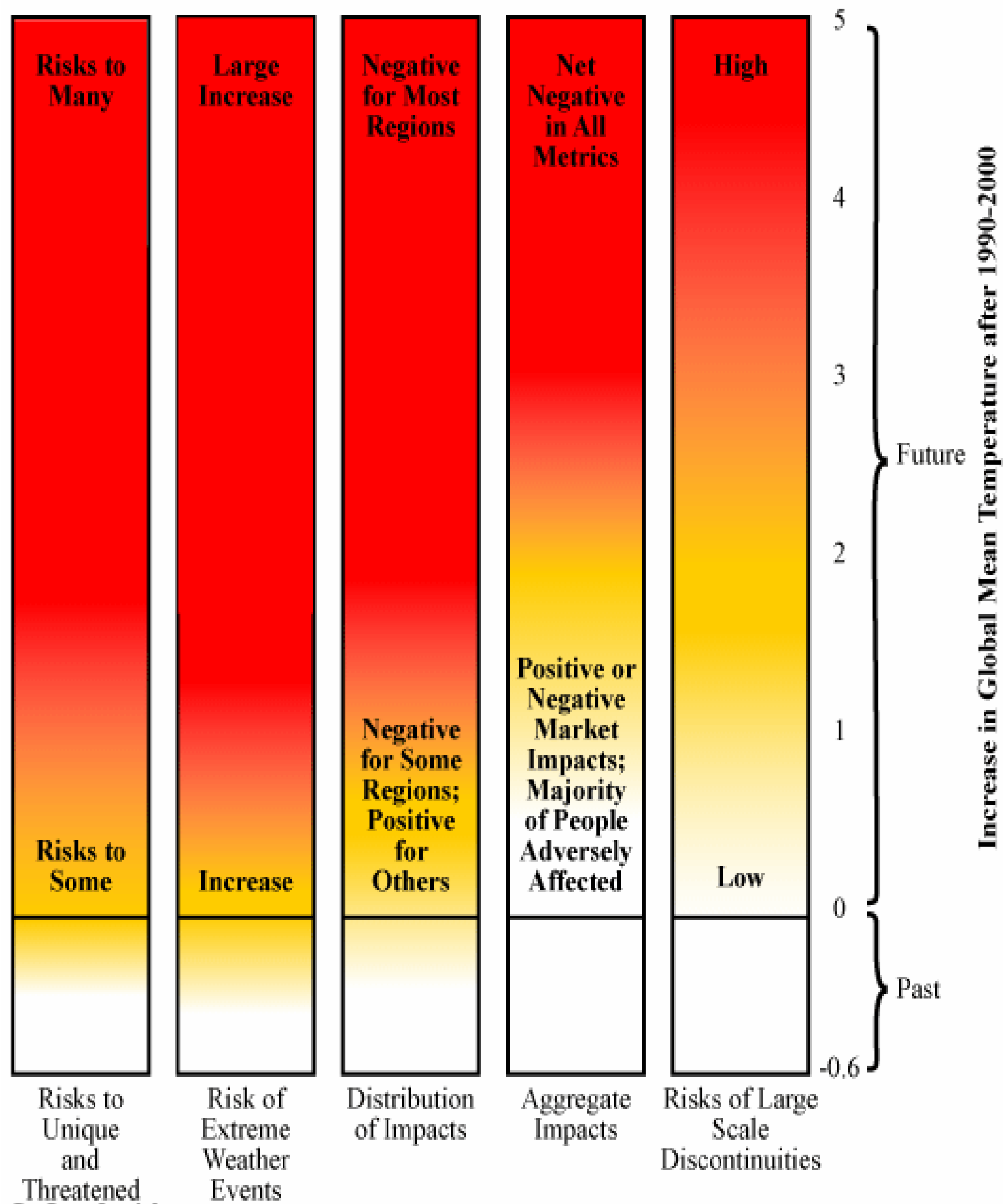
IPCC

Reasons for concern (TAR-2001)



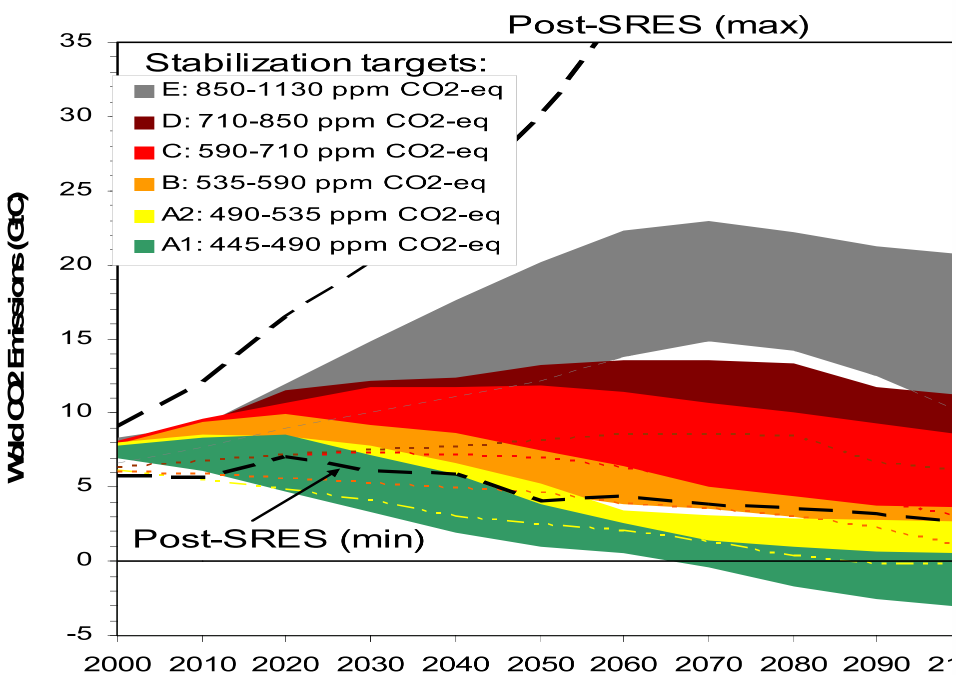
Source: www.ippc.ch

Reasons for concern (Smith et al, 2009, PNAS, based on AR4-2007)

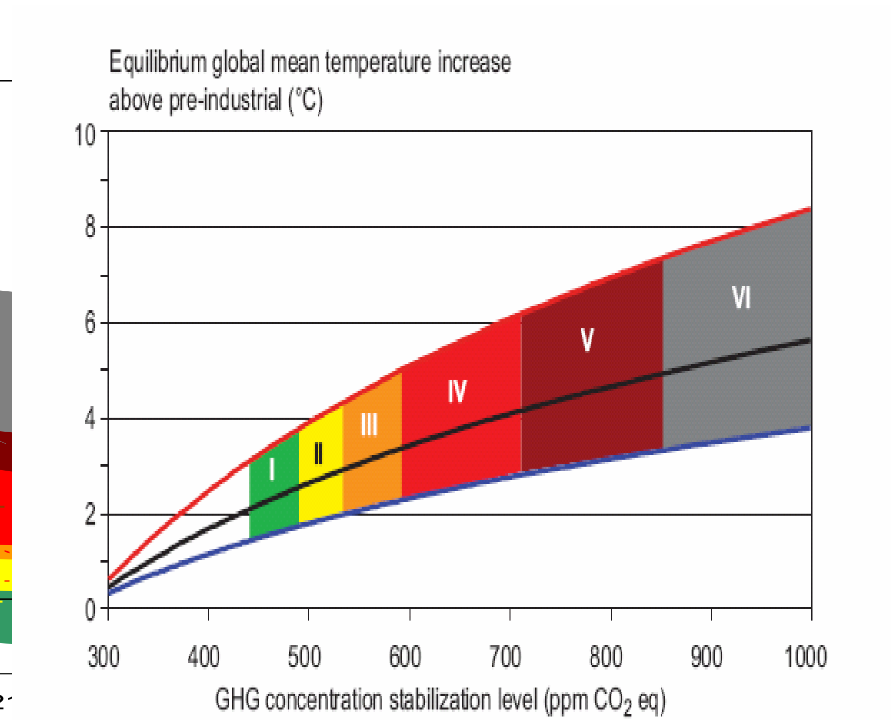


Source: www.pnas.org

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



Multigas and CO2 only studies combined



Contribution of Working Group III to the Fourth Assessment Report of the IPCC,

- **Technical Summary, page 39:**

Table TS.2: *Classification of recent (Post-Third Assessment Report) stabilization scenarios according to different stabilization targets and alternative stabilization metrics [Table 3.5].*

Category	Additional radiative forcing (W/m^2)	CO_2 concentration (ppm)	CO_2-eq concentration (ppm)	Global mean temperature increase above pre-industrial at equilibrium, using "best estimate" climate sensitivity[a], [b] (ºC)	Peaking year for CO_2 emissions[c]	Change in global CO_2 emissions in 2050 (% of 2000 emissions)[c]	No. of assessed scenarios
I	2.5-3.0	350-400	445-490	2.0-2.4	2000 - 2015	-85 to -50	6
II	3.0-3.5	400-440	490-535	2.4-2.8	2000 - 2020	-60 to -30	18
III	3.5-4.0	440-485	535-590	2.8-3.2	2010 - 2030	-30 to +5	21
IV	4.0-5.0	485-570	590-710	3.2-4.0	2020 - 2060	+10 to +60	118
V	5.0-6.0	570-660	710-855	4.0-4.9	2050 - 2080	+25 to +85	9
VI	6.0-7.5	660-790	855-1130	4.9-6.1	2060 - 2090	+90 to +140	5
						Total	177

Notes:

a) Note that global mean temperature at equilibrium is different from expected global mean temperatures in 2100 due to the inertia of the climate system.

b) The simple relationships $T_{eq} = T_{2\times CO2} \times \ln([CO_2]/278)/\ln(2)$ and $\Delta Q = 5.35 \times \ln([CO_2]/278)$ are used. Non-linearities in the feedbacks (including e.g., ice cover and carbon cycle) may cause time dependence of the effective climate sensitivity, as well as leading to larger uncertainties for greater warming levels. The best-estimate climate sensitivity (3 °C) refers to the most likely value, that is, the mode of the climate sensitivity PDF consistent with the WGI assessment of climate sensitivity and drawn from additional consideration of Box 10.2, Figure 2, in the WGI AR4.

c) Ranges correspond to the 15th to 85th percentile of the Post-Third Assessment Report (TAR) scenario distribution. CO_2 emissions are shown, so multi-gas scenarios can be compared with CO_2-only scenarios.

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 modelling uncertainties). In addition, the relationship that was used to relate different stabilization metrics is also subject to uncertainty (see Figure 3.16).

Contribution of Working Group III to the Fourth Assessment Report of the IPCC,

- **Chapter 13, page 776:**

Box 13.7 The range of the difference between emissions in 1990 and emission allowances in 2020/2050 for various GHG concentration levels for Annex I and non-Annex I countries as a group[a]

Scenario category	Region	2020	2050
A-450 ppm CO_2-eq[b]	Annex I	–25% to –40%	–80% to –95%
	Non-Annex I	Substantial deviation from baseline in Latin America, Middle East, East Asia and Centrally-Planned Asia	Substantial deviation from baseline in all regions
B-550 ppm CO_2-eq	Annex I	-10% to -30%	-40% to -90%
	Non-Annex I	Deviation from baseline in Latin America and Middle East, East Asia	Deviation from baseline in most regions, especially in Latin America and Middle East
C-650 ppm CO_2-eq	Annex I	0% to -25%	-30% to -80%
	Non-Annex I	Baseline	Deviation from baseline in Latin America and Middle East, East Asia

Notes:

[a] The aggregate range is based on multiple approaches to apportion emissions between regions (contraction and convergence, multistage, Triptych and intensity targets, among others). Each approach makes different assumptions about the pathway, specific national efforts and other variables. Additional extreme cases – in which Annex I undertakes all reductions, or non-Annex I undertakes all reductions – are not included. The ranges presented here do not imply political feasibility, nor do the results reflect cost variances.

[b] Only the studies aiming at stabilization at 450 ppm CO_2-eq assume a (temporary) overshoot of about 50 ppm (See Den Elzen and Meinshausen, 2006).

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Some of the Challenges for AR5

- Improve policy-relevance, without becoming policy-prescriptive
- Improve quality and readability
- Provide elements of answer to difficult/new questions (+ some treated as FAQ)
- Integrate Synthesis Report « design » in the scoping process from the start
- Improve developing countries participation

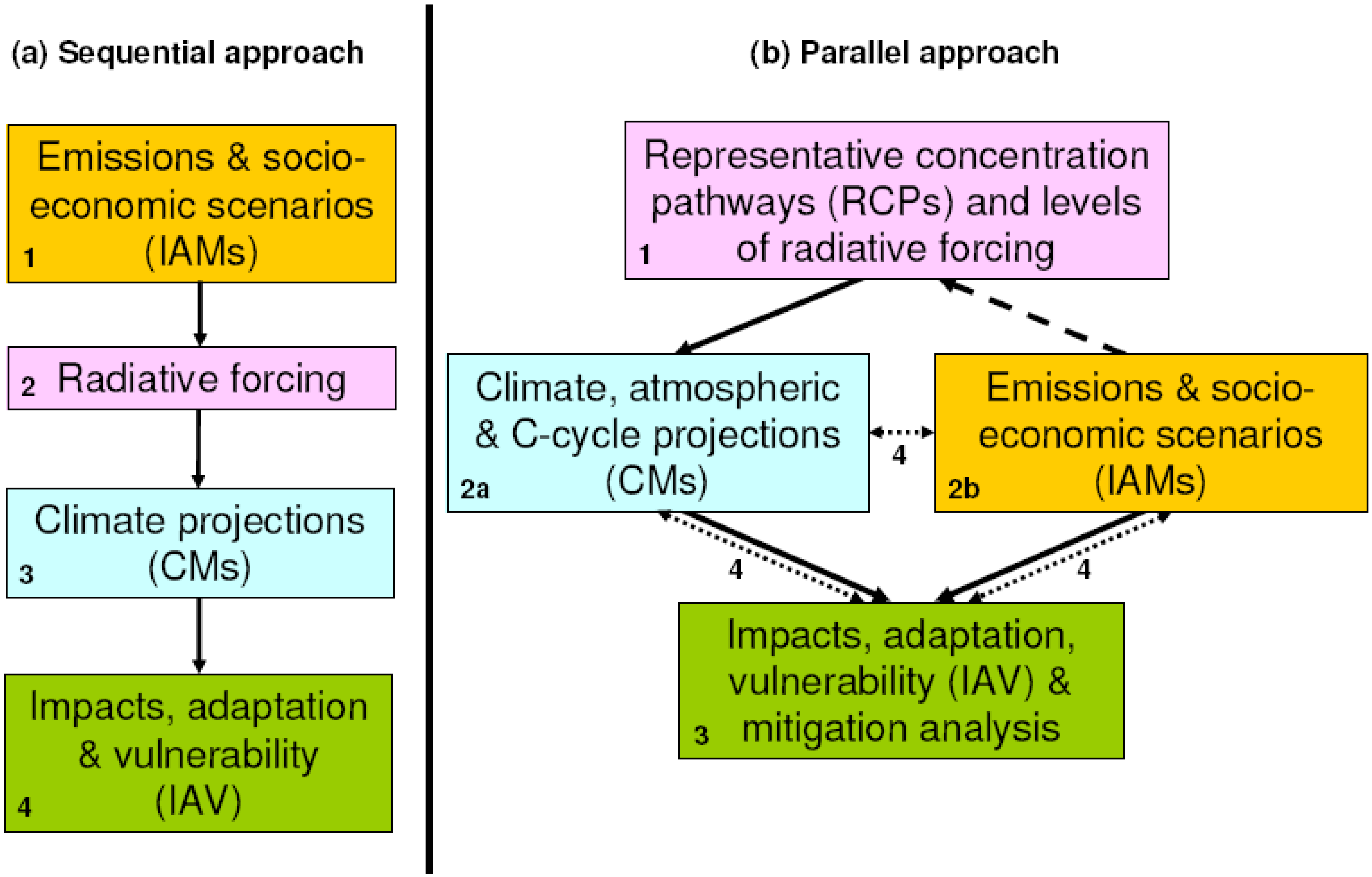
Next steps towards AR5

- **Scoping meeting (by invitation), Venice, mid-July**
- **Circulate scoping document to governments for comments**
  - comments due by early September (tbc)
- **Circulate final scoping document as P-31 document**
  - Beginning of October
- **P-31 and Sessions of WGs, Bali, 26-29 October 2009**
- **Call for nomination of LAs**
  - Until mid February 2010 (tbc)
- **Selection of LAs**
  - By mid April 2010 (tbc)

Scenarios for IPCC AR5 and further

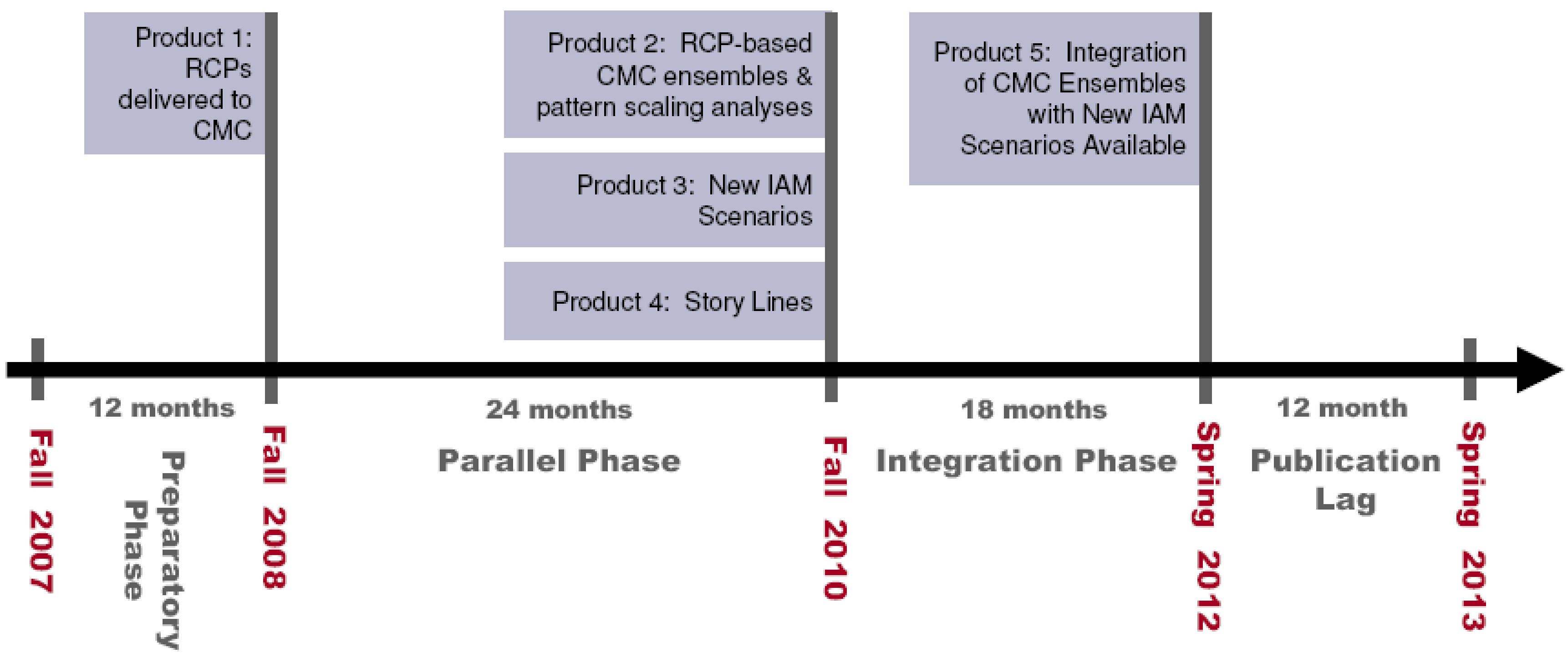
(See report on new scenarios on www.ipcc.ch)

New scenarios development process – parallel vs. sequential approach



Product	Phase	Time to Produce	Short Description
Product 1: Representative Concentration Pathways (RCPs)	Prep. Phase	12 months	Four RCPs will be produced and include time paths for emissions and concentrations of the full suite of greenhouse gases, aerosols, and chemically active gases, as well as land use/land cover (see Table A1.1). Extension of RCPs to 2300 a research issue.
Product 2: Climate Model Ensembles and Pattern Scaling	Parallel Phase	<24 months	The long-term scenarios are expected to be run at approximately 2° resolution, while the near-term scenarios may have higher (0.5° to 1°) resolution. Pattern scaling a research challenge.
Product 3: New IAM Scenarios	Parallel Phase	24 months	New socio-economic and emissions scenarios developed by the IAM community (with the IAV community).
Product 4: Global Narrative Storylines	Parallel Phase	24 months	Detailed descriptions of assumptions associated with the four RCPs and new scenarios to encourage coordination across finer scale work at regional scale. This remains a key research issue.
Product 5: Integrated Scenarios	Integration Phase	18 months	Synthesis of IAM, CM, and IAV work, including incorporation of feedbacks. Also still recognized as a research challenge.

New scenarios development process – timeline and key products



Representative Concentration Pathways (RCPs)

- Produced by IAMs to satisfy the data requirements of the CM community and respond to the IPCC's request for "benchmark" scenarios
- The RCPs are <u>not</u> to be the focus of all subsequent research but are intended to start the scenario development process
- Should be "compatible with the full range of stabilization, mitigation and baseline emission scenarios available in the current scientific literature"
- Must provide information on a range of factors beyond concentrations and emissions of long-lived GHGs, including emissions of other radiatively active gases and aerosols (and their precursors), land use, and socioeconomic conditions.

Intended uses and limits of RCPs

- Intended uses
  - Input to CMs
  - To explore climate implications of forcing patterns
  - To explore ranges of socioeconomic conditions and emissions that are consistent with different forcing levels
- Limits
  - Not forecasts or absolute bounds
  - Not policy prescriptive
  - Socioeconomics underlying each RCP are not unique; and, across RCPs, are not a set (no common "reference" scenario)
  - Uncertainties in the translation of emissions profiles to concentrations and radiative forcing.

Four Types of RCPs

Table 1. *Types of representative concentration pathways.*

Name	**Radiative Forcing**[1]	**Concentration**[2]	**Pathway shape**
RCP8.5	>8.5 W/m^2 in 2100	> ~1370 CO_2-eq in 2100	Rising
RCP6	~6 W/m^2 at stabilization after 2100	~850 CO_2-eq (at stabilization after 2100)	Stabilization without overshoot
RCP4.5	~4.5 W/m^2 at stabilization after 2100	~650 CO_2-eq (at stabilization after 2100)	Stabilization without overshoot
RCP3-PD[3]	peak at ~3W/m^2 before 2100 and then decline	peak at ~490 CO2-eq before 2100 and then decline	Peak and decline

Scenarios for two time periods

- “Near-term” scenarios that cover the period to about 2035
- “Long-term” scenarios that cover the period to 2100 and, in a more stylized way, the period to 2300

Integrated Assessment Modeling Consortium

International Institute for Applied Systems Analysis (IIASA)	Energy Modeling Forum (EMF) Stanford University	National Institute for Environmental Studies (NIES)
➢**Australian Bureau of Agricultural and Resource Economics (ABARE)** - *Hom Pant* ➢**Business Council for Sustainable Development – Argentina** - *Virginia Vilariño* ➢**CEA-LERNA, University of Social Sciences** - *Marc Vielle* ➢**Centre for International Climate and Energy Research (CICERO), University of Oslo** - *H.Asbjorn Aaheim* ➢**Argonne National Laboratory** - *Donald Hanson* ➢**Centre International de Recherche sur l'Environnement et le Developpement, EHESS - U.A. CNRS 940 (CIRED)** - *Jean-Charles Hourcade* ➢**CRA International** - *Brian Fischer* ➢**Dept. of Energy, Transport, Environment, DIW Berlin** - *Claudia Kemfert* ➢**Electric Power Research Institute (EPRI)** - *Richard Richels* ➢**Energy Research Institute, National Development and Reform Commission (NDRC)** - *Kejun Jiang*	➢**Freelance Professional Economist** - *Thomas Rutherford* ➢**Hamburg University and Economic and Social Research Institute (ESRI)** - *Richard Tol* ➢**Indian Institute of Management** - *Priyadarshi Shukla* ➢**Institut d'Economie et de Politique de l'Energie, IEPE-CNRS** - *Patrick Criqui* ➢**International Institute for Applied Systems Analysis (IIASA)** - *Nebojsa Nakicenovic, Keywan Riahi* ➢**IPCC and San Marcos University** - *Eduardo Calvo* ➢**National Institute for Environment Studies (NIES)** - Mikiko Kainuma ➢**Ohio State University** - Brent Sohngen ➢**Pacific Northwest National Laboratory, Joint Global Change Research Institute at the University of Maryland** - *Jae Edmonds, Hugh Pitcher, Ronald Sands, Steve Smith* ➢**Programa de Planejamento Energético - PPE/COPPE/UFRJ** - *Emilio Lèbre La Rovere*	➢**Purdue University** - *Thomas Hertel* ➢**RAND** - *Rob Lempert* ➢**Research Institute of Innovative Technology for the Earth (RITE)** - *Keigo Akimoto* ➢**Stanford University** - *John Weyant* ➢**Texas A&M University** - *Bruce McCarl* ➢**The Institute of Applied Energy** - *Atsushi Kurosawa* ➢**The Netherlands Environmental Assessment Agency (MNP)** - *Detlef van Vuuren* ➢**Universidad de Los Andes / Universidad Nacional de Colombia** - *Jose Eddy Torres* ➢**Universidad Iberoamericana Puebla** - *Maria Eugenia Ibarraran Viniegra* ➢**US Environmental Protection Agency** - *Francisco de la Chesnaye, Allen Fawcett, Steven Rose*

Increasing DC/EIT participation in scenario work

- Improvements in DC/EIT capacity are needed and could be facilitated by a network of institutions
- Financial constraints limit the participation of DC/EIT experts
- There is a clear need for improved coordination among DC/EIT experts to determine their own goals/needs for enhanced participation with the larger community