15.023J / 12.848J / ESD.128J Global Climate Change: Economics, Science, and Policy
Spring 2008

15.023 - 12.848 - ESD.128
Global Climate Change: Economics, Science and Policy

- Course introduction (again)

- Institutional context of the climate issue
  - Negotiation of a climate regime: the FCCC
    - The search for a global regime
    - What beyond the Kyoto protocol?
  - Analysis and assessment
    - Historical analogy: the CFC-ozone issue
    - The IPCC

Materials

- Readings
  - Packet to purchase, E52 Copy Center ($30)
  - Hand-outs
  - Stellar.mit.edu (syllabus, notes, materials)
  - Material on web (http://globalchange.mit.edu/)
  - Keep an eye on the news!

- Computer needs
  - “Toy” IGSM in the Sloan Computer Lab
  - Excel or other worksheet program

Course Organization

	Monday	Wednesday
2/11	Institutions	Background/science
2/19	Climate - I	Economics
2/25	Climate - II	Enviro. economics
3/3	Econ - I	Int'n negotiations
3/10	Econ - II	Integration (Toy)
3/17	Climate - III	Damage/benefits
3/26	Holiday	
3.31	Econ - III	Trading/tax systems
4/7	Climate - IV	Uncertainty
4/14	Uncertainty analysis	Sea level/storms
4/21	Holiday	Decision analysis
4/28	Deciding near-term effort	Arctic change
5/7	Climate - V	Discussion/questions
5/14	Student presentations	

International Environmental Agreements

- Whaling Convention
- Law of the Sea
- Basle Convention (shipment of toxic waste)
- Convention on International Trade in Endangered Species (CITES)
- Vienna Convention and Montreal Protocol
- Biodiversity Treaty
- [Forest Convention]
- Framework Convention on Climate Change

Objective & Difficulties

- Need a regime “architecture”: a unifying structure to guide potential agreement
  - The metaphor
  - Examples in environment, trade, etc.
- Complexities of this commons problem
  - 20 or so rich AND poor countries matter
  - Economic as well as environmental issue
  - Many emissions & land use contribute
  - Continuity over century and more
  - Parties are sovereign nations

Acronyms: International Institutions

- FCCC Framework Convention on Climate Change
- SBSTA Subsidiary Body on Scientific and Technical Advice (FCCC)
- SBI Subsidiary Body on Implementation (FCCC)
- AGBM Ad-Hoc Group on the Berlin Mandate
- COP Conference of the Parties (FCCC)
- MOP Members of the (Kyoto) Protocol
- IPCC Intergovernmental Panel on Climate Change
- GEF Global Environmental Facility ($$)
- WMO World Meteorological Organization
- UNEP U.N. Environment Program

Acronyms: National Groupings

- Annex I = OECD + Economies in Transition
  - OECD = EU + USA, Canada, Australia, New Zealand, Scandinavia, Austria (rich nations)
  - EIT = Econ's in Transition (Russia, others of former Soviet Union, Eastern Europe)
- Annex B Slight variation on Annex I
- Annex II OECD, with special responsibilities
- Non-Annex I Developing Countries
- G-77 & China Coalition of developing nations
- AOSIS Alliance of Small Island States

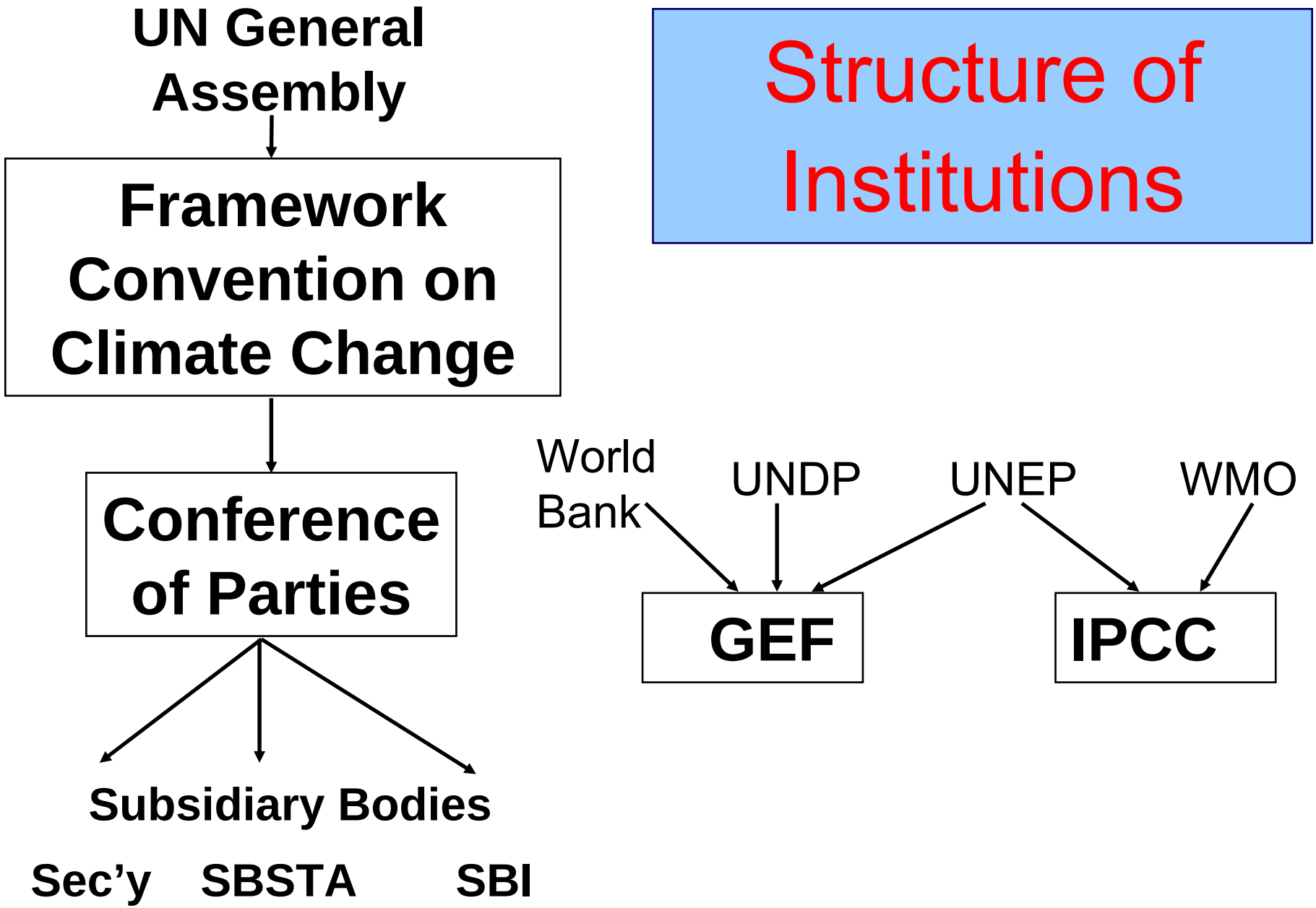
Convention-Protocol Process

- Negotiation of a general framework
  - Goals, obligations
  - Procedures, data reporting
  - Bureaucracy, funding
- Separate protocols (*e.g.*, CFC-ozone problem)
  - Universal acceptance not essential
  - Add without re-ratification of underlying treaty
- Contrast to conventional treaty (*e.g.*, Law of the Sea)
  - Universal and inclusive *re*. issues and participants
  - Requires consensus on comprehensive package

The Lure of a Comprehensive Architecture for Climate

- A global commons problem
  - So include all nations from the start
- Both rich and poor nations are important
  - So agree to base regime on "common but differentiated responsibilities"
- Many substances contribute to forcing
  - So include all gases in a common system
- Country cost differences will be inefficient
  - So introduce flexibility mechanisms

Structure of Institutions



FCCC Process to Kyoto

- Key Features of the FCCC (Rio 1992)
  - Article 2: GHGs stabilization to avoid "danger"
  - Article 4: Separate Annex I and Non-Annex I
    Review of progress
  - "Aim" to return to 1990 emissions by 2000
- COP-1 in 1995 and the "Berlin Mandate"
  - Targets and timetables for cuts (1990 baseline)
  - Policies and measures
  - No discussion of Non-Annex I commitments
- The AGBM process to COP-3 (1997 in Kyoto)

Role of the Stabilization Goal

- FCCC Article 2: The ultimate objective of this Convention . . . is to achieve . . . stabilization of greenhouse gas concentrations in the atmosphere at a level that would prevent dangerous anthropogenic interference with the climate system.
- Issues
  - Does a threshold exist?
  - Can a level be agreed? Is it needed?
  - Role of review of “adequacy of commitments”

Regulatory Jargon

- Sinks—Storage of carbon in forests (and soils)
  - Article 3.3: new projects since 1990
  - Article 3.4: pre-existing forests ("do nothing" sinks)
- Allowance trading—parties in one Annex B country can buy allocated amounts from another (AAUs)
- Supplementarity—restriction on use of purchased allowances to meet the Kyoto target
- CDM (Clean Development Mechanism): credits for reductions in Non-Annex I countries (CERs)
- JI (Joint Implementation): credits in Annex I (ERUs)
- PAMs—Policies and measures
- Hot air—allocation larger than forecast emissions

Issues, Players and Positions

Components of Policy

- Targets and timetables
  - Stringency?
  - Differentiation?
- Policies and measures
- Emissions trading
  - Supplementarity
  - Russian “hot air”
- Land use & forests
- Accession of LDCs

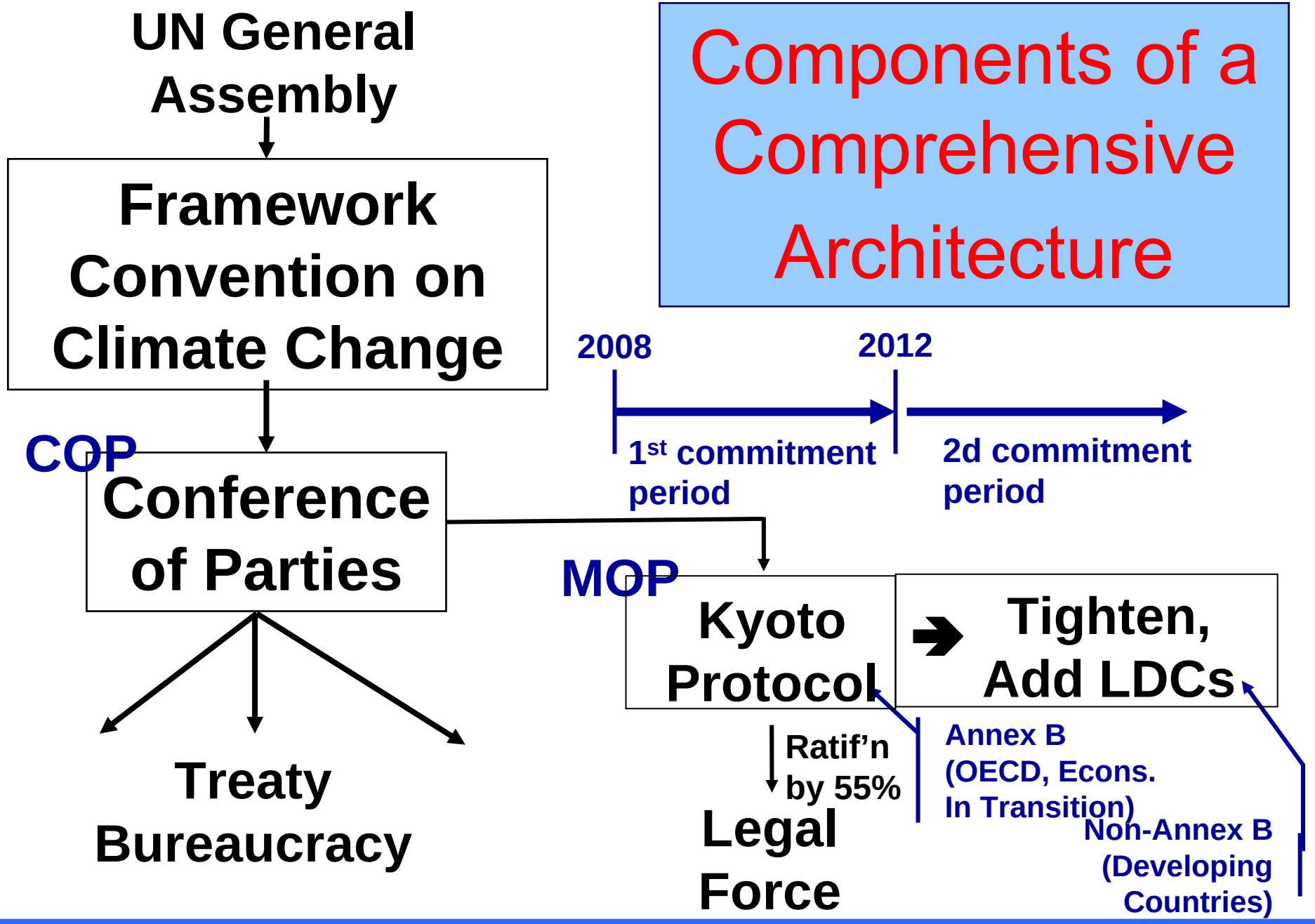
Players & Coalitions

- European Union
- Japan
- United States
- Can., Aus., N.Z.
- Russia (& E. Europe)

Annex B

- G-77 *plus* China
  - OPEC
  - AOSIS

Components of a Comprehensive Architecture



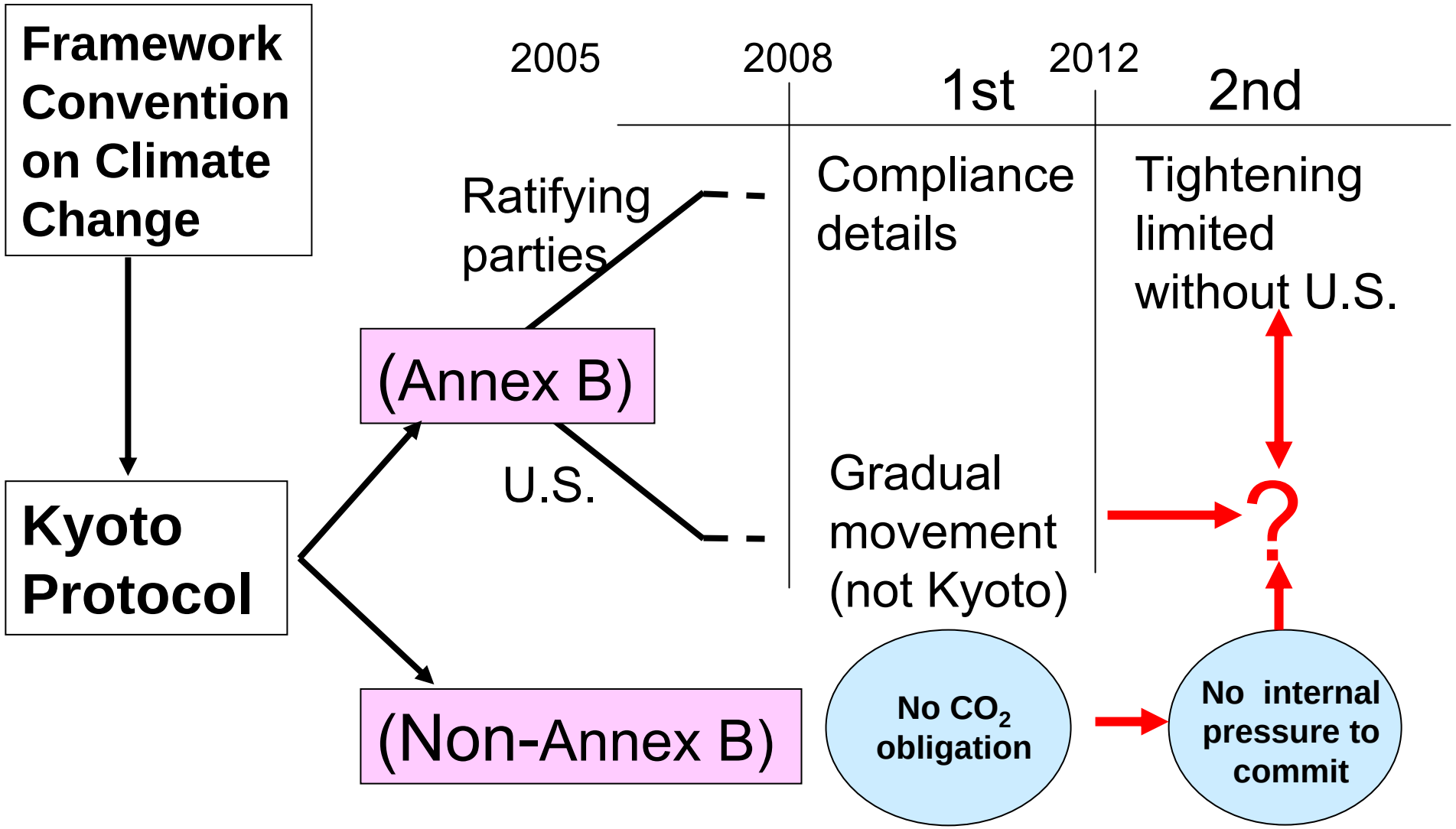
Kyoto Details

- What was included
  - National targets and timetables
  - 1st commitment period (tightening later)
  - Flexibility mechanisms (trading & CDM)
  - Carbon sinks (new & existing)
  - No Non-Annex B reductions (accession later)
- Other approaches?
  -
  -

Problems with Kyoto

- Fixed, legally binding, short-term targets
  - Unrelated to economic growth along the way
  - Unknown cost
  - Unequal burdens
- Trading/sinks: artifact of premature targets
  - Imply large international financial flows
  - Damaging fight over carbon sinks
- Handling of developing countries
  - No discussion of how they might participate
- Seek US policy ahead of Congress

Now, Fragmentation



Path to Today's Situation

- Nov. 2000: Negotiations collapse on details
  - Purchased reductions & "do nothing" sinks
- Mar. 2001: Bush rejects Kyoto
- Jul./Oct. 2001: Political deals (*ex* the US)
  - More sinks to Canada, Japan, Russia
  - Remove limit on purchased reductions
- Nov. 2005: Entry of Kyoto into force
  - Since 2005: the COP and MOP debate details
- Dec. 2007: Bali Declaration (March 5 class)
  - Instructions to negotiators: target in 11/09 COP

Lessons Learned the Hard Way

- A common view of international process
  (1) Agree on the structure for negotiations
  (2) Negotiate commitment levels & measures
  (3) Nations implement control measures
- For an issue like climate change the process begins the other way around
  - Nations only agree to a potentially costly commitment if confident they can meet it
  - Binding agreements follow (not lead) domestic commitment

Prospects for Achieving the 2008-12 Kyoto Targets

- Key parties
  - EU and its member countries
  - Japan
  - Canada
  - Australia & New Zealand
- Key developments
  - CDM
  - Russia trade
  - Economic growth

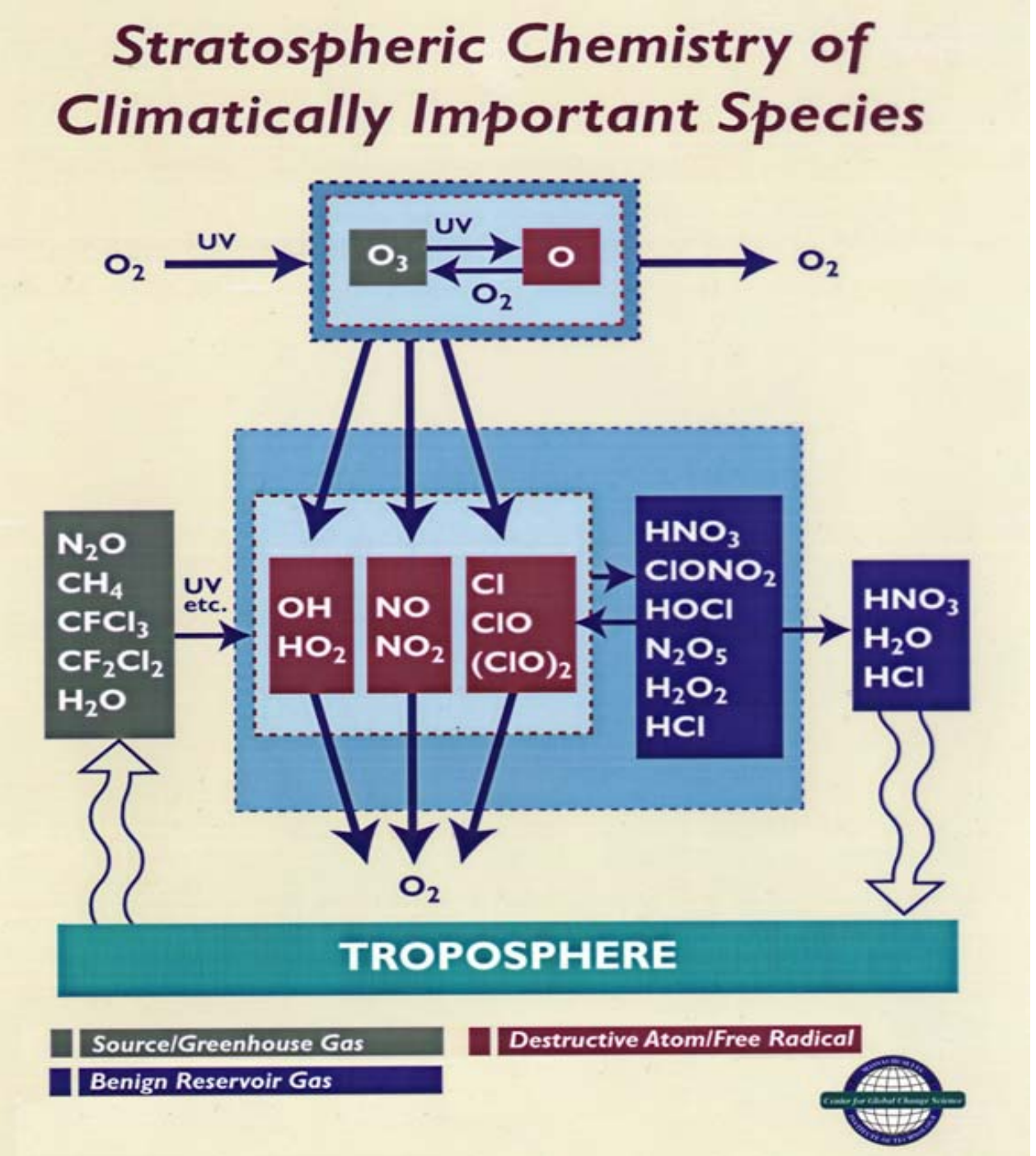
Efforts on Post-2012

- Within the FCCC
  - Bali Action Plan (Ad Hoc Working Group on Long-term Cooperative Action)
  - Seek incentives to save tropical forests
- Group of Eight (international summit)
- Bush meetings of large nations
- Bilateral negotiations
  - EU and China
  - US and many others (technical cooperation)

SCIENTIFIC ASSESSMENTS AS INPUTS TO POLICY

1. ***Scientific Assessment of Ozone Depletion***
   World Meteorological Organization (WMO)
   United Nations Environment Program (UNEP)
   Vienna Convention (1985) for Protection of the Ozone Layer

2. ***Intergovernmental Panel on Climate Change***
   (WMO-UNEP)
   Framework Convention on Climate Change



LEARNING FROM THE OZONE ASSESSMENT PROCESS

Image removed due to copyright restrictions: title page of Scientific Assessment of Ozone Depletion: 2006, World Meterological Organization.

Year	Policy Process	Scientific Assessment
1981		*The Stratosphere 1981 Theory and Measurements.* WMO No. 11.
1985	Vienna Convention	*Atmospheric Ozone 1985.* Three volumes. WMO No. 16.
1987	Montreal Protocol	
1988		*International Ozone Trends Panel Report 1988.* Two volumes. WMO No. 18.
1989		*Scientific Assessment of Stratospheric Ozone: 1989.* Two volumes. WMO No. 20.
1990	London Adjustments and Amendment	
1991		*Scientific Assessment of Ozone Depletion: 1991.* WMO No. 25.

Year	Policy Process	Scientific Assessment
1992		*Methyl Bromide: Its Atmospheric Science, Technology, and Economics* (Assessment Supplement). UNEP (1992).
1992	Copenhagen Adjustments and Amendment	
1994		*Scientific Assessment of Ozone Depletion: 1994.* WMO No. 37.
1995	Vienna Adjustment	
1997	Montreal Adjustments and Amendment	
1998		*Scientific Assessment of Ozone Depletion: 1998.* WMO No. 44.
1999	Beijing Amendment	
2002		*Scientific Assessment of Ozone Depletion: 2002.* WMO No. 47
2006		*Scientific Assessment of Ozone Depletion: 2006.* WMO No. 50

INTERGOVERNMENTAL PANEL ON CLIMATE CHANGE

Recognizing the problem of potential global climate change the World Meteorological Organization (WMO) and the United Nations Environment Programme (UNEP) established the Intergovernmental Panel on Climate Change (IPCC) in 1988. It is open to all members of the UNEP and WMO.

The role of the IPCC is to assess the scientific, technical and socio-economic information relevant for the understanding of the risk of human-induced climate change. It does not carry out new research nor does it monitor climate related data. It bases its assessment mainly on published and peer reviewed scientific technical literature.

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The IPCC has three working groups and a Task Force

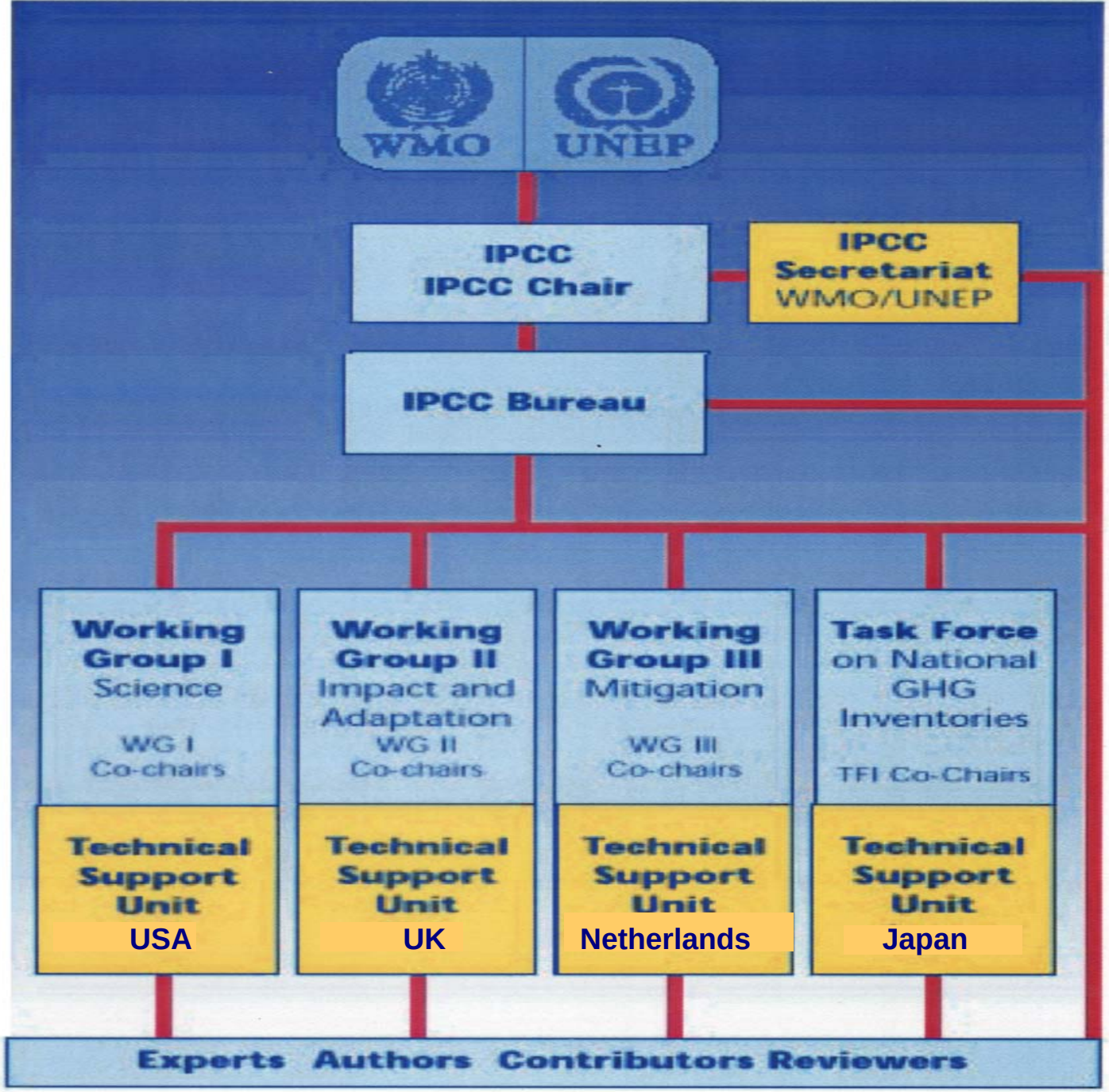
- ***Working Group I*** assesses the scientific aspects of the climate system and climate change.

- ***Working Group II*** addresses the vulnerability of socio-economic and natural systems to climate change, negative and positive consequences of climate change, and options for adapting to it.

- ***Working Group III*** assesses options for limiting greenhouse gas emissions and otherwise mitigating climate change.

- ***The Task Force*** on National Greenhouse Gas Inventories oversees the National Greenhouse Gas Inventories Programme

GLOBAL SCIENCE POLICY CHANGE MIT



Courtesy of the Intergovernmental Panel on Climate Change. Used with permission. http://www.ipcc.ch/about/chart.htm

List of Major IPCC Reports

Climate Change 2001: The Scientific Basis - Contribution of Working Group I to the IPCC Third Assessment Report
2001

Climate Change 2001: Impacts, Adaptation and Vulnerability - Contribution of Working Group II to the IPCC Third Assessment Report
2001

Climate Change 2001: Mitigation - Contribution of Working Group III to the IPCC Third Assessment Report
2001

Climate Change 2001: IPCC Third Assessment Synthesis Report
2001

Good Practice Guidance and Uncertainty Management in National Greenhouse Gas Inventories
2000

Emissions Scenarios - IPCC Special Report
2000

Land Use, Land-Use Change, and Forestry - IPCC Special Report
2000

Methodological and Technological Issues in Technology Transfer - IPCC Special Report
2000

Aviation and the Global Atmosphere - IPCC Special Report
1999

The Regional Impacts of Climate Change: An Assessment of Vulnerability - IPCC Special Report
1998

Implications of Proposed CO_2 Emissions Limitations - IPCC Technical Paper IV
1997

Stabilization of Atmospheric Greenhouse Gases: Physical, Biological and Socio-Economic Implication - IPCC Technical Paper III
1997

An Introduction to Simple Climate Models used in the IPCC Second Assessment Report - IPCC Technical Paper II
1997

Technologies, Policies and Measures for Mitigating Climate Change - IPCC Technical Paper I
1996

Climate Change 1995: The Science of Climate Change - Contribution of Working Group I to the IPCC Second Assessment Report
1996

Climate Change 1995: Impacts, Adaptations and Mitigation of Climate Change: Scientific-Technical Analyses - Contribution of Working Group II to the IPCC Second Assessment Report
1996

Climate Change 1995: Economic and Social Dimensions of Climate Change - Contribution of Working Group III to the IPCC Second Assessment Report
1996

Climate Change 1995: IPCC Second Assessment Synthesis of Scientific-Technical Information Relevant to Interpreting Article 2 of the UN Framework Convention on Climate Change
1996

Revised 1996 IPCC Guidelines for National Greenhouse Gas Inventories
1996

Climate Change 1994: Radiative Forcing of Climate Change and an Evaluation of the IPCC IS92 Emission Scenarios
1995

IPCC Technical Guidelines for Assessing Climate Change Impacts and Adaptations
1995

Climate Change 1992: The Supplementary Report to the IPCC Scientific Assessment - Report of the IPCC Scientific Assessment Working Group
1992

Climate Change 1992: The Supplementary Report to the IPCC Impacts Assessment - Report of the IPCC Impacts Assessment Working Group
1992

Climate Change: The IPCC 1990 and 1992 Assessments - IPCC First Assessment Report Overview and Policymaker Summaries, and 1992 IPCC Supplement
1992

Climate Change: The IPCC Scientific Assessment - Report of IPCC Working Group I
1990

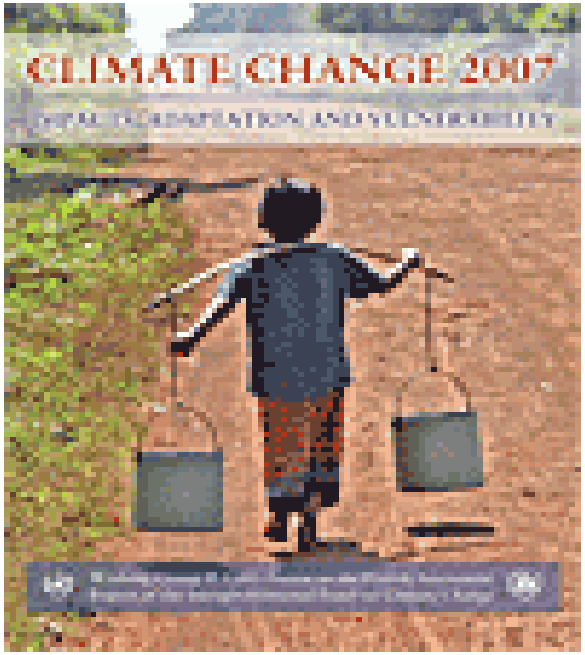
Climate Change: The IPCC Impacts Assessment - Report of IPCC Working Group II
1990

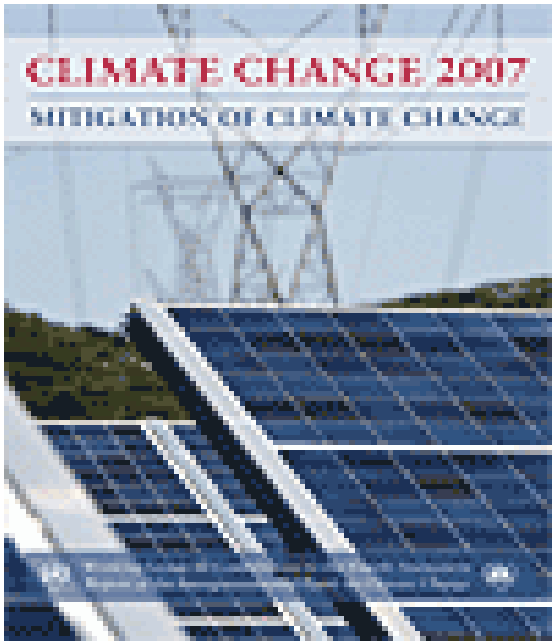
Climate Change: The IPCC Response Strategies - Report of IPCC Working Group III
1990

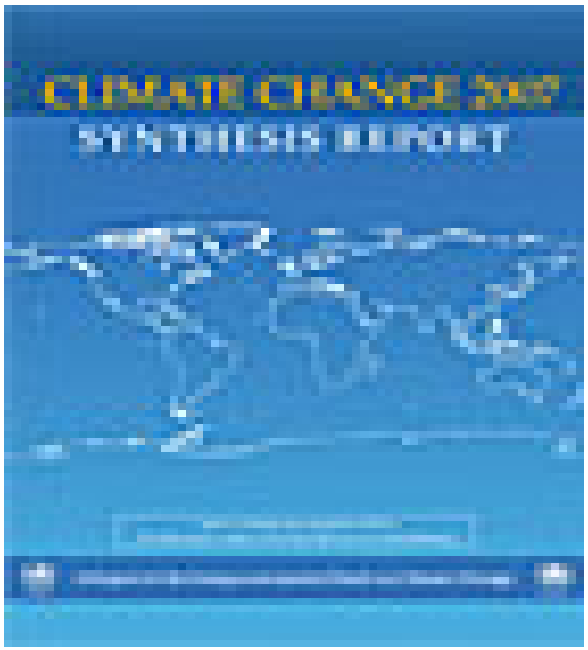
Enquiries: IPCC Secretariat, c/o World Meteorological Organization, 7bis, Avenue de la Paix, Case Postale 2300, 1211 Geneva 2, Switzerland

http://www.ipcc.ch/

THE PROCESS BEFORE THE FOURTH ASSESSMENT







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CLIMATE CHANGE 2007: The Physical Science Basis

Summary for Policymakers

A. HUMAN AND NATURAL DRIVERS OF CLIMATE CHANGE

➢ Global atmospheric concentrations of carbon dioxide, methane and nitrous oxide have increased markedly as a result of human activities since 1750 and now far exceed pre-industrial values determined from ice cores spanning many thousands of years. The global increases in carbon dioxide concentration are due primarily to fossil fuel use and land-use change, while those of methane and nitrous oxide are primarily due to agriculture.

➢ The understanding of anthropogenic warming and cooling influences on climate has improved since the *Third Assessment Report (TAR),* leading to ***very high confidence*** that the globally averaged net effect of human activities since 1750 has been one of warming, with a radiative forcing of +1.6 [+0.6 to +2.4] W m^{-2}.

B. OBSERVATIONS OF RECENT CLIMATE CHANGE

- Warming of the climate system is unequivocal, as is now evident from observations of increases in global average air and ocean temperatures, widespread melting of snow and ice, and rising global mean sea level.

- At continental, regional, and ocean basin scales, numerous long-term changes in climate have been observed. These include changes in Arctic temperatures and ice, widespread changes in precipitation amounts, ocean salinity, wind patterns and aspects of extreme weather including droughts, heavy precipitation, heat waves and the intensity of tropical cyclones.

- Some aspects of climate have not been observed to change: Diurnal temperature range, Antarctic sea ice extent, Antarctic atmospheric temperatures, meridional overturning circulation of the global ocean, tornadoes, hail, lightning and dust storms.

- Paleoclimate information supports the interpretation that the warmth of the last half century is unusual in at least the previous 1300 years. The last time the polar regions were significantly warmer than present for an extended period (about 125,000 years ago), reductions in polar ice volume led to 4 to 6 metres of sea level rise.

C. UNDERSTANDING & ATTRIBUTING RECENT CLIMATE CHANGE

- Most of the observed increase in globally averaged temperatures since the mid-20th century is ***very likely*** due to the observed increase in anthropogenic greenhouse gas concentrations. Discernible human influences now extend to other aspects of climate, including ocean warming, continental-average temperatures, temperature extremes and wind patterns.

- Analysis of climate models together with constraints from observations enables an assessed ***likely*** range (of 2 to 4.5^{o}C) to be given for climate sensitivity for the first time, and provides increased confidence in the understanding of the climate system response to radiative forcing.

D. PROJECTIONS OF FUTURE CLIMATE CHANGE

- For the next two decades a warming of about 0.2°C per decade is projected for a range of SRES emission scenarios. Even if the concentrations of all greenhouse gases and aerosols had been kept constant at year 2000 levels, a further warming of about 0.1° C per decade would be expected.
- Continued greenhouse gas emissions at or above current rates would cause further warming and induce many changes in the global climate system during the 21st century that would ***very likely*** be larger than those observed during the 20th century. (***Likely*** ranges are 2.4 to 6.4°C for a high emissions SRES scenario.)
- There is now higher confidence in projected patterns of warming and other regional-scale features, including changes in wind patterns, precipitation, and some aspects of extremes and of ice.
- Anthropogenic warming and sea level rise would continue for centuries due to the timescales associated with climate processes and feedbacks, even if greenhouse gas concentrations were to be stabilized.