Environmental Policy and Legislation

4201-431

ENVIRONMENTAL POLICY

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Lecture Topic 6: Climate Change
Part I + II

Lecture notes and further information:
http://www.uni-hohenheim.de/apo

OUTLINE TOPIC 6 – PART I (Introduction)

- **Main Environmental Problems and Causes**
  Focus: Climate Change
  - Climate Change – man made or natural causes?
  - The Enhanced Greenhouse Effect
  - Main Greenhouse Gases
  - International comparison of per capita emissions

OUTLINE TOPIC 6 – PART II

- **Main Environmental Problems and Causes**
  Focus: Climate Change
  - Consequences and Impacts of Climate Change
  - Policy Implications
- **International Climate Change Policy:**
  - Global Climate Change Strategies and The Kyoto Protocol

Main ENVIRONMENTAL PROBLEMS and CAUSES

Main environmental pollution/problems refer to:

- **Climate change**
- **Water resources**
- **Soil degradation**
- **Biodiversity**
- **Energy and resources**

⇨ Most environmental problems are traceable to the common property nature of environmental resources.

⇨ 'Pollution transcends borders', in other words protection of the environment has an international implication.

Main ENVIRONMENTAL PROBLEMS and CAUSES

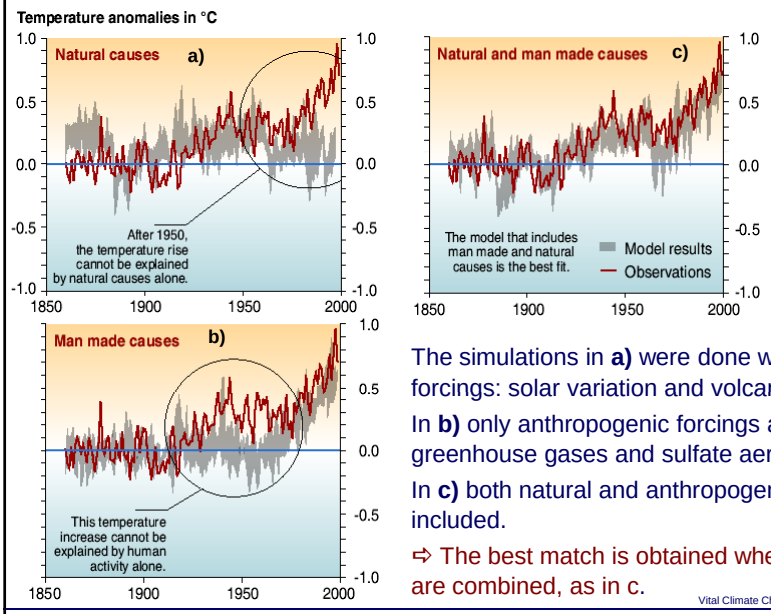
The underlying causes of environmental degradation….

….in general may be a result of the dynamic inter play of socio-economic, institutional and technological activities. Environmental changes may be driven by many factors including:

- *social factors:* such as population growth, poverty, and urbanization.
- *economic factors:* such as market failure, level and pattern of economic growth, intensification of agriculture, rising energy use and transportation etc.
- *institutional factors:* such as dependencies on other institutions, lack of integration and effective coordination etc.

⇨ The factors are acknowledged by the concept of sustainability.

Climate Change – man made or natural causes?



The simulations in **a)** were done with only natural forcings: solar variation and volcanic activity.

In **b)** only anthropogenic forcings are included: greenhouse gases and sulfate aerosols.

In **c)** both natural and anthropogenic forcings are included.

⇨ The best match is obtained when both forcings are combined, as in c.

Source: UNEP (2005): Vital Climate Change Graphics. www.vitalgraphics.net

Climate Change - The Enhanced Greenhouse Effect

- Greenhouse gases are a natural part of the atmosphere. As these gases accumulate in the atmosphere, they trap infrared radiation (heat) that could otherwise escape into the earth's atmosphere. Hence, the name greenhouse effect.
- Naturally occurring greenhouse gases include: water vapour, carbon dioxide, methane, nitrous oxide, and ozone. Without these gases the global average temperature would be around -19ºC.
- Problem: human actions are increasing concentrations of greenhouse gases ⇨ The more of these gases there are, the more heat is trapped ⇨ known as the enhanced greenhouse effect.

Climate Change - MAIN GREENHOUSE GASES

Name	Pre-industrial concentration (ppmv *)	Concentration in 1998 (ppmv)	Atmospheric lifetime (years)	Main human activity source	GWP **
Water vapour	1 to 3	1 to 3	a few days	-	-
Carbon dioxide (CO_2)	280	365	variable	fossil fuels, cement production, land use change	1
Methane (CH_4)	0,7	1,75	12	fossil fuels, rice paddies waste dumps, livestock	23
Nitrous oxide (N_2O)	0,27	0,31	114	fertilizers, combustion industrial processes	296
HFC 23 (CHF_3)	0	0,000014	260	electronics, refrigerants	12 000
HFC 134 a (CF_3CH_2F)	0	0,0000075	13,8	refrigerants	1 300
HFC 152 a (CH_3CHF_2)	0	0,0000005	1,4	industrial processes	120
Perfluoromethane (CF_4)	0,00004	0,00008	> 50 000	aluminium production	5 700
Perfluoroethane (C_2F_6)	0	0,000003	10 000	aluminium production	11 900
Sulphur hexafluoride (SF_6)	0	0,0000042	3 200	dielectric fluid	22 200

* ppmv = parts per million by volume, ** GWP = Global warming potential (for 100 year time horizon).

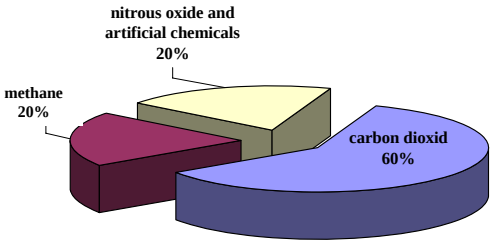
Global Warming Potential (GWP):

An attempt to provide policy makers with a means of comparing the relative climatic effects of the various greenhouse gases with that of an equivalent emission of CO_2.

Source: UNEP (2005): Vital Climate Change Graphics. www.vitalgraphics.net

Climate Change - MAIN GREENHOUSE GASES

Contribution of the greenhouse gases to the enhanced greenhouse effect:

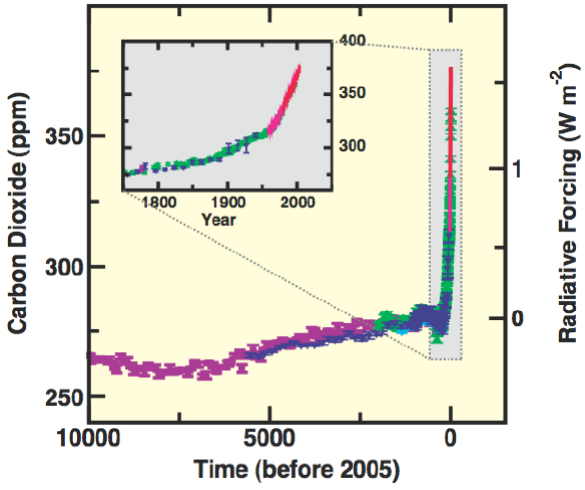


Source: United Nations Climate Change Secretariat

- ⇨ Carbon dioxide is by far the most important greenhouse gas.
- ⇨ In the last century, we have blown out more carbon than plants have been able to suck in, and the volume of carbon dioxide in the atmosphere has increased by 25%.

Climate Change
- Changes in GHGs from ice core and modern data

Atmospheric concentrations of CO_2 over the last 10,000 years (large panel) and since 1750 (inset panel).

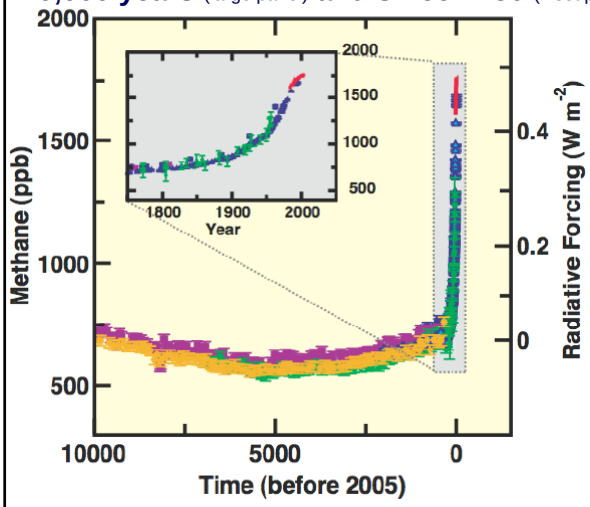


- Global atmospheric concentration of CO_2:
  - pre-industrial: ~ 280 ppm
  - in 2005: 379 ppm
- Natural range over the last 650,000 years as determined from ice cores: 180 to 300 ppm
- ⇨ Significant increase of CO_2-Concentration since industrialisation (> +30%).
- Primary source: fossil fuel use; also: land-use change

Source: IPCC, 2007: Climate Change 2007: The Physical Science Basis. Contribution of Working Group I to the 4th Assessment Report of the IPCC

Climate Change
- Changes in GHGs from ice core and modern data

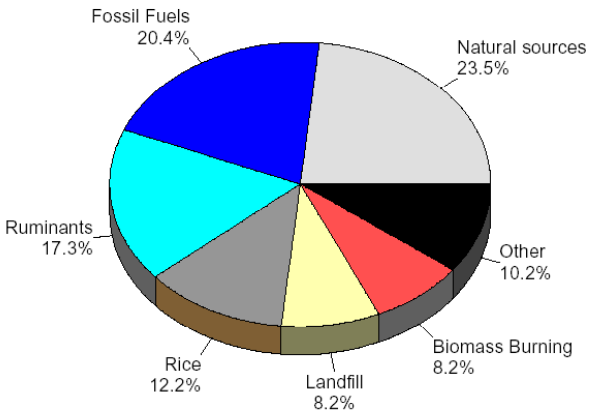
Atmospheric concentrations of Methane, over the last 10,000 years (large panel) **and since 1750** (inset panel)**.**



- Global atmospheric concentration of Methane:
  - pre-industrial: ~ 715 ppb
  - in 2005: 1774 ppb
- Natural range over the last 650,000 years as determined from ice cores: 320 to 790 ppb
- ⇨ Significant increase of CH_4-Concentration since industrialisation (> +145%).
- Primary source: agriculture and fossil fuel use

Source: IPCC, 2007: Climate Change 2007: The Physical Science Basis. Contribution of Working Group I to the 4th Assessment Report of the IPCC

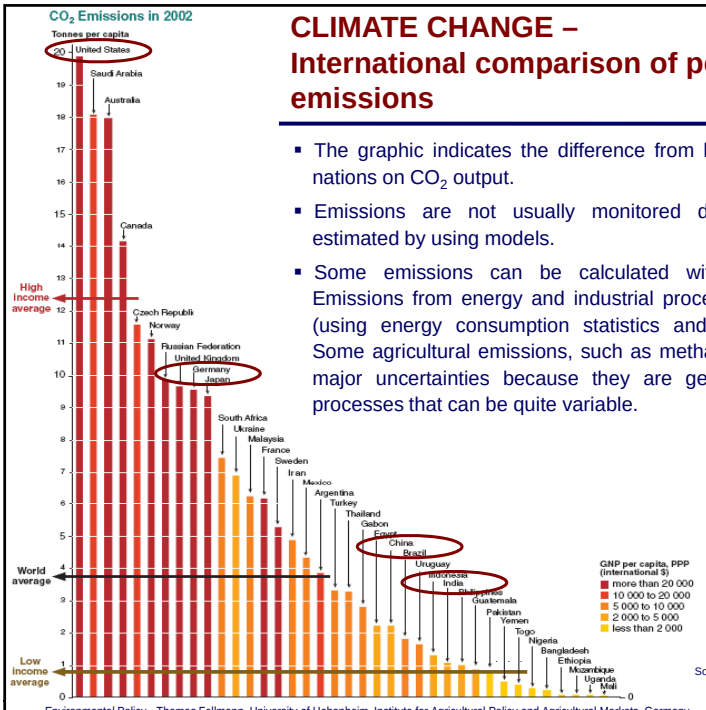
Climate Change -
Sources of global methane emission



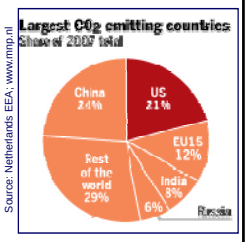
- More than 75% of current global methane emissions come from anthropogenic sources.
- Primary human sources are fossil fuel production/ consumption and agricultural activities.
- The primary natural methane source is emissions from wetlands.

Source: Carbon Dioxide Information Analysis Center, http://cdiac.esd.ornl.gov

CLIMATE CHANGE – International comparison of per capita emissions



- The graphic indicates the difference from high income to low income nations on CO_2 output.
- Emissions are not usually monitored directly, but are generally estimated by using models.
- Some emissions can be calculated with only limited accuracy: Emissions from energy and industrial processes are the most reliable (using energy consumption statistics and industrial point sources). Some agricultural emissions, such as methane and nitrous oxide carry major uncertainties because they are generated through biological processes that can be quite variable.



Source: Netherlands EEA; www.mnp.nl

Source: UNEP (2005): Vital Climate Change Graphics. www.vitalgraphics.net

OUTLINE TOPIC 6 – PART II

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Climate Change
- Consequences and Policy Implications

Reminder: The underlying causes of climate change….

- Ice cores are an excellent source of information on past global climates and atmospheric composition.

⇨ Antarctic ice cores indicate low concentration of CO_2 and methane during glacial periods and high concentration during interglacials.

⇨ Greenhouse gas changes correlate closely with temperature changes.

⇨ This suggests greenhouse gas changes have an important role in changes of global temperature.

Climate Change
- Consequences and Policy Implications

Consequences of climate change….

- Over the past 100 years, global mean temperature has increased by 0.6 °C (IPCC 2001) / 0,74 °C (IPCC 2007).
- The 1990s were the warmest decade over the past 150 years.
  - 11 out of the dozen years from 1995-2006 were among the 12 hottest years since 1850.
- Mean sea level has risen by 10 to 20 cm since the late 19th century.

- IPCC (2001): 'Overall, there is new and stronger evidence that most of the warming observed over the last 50 years is attributable to human activities.'
- IPCC (2007): 'Most of the observed increase in global average temperatures since the mid-20th century is *very likely* (i.e. > 90% probability), due to the observed increase in anthropogenic greenhouse gas concentrations.'

(Intergovernmental Panel on Climate Change (IPCC), www.ipcc.ch)

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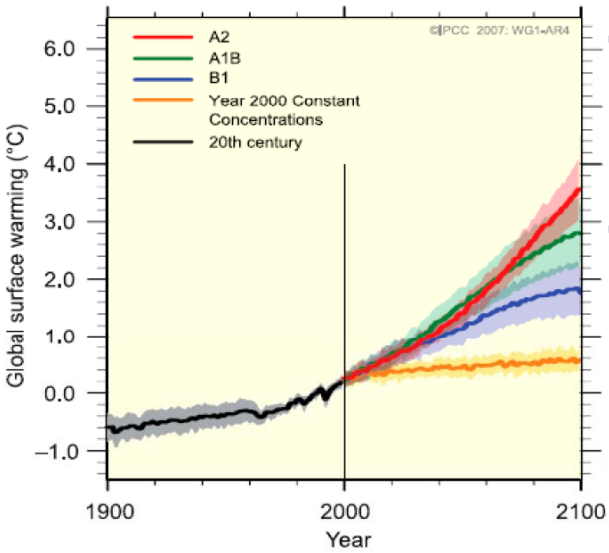
Climate Change – Consequences
Ranges for predicted surface warming

Multi-model averages and assessed ranges for surface warming



- Estimates for globally average surface air warming till 2100 range from 1.1-6.4°C (best estimate for the low scenario +1.8°C, for the high scenario +4.0°C).
- Even if GHG concentrations were to be stabilised, a further increase in global average temperature of about 0.6°C would still be expected.

IPCC: Climate Change 2007: Synthesis Report

Climate Change
- Consequences and Policy Implications

Consequences of climate change….

- A doubling of atmospheric carbon dioxide in about 60 years will *increase global temperatures*, although it is unclear by how much.

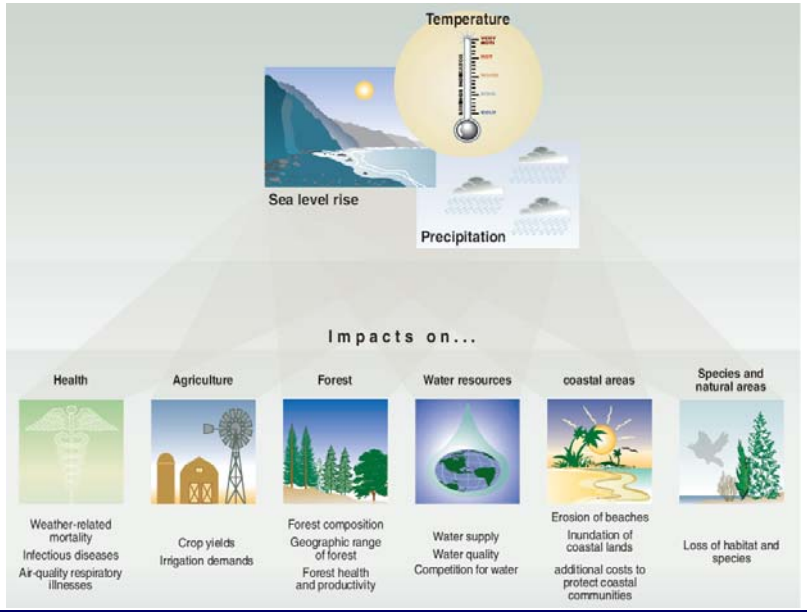
⇨ IPCC's range of predictions of the rise in the temperature by 2100 has increased from 1.4-5.8 °C (2001 report) to 1.1-6.4 °C (2007).

- Scientists expect total *rainfall to increase*, with some areas getting more and others less rain, with a likely negative effect on agricultural.
- *Sea levels will rise* (due to the thermal expansion of the oceans) and inundating the amount of land available for agriculture or living space.

Climate Change
- Consequences and Policy Implications

…heavier precipitation, more intense and longer droughts…

Potential CLIMATE CHANGE IMPACTS according to IPCC92 scenarios



Source: UNEP (2005): Vital Climate Change Graphics. www.vitalgraphics.net

Climate Change
- Consequences and Policy Implications

Impacts of climate change....

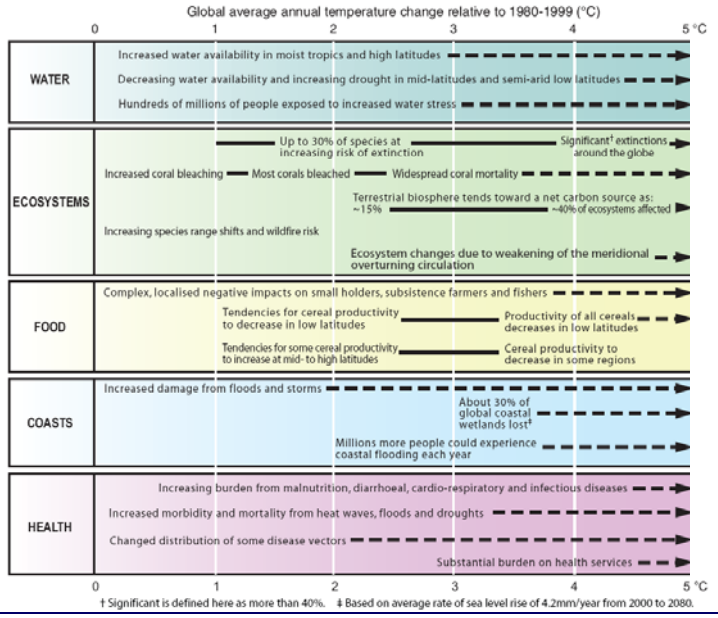
- Changing temperatures, precipitation and atmospheric composition affect *plants and animals*, both in managed and in unmanaged systems.
- The specialized are likely to loose, as are the marginalised.
- Climate change affects *water* (for drinking, irrigation, cooling), droughts and floods.
- Climate change affects *energy production and consumption*, tourism, construction, transport, labour productivity etc.

Climate Change
- Consequences and Policy Implications

Impacts of climate change....

- Sea level rise leads to *land loss and higher costs for coastal protection*, wetland loss, salt intrusion.
- Climate change also affects *human health*, through heat stress, cold stress, vector-borne diseases (malaria), other infectious diseases (cholera), water and food quantity and quality, air pollution, and extreme weather events.
- Example: Impacts on Agriculture ?

Examples of impacts associated with global average temperature change
(Impacts will vary by extent of adaptation, rate of temperature change and socio-economic pathway)



IPCC: Climate Change 2007: Synthesis Report, p.51

Climate Change
- Consequences and Policy Implications

POLICY OPTIONS TO ADDRESS CLIMATE CHANGE

Two categories of instruments need to be considered:

- *Domestic policy instruments:* to enable individual nations to achieve their specific targets/goals.
- *International policy instruments:* to allocate responsibility among nations.

Main criteria for the choice of policy instrument:

- cost effectiveness criterion (minimum aggregate costs)
- dynamic incentives for technology innovation & diffusion (lower costs over time)
- adaptability to economic & social changes
- distributional equity
- institutional (political and administrative) feasibility

Policy Options to Address Climate Change

Direct Regulation: “Command-and-Control”

⇨ The conventional approach to environmental problems in virtually all countries.

- Technology-based (or design) standards;
  - GCC example: requirements for energy efficient motors, combustion processes
- Performance-based standards;
  - GCC example: maximum allowable levels of CO2 emissions
- Typically not cost effective (in static, allocative sense)
- Do not provide dynamic incentives for development, adoption, and diffusion of superior technologies

Policy Options to Address Climate Change

Market-Based Policy Instruments

⇨ Because of great anticipated costs, much attention is given to market-based instruments

- Market-based instruments can be cost-effective, provide dynamic incentives, and address concerns about distributional equity

⇨ Examples:
1. Domestic Carbon Taxes
2. Domestic Tradeable Permits
3. Domestic Hybrid Instrument

Policy Options to Address Climate Change

1. Domestic Carbon Taxes

- Fossil-fuel carbon tax, combined with sequestration tax credit (linked with land use changes)
- Note: CO2 emissions roughly proportional to carbon content (unlike SO2 and sulfur content)
- Tax $100/ton of carbon could cut CO2 emissions by 20%: 240% increase in price of coal; 72% increase in price of oil; 86% increase in price of natural gas. Average 30% increase in residential electricity prices.
- Economic effects depend on use of revenues

Policy Options to Address Climate Change

2. Domestic Tradeable Permits

- Fossil-fuel carbon rights, held by fuel producers and importers
- Like carbon tax, can be linked with sequestration
- Can be distributed freely (“grandfathering”) or by auction
- Auction revenue - like tax revenue - can be used to reduce pre-existing distortionary taxes

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Policy Options to Address Climate Change

3. Domestic Hybrid Instrument

- Combination of price and quantity instrument
- Tradeable permits combined with government offer to sell additional permits at stated price
- That price becomes an abatement-cost ceiling
- Reduces cost uncertainty, but maintains political attraction of the tradable permits approach
- Called *"safety-valve" system*

Policy Options to Address Climate Change

INTERNATIONAL INSTRUMENTS

- Greenhouse problem is fundamentally global
- In addition to considering how an individual nation might seek to achieve a domestic target, ...
  - How could the community of nations seek to address some collective target?
  - How could the responsibility for meeting a collective target be allocated among individual nations?
- We consider two international instruments
  1. International Carbon Taxes
  2. International Tradeable Permits

Policy Options to Address Climate Change

International Carbon Taxes

- One possibility: a carbon tax imposed on nation states by an international agency
  - Need tax rate & formula for revenue allocation
  - What agency could really impose & enforce?
- An alternative: harmonized domestic carbon taxes.
  - Stipulates same tax level for all nations
  - Provides for specified payments (from rich to poor countries for distributional equity)

Policy Options to Address Climate Change

International Tradeable Permits

- Coalition countries receive permits for net emissions
- Allocation criteria: GNP, population
  - will have adherents (those with larger allocation costs)
- Whatever initial allocation, trading can lead to C/E (if small TCs); can pursue C/E and equity objectives
- Problem:
  - Are countries cost-minimizers?
  - Do countries have MC information?
  - Possible solution: all countries use domestic TP system, and allow firm-firm international trading
  - But: what about domestic sovereignty of instrument choice?

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Policy Options to Address Climate Change

Implementation Issues: ***Free-Riding*** *and* ***Emissions Leakage***

- Question: can a unilateral or multilateral policy (by a group of cooperating countries) be effective in abating global greenhouse gas emissions?

⇨ Answer depends on how non-cooperating nations respond: free-riding and leakage can undermine any initiative, market-based or conventional.

Free-riding ⇨ arises when countries that do not contribute to abatement still benefit from global abatement.

- Voluntary participation in international agreement gives free-riding incentive → below-optimal global abatement.
  - Threatened trade sanctions could support fuller participation
  - But: introduces distortions in global economy

Policy Options to Address Climate Change

Emissions Leakage

⇨ arises when abatement by cooperating countries alters world relative prices and thus leads non-cooperating countries to increase their emissions.

Two channels:

1. An agreement may shift comparative advantage in production of carbon-intensive goods towards non-participating countries ...
   ⇨ so production of these goods and hence CO2 emissions rise outside coalition.
2. A unilateral policy may lower demand for carbon-intensive fuels, and so reduce world price for fossil fuels ...
   ⇨ and so demand for these fuels (and CO2 emissions) can rise outside coalition.

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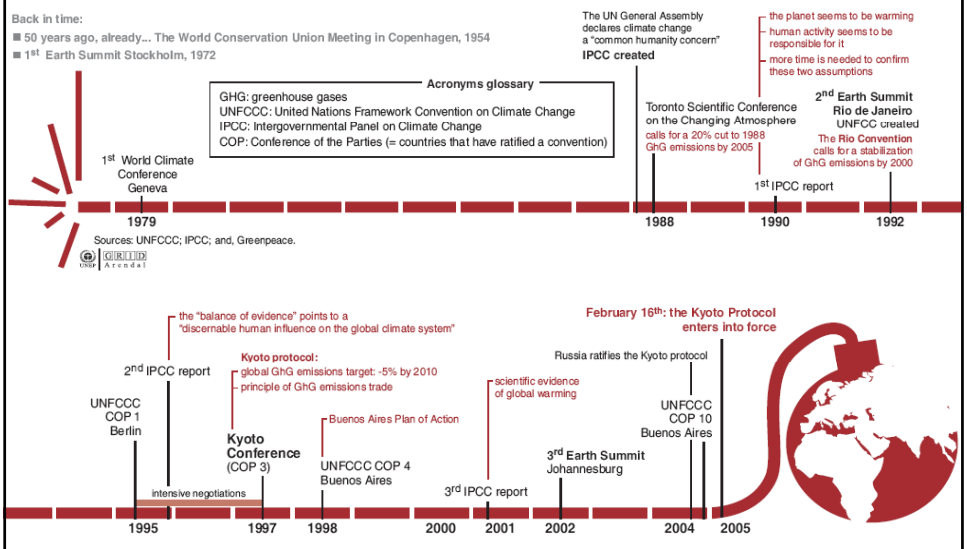
Policy Options to Address Climate Change

What can be done to reduce Emissions Leakage?

⇨ Set tariffs to reduce comparative advantage effect...

- But tariff (subsidy) has to be set proportionately to carbon-intensity of every product.
- Further, whether the welfare loss (distortions) caused by tariffs are greater or less than the welfare loss reduced by cutting emissions leakage is an open question.
- Finally, such border tax adjustments pose other problems, one of which is possible conflict with multilateral trading rules.

CLIMATE CHANGE and the INTERNATIONAL COMMUNITY



Source: UNEP (2005): Vital Climate Change Graphics. www.vitalgraphics.net

The International Response to Climate Change

The Kyoto Protocol

- The Kyoto Protocol is an agreement made under the *United Nations Framework Convention on Climate Change* (UNFCCC)
- Countries that ratify this protocol commit to reduce their emissions of CO2, CH4, N2O, SF6 ,HFCs and PFCs or engage in emissions trading if they maintain or increase emissions of these gases.
- Objective:
  "stabilization of greenhouse gas concentrations in the atmosphere at a level that would prevent dangerous anthropogenic interference with the climate system"

The International Response to Climate Change

The Kyoto Protocol

- The Kyoto Protocol sought a 5.2 % reduction in overall (carbon-equivalent) greenhouse gas emissions by 2008-2012 commitment period relative to 1990.
- Target applies collectively only to industrialised economies
  - developing countries have no mandatory targets.
- Target is differentiated between industrialised countries

⇨ Note that the actual reductions negotiated under the Kyoto Protocol were changed in subsequent negotiations and are *now smaller* than the 5.2% originally agreed

⇨ In addition, in 2001 the USA has refused to ratify the treaty

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The International Response to Climate Change

Emission Reduction Commitments under the Kyoto Protocol

(% Reductions 2008-12 relative to 1990, for six greenhouse gases)

Country	Kyoto-Target
EU-15, Bulgaria, Czech Republic, Estonia, Latvia, Liechtenstein, Lithuania, Monaco, Romania, Slovakia, Slovenia, Switzerland	- 8%
USA*	- 7%
Canada, Hungary, Japan, Poland	- 6%
Croatia	- 5%
New Zealand, Russian Federation, Ukraine	0
Norway	+ 1%
Australia	+ 8%
Iceland	+ 10%

The International Response to Climate Change

European Union Burden Sharing Agreement (EU-15)

Country	Emission Reduction %
Austria	-13
Belgium	-7.5
Denmark	-21
Finland	0
France	0
Germany	-21
Greece	+25
Ireland	+13
Italy	-6.5
Luxembourg	-28
Netherlands	-6
Portugal	+27
Spain	+15
Sweden	+4
United Kingdom	-12.5

(% Reductions 2008-12 relative to 1990, for six greenhouse gases)

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The International Response to Climate Change

Country	2010 projected CO2	2010 Kyoto target	Scale of emission reduction required
USA	1724	1244	480
Canada	151	110	41
Australia	101	78	23
N Zealand	11	7	4
Japan	311	273	38
Austria	18	14	4
Belgium	34	28	6
Denmark	12	12	0
Finland	21	15	6
France	110	103	7
Germany	244	212	32
Greece	37	25	12
Ireland	12	10	2
Italy	136	109	27
Luxembourg	2	2	0
Netherlands	45	41	4
Portugal	18	15	3
Spain	78	71	7
Sweden	17	18	-1
UK	173	137	36

Scale of Emission Reductions for CO2:
2010 targets relative to 2010 'Business as Usual' (million tonnes carbon)

The International Response to Climate Change

The Kyoto Protocol

- Kyoto was only one step; Administration says it was a good first step; others disagree.
- Real question is: what is the next step?
- What was next after Kyoto?
- Greater Public Understanding Needed
  - Debates have been dominated by advocates claiming either "costless reduction," on the one hand, or "economic catastrophe" on the other.
  - Best analysis indicates that neither view is correct.
- So, better understanding is needed of real benefits and real costs of climate policies.

The International Response to Climate Change

The Kyoto Protocol

- Kyoto Protocol (1997) has come into force (February 16, 2005)

⇨ Despite lack of participation by United States, numerical requirement was achieved.

⇨ Ratification requirement: 55 nations, 55% of 1990 industrialized world emissions

- All countries except U.S. = 63.9%
- All except U.S. & Australia = 61.8%
- All except U.S., Australia, & Canada = 58.5%
- All except U.S., Australia, & Japan = 53.3%
- All except U.S., Australia, & Russia = 44.4%

The International Response to Climate Change

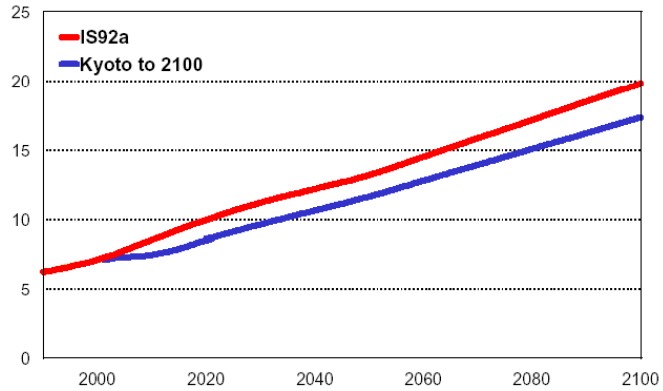
The Kyoto Protocol

- Impacts of KP (2008-2012) will be much less than originally anticipated
- Largest emitter not participating
- Rules written in Bonn & Marrakech (2001) reduced targets
  - Kyoto Protocol: 13% emission reduction by 2050 (relative to 1990)
  - Without U.S.: 3-5% emission reduction by 2050
  - New rules: 1-2% emission reduction by 2050

⇨ Whether or not even with a full-blown KP coming into force, there would/will be virtually no impact on global climate change.

GLOBAL CO2 EMISSIONS

GLOBAL CO2 EMISSIONS: Kyoto Scenarios vs IS92a



- CO2 emissions are projected to rise in the future under a business-as-usual scenario (IS92a).
- Full implementation of the Kyoto Protocol will not significantly reduce future emissions of CO2.

The International Response to Climate Change

The Kyoto Protocol

⇨ Scientific consensus is increasing of likely future climate change due to anthropogenic emissions of CO2, methane, and other greenhouse gases.

⇨ And economic analysis increasingly points to wisdom of ⇨ some kind of policy action.

Summary:

KP came into force without U.S. participation, effects on climate change will be virtually non-existent, scientific and economic consensus point to the need for a credible approach.

⇨ What can be done?

The International Response to Climate Change

What Can Be Done?

⇨ **A credible and effective *international* approach is needed.**

- United Nations Framework Convention on Climate Change (1992), signed by 161 nations and ratified by 50 (including U.S.), entered into force in 1994.
- UNFCCC provides a sensible foundation, established principle of "common but differentiated responsibilities:"
  - all nations must engage in solution (because of the global commons nature of the problem),
  - but different countries can participate in different ways.

The International Response to Climate Change

⇨ Can the Kyoto Protocol Provide the Way Forward?

Three Major Architectural Elements in KP

1. targets apply only to industrialized nations;
2. ambitious, short-term emission reduction targets, but no long-term target;
3. flexibility provided through market-based mechanisms, such as tradeable permits.

KP Architecture has been criticized:

⇨ Imposes high costs, effectively forbids developing country participation

⇨ Generates *modest* short-term climate benefits, *fails* to provide long-term solution

⇨ **Is there a better way forward?**

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The International Response to Climate Change

What can be done?

⇨ **A credible approach based on sound science, rational economics, and pragmatic politics**

Three-Part Global Climate Policy Architecture

1. **All nations involved:**
   economic trigger mechanism, plus growth targets
2. **Long-term targets:**
   short-term firm but moderate, long-term flexible but stringent
3. **Market-based policy instruments:**
   emissions trading, carbon taxes, and hybrids

A Three-Part Global Climate Policy Architecture

Part 1: All nations must be involved

⇨ important that *all countries* participate:
Global commons nature of the problem calls for a multi-national, if not fully global, approach

⇨ *developing countries must be fully involved*, because:

a. developing countries will account for more than half of global emissions by 2015, if not before;

b. developing countries provide the greatest opportunities *now* for relatively low-cost emissions reductions now;

c. if developing countries are not included, comparative advantage in carbon-intensive goods/services will shift, making developing economies *more* carbon-intensive, increasing their costs of joining coalition later.

A Three-Part Global Climate Policy Architecture

Part 1: All nations must be involved

- ⇨ But we can not expect developing countries to *pay* in short term: very costly, would retard their development
- ⇨ So, they must be included on an *equal* footing in terms of *targets*, but can't be expected to pay: "they must get on the train, but need not pay for their tickets"

A Three-Part Global Climate Policy Architecture

Four elements to include LDC's in global climate policy

1. Mechanism for *voluntary accession* of developing countries into group which take on binding commitments
2. *Trigger mechanism* whereby developing countries are *obligated* to take on binding commitments once per capita GDP reach an agreed levels
3. *"Growth targets"* that become more rigorous as they become wealthier
4. Well-designed *international tradeable permit program*

A Three-Part Global Climate Policy Architecture

Part 2: Long-term targets and timetables

- *Long-term problem:* GHGs remain in atmosphere for decades to centuries
- *But:* Kyoto Protocol has only *short-term* targets
  - Average 5% reduction from 1990 levels by 2008-2012 = 30% reduction for U.S. from business-as-usual emissions
  - Targets are both ***too little and too fast****:* do little about problem, but unreasonable for countries with significant economic growth post-1990.

A Three-Part Global Climate Policy Architecture

Part 2: Long-term targets and timetables (cont.)

- So, two elements are needed:
  - Firm, but *moderate* targets in *short-run* (to avoid premature capital obsolescence)
  - Flexible, but more *stringent* targets for *long-term* (to motivate *now* needed technological change)
- Consistent with estimates of least-cost emissions path for achieving long-term concentration-targets: short-term emission increases, just slightly below business-as-usual path, subsequent emissions reductions (not inconsistent with some “politics as usual”).

Environmental Policy - Thomas Fellmann, University of Hohenheim, Institute for Agricultural Policy and Agricultural Markets, Germany

A Three-Part Global Climate Policy Architecture

Part 3: Market-based policy instruments

⇨ Third key element already is part of the Kyoto Protocol: *work through the market* rather than against it.

- Conventional regulatory approaches cannot do the job, certainly not at acceptable cost.
- To keep costs down in the short term and bring them down even *lower* in long term *through technological change*,
  ⇨ embrace market-based instruments as chief means of reducing greenhouse gas emissions.

A Three-Part Global Climate Policy Architecture

Part 3: Market-based policy instruments (cont.)

⇨ For some countries *domestically*, system of tradeable permits might be used to achieve national targets.

- Same mechanism used in U.S. to eliminate leaded gasoline from the market in the 1980's at a savings of over $250 million per year;
- Same mechanism now used in U.S. to cut SO2 emissions by half, at savings of $1 billion/year.

⇨ For other countries, system of domestic carbon taxes may be more attractive (depends upon domestic politics).

Environmental Policy - Thomas Fellmann, University of Hohenheim, Institute for Agricultural Policy and Agricultural Markets, Germany

A Three-Part Global Climate Policy Architecture

Part 3: Market-based policy instruments (cont.)

⇨ Another promising market-based approach: *hybrid* of tax and tradeable-permit system

- Ordinary tradeable permit system, plus government promise to sell additional permits at stated price.
- Creates price (and cost) ceiling -- "safety-value system"

⇨ *International* policy instruments are also required

- International System of tradeable permits can bring down costs to 25% of what they otherwise could be.
- Must be designed to facilitate integration with domestic policies, including domestic tradeable permits.

⇨ Lots of other problems, but "Churchill on democracy"

Tradable Permit Systems - International Linkage

⇨**Tradable Permit Systems emerge as the favored approach worldwide:**

- Several GHG Tradable Permit Systems Have Already Emerged:
  - European Union's Emissions Trading Scheme (EU ETS)
  - Regional Greenhouse Gas Trading Initiative (RGGI)
  - Cap-and-Trade in Norway, Switzerland, and others
  - Clean Development Mechanism (emission reduction credit system)
- Additional Systems Are Likely to Emerge:
  - Australia
  - Canada
  - Japan
  - United States: U.S. Congress, AB 32 in California

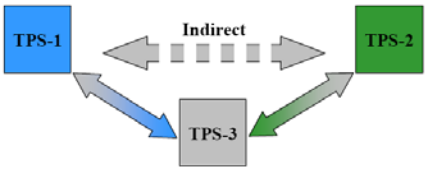
Tradable Permit Systems - International Linkage

How can the different Tradable Permit Systems be linked?

- Direct or indirect connections among tradable permit systems that allow emission reduction efforts to be redistributed across systems

- *Direct linkage:* One or both systems recognize the other's allowances for compliance (can be unilateral/one-way or bilateral/two-way)

- *Indirect linkage:* Allowance supply and demand in one system affects S & D in another through direct links with a common system



Source: IETA (2007): Linking Tradable Permit Systems for Greenhouse Gas Emissions, p.11

Tradable Permit Systems - International Linkage

What are the *potential benefits* of linkage?

- Cost savings (due to price convergence)
- Larger, more liquid markets can reduce transaction costs, reduce concerns about market power, and reduce price volatility
- Can allow for FCCC's "common but differentiated responsibilities" without sacrificing cost-effectiveness

What are the *concerns* about linkage?

- Can increase overall emission (through additionality) or decrease overall emissions (by reducing leakage)
- Automatic propagation of cost-containment provisions from one cap and-trade system to another (banking, borrowing, safety-valve)
- Nations have reduced control over allowance prices, emissions impacts, etc.

Tradable Permit Systems - International Linkage

Bottom Line on Linkage

- Two-way links between cap-and trade systems will be challenging
  - automatic propagation of cost containment design elements
  - needs harmonisation of some design elements
  - needs mutual recognition of targets
- In short term, indirect links among cap-and-trade systems (via one-way links with CDM) can achieve much of the near-term cost-savings and risk diversification without design propagation.
- Such linkage may be the de facto, if not de jure, (bottom-up) post-Kyoto international policy architecture.

For further information see:
IETA (2007): Linking Tradable Permit Systems for Greenhouse Gas Emissions: Opportunities, Implications, and Challenges