Climate Change Economics and Policy: Mitigation and Adaptation

Andy Keeler

John Glenn School of Public Affairs

The Ohio State University

IPROMO Mountain Environment and Global Change Course

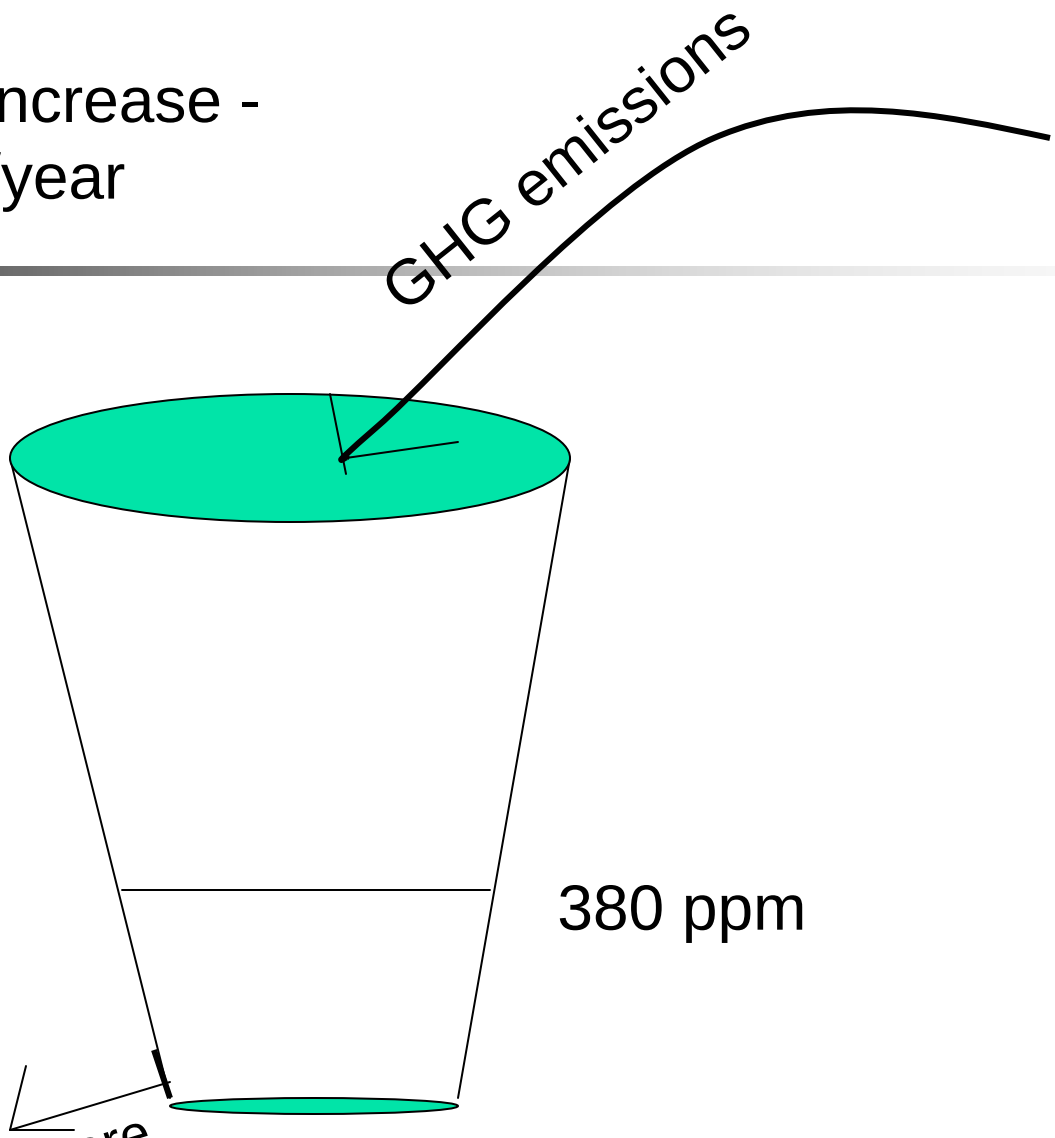
What I Hope Everyone Remembers When I'm Done

- The difference between mitigation and adaptation in climate policy
- The kinds of actions governments can take to lower GHG emissions
- Carbon trading, offsets, and developing countries

Bare Essentials - Science

- Make policy based on the probability distribution of peer-reviewed climate science
  - High probability of human-induced climate change
  - Significant expected damages that are an increasing function of
    - Atmospheric concentration
    - Rate of Change

Current net increase -
1.5 - 2 ppm /year



It’s a Stock

- Location of Emissions Does Not Matter
- Timing of Emissions Matters, but very little within a decade or so
- **Stabilizing Concentrations is very difficult - freezing or cutting emissions by 50% won’t do it**

Climate Policy: Mitigation and Adaptation

- **Mitigation** is the jargon for reducing the risks of climate change by reducing anthropogenic climate forcings
  - Reduced CO2 emissions
  - Increased carbon sequestration
  - Reduced emissions of methane, nitrous oxide, and other GHGs

Climate Policy: Mitigation and Adaptation

- Adaptation is what people do to react to climate change

- any adjustment in natural or human systems in response to actual or expected climatic stimuli or their effects, which moderates harm or exploits beneficial opportunities. The objective of **adaptation** is to reduce vulnerability to climatic change and variability, thereby reducing their negative impacts.

Climate Policy: Mitigation and Adaptation

- Mitigation is a global public good – reducing emissions in one location benefits the entire world
- Adaptation is much more local – reducing vulnerability to negative effects benefits the people that make the investment

Climate Policy: Mitigation and Adaptation

- Mitigation has gotten the greatest share of attention –the Kyoto Annex 1 caps, the European Trading System, the US legislative proposals
- Adaptation is widely agreed to be essential – but little actual money has been spent nor specific policies considered

Climate Policy: Mitigation and Adaptation

- Mitigation policy takes place at all levels
- Adaptation policies are much more place-specific

Mitigation Basics

- Basic tasks are well understood
  - Change economic incentives and technical standards to reduce GHGs
  - Change behavior and attitudes towards energy use and GHG emissions
  - Drastically increase research and development into low- and zero-carbon energy technology

  => easy to list, very hard to do politically at all levels

It’s the Long Run That Matters

Energy systems take a long time to change

Mitigation Basics

- Risks are a function of atmospheric GHG concentrations and rate of change, so
  - Mitigation is not a 0/1 proposition – more mitigation means lower risks
  - Starting NOW makes sense
- Huge literature
- Enormous amount of public attention
- Clearly defined metrics (although their meaning is far from clear)

Mitigation Goals – Emissions Targets

- Annual and Long-term limits on GHG emissions
  - International targets
  - National targets

- => Everyone agrees they are needed; no one knows how to bring them about or what they should be

What can international agreements / policy do?

- Encourage commitments to national policies
- Coordinate national policies
  - Equity
  - Efficiency
- Transfer technology, capacity, and resources

What can international agreements / policy NOT do?

- Mandate specific actions
- Create legally enforceable commitments
- Coerce or require particular policies
- Enforce treaty provisions with the force of law

The Framework Convention

- Ratified by 188 Countries, including the US
- Sets forth aspirational goals and basic principles
- Framework for coordinating international actions and negotiating specific agreements

The Kyoto Protocol

- Negotiated under the framework convention
- Rich countries and EITs take on quantitative GHG limits for 2008-2012
- Limits based on 1990 emissions
- Poor countries make no binding commitments

The Kyoto Protocol

- Emissions trading architecture
- Some Opt-ins for Sequestration and Developing Countries
- No direct mandating of specific policies and measures
- No binding quantitative commitments to R&D Expenditures

Policy Toward Kyoto under Clinton

- Administration support for the “right” rules that limit economic costs and engage developing countries
  - Unfettered flexibility mechanisms
  - Expansive reading of sinks provisions
  - Non-Draconian compliance / liability system

Negotiating Kyoto

- 1997 - 2000: serious disagreements about
  - emissions trading limits
  - measurement of carbon sequestration
  - penalty/compliance procedures

The man responsible for overcoming these to achieve ratification was…

US Withdrawal

- Created unity through anger
- EC made major concessions
- Expected emissions allowance price dropped sharply

Current Status of Kyoto

- Ratified
- European countries have made significant efforts in non-transportation sectors
- Other rich countries have mainly talked about doing something (Canada, Japan)
- The only way targets will be met is with significant use of Russian allowances

Problems with Kyoto

- Short time horizon “too little, too fast”
- Enforcement
- Non-universal participation in mandatory reductions
- Very little about adaptation
- Very little engagement of developing countries

Virtues of Kyoto

- ** It's a Start **
  - Concrete steps
  - Institution building
  - Policy learning
  - Creates expectations of more stringent future limitations
- Explicit recognition of cost and efficiency issues

Centrality of the US

- As the largest emitter and the largest economy, international progress requires US participation
- As a critic of Kyoto, the most constructive step the US could take is a strong national GHG mitigation policy

The Road to Copenhagen

- There is tremendous desire to have an agreement reached in the December 2009
  - Rich country targets
  - Developing country actions
- Right now no one knows whether there will be an agreement, and what it will consist of

National Policies – Rich Countries

- Putting a price on emissions
  - Taxes
  - Cap-and-trade
- Policies and measures
  - Mandates and standards
  - Information
- Technology development

Putting a price on emissions

- GHG emissions are an *externality* – people do not take the risks of climate change into account when they decide to burn fossil fuels, emit methane, etc.
- If people have to pay when they emit, they will do less

GHG Taxes

- Some experience *for some sectors* in Europe
- Comprehensive tax in British Columbia, Canada
- Politically difficult to implement

Cap and Trade (Emissions Trading, Carbon trading)

- Set an overall limit on GHG Emissions
- Create a system of permits (allowances) consistent with this cap
- To emit a unit of GHGs, you must possess and surrender a permit
- Permits can be bought and sold for whatever price is agreed upon between buyers and sellers

Cap and Trade (Emissions Trading)

- Works by creating a price for CO2 emissions
- This price increases the cost of fossil energy use,both directly and in product markets
- “Making the market tell the truth”
- Program details determine what “truth” we put into practice

Cap and Trade (Emissions Trading)

- Allows cost-effective reductions and flexibility
- Gives clear incentives and price information
- Has been very successful in programs to limit sulfur dioxide and nitrogen oxides
- Central to the Kyoto Protocol and EU policy
- Has wide support among industry and environmentalists in Europe and the US

Emissions Trading is a tool - What it Accomplishes Depends on Its Design

- What is the Cap?
  - **How stringent** - determines how much GHGs will be reduced
  - Can be based on
    - Emissions History
    - Emissions Intensity
    - External criteria (international agreements)
- More stringent caps => higher permit prices => higher energy costs

Coverage

- The more of the economy that is covered by the system
  - The more emissions are brought under the control of quantitative regulation
  - The lower the cost of any given level of emissions reductions
  - Key factor is coverage of transportation (something the EU has yet to do)

Non-CO2 GHGs

- Methane and N2O are significant contributors to climate forcing in the atmosphere
- Cost-effective opportunities exist to reduce these emissions

Offsets and Emissions Trading

- Emissions trading limits the ***covered*** companies and sectors to a particular cap
- **Offsets** allow the covered entities to exceed the cap by offsetting these emissions with reductions from *non-covered companies and sectors*

Offsets: Example

- Electric Utilities are allowed 200 million metric tons of CO2 per year
- Brazil invest in a carbon sequestration project that takes 10 million tons of CO2 out of the atmosphere
- Some recognized entity approves and certifies the Brazilian sequestration

Offsets: Example

- Brazil sells 10 million tons of CO2 credits to US utilities for a mutually agreed upon price
  - Which may or may not be identical to the domestic CO2 price, depending on market rules and limitations

Offsets: Example

- US utilities now emit 200 million + 10 million = 210 million tons of CO2
- Brazil reduces atmospheric carbon by 10 million tons
- Net emissions are identical
- Overall costs go down as long as the Brazilian sequestration is less expensive than further utility emissions reductions

Sources of Offsets

- Biological and terrestrial sequestration
  - Domestic
  - Foreign
- Non-CO2 gasses
  - Methane
  - Nitrogen oxides

Sources of Offsets

- Non-covered CO2 emissions
  - Foreign energy projects
  - Domestic non-covered sectors (e.g. transportation)
  - Early action credits

Virtues of Offsets

- Creates a price for emissions in otherwise uncovered sectors
- Funds sequestration projects with a revenue source from outside government
- Reduces overall costs of emissions reductions

Issues with Offsets

- Additionality
- Leakage
- Permanence

- System Evolution

Additionality

- Does the offset actually represent reduced emissions relative to what would have been observed without the offset system?
  - Baseline - including policy?
  - Profitability tests and measures
  - Proving the counterfactual

Leakage

- Does the offset bring about greater emissions somewhere else
  - Example of forest sequestration - does harvest move elsewhere
  - Energy Example - if a country builds a wind farm and also builds a coal plant, do you credit the wind farm?
- The easiest solution for leakage is comprehensive coverage

Permanence

- Particularly a concern for sequestration - does sequestered carbon remain sequestered?
- If not, how is it accounted for in the trading system

Offsets: Example

- Electric Utilities are allowed 200 million metric tons of CO2 per year
- Brazil invest in a carbon sequestration project that takes 10 million tons of CO2 out of the atmosphere
- Ten years later, Brazil cuts down most of the forest and releases 9 million tons of CO2

Offsets: Example

- US utilities now emit 200 million + 10 million = 210 million tons of CO2
- Brazil reduces atmospheric carbon by 10 million tons now
- Net emissions are identical, then releases 9 tons in the future
- Net emissions are now 210 - 10 + 9 = 209 million tons - the offsets have allowed the US utilities to increase CO2 emissions by 9 million tons

System Evolution

- Sectors that are covered by offsets are in a position where they profit by being on the outside of the system
- It will be difficult to move them inside the system to have obligations to reduce GHGs
- This is a concern for GHG emissions more than for sequestration projects

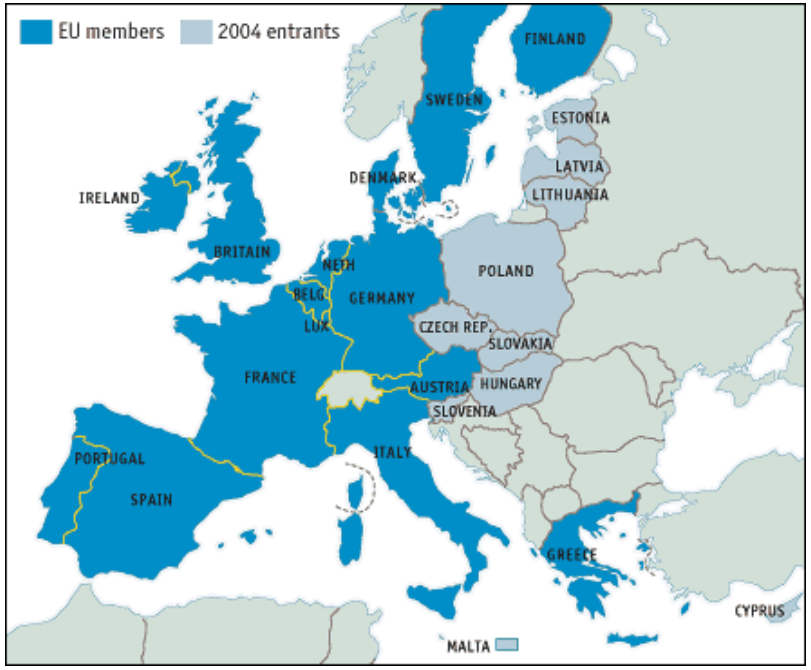
Implications for Land Managers

- High payoff to documentation and quantification of BAU
- PLA issues are endemic and require policy and technical innovation to solve
- Economic development and environmental protection benefits *likely, but not certain* to be a plus
- Offsets are particularly important for sequestration

Cap and Trade - Summary

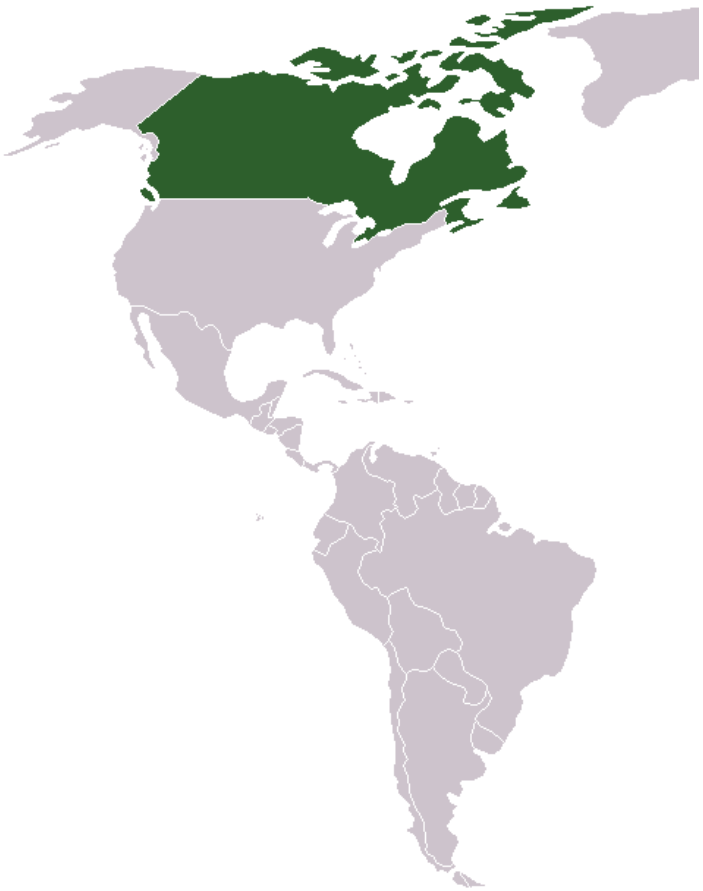
- Cap and trade is a good policy design for implementing GHG reduction incentives
- How strong and how broad these incentives are depends on program parameters

European Union



- Emissions trading energy activities (including electric power), iron & steel, minerals, pulp and paper
- ~12,000 installations covering 46% of CO_2 emissions
- 25 Member States (MS) propose cap-level and allocation in National Allocation Plans (NAP)

Canada

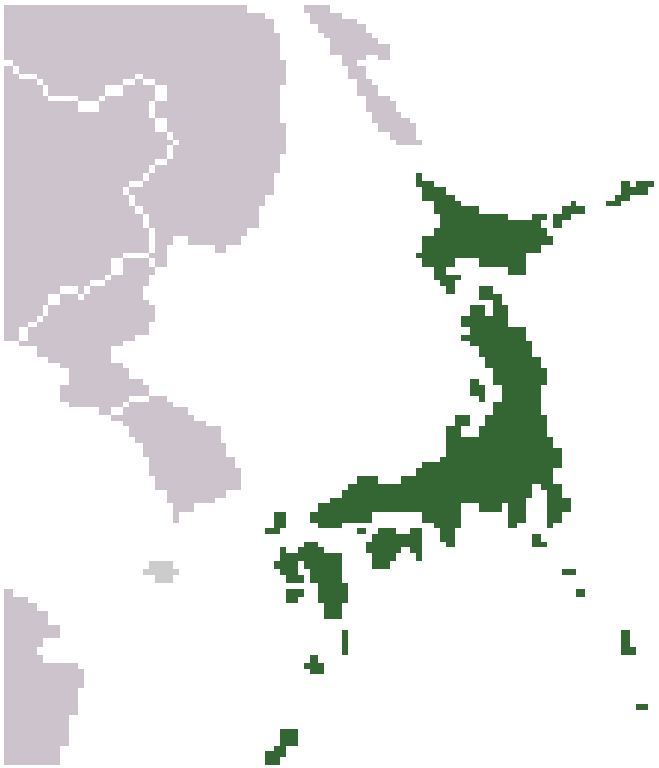


- Emissions trading for Large Final Emitters (LFE): oil & gas, electricity, mining, manufacturing.
- *Intensity*-cap: emission limit indexed to output.
- Safety valve: extra allowances at C$15/t$CO_2$
- With new government, program is on hold
- Carbon tax in British Columbia

New Zealand

- Carbon tax at NZ$15-25 / tCO_2 in 2007, aligned to international carbon price.
- Vulnerable energy intensive industries can opt for voluntary agreement instead.
- Agricultural methane and N_2O (more than half NZ emissions) excluded.
- Abandoned 12/05. May pursue emissions trading.
- Increased interest in international purchasess

Japan



- Existing efficiency and renewable programs.
- Voluntary emissions trading.
- Discussed possibility of ¥2,500-3,000 / tC tax ($5-6 / tCO_2).
- Public and private programs to buy offsets.
- International investments

Australia

- Did not ratify Kyoto
- Announced future national cap-and-trade July 2007
- New South Wales trading program since 2003 for power plants; AU$10-14 / tCO_2.

USA

- Cap and trade system for electricity in northeastern states
- Multiple bills in Congress
- Waiting for presidential election results for action

Energy Efficiency Standards

Standards

- Appliances - relatively successful, cooperation of manufacturers
  - Allow for exceptions and heterogeneity
- Information - Energy Star (USA), energy consumption labels

Standards - Vehicles

- Effectiveness is inherently limited by
  - Inability to control VMT
  - Bounceback
- Energy efficiency standards work together with energy pricing

Other Issues:Research, Development, and Innovation of low- or zero-carbon energy

- Strong economic rationale for dramatically increased government funding
- Funding should go to a portfolio of approaches
- Willingness to try low probability approaches, show patience, and tolerate failure
- Prizes?

Pricing carbon guides innovation but is not enough

Developing Countries and GHG Emissions

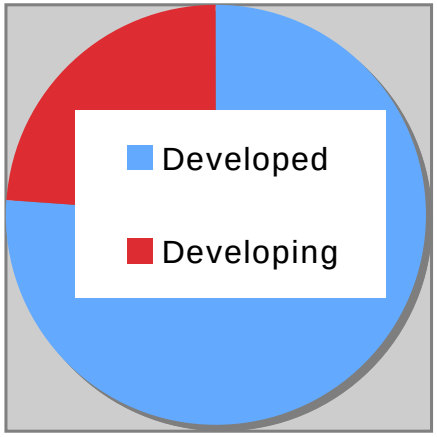
Developing countries

- Didn't cause the problem
- Have low GDP/person AND low GHG/person compared to rich countries

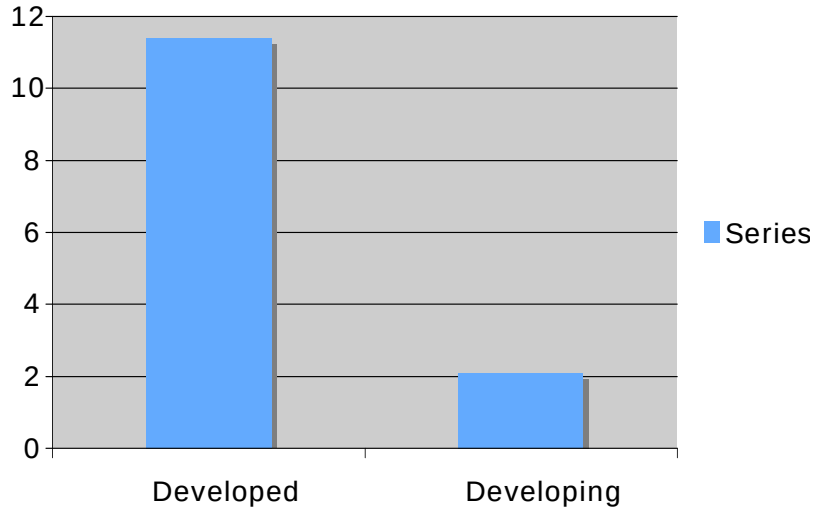
BUT

- Account for a large and growing share of emissions
- Are **absolutely essential** if concentrations are to be limited

Cumulative CO2 Emissions 1850-2002



Per Capita CO Emissions 2000



Source: World Resources Institute 2006

International Expectations of Developing countries

- History of “common but differentiated responsibility”
- Use of poor countries as an excuse for inaction
- General recognition that action requires resources
- Heterogeneity of developing countries
- Don’t directly depend on government transfers

Transfers from rich country mitigation programs

- Have a history in international and national programs
- Don’t directly depend on government transfers

Experience with the CDM

- High transactions costs
- Concentration of benefits to a few countries and sectors miss huge opportunities
- Large changes have been proposed

3 Central Issues

- What do developing countries gain by participating in transfers?
- What do the rich countries gain by participating in transfers?
- What is the effect on “the climate”?

Developing countries and mitigation

- Cost-effective and verifiable mitigation
  - More of interest to rich countries
- Transformation of energy systems
  - Emphasis on infrastructure and technology
  - Context of expansion of transportation and electricity
- Land use and environmental concerns

Developing country priorities

- Progress toward adaptation
  - Of interest and increasing focus, but still difficult to target resources effectively
- Increases in wealth and capacity
  - Of great interest to developing countries, and a key determinant of adaptive capacity

Rich country interest in transfers

- Lower cost of meeting commitments
  - International
  - Domestic
- Technology markets / standards
- Engaging developing countries in mitigation
  - Path dependency of mitigation efforts
  - Creating conditions where self-interest leads to integration
- Interest in adaptation and economic development

The Climate

- Cost-effective mitigation in the short run
- Cost-effective mitigation in the long run
- Inducing participation / commitment by developing countries to an international process

Mechanisms

- ton-for-ton accounting (CDM)
- fund for addressing climate change in developing countries (World Bank, bilateral)
- tax on transactions
- BAU targets

Criteria

- Measurable mitigation
- Accountability
- Cost-effectiveness
- Progress toward commitments and integration

Institutional Structure for Transfer Decisions and Evaluation

- Build on existing organizations
  - Likely forums: World Bank, Climate Secretariat
- Composition
- Authority
  - Enforcement, adjustment, liability

Developing Countries and GHG Emissions

- Technology Transfer
- Capacity Transfer
- Incentives through offset markets (Clean Development Mechanism)
- No-Risk Targets?

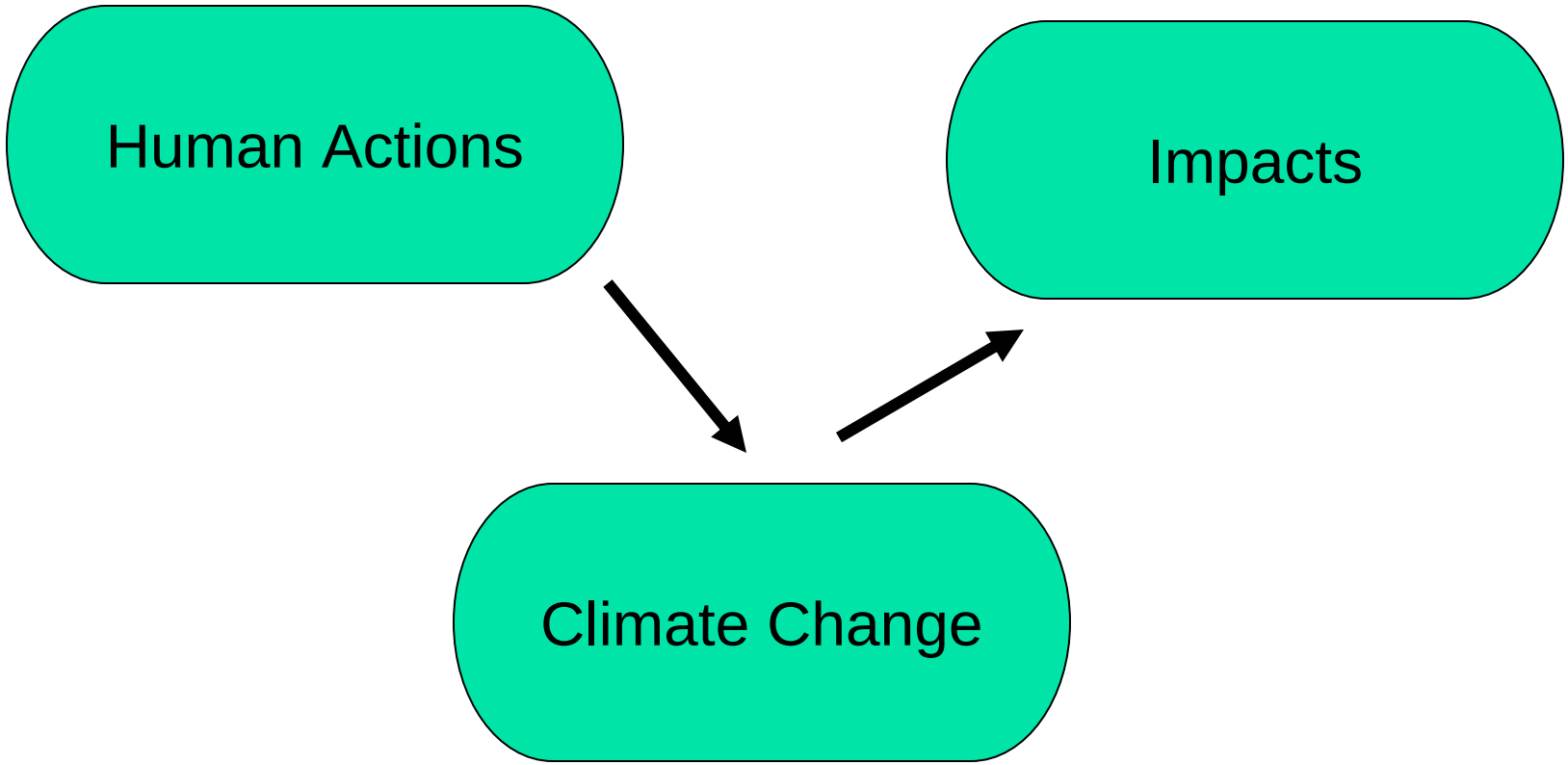
Needs to be approached as part of economic development strategy

A very challenging diplomatic, technological, political, and economic problem!

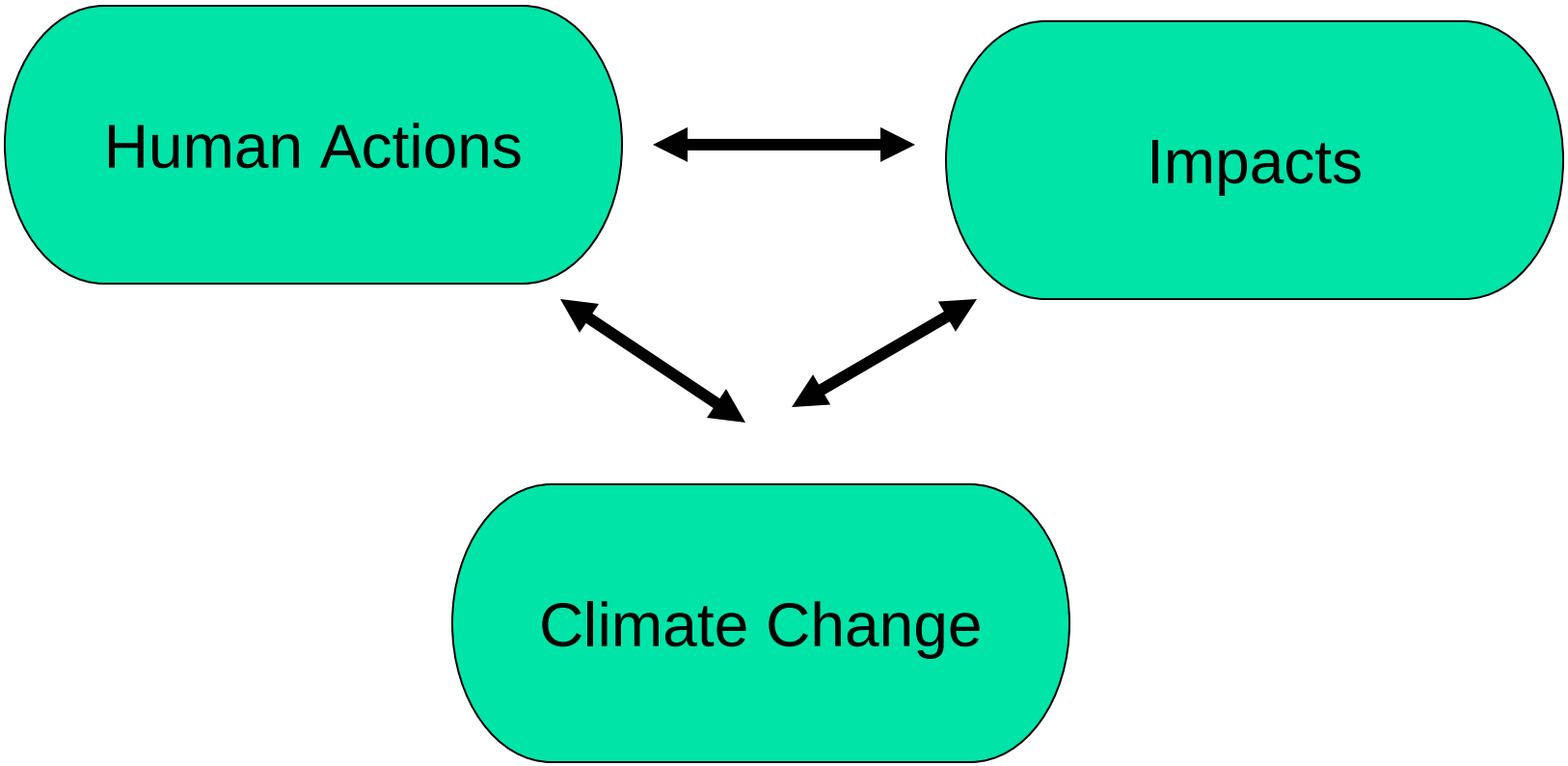
Developing Countries

- How are commitments differentiated by economic status?
- What incentives for participation?
- What kinds of resource transfers and accountability/evaluation mechanisms?
- What kind of graduation criteria?

Focus of Impacts Literature



Necessary Complexity for Studying Adaptation



Adaptation options

- •Bear the loss
- •Share the loss
- •Alter resource use
- •Change location
- •Do research on potential responses
- •Modify effects
- •Provide information to bring about behavioral change

Adaptation

- Adaptation economics
  - Individuals and private companies will find it in their interest to spend money on adaptation
  - Some adaptation expenditures will have to be public
  - Costs of anticipating in some areas will be much lower than costs of waiting
  - Multiple paths to the same outcome – hard to make efficient decisions

Economics and Adaptation

Economic modeling focuses on choices

- By individuals
- By institutions

that depend on

- Natural resource flows
- Disaster risk
- Other climate related factors

in a system of relationships

Economics and Adaptation

- Economic choice depends on
  - Assumptions about individual behavior
  - institutional setting, values, and strategy

- Useful knowledge gained from economic studies of adaptation depend on some key questions

Three Issues

- How do individuals make choices about adaptation under uncertainty in a complex environment?
- In what ways is it useful to approach adaptation policy as different than economic development policy?
- How should international resource transfers affect adaptation decisions?

Issue 1: Mix of Autonomous and Policy-Driven Adaptation

- In what ways is adaptation driven by autonomous response, and in what ways is it – or should it be – a result of deliberate policy decisions?

Issue 1a: use of information

- How well will economic agents use information?
  - “dumb” farmers do not change
  - “smart” farmers are fully knowledgeable and forward-looking
  - Real world encompasses a variety of in-between behaviors
    - Partly knowledgeable
    - Knowledgeable but delayed
- How well people use information is key to the mix of adaptation policies and investments

Issue 1b: Substitutes or complements?

- Are autonomous and policy actions substitutes or complements?
- Example - Water stress
  - can change crops or technology (autonomous)
  - can improve water storage (policy)
- Understanding the interaction of autonomous and policy responses is essential

Issue 1c: Infrastructure vs. technology and institutions

- What are the relative roles of investing in infrastructure vs. other adaptive activities ?
  - Infrastructure can ideally make big contributions to promoting adaptation, but it requires *ex-ante decisions* – there is an unavoidable element of placing a bet
  - Knowledge tends to increase the ability of systems to adapt in real time and *ex-post*
  - Institutions can produce useable knowledge and coordinate real-time and ex-post responses
- The role of *ex-ante* bets vs. *ex-post* capacity to adapt under uncertainty is central.

Issue 2: How are adaptation and development connected?

- Broad recognition that adaptation policy must be “mainstreamed” and pursued in the context of development objectives
- Question remains of how specific measures to adapt to climate change should be prioritized to increased economic development

Issue 2: How are adaptation and development connected?

- How do strategies for adapting to climate change differ from a general strategy of economic development ?
- Depends on the uniqueness / substitutability of the environmental services altered by climate change
- Matters for framing policy questions and for the complexity of research and policy responses

Issue 2b: Who gets helped?

- What is the role of adaptation policy on the distribution of benefits?
  - Does it help the most vulnerable or the most able?
  - Does it favor particular regions?

Issue 3: Adaptation, Mitigation, and Resource Transfers

- How should international resource transfers affect adaptation decisions?
  - Likely that larger resource flows will be available for GHG mitigation
  - Mitigation likely does less good per $ spent in poor countries than does adaptation

  To what extend can mitigation and adaptation be joined to gain access to resources?

How do we learn more?

- How do we learn about what works best in different contexts?
  - Study individual behavior in places where significant adaptation has taken place
  - Study policy choice in these environments with specific attention to uncertainty and institutions
  - Build models around the natural resource flows that are affected by climate change

Economic Incentives and Adaptation

- Insurance
- Environmental Markets
- Public private partnerships

Insurance

- Long history in dealing with weather
  - E.g. hurricanes, crop failure
- Moral hazard – spreading risk while retaining incentives for protective (adaptive) behavior
  - If I know insurance will provide resources if my crops fail, I will
    - plant fewer drought-resistant crops
    - try less hard to find alternative ways of producing wealth

Insurance

- Private insurance can provide some of this coverage, but much weather-risk coverage has required government participation
- Subsidized insurance prevents adequate adaptation response
- Index-based insurance – you get a payout based on events, not on your own damage (gets around moral hazard)

Insurance

- Catastrophe bonds – investors get high yields but forfeit capital if there is a payout event
- Improve hazard information – probabilities and damage

Prices as Adaptation Policy

- Water pricing – encourage optimal use and conservation
  - Most important in agriculture
- Water markets – one way to do this that can get around wealth effects, but remains intensely controversial

- Water – adaptation costs strictly due to CC estimated at USD 225 billion thru 2030 – mostly in Africa and Asia
- Water would be a tremendous challenge even without CC

Payment for Ecosystem Services (PES)

- Currently *en vogue*
  - Watershed protection
  - Carbon sequestration
  - Biodiversity protection
  - Landscape and cultural preservation
- CDM is an example
- **Requires a funding mechanism to work**

Healthy ecosystems have adaptive value

- Downstream payments to upstream actors for water quality and quantity protection
- Mangrove forests / coastal ecosystems as weather protection
- Wildlife corridors
- *Somebody has to pay for this*

Public Private Partnerships

- Private sector involvement in infrastructure and other public responses to CC adaptation
  - E.g. large scale flood protection financed by government but carried out by private companies
  - Virtue is the availability of capital in constrained environments

Role of Science

- Adaptation actions and policy are directly informed by improvements in
  - Knowledge about localized climatic effects
  - Knowledge about ecosystem and species response
  - Assessment of strategies to reduce risk, reduce dmage, or compensate losses