Implementing Climate Change Policy: Promises and Challenges

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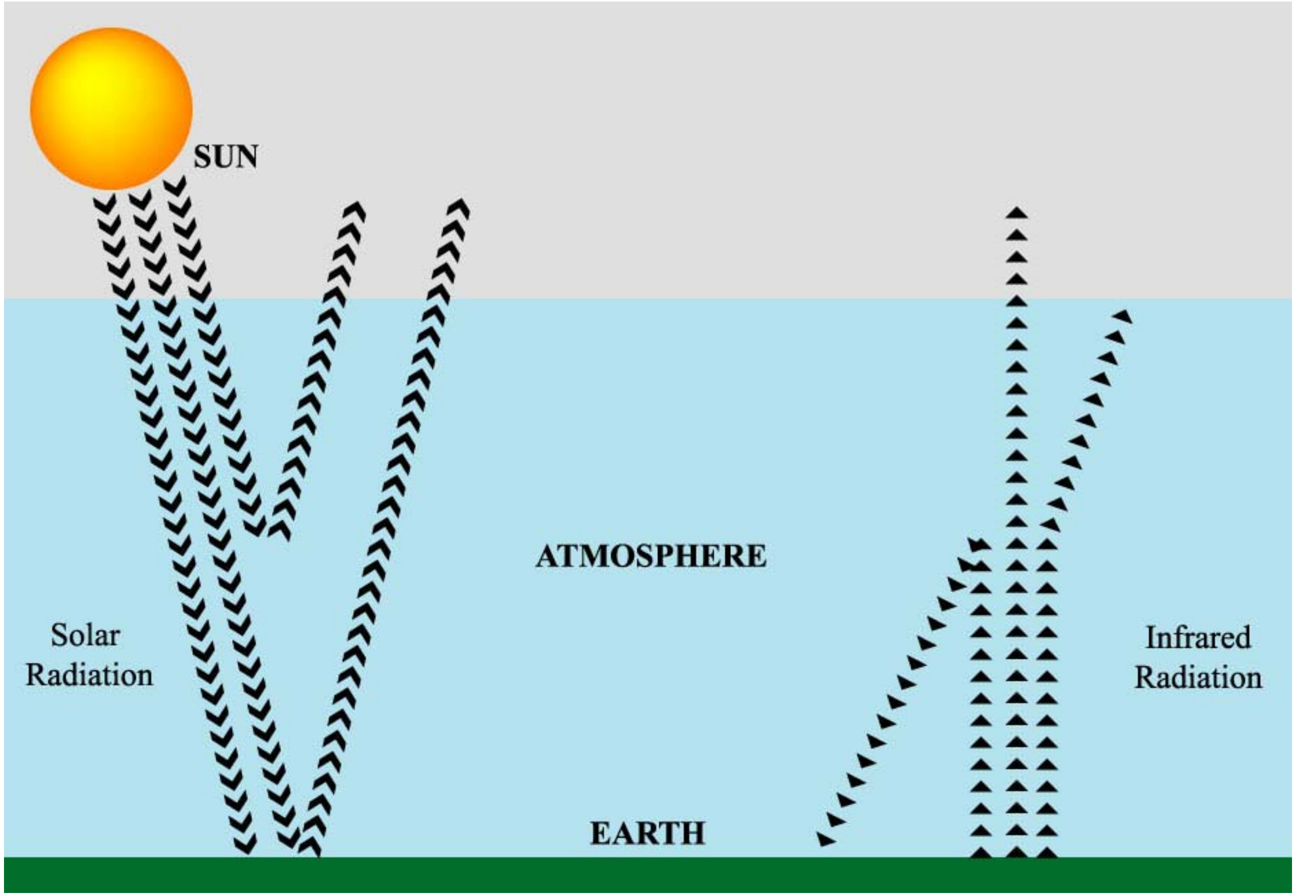
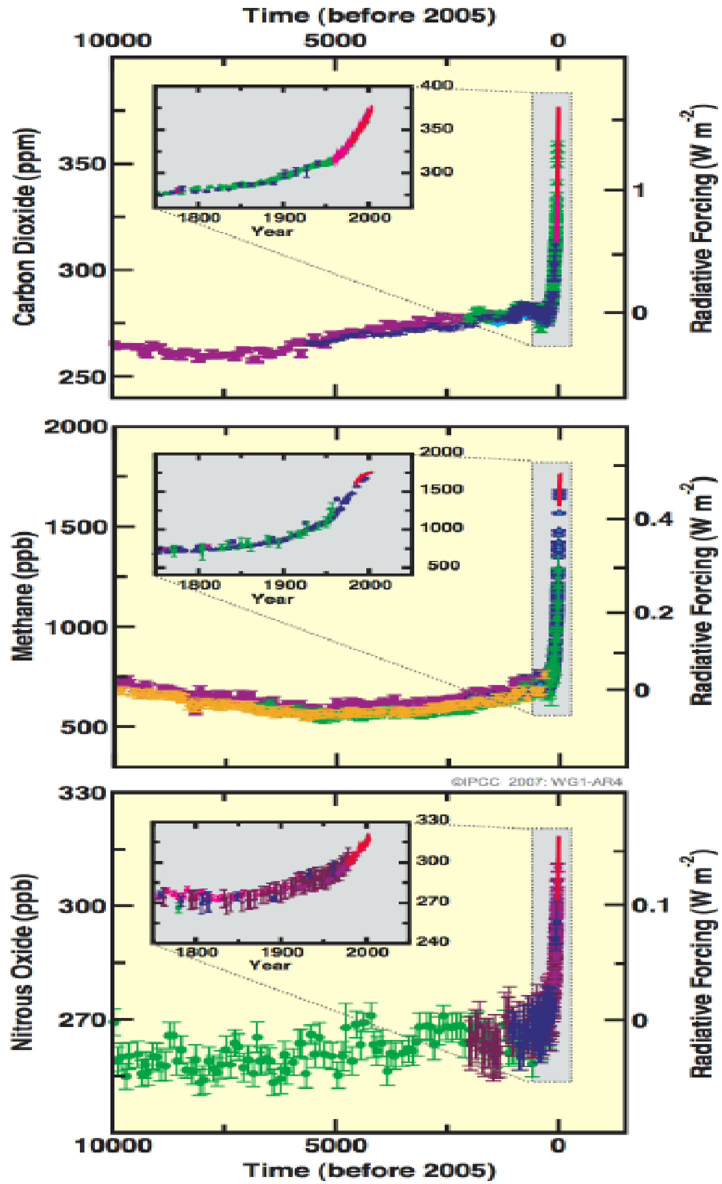
Greenhouse Effect



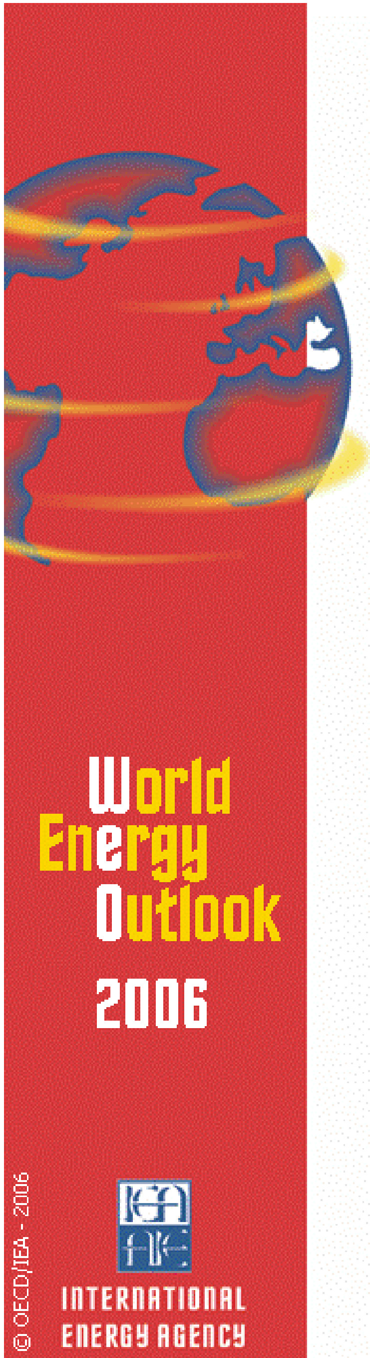
Concentrations rising – of several GHGs

Changes in Greenhouse Gases
from ice-Core and Modern Data

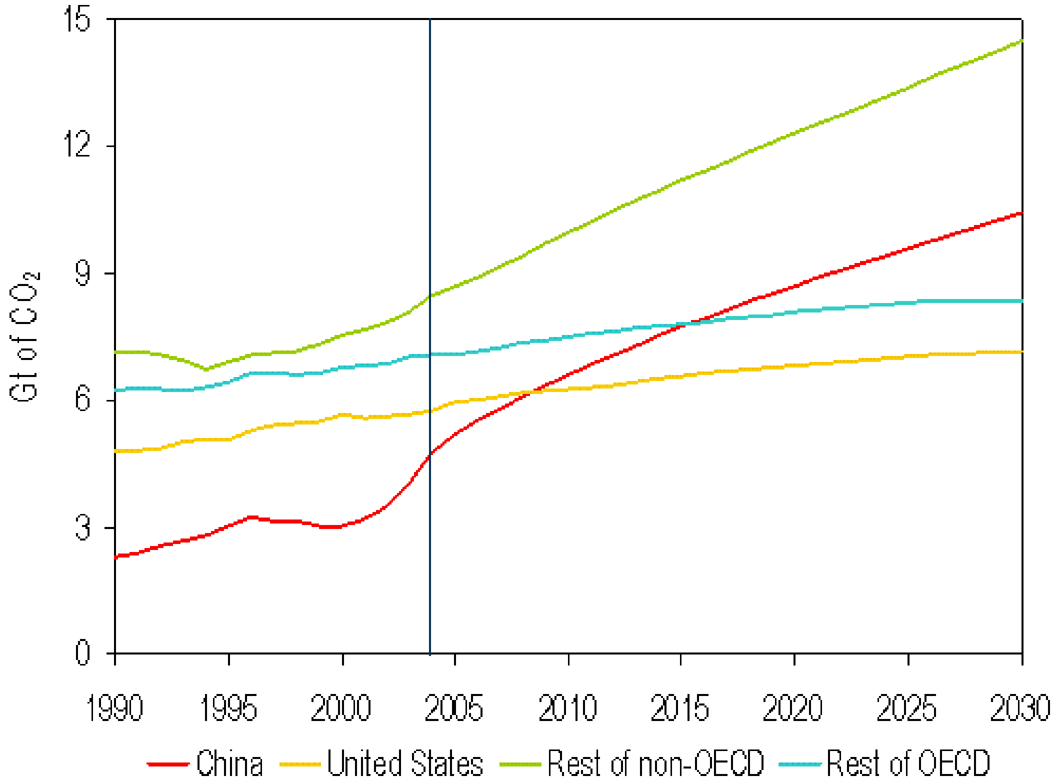


Source: IPCC, Fourth Assessment Report, *Climate Change 2007: The Physical Science Basis*, Summary for Policymakers, 5 Feb. 2007, p.3, at http://www.ipcc.ch/SPM2feb07.pdf .

FIGURE SPM-1. Atmospheric concentrations of carbon dioxide, methane and nitrous oxide over the last 10,000 years (large panels) and since 1750 (inset panels). Measurements are shown from ice cores (symbols with different colours for different studies) and atmospheric samples (red lines). The corresponding radiative forcings are shown on the right hand axes of the large panels. {Figure 6.4}



CO_2 Emissions Trends in the Reference Scenario, 1990-2030



From http://www.worldenergyoutlook.com/graphs/Slide4.gif

China's CO_2 emissions rising faster than forecast

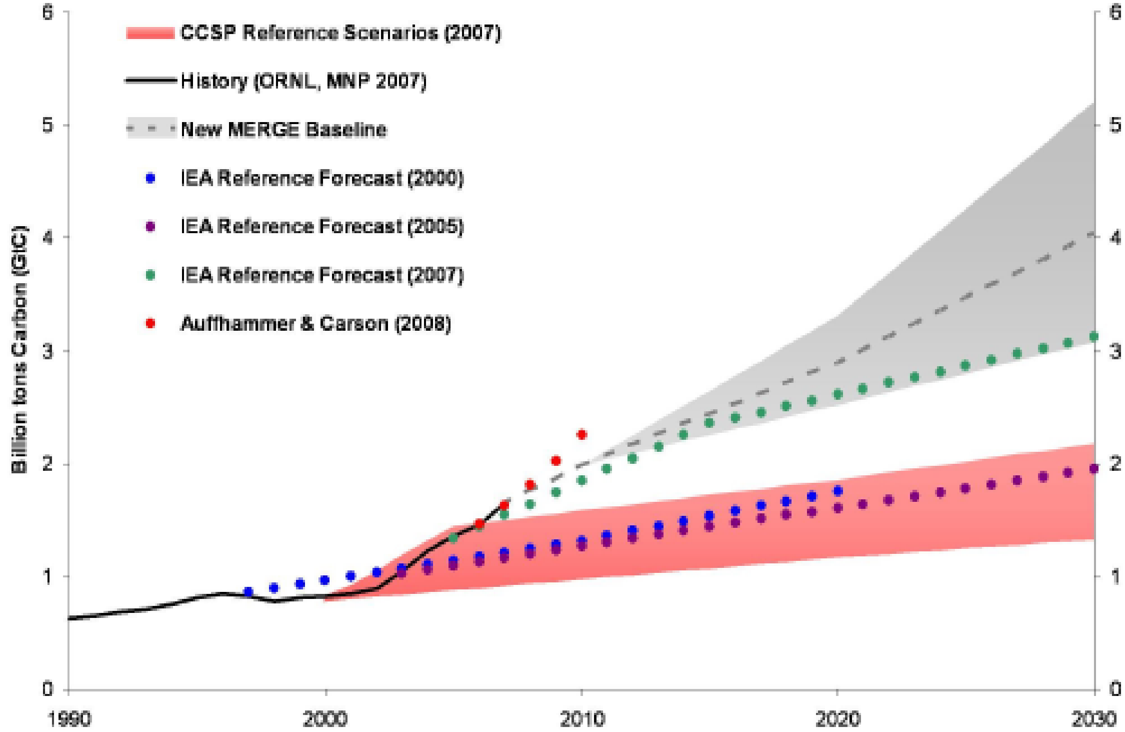
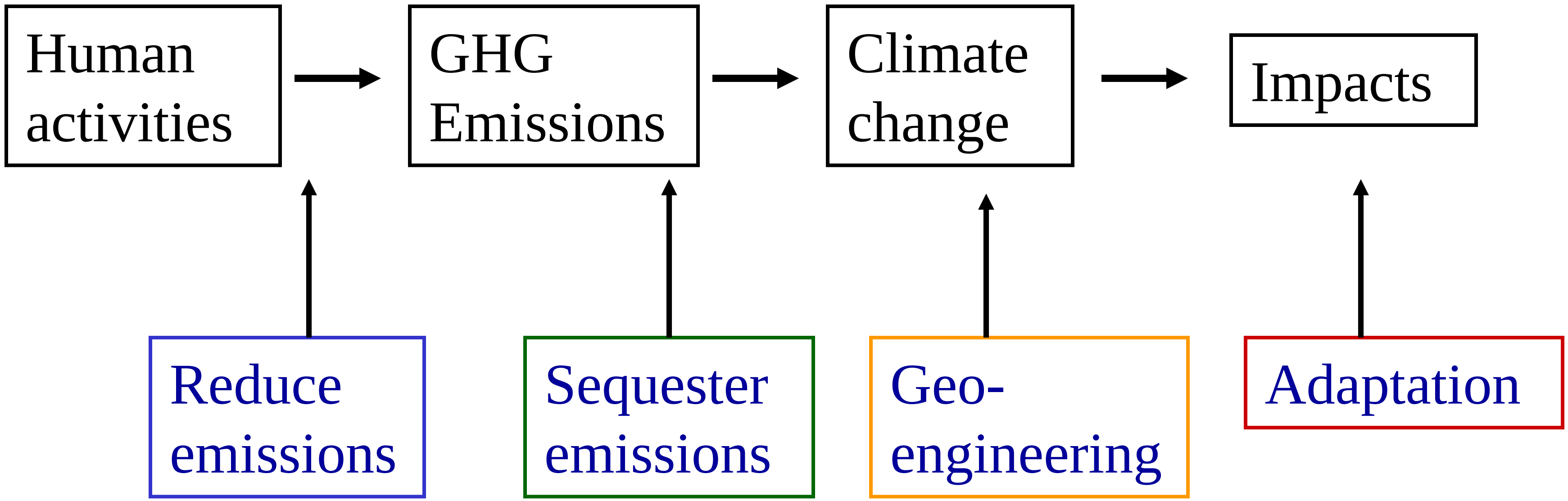


Figure 2. Energy-related CO_2 emissions in China.

Historical emissions began increasingly rapidly after 2001. IEA forecasts did not detect the acceleration until after 2005, and projections in the 2007 CCSP report reflected earlier forecasts. A 2008 econometric study projects an exponential extrapolation of the current annual growth rate through 2010. The new MERGE baseline projections reach 4 GtC by 2030 (dashed line) in the reference growth scenario, 3.1 GtC in the low scenario, and 5.2 GtC in the high scenario (bounds of the gray shaded region).

Source: Geoffrey J. Blanford, Richard G. Richels, & Thomas F. Rutherford, "Revised Emissions Growth Projections for China: Why Post-Kyoto Climate Policy Must Look East," EPRI Working Paper (September 2008)

Policy Options



The Climate Commons

- Atmosphere = open-access disposal site for GHGs.
  - Emissions & impacts spread globally; benefits shared widely.
  - Costs of emissions reduction fall on each emitter. = “free riding.”
  - Result: overuse of the climate commons.
- Restricting access to the commons is warranted if it yields collective net benefits for society. (Kaldor-Hicks)
  - Under international law, treaty participation requires consent, i.e. need individual net benefits for each party to join. (Pareto)
- How best to restrict access to the commons?
  - Fencing a fixed territory: Property, Sovereignty
  - “Fencing” mobile resources (fish, air): how? Which policy tool is best?

Bruegel, *The Fall of Icarus*: choice of tools matters

Environmental markets: a Brief History

- Adam Smith (1776): markets unleash gains from trade
- Jeremy Bentham (1802): markets depend on law; "property and law are born together, and die together"

- A.C. Pigou (1920): markets may fail if social costs are external to private decisions. Solution: tax the externality.
- Ronald Coase (1960): alternative solution: correct externalities via markets: trade in property rights to emit
- Thomas Crocker (1966): tradable permits for air pollution
- J.H. Dales (1968): set up emissions trading markets
- Garrett Hardin (1968): "The Tragedy of the Commons"

- 1970s-80s: major scholarship by, e.g., Montgomery, Weitzman, Roberts & Spence, Tietenberg, Hahn, Stavins, Ackerman & Stewart, others …
- Bipartisan "Project 88"; advocacy by EDF (esp. Dudek), increasingly others
- Bush-41 Acid Rain Trading Program in 1990 CAAA: Gray, Elliott et al.
- Proposals for GHG cap & trade: Stewart & Wiener 1989, 1990, 1992, 2003; FCCC, KP; EU ETS; Lieberman-McCain, Waxman-Markey, Kerry-Boxer…

Environmental markets: Past examples

- Fisheries tradable catch quotas (esp. in NZ, Canada)
- EPA emissions trading under CAA (Carter, late 1970s -)
  - *Chevron* upheld (1984)
  - Cost savings ~ $5-12B
- Lead Phasedown (Reagan, 1980s)
  - Faster phasedown
  - Cost savings ~ $250M/yr
- CFC Phaseout (1980s-90s)
  - Faster reductions
- Acid Rain Trading Program (Bush, 1990 CAAA; Clinton, 1995-)
  - Faster reductions
  - Cost savings > $1B/yr (about 40-80% less than without trading)
- RECLAIM SOx and NOx; and Northeast Ozone Transport (1990s-)
  - Cost savings ~ 40%
- EU Emissions Trading System (2001-)

[See Stavins, Harv. Envtl. L. Rev. (2008), Table 13; Burtraw & Szambelan, RFF 2009.]

Trading and Cost Savings: a simple illustration

If cost of abatement varies across sources, then flexibility in location of abatement = lower cost

Example: **Status Quo: 4 total units of "Smox" emitted by two firms, A and B. Goal: cut total by 50% (to 2).**

	Status Quo	Technology Standard		Uniform Performance Std.		Tradeable Allowances	
	Em.	**Em.**	**Cost**	**Em.**	**Cost**	**Em.**	**Cost**
Firm A	**2**	**1**	**$20**	**1**	**$ 8**	**0**	**$18 ***
Firm B	**2**	**1**	**$20**	**1**	**$20**	**2**	**$ 0 ***
Total	**4**	**2**	**$40**	**2**	**$28**	**2**	**$18**

*** B pays A $10 to abate 2nd unit (B buys 1 allowance from A)**

The Policy Toolbox: Options to Reduce Net Emissions

1. Design/Technology (ex.: new sources in CAA, CWA)
2. Price:
    - A. Subsidies, incl. R&D (ex.: ARPA-E)
    - B. Taxes (ex.: pollution taxes)
3. Quantity:
    - A. Performance standards (ex.: under CAA, CWA)
    - B. Cap & trade (ex.: Acid rain, Lead, EU ETS, RGGI)
4. Information disclosure (ex.: TRI, proposed GHG reporting)

Notes:

- 40+ years of experience in USA, Europe, Canada, NZ, …
- One or a combination of tools may be best
- Choice is pragmatic, may vary in each application

Five Selection Criteria

Pragmatic choice among policy tools depends on:

- Effectiveness
  - Target benefits (reducing climate change damages)
  - Ancillary impacts, risk-risk tradeoffs (both harmful & beneficial); seek risk-superior moves
- Cost
  - Social cost
  - Administrative cost
- Innovation / Dynamic
  - Technological advance
  - Policy improvement
- Fairness
  - Distribution of costs
  - Distribution of environmental impacts
- Participation
  - Legislation: Engaging majority coalition to enact
  - Treaty: Engaging international consent to cooperate

1. Design/Technology standards

(Mandate control technology, e.g. scrubbers, CCS, electric vehicles, fuel efficiency)

- Effectiveness:
  - May reduce emissions
  - Must monitor technology
  - But: no cap on emissions
  - New/old distinction: slows adoption of new tech
  - Efficiency standards: rebound effect increases use
- Cost: high; insensitive to cost variations
- Dynamic:
  - may force technology, but then may discourage innovation
- Fairness
- Participation: high cost may discourage

2A. Subsidies

(Public funding, R&D, subsidies to abate)

- Effectiveness:
  - Public funding helps correct distinct market failure in R&D.
  - Sources will adopt new tech if price drops below conventional technology; or, still need tax or cap & trade to induce adoption.
  - Subsidy to abate w/o cap (e.g. CDM) can reduce emissions at each source, but can increase total emissions, and can undermine incentive to join formal cap & trade market.
- Cost:
  - Public financing: must raise revenues; possible political distortions in spending
  - Concern re government subsidizing wrong technology
- Dynamic:
  - Could yield new technologies for energy, transport, sequestration, etc.
- Fairness
- Participation: payments can attract (ex.: Montreal Protocol)

2B. Taxes

- Effectiveness:
  - Sets price (lets emissions vary in market)
  - Must monitor emissions, collect taxes
- Cost: much reduced
  - “How” flexibility in methods
  - Sources abate where cost < tax, else pay tax; tax limits total cost
  - But: concern that tax may allow emissions escalation
    - Which is worse, cost escalation or emissions escalation?
  - Can raise revenue to reduce other taxes
- Dynamic:
  - Incentive to innovate to reduce emissions at cost < tax.
  - Sources lobby to relax tax; Gov’t may set tax low to raise revenues.
- Fairness:
  - Regressive? Can use revenue to reduce other taxes.
- Participation: cost may discourage (ex.: EU pre-ETS)

3A. Performance standards

(Quantity limits on emissions, fixed for each source)

- Effectiveness:
  - Reduce emissions
  - Must monitor emissions
- Cost:
  - Reduced through “how” flexibility (methods)
  - Insensitive to cost variations across sources
- Dynamic:
  - Incentive to innovate to reduce cost of meeting standard
- Fairness
- Participation: cost may discourage

3B. Cap & trade

- Effectiveness:
  - Caps emissions (lets price vary in market)
  - Must monitor emissions, track trades
- Cost: much reduced. "How" flexibility in methods, plus:
  - "Where" flexibility across sources
  - "When" flexibility over time via banking & borrowing
  - But: concern that cap allows cost escalation, price volatility
    - Which is worse, cost escalation or emissions escalation?
    - Can contain costs via price ceiling/floor, allowance reserve
  - Can raise revenue (via allowance auction) to reduce other taxes
- Dynamic:
  - Incentive to innovate to reduce emissions at cost < allowance price.
  - Sources holding allowances lobby to enforce cap.
- Fairness: Hotspots: not for most GHGs. Costs: revenues, allocation.
- Participation: can engage via allowance allocation, incl. headroom as side payment w/ cap (ex.: Acid Rain, Kyoto Protocol, EU ETS).

4. Information disclosure

(Emissions release inventories, e.g. TRI, and EPA GHG Reporting rule. Disclosures in products, securities (SEC).)

- Effectiveness:
  - Does not cap emissions
  - Lets information influence consumers, workers, shareholders, neighbors, etc., and thereby influence managers.
  - Can be potent. E.g. Toxics Release Inventory (TRI).
- Cost: low.
- Dynamic:
  - Incentive to innovate to reduce emissions at cost < information disclosure cost
- Fairness
- Participation

Reprise: The Debate over Taxes vs. Trading

3 criteria emphasized in the economics literature:

- **Cost**
  - Tax constrains cost; Cap & trade constrains emissions
  - Results will differ under uncertainty about costs (Weitzman 1974)
    - Best choice depends on relative slopes of MC, MB (avoided damages)
    - Which is worse: Cost escalation vs. Emissions escalation ?
  - Can use cap & trade, but still contain costs
    - "thick" market; banking & borrowing; price ceiling (safety valve); price ceiling & floor (collar); allowance reserve; coupons
- **Revenue-**raising to rebate, offset other taxes, or invest
  - Revenue can be raise from tax -or- from allowance auction
- **Innovation**: both tax and cap & trade can spur

4th key criterion:

- **Participation**
  - Crucial to engage most major GHG emitters (else "leakage")
  - Need national consent & implementation

Comparing GHG Policy Tools: a rough ranking

	Design/ Tech Stds.	Subsidies	Taxes	Performance Standards	Cap & trade	Information Disclosure
Effective-ness	*	R&D: * Other: -	***	**	****	**
Cost	–	–	****	**	***	**
Dynamic/ Innovation	–	*	***	*	***	**
Fairness		*	–		**	
Participa-tion (esp. Int'l)	–	*	–		***	*

(One or a combination of tools may be best.)

Policy Coverage and "Leakage"

- Most GHGs mix globally in the atmosphere
  - Reduces past concern about "hotspots"
  - Increases concern about "leakage"

- Partial coverage may yield leakage
  - ***Geographic scale***
  - ***Causal scope***

- *Scale*: Each policy tool may be implemented at various levels –
  - International / Global
  - National
  - State & local

- *Scope*: coverage of GHGs, sectors

Policy Coverage and Leakage (2)

- ***Geographic scale***: regulation of GHGs in some places (countries, states) may spur leakage to unregulated places
  - Relocation of facilities (e.g. steel, cement)
  - Changing relative prices (for e.g. energy, food, timber)
- Impacts of leakage:
  - Undermines effectiveness of GHG policy
  - May even exceed 100% (increase net emissions), if GHG emissions per unit of economic output are higher in the receiving location
  - Leakage makes receiving country more GHG-intensive, inhibits its policy action
  - Fear of leakage inhibits political will in the regulating jurisdiction
  - Border trade restrictions: may not be effective; may spur trade retaliation

Policy Coverage and Leakage (3)

- ***Causal scope***: regulation of some GHGs (or sectors), but not others, may spur shifts. E.g.:
  - Coal-to-gas switch may reduce CO_2, but may increase CH_4
    - CH_4 is ~20+ times more potent a GHG than CO_2
    - Some natural gas systems release large fugitive CH_4 emissions
  - Biofuels may reduce CO_2 at vehicle tailpipe, but may
    - Increase CO_2 from deforestation
    - Increase N_2O from crop fertilizers
  - Monitoring costs: endogenous; and justified by benefits
  - More generally: Need to consider ancillary impacts (risk tradeoffs) of alternative energy sources (nuclear, wind, solar, biofuels, etc.), land uses, CCS, geoengineering, etc.

Policy Coverage and Leakage (4)

- Solution: Comprehensive Coverage
  - Participation by all major net emitters
  - Coverage of all major GHGs, sectors
    - Includes benefit of conserving forest sinks
    - Broader coverage also reduces abatement costs
      - All major emitting countries (with trading): about half or even less costly than industrialized countries only
      - All GHGs & sectors: about half as costly as energy CO_2 only. (Opportunities: CH_4, black carbon.)
  - Consideration of ancillary impacts, tradeoffs

Paths to GHG markets ?

- International accord – Copenhagen and beyond
- EU ETS
- US Congress – new legislation
- US EPA under CAA – new regulations
- Regional/state programs – growing, linking
- Tort lawsuits – offsets as a remedy
- Voluntary markets

Issues in legislating a US GHG cap & trade system (1)

- Cap: stringency and adjustability over time
- Scope: which gases (all GHGs?); which sectors (economy-wide, electric power, industry, transportation, agriculture, forests, …)
- Allocation of allowances
- Point of regulation (upstream, midstream, downstream, …)

- Cost containment (e.g. safety valve, price collar, allowance reserve, coupons, banking & borrowing, …)
- Offsets – domestic (agriculture/forests), international; credible measurement, verification
- Linkage of US market to other countries' trading systems (e.g. EU ETS, others)
- Global effectiveness (vs. leakage)
  - Engaging other major emitting countries – Copenhagen and beyond
  - US Competitiveness (leakage, border tariffs/allowances, conditionality of US cap schedule on comparable action by key other emitting countries, etc.)
  - Measurement, reporting & verification of countries' actions

Issues in legislating a US GHG cap & trade system (2)

- Authority
  - Who can adjust the cap schedule & cost containment over time? E.g. Congress, President, agency, "Fed," etc.
  - State programs: embrace, or preempt, or other treatment? Issues re policy conflicts, dormant commerce clause, interstate compact clause, etc.
  - EPA authority under current Clean Air Act and other laws: let it continue, or block/carve out? Potential conflict with New Source Review requirements, etc.
  - Which agency(ies) will oversee the US program(s)? e.g. EPA, DOE, CFTC, USDA …
  - Relation to international negotiations, other countries'markets
- Technology
  - Role of public support for advanced R&D and diffusion?
  - Emphasis or restriction on specific technologies (e.g. nuclear, wind)?

Thank you.

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