Global Climate Policy — Without the Hot Air

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"The principle problem …

is that carbon pollution is not priced correctly.

—MacKay, p. 222

- **[For] climate change, or ensuring security of supply, … we need a carbon price that is stable and high.**

  —MacKay, p. 226

- **"… we have a clear national interest in insuring that the world tackles climate change together. … [with] a comprehensive global climate change agreement."**

  —DECC Carbon Plan, p. 13

DECC's most pressing question

How best to arrange a high carbon price?

Today's Talk

—MacKay, P. 226

- **Why is this question most pressing?**

  Every BIG helps. —MacKay, p. 114

  UK emissions are little. — **1.5% and shrinking.**

  The UK is BIG intellectually and politically.

- **What's Not the Answer?**

  If the United States leads, China will follow.

  —Al Gore

  http://www.guardian.co.uk/world/feedarticle/8472534

What is the answer?

- **Change the game.**

  Global cap and trade is the wrong game.

  Its Nash equilibrium looks just like

  what actually happened.

- **Design a game with a cooperative equilibrium.**

There is a science of cooperation

- **Behavioral Game Theory** (Google it!)
  - 60 years old
  - Brilliant theorists (von Neumann, Nash)
    - Eight Nobel prizes
  - 1000's of experiments
  - Observations of natural experiments

***The Art of Strategy* — a fun introduction**

How to apply the science

1. Design a treaty with no carbon commitments,
   just fair decision rules,
   and a cooperative equilibrium.
2. Get it signed.
3. Rely on its rules to decide commitments.

In 1974, Nixon & Kissinger came pretty close

- They designed a treaty.
- Nations agreed complex voting rules in a few months.
- 17 Nations signed the treaty.
- They tried quantity limits — agreement impossible.
- They agreed a global oil-carbon price.

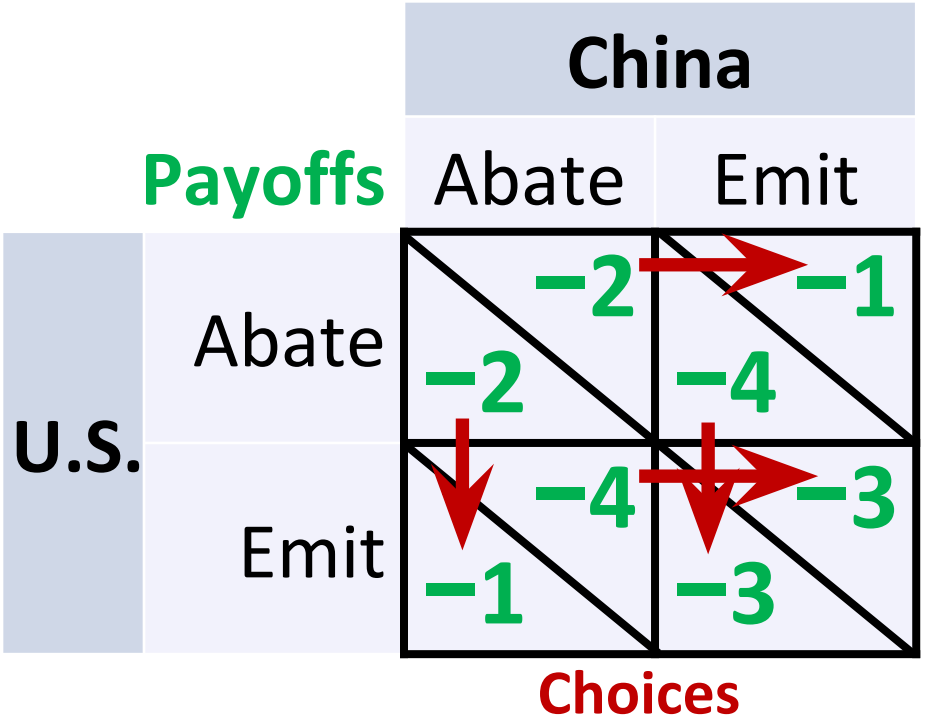
—The International Energy Agency (IEA).

To Change the Game, First Understand It

THE PRISONERS' DILEMMA GAME

Nations are climate prisoners

- The Prisoners' Dilemma has only 2 prisoners.
- First experiments: 1950



- PD Nash Equilibrium: Whatever your strategy is, my best strategy is **Emit**.

The prisoners' climate model

- Cost of abatement for 1 country: $C = A_i^2$
- Global benefit: $B = 4 \times \sum A_i - 12$
- Each country receives half the benefit.
- Abate □ $A_i = 2$, optimal cooperation
- Emit □ $A_i = 1$, pure self interest

How to Get Cooperation?

- **Let them play repeatedly.**
- **Repeated play = a "Super Game"**
- **It has many more strategies:**
  - **Nice, nice, nice, nice … —Al Gore**
  - **Mean, mean, mean … OPEC**
  - **I'll be nice if you're nice.**

A Prisoners' Tournament

- **Many prisoners**
- **Each chooses a strategy and sticks to it**
- **They each play all others a series of 200 games**
  - Google: Axelrod dilemma
- **Three tournaments and over 100 strategies tested**
  - Starting in 1984.
- **The winner in all three … Tit-For-Tat:** First cooperate, then do what your opponent did last time.

To cooperate: reward and/or punish

- Many experiments have found this.
- Just being nice is not enough.

More Prisoners; Less Cooperation

THE CLIMATE GAME

The climate game (without a treaty) is:

- **A Prisoners' Dilemma with more prisoners.**

The Global Public-Goods Game

Example:

- **4 countries have marginal benefits of $20/tonne.**
- **4 countries have marginal benefits of $5/tonne.**

- **The world has a marginal benefit of $100/tonne.**

Nash equilibrium:

- 4 countries price carbon at $20/t,
- 4 countries price carbon at $5/t

The optimal carbon price is $100/t.

The Public-Goods Super Game

- With more prisoners They cooperate less in the super game.
- We need more than Tit-for-Tat.
- We need a treaty.
- It will specify a new, larger climate game.

A New, Larger Climate Game

GLOBAL CAP AND TRADE?

A global cap-&-trade (CT) game

- **Same as the Publics Goods (PG) game, except**

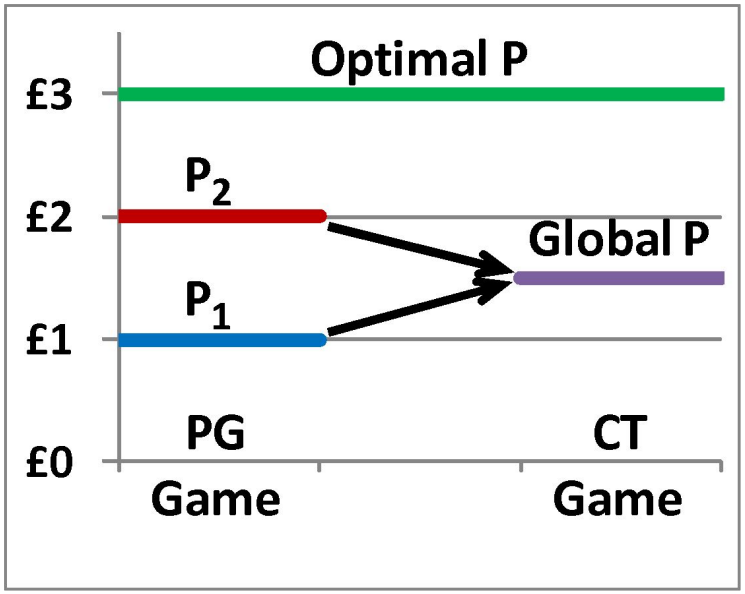
1. **Players choose targets*, instead of abatements.**
2. **They can meet targets by trading.**

- **Not like national cap and trade**
- **No global government**
- **The coal plants (countries) choose their own targets !**

* Helm, Carsten (2003) "International Emissions Trading with Endogenous Allowance Choices," Journal of Public Economics, 87, 2737–2747.

A global price □ efficient abatement

- Trading □ one price □ efficiency



- Global cap-and-trade
- Two-countries
- See spreadsheet with IAEE paper.

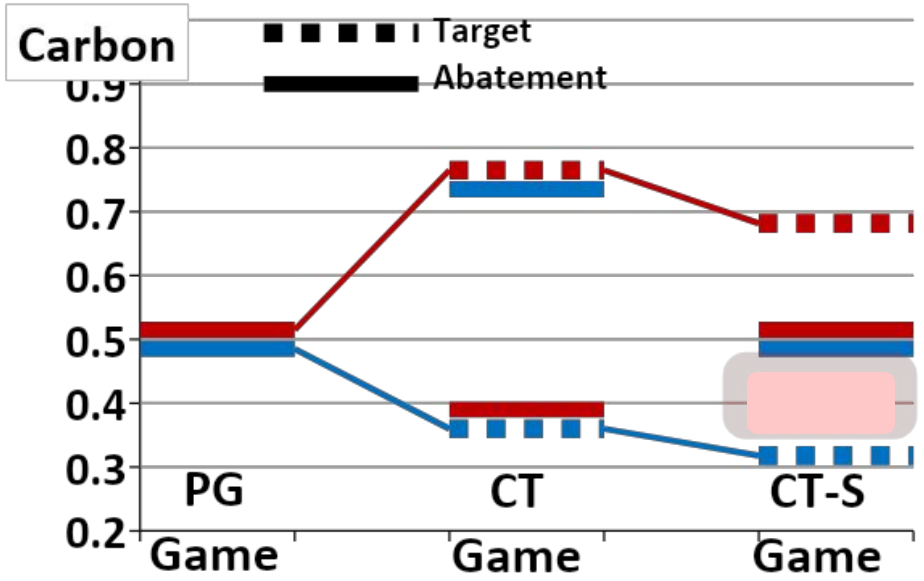
- If Cap-&-Trade increases abatement, then $P \leq Avg(P_i)$.

Cap & trade with subsidies

- Helm analyzed the pure **CT** game.
- But Kyoto does not prohibit subsidizing or taxing fossil fuel.
- The **CT-S** is permissive like Kyoto.
- So countries “game” cap and trade.

Three climate policy games

- Public Goods = No Policy
- CT = Pure Cap & Trade
- CT-S = CT with subsidies

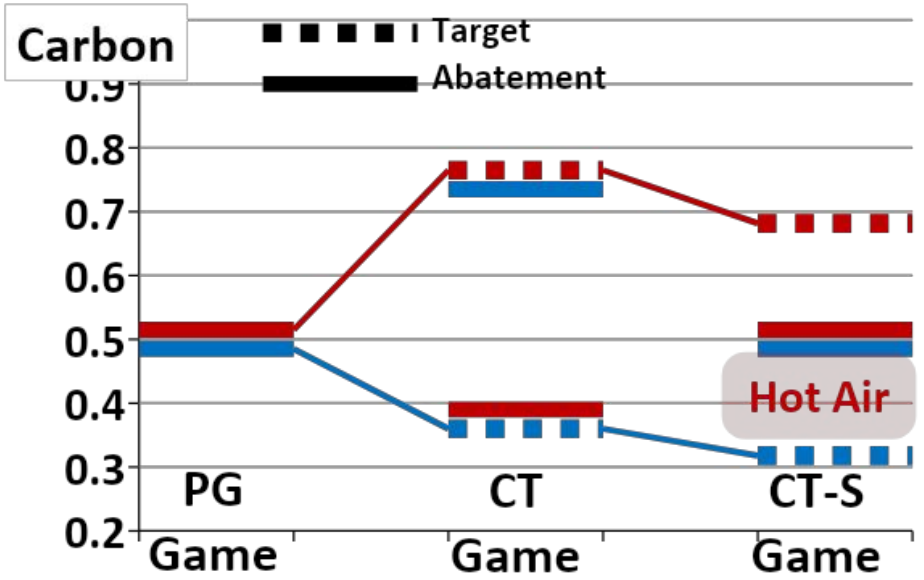


- Levels shown as very close are equal.
- The CT game increases abatement.
- "Gaming" in CT-S cancels the CT increase.

- Red = high-priced country
- Blue = low-priced country (in the PG game)

The special theory of "Hot Air"

- **In CT-S, nothing physical changes.†**
- **There is still trade.**
- **High-price countries pay low-price countries.**
- **Trade is Hot Air.**



†Godal, Odd and Bjart J. Holtsmark (2011) "Permit Trading: Merely an Efficiency-Neutral Redistribution Away from Climate Change Victims?" *Scandinavian Journal of Economics*, 113, 784-797.

The special theory of Hot Air (2)

- **"Japan Denies Buying 'Hot Air' to Meet Kyoto Target"**
  —July 23, 2009 (Bloomberg Headline)
- **Russia's carbon (AAU) credits reduce its target.**
- **Its private sector does not face the global cap-trade price. In effect that's a subsidy.**

- **China's HFC-23* producers don't even face a £1/t price.**
- **That subsidy allows them to sell CDM credits to the EU.**
- **More cheap Hot Air.**

***HFC-23 (trifluoromethane or CHF_3) is 14,800 more potent than CO_2.**
http://igsd.org/documents/Montzka_HFC23_Factsheet.pdf

The General Theory of Hot Air

Why the Kyoto Concept Is Doomed

1. "Coal plants" choose their caps.
2. There's no fair way to allocate caps.*
3. Countries will choose weak caps out of self interest —US, China, India† …

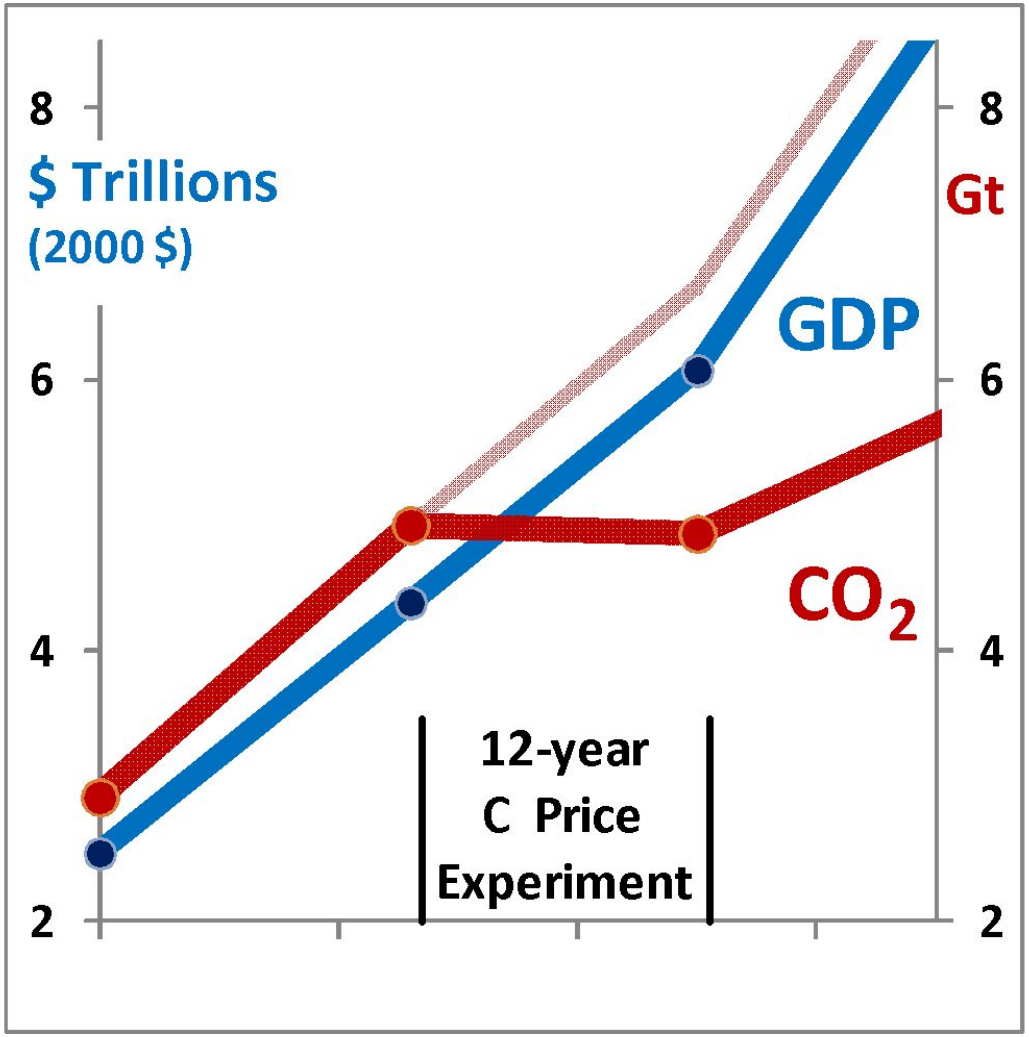
* See Stiglitz, *Making Globalization Work*

† The U.S. tried to cap India at the US emissions level in 1852.

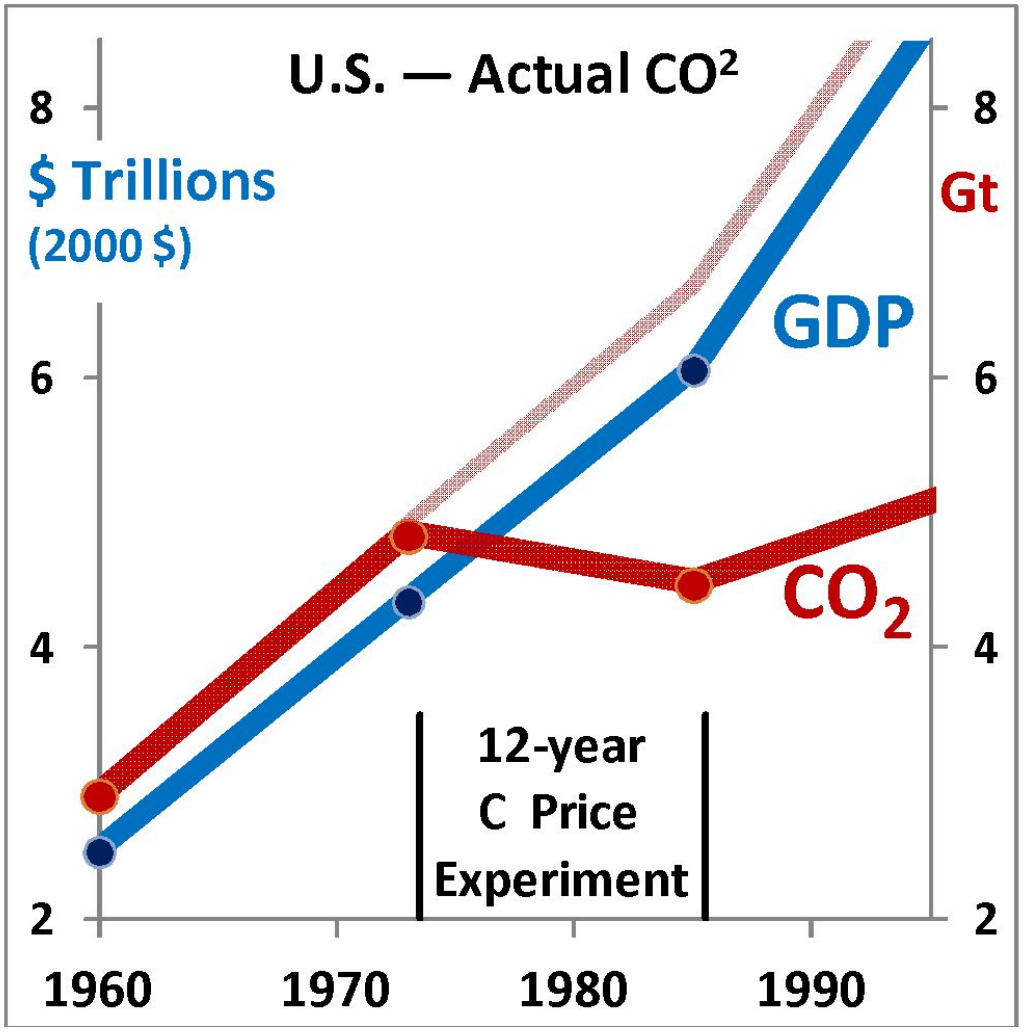
Do You Believe in

CARBON PRICING

Do You Believe in Pricing?



New Technology + Pricing



That was a terrible pricing policy

- We paid OPEC $2 trillion to price carbon.
- They forgot:
  - To price coal carbon
  - To price natural-gas carbon
- Price was not “stable.” (MacKay, p. 226)

- GDP still went up 39%
- CO_2 still went down.

Why Pricing Is So Cheap

- **Suppose:**
  - **The UK emits 500 Mt of CO_2/year.**
  - **It prices carbon at £20/t**
  - **Emissions are reduced by 20%.**
- **How much does that cost the UK / year?**
- **(1 – 20%) × 500 × £20 = £800M/year (wrong)**
- **And, if it doesn't work, it's free!**

*** Assumed quadratic abatement costs. Approved by the US EPA.**

Treaties and Focal Points

DESIGN WITHOUT HOT AIR

How to avoid Hot Air

- **Design a treaty on how to decide.**

- **Base the design on "focal points."**
  - A "focal point" is a strategy (e.g. a part of the treaty) that players see as "natural."
  - This helps people agree on the treaty.

Possible focal points

1. **A uniform global price of carbon**
   - The justification for cap and trade.
   - The justification for a carbon tax.
   - Standard Econ since Arthur Pigou, 1920.*
2. **A Green Fund**

* *The Economics of Welfare*, London: Macmillan.

(St. Martin's Street, about ¼ mile NE.)

A treaty puzzle

- All countries are identical except for size.
- They understand this,
- except that they are afraid that some country might want a super-strict climate policy.
- No country is willing to accept a treaty that might make it worse off.
- What's the best treaty?

The treaty:

- **Every country must name a price for emissions.**
- **Then, every country must set their price of carbon as high as the *lowest price* named by any country.**

- **All will vote for the optimal price, because …**
- **If their vote matters, it will raise everyone's abatement.**
- **If the treaty said "average price," countries would fear that they would be made worse off by signing.**

Proof that large & small vote alike

Global benefit = B(A(P)), where A = total abatement.

Global abatement cost = C(A(P))

- P = global price, s = the size of some country, s<1.

  Since countries are identical they are scaled versions of the entire world.

- dB/dP = dC/dP □ Global Optimum
- s · dB/dP = s · dC/dP □ Country Optimum

What about a global cap?

1. Countries would vote for the right cap, but …
2. there is no focal point for "dividing up" a global quantity target.

Read Stiglitz.

Problems with “The low vote wins.”

- **Fossil countries:**
  - Want the policy to fail, so they can sell oil.
- **Poor countries:**
  - Have not caused the problem,
  - are poor, and
  - have a high discount rate.
- **Both types will vote for too-low a price.**

A solution for fossil countries

- **Don’t count their votes.**
- **Only count votes for the highest prices**
- **Count votes that cover, say, 70% of all emissions.**

A Treaty that Fosters Cooperation

DESIGNING THE GREEN-FUND GAME

Getting Rich and Poor to Cooperate

Climate Treaty Rule #1

- If a higher global price target, $\mathbf{P^T}$, is agreed,
- The Green Fund will be more generous.

Climate Treaty Rule #2

- Country **i** must set price $\mathbf{P^T}$ to get its Green-Fund payments

How to implement Rule #1

- **The Green Fund will pay:** $G \cdot \Delta E \cdot P^T$

  G is the strength (*generosity*) parameter

  ΔE is a country's *emissions shortfall* relative to the global per-capita average

  P^T is the global *price target*.

- **High-emission countries will have a negative ΔE**
  - they must pay.
- **The payments sum to zero.**

A bonus incentive

- **If any country increases ΔE (emissions shortfall) it will receive more from or pay less into the Green Fund.**
- **Encourages measures missed by carbon pricing.**
- **The formula ($G \cdot \Delta E \cdot P^T$) might become a focal point:**
  - It's simple
  - It does not play favorites
  - It rewards emission reductions

How to choose G?

Climate Treaty Rule #3

Countries with ΔE near zero will "vote for" G.
The median "vote" wins.

- **These countries neither pay to nor receive much from the Green Fund.**
- **The median prevents any country from having a large influence.**

How to Choose P^T?

Climate Treaty Rule #4

All countries "vote for" P^T. The 30^{th} percentile "vote" wins.

- **Hence, 70% of the worlds emissions are from countries that suggest a target as high or higher than the one selected.**

Example Green-Fund Game

			No Green Fund		With Green Fund			
	Pop. in billions	Tons / cap./yr	Voted P	%	Voted P	%	Cost/ cap./day	G.F. Cost/ cap./day
U.S.	0.3	18	$31	6.7%	$26.4	17.6%	11.5¢	4¢
China	1.2	5.0	$31	6.7%	$31.0	17.6%	3.2¢	0
India	1.0	1.1	$10	9.1%	$26.4	24.0%	1.0¢	-1.2¢
World	2.5	5.0	$10	6.9%	$26.4	18.2%	$30B	$4.3B

"%" means "% reduction of emissions." World cost is in $B/year.
China picks G=.042 □ $1.11/t of emissions shortfall.

Assumptions:

Countries would optimally price at $30/t and this would reduce emissions by 20%. But India, taking account of a high discount rate, prefers $10/t.

Stability?

1. Stability depends on what other countries do if one country defects.
2. If the US or China reneges, the 70% rule will guarantee a weak treaty and dangerous climate change.
3. If India defects, it loses money.
4. Eventually, there should be an enforcement mechanism based on trade sanctions—Read Stiglitz.
5. Reputation also provides some stability.

Other Strategic Considerations

- **Measure Price by (carbon revenue)/emissions**
- **Launch the agreement with only a few players, e.g.:**
  - China, US, EU, Japan, India, Brazil
- **Enforcement makes a treaty more attractive to honest participants – it assure they won't be double crossed.**
- **As the climate worsens, P^T will be raised. Trying to force a high price early only prevents cooperation.**