



# **A PRICE ON CARBON: CARBON TAXES V. CARBON TRADING**

**CE 5212/PA 5232**

**November 5, 2008**

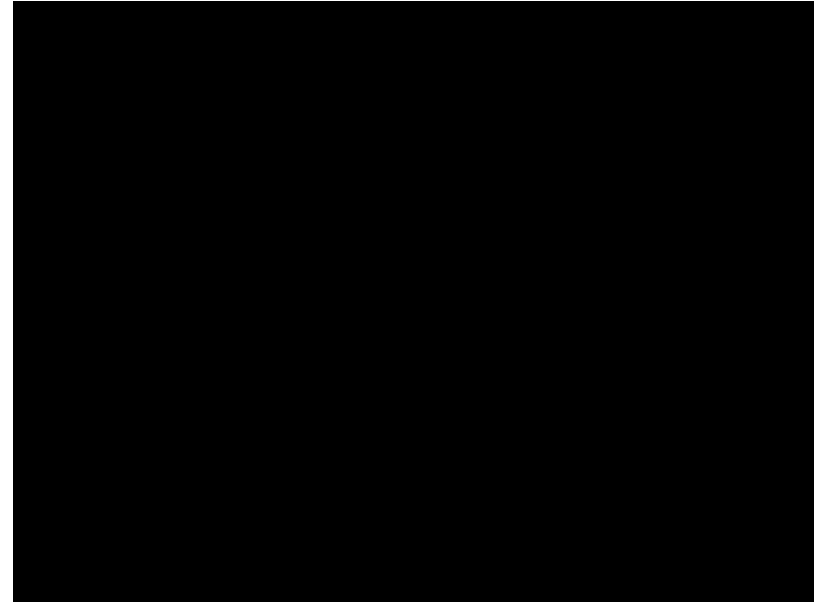
**Robert Jorgenson**

**Alex Peritz**

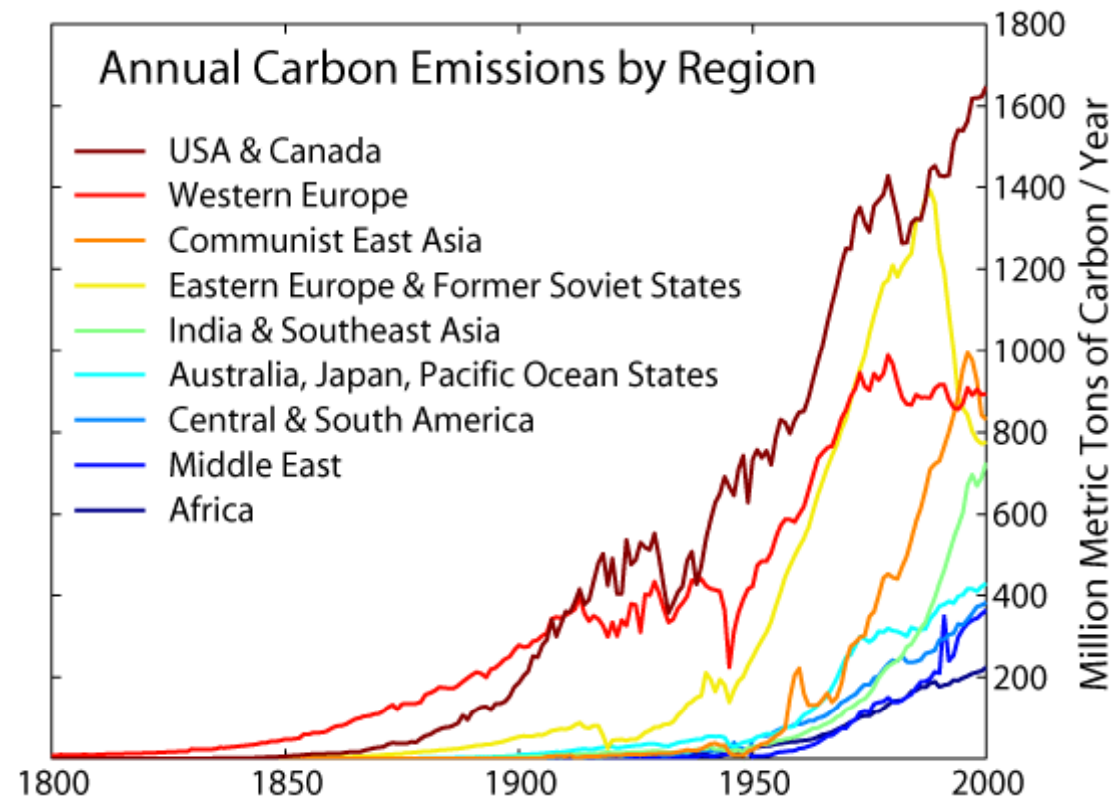
**Jie Sun**

# GREEN HOUSE GAS EMISSIONS

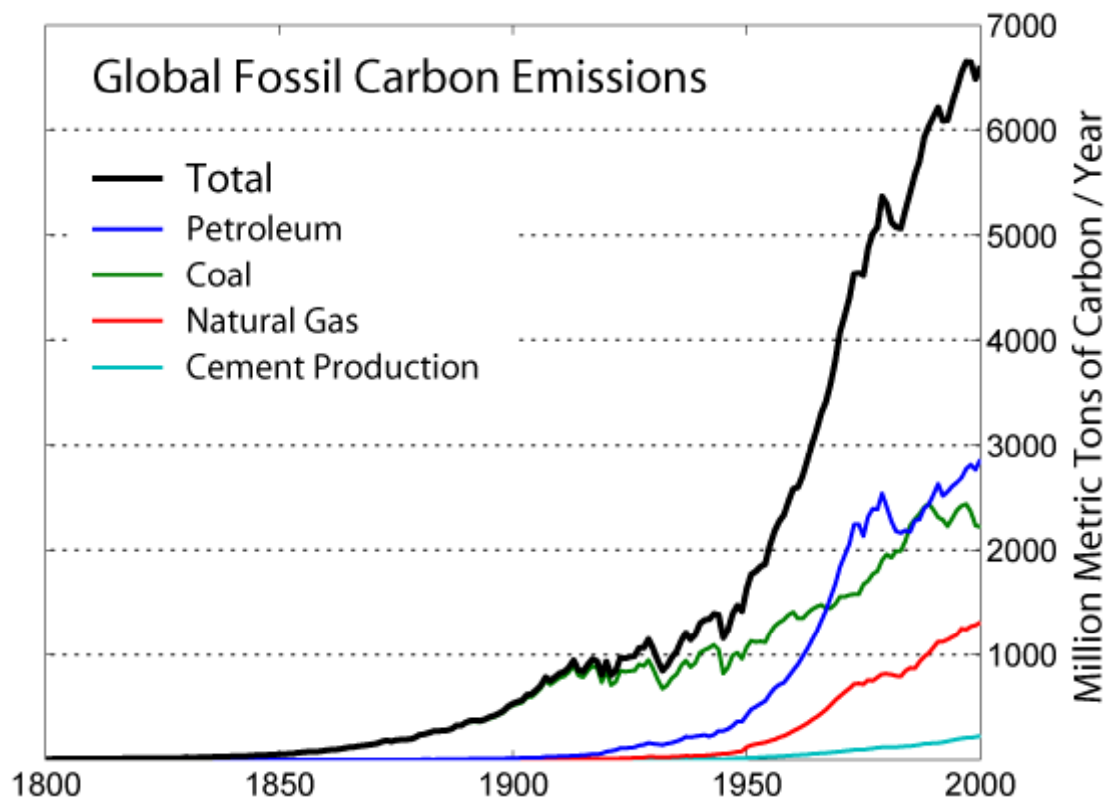
- Ozone,  $O_3$
- Methane,  $CH_4$
- Sulfur Dioxide,  $SO_2$
- Nitrous Oxide,  $NO_2$
- Hydro fluorocarbons, HFCs
- Carbon Dioxide,  $CO_2$



# ANNUAL CARBON EMISSIONS BY REGIONS IN THE WORLD



# SOURCES OF CARBON IN THE ATMOSPHERE



# ACTORS

- Clean Air Act
- Sulfur Dioxide Trade
- United States
- China
- European Union
- Kyoto Protocol Countries
- EPA
- Sweden
- Finland
- British Columbia, Canada
- New Zealand



## TIMELINE

- 1824 The greenhouse effect was theorized by Joseph Fourier
- 1990 Clean Air Act in the United States
- 1990 Finland first to enact carbon tax
- 1991 Sweden enacts carbon tax
- 1997 Kyoto Protocol initially adopted on December 11
- 2001 Great Britain introduces climate change tax
- 2005 New Zealand proposes carbon tax, but is not enacted



## TIMELINE CONTINUED

- January 1, 2005 European Union Emissions Trading System introduced
- April 1, 2007 Boulder, Colorado taxes electricity for carbon emissions
- October 1, 2007 Quebec, Canada is first province to tax carbon
- July 1, 2008 British Columbia, Canada enacts carbon tax



# EMISSION TRADING

- Clean Air Act in 1990
- Sulfur Dioxide Trade
  - Reduce Carbon Emissions by 10 million tons below 1980 levels
  - Phase I began in 1995 and affected utility plants in the East and Midwest United States
  - Phase II began in 2000 and affected entire country while tightening standards
  - Gave allowances out at beginning of each phase



# EMISSION TRADING CONTINUED

- European Union Emission Trading System
  - Regulates all greenhouse gas emissions, but primarily aimed at carbon dioxide
  - Phase I began in 2005 and went until 2007
  - Aimed at reducing approximately 40% of carbon dioxide emissions
  - Affects 12,000 installations in 15 European countries



# CARBON TRADING DEFINED

- Using economic incentives to reduce carbon emissions in the atmosphere
- Governments limit amount of pollutants emitted
- Groups given allowances to emit a certain amount of emissions



# CARBON TAX

- Energy tax paid by individuals, industries, and countries
- Taxes fossils fuels
  - Oil
  - Coal
  - Natural Gas
  - Liquefied Petroleum
  - Aviation Fuel
- Used to promote the use of sustainable technologies not to increase revenue



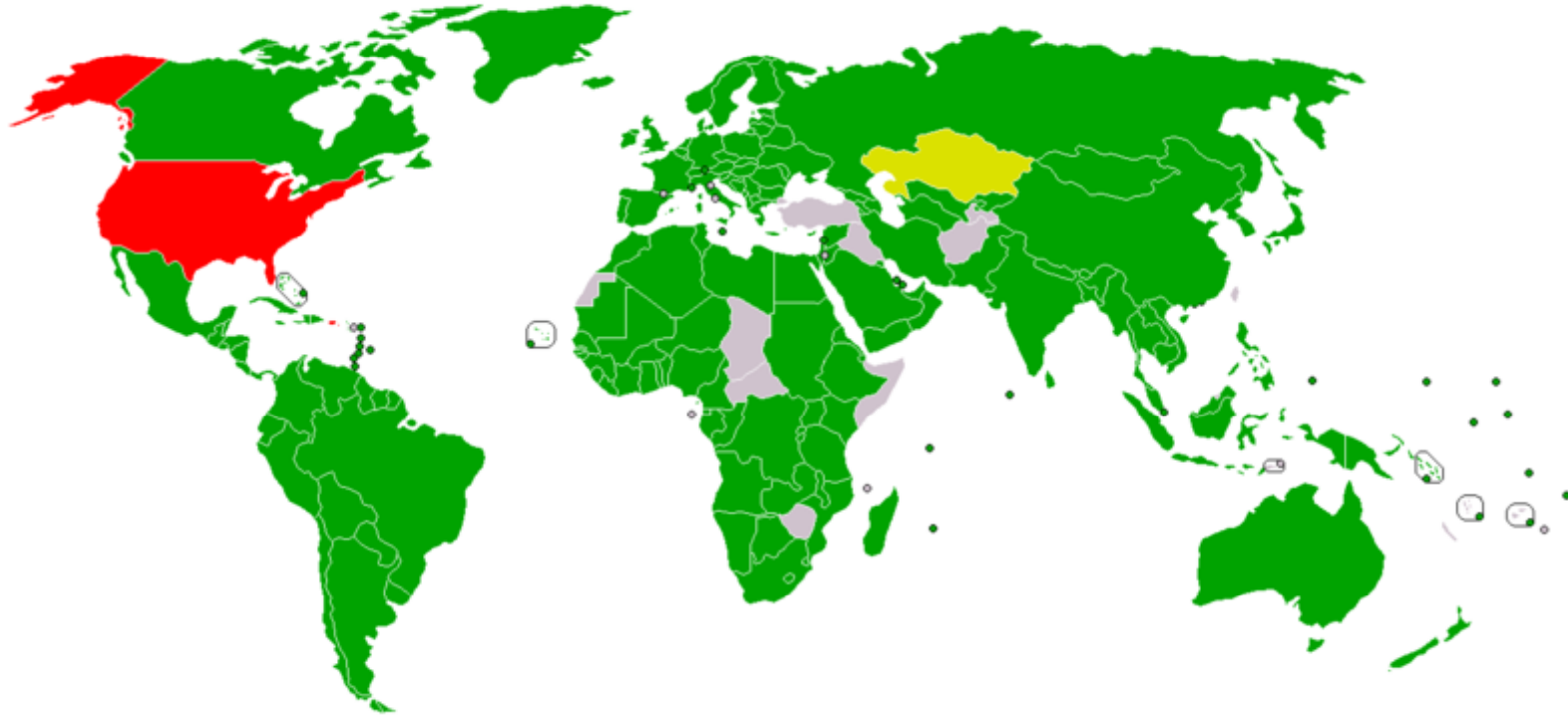
# THE KYOTO PROTOCOL

- Kyoto Protocol is a treaty between nations to binding them to reduce their greenhouse emissions formed in 1997
- Kyoto Protocol offers flexible market based mechanisms to control emissions
- The mechanisms allow greenhouse gas trading in a way that helps stimulate investment in meeting cleaner emissions standards
- Most countries have signed and ratified the treaty except the United States (declined ratification), Kazakhstan (ratification pending) and several nations that have taken no position



# NATIONS PARTICIPATING IN KYOTO PROTOCOL

Nations Participating in the Kyoto Protocol as of 2005

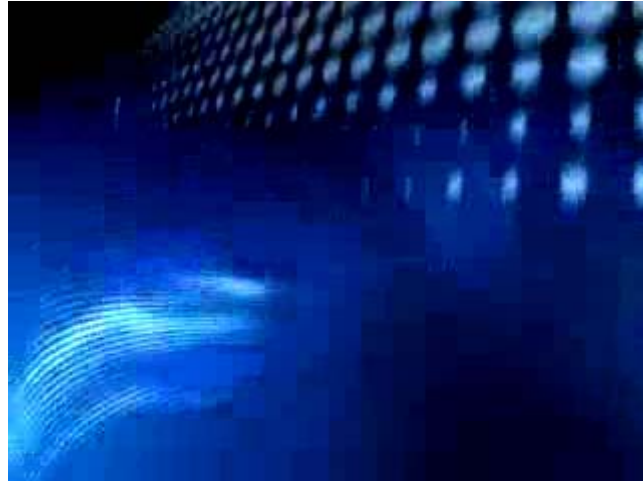


- Signed and ratified.
- Signed, ratification pending.
- Signed, ratification declined.
- No position.

(Wikipedia 2005)

[http://en.wikipedia.org/wiki/Image:Kyoto\\_Protocol\\_participation\\_map\\_2005.png](http://en.wikipedia.org/wiki/Image:Kyoto_Protocol_participation_map_2005.png)





## DISCUSSION QUESTION

- Do you think the U.S. should ratify Kyoto Protocol?
- What are the impacts on the U.S compared to developing countries?



# WHAT IS CARBON TRADING?

- Carbon or emissions trading is the system by which the Kyoto Protocol manages the buildup of greenhouse gases
- Carbon trading is a form of emissions trading that permits buying and selling of *credits* or *allowances* created by a mandated *cap*



Ken Costello

Petroleum refinery

(sources Images smokestacks)

<http://search.live.com/images/results.aspx?q=co2+pollution>

# WHAT IS CARBON TRADING?

- A *credit* is distributed by a government that rewards firms that meet or exceed a regulatory standard
- An *allowance* is the set amount of emissions that the government allows its industries to emit
- One ton of CO<sub>2</sub> is a common unit of allowance in greenhouse markets



<http://search.live.com/images/results.aspx?q=co2+pollution>



(sources Images  
smokestacks)  
Beijing China

## WHAT IS CARBON TRADING?

- Carbon trading is a market tool that provides incentives to control pollution
- It has two approaches voluntary and mandated.
- Mandated or cap and trade, requires countries and firms to reduce emissions to a certain level
- Voluntary, countries and firms are allowed to counterbalance emission and are not legally obliged



# WHAT IS CARBON TRADING?

- Carbon trading uses cap and trade that assumes emissions are a global problem
- Cap and trade incorporates three methods: **1)** carbon emitting control devices, **2)** improving emissions technologies, **3)** develop projects that reduce greenhouse gases, e.g. planting trees.



Smokestack, Pollution, Smoke, Factory, Industry  
Wood, Lumber

# WHAT IS CARBON TRADING?

- Cap and trade attempts to make all three methods work together with economic efficiency.
- Cap and trade sets an overall limit on total emissions
- The final goal is to reduce emissions below the set cap
- Participants in cap and trade can buy or are given *allowances* expressed in metric tons of CO<sub>2</sub>
- The metric tones of CO<sub>2</sub> or GHGs are what they are allowed to emit.
- The sum of the allowances adds up to the cap



# WHY WE NEED CARBON TRADING OR EMISSIONS TRADING?

- It is very likely that our climate is changing in a way that threatens the entire biosphere, through human emission of greenhouse gases
- Emissions trading is a flexible mechanism that does not needlessly create burdensome regulation
- It minimizes the costs of reducing emissions.
- Other methods such as taxes and direct government regulation tend to be more costly towards industry



# HOW DOES CAP AND TRADE WORK?

## REGULATED COMMAND AND CONTROL

- Carbon trading can be explained by a simple example of a world with just two CO<sub>2</sub> emitters
- Emitter A a power plant and emitter B a manufacturing plant both emit 900 tons of CO<sub>2</sub> per year
- Their government sets an emissions limit of 600 tons a year



# HOW DOES CAP AND TRADE WORK?

## REGULATED COMMAND AND CONTROL

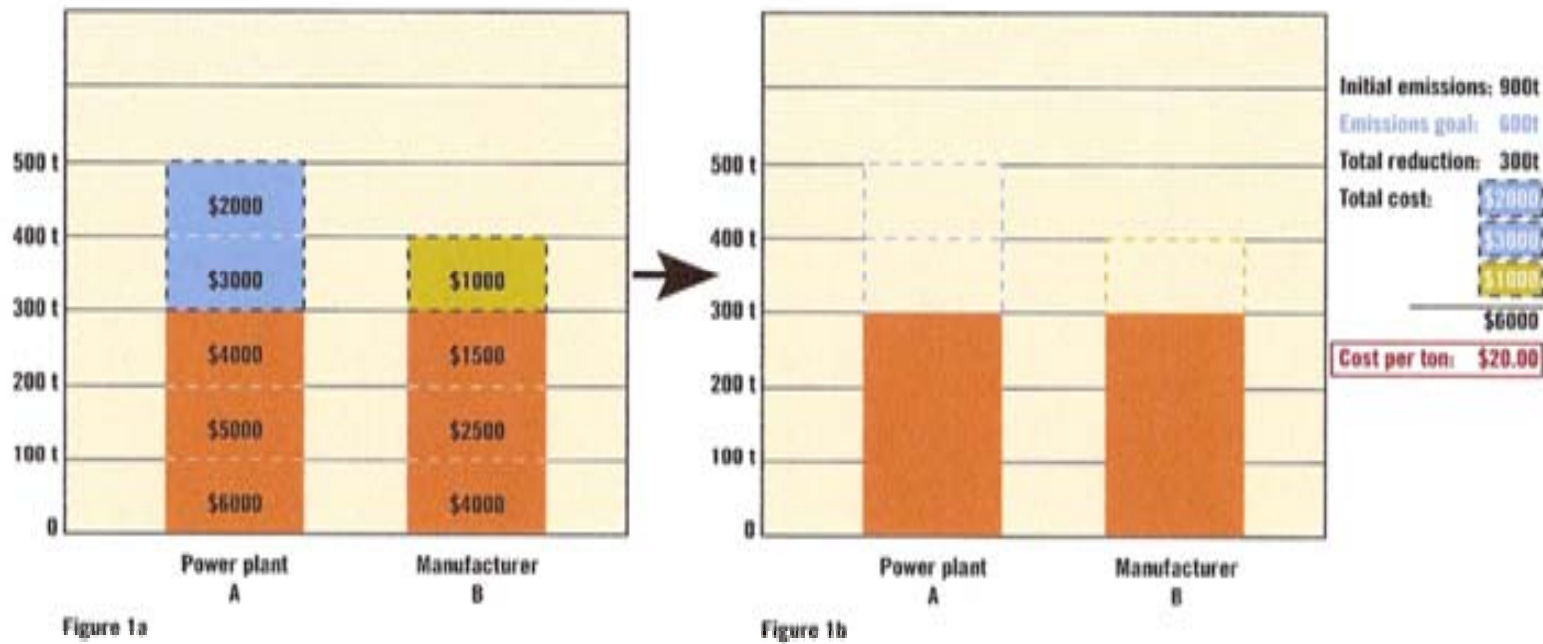
- The cost to emitter A is greater than emitter B (figure 1)
- For emitter A 100 tons of CO<sub>2</sub> reductions is \$2,000
- Emitter B's cost of reducing 100 tons is \$1,000
- Regulators decide to direct both plants to reduce emissions by 300 tons
- Emitter A's costs are \$5,000 (in blue) and emitter B's costs are \$1,000 (in yellow) or \$20 per ton reduced.



# CARBON TRADING BASICS: A GRAPH OF SIMPLIFIED EXAMPLE (GRAPH 1)

Figure 1

**Command and Control**



# HOW DOES CAP AND TRADE WORK?

## CAP AND TRADE

- A government can set an overall cap on the 600 tons of emissions
- The government then issues 600 emissions allowances
- When allowances are distributed evenly emitter A and B have incentive to trade since A's emissions costs are higher than B's



# HOW DOES CAP AND TRADE WORK?

## CAP AND TRADE

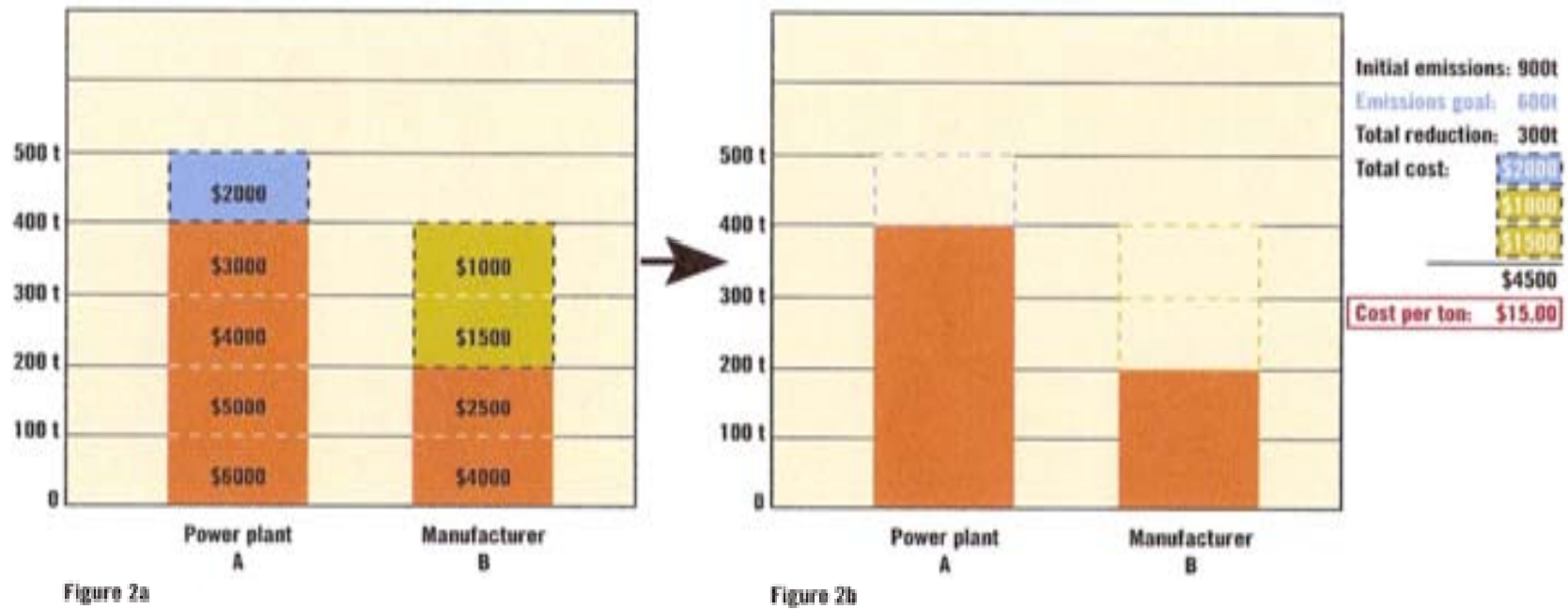
- Emitter B cuts its emissions by 200 tons and sells the surplus to emitter A for less than it cost emitter A to reduce its CO<sub>2</sub> (figure 2)
- \$2500 for say 100 allowances
- \$4500 is the lower cost for the emission level or \$15 per ton in the example
- Total cost is lower for each facility under regulation



# CARBON TRADING BASICS: A GRAPH OF SIMPLIFIED EXAMPLE (GRAPH 1)

Figure 2

**Cap and Trade**



## DISCUSSION QUESTIONS

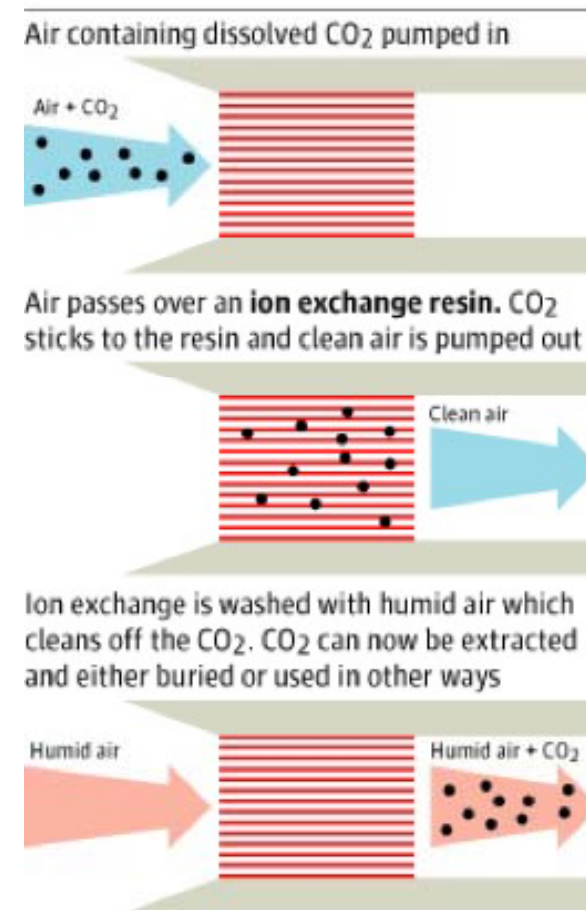
- Should a carbon trading system be international, national, or a combination of both?
- What sectors of economy should be regulated by a carbon trade?



# CARBON TRADING BENEFITS & DRAWBACKS

- Cap and trade provides incentives for reducing emissions continuously (new emissions technology)
- There is little to no incentive to reduce beyond command and control regulatory standards

## The CO<sub>2</sub> extractor



Ion CO<sub>2</sub> scrubber, sucks up one ton of CO<sub>2</sub> per day  
(Source Treehugger a Discovery Company)

<http://cc.msnsnscache.com/cache.aspx?q=smokestack+co2+scrubbing+devices&d=74343330485128&mkt=en-US&setlang=en-US&w=b20ad3c3,d0d50a3c>

# CARBON TRADING BENEFITS & DRAWBACKS

- A problem with carbon trading under Kyoto is an “untested economic experiment” globally
- Some of the largest polluters are actually rewarded by pollution credits provided by the government are reported as assets and valued at market prices
- Firms can often buy cheap “offset” credits from elsewhere in the world that can wind up subsidizing a project that burns gas to generate electricity in the developing world.



## DISCUSSION QUESTION

- Do you think there should be a more aggressive world standard that for carbon trading than what is currently discussed?

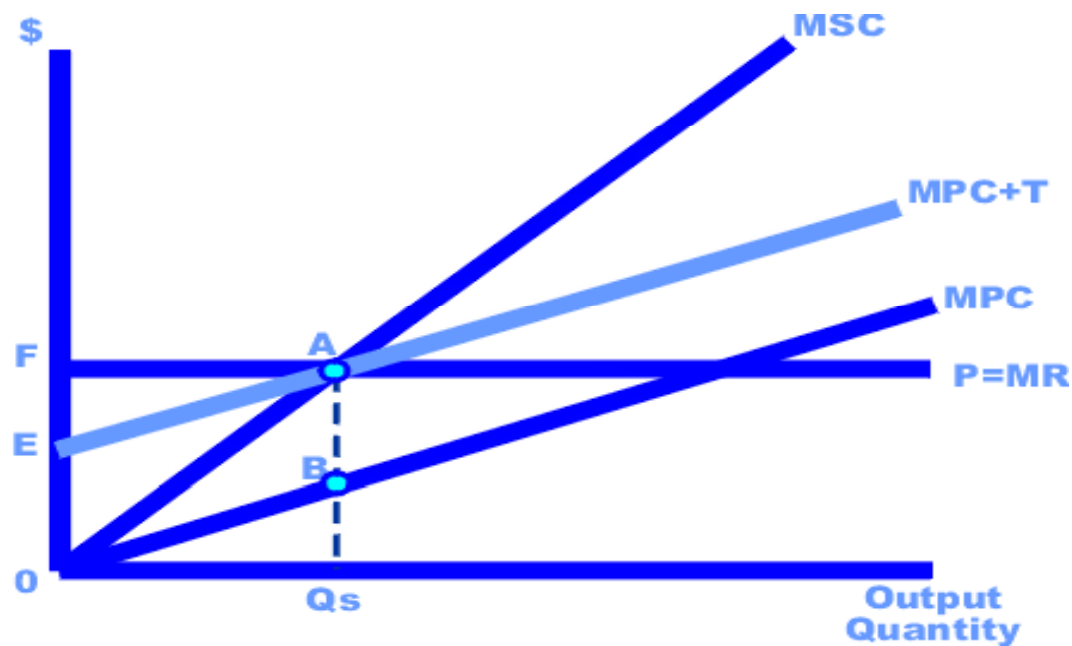


# CARBON TAX



# WHAT IS CARBON TAX?

- Deal with the negative externality caused by carbon dioxide emission



# WHAT IS CARBON TAX?

- A tax on energy, not directly on carbon dioxide.

Fuel	Code	Emission Coefficients		
		Pounds CO2 per Unit Volume or Mass		Pounds CO2 per Million Btu
<b>Petroleum Products</b>				
Aviation Gasoline	AV	18.355	per gallon	152.717
		770.916	per barrel	
Distillate Fuel (No. 1, No. 2, No. 4 Fuel Oil and Diesel)	DF	22.384	per gallon	161.386
		940.109	per barrel	
Jet Fuel	JF	21.095	per gallon	156.258

- From Energy Information Administration, U.S. Department of Energy



## MOSTLY TAXED ON

- **Petroleum (motor gasoline, diesel, jet fuel)**
- **Natural gas**
- **Coal**
- **Electricity**



## DISCUSSION QUESTION

- What sectors of economy should be levied by a carbon tax?
- Where should the revenue of carbon tax go?



# CARBON TAX AROUND THE WORLD

## ○ Finland:

- the first country to enact a carbon tax. (1990)
- Initial price: \$1.45 per metric ton of carbon dioxide.
- Consistently rising: \$2.96 in 1993, \$8.34 in 1995, \$24.39 in 2007 and \$ 25.20 in 2008.
- Revenue is used to reduce income and capital tax
- 5% lower carbon dioxide emission than without the tax.



# CARBON TAX AROUND THE WORLD

## ○ Sweden

- Carbon tax was introduced in 1991.
- Initial price: \$36.8 per metric ton of carbon
- The tax was \$150 per ton of carbon in 2007
- Different rate for industry and consumer
- carbon emissions was reduced by 13%, from 1987 to 1994.
- Revenue goes to public use or tax reduction



## NETHERLANDS

- a carbon tax in 1990 but replaced it with a 50/50 carbon/energy tax in 1992
- Environmental Tax on Fuels and Regulatory Tax on Energy
- "in line with the government's aim of shifting the tax burden away from labor and capital based income and towards use of the environment."



# GREAT BRITAIN

- “climate change tax” was introduced in 2001.

Carbon Tax rate of Great Britain

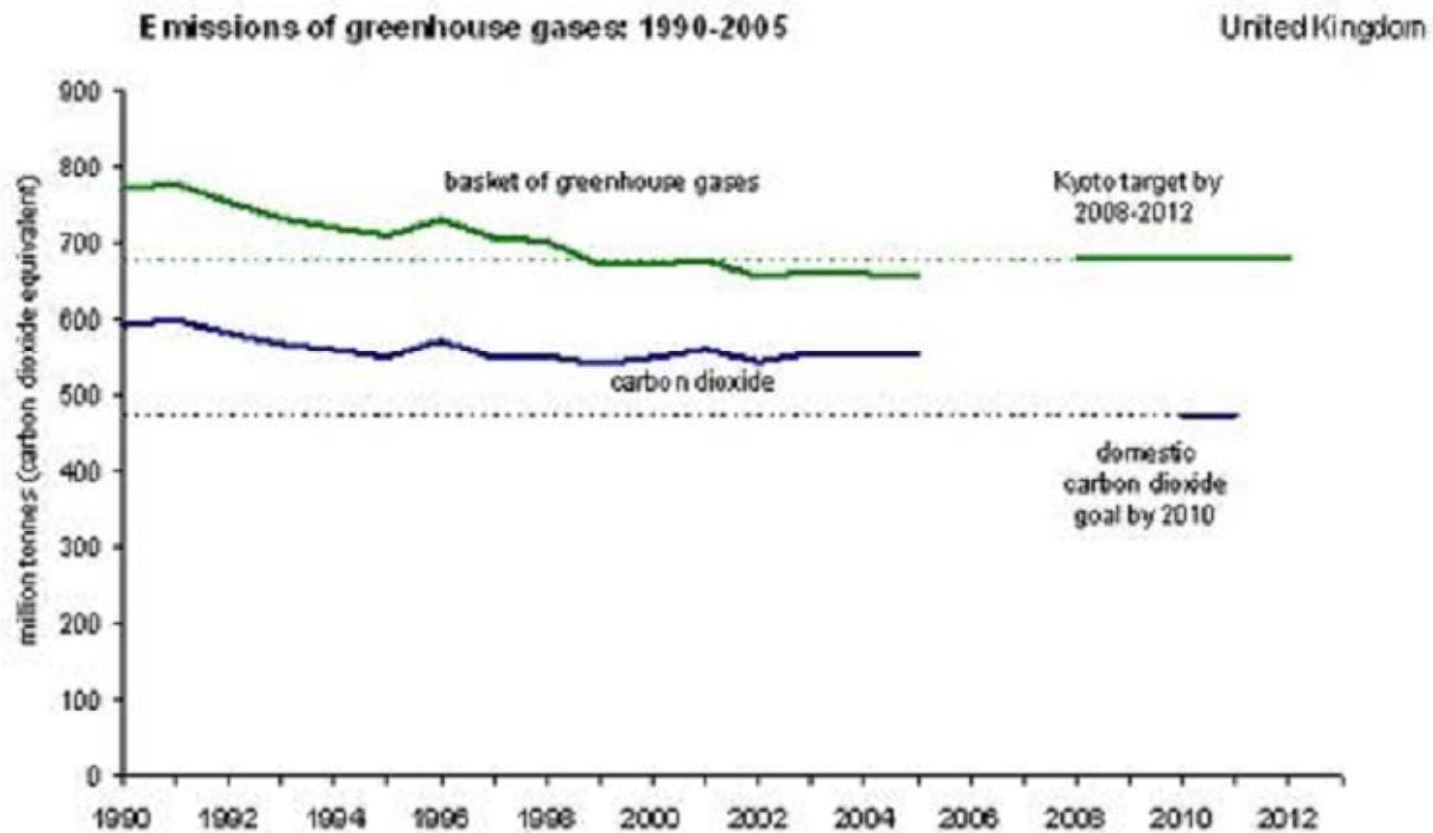
item	gas	Liquefied petroleum gas	electricity	Other taxable commodity
Rate p/kWh	0.15	0.07	0.44	0.12

Source: Department for Environment Food and Rural Affairs, Great Britain

- Revenue of tax is returned to the non-domestic sector.



# GREAT BRITAIN



Source: AEA

Emission of greenhouse gases in United Kingdom



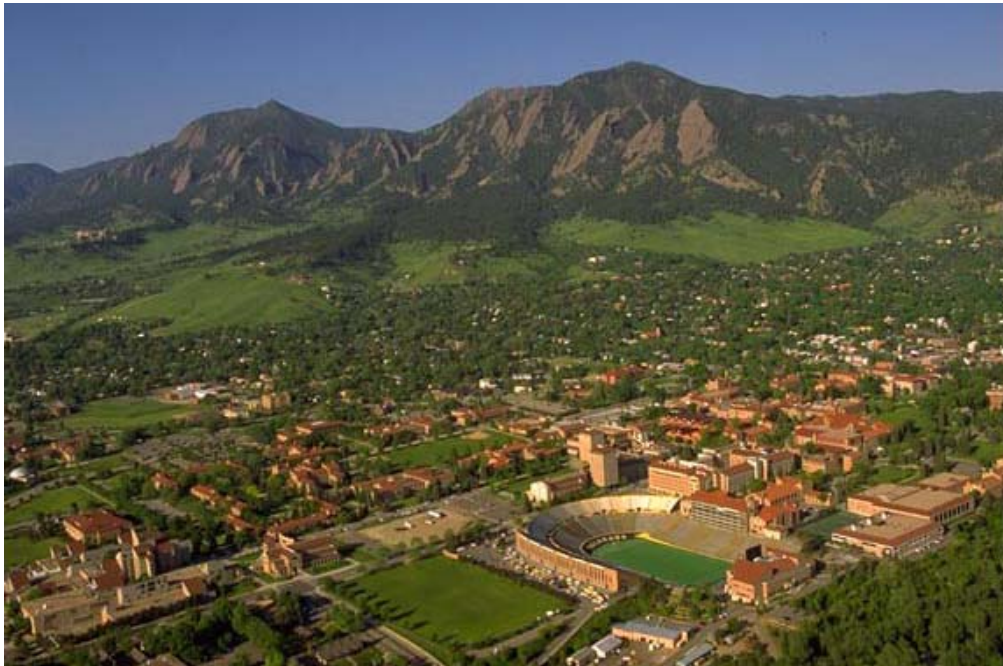
## NEW ZEALAND

- A carbon tax was proposed in New Zealand in 2005
- Rate: \$10.67 of U.S. per ton of carbon
- Abandoned after the election of 2005.



## BOULDER (COLORADO)

- Beginning from April 1, 2007
- \$7 per ton of carbon
- revenues will go to Boulder's climate action plan
- Expire by 2012



## QUEBEC

- First state or province in North America places a carbon tax: on Oct. 1, 2007
- Rate: 3.1 U.S. cents per gallon of gasoline and 3.6 U.S. cents for diesel



# BRITISH COLUMBIA

- Carbon tax started on July 1, 2008
- Rate:\$10 (Canadian) per metric ton of CO<sub>2</sub>
- Annual rising of \$5 (Canadian), \$30 (Canadian) by 2012.
- revenue neutral, so the revenue will be returned to taxpayers
- estimated that the carbon tax reduce BC's 3 million tons of CO<sub>2</sub> –equivalent annually



## DISCUSSION QUESTION

- Do these methods reduce enough green house gases, such as carbon to control the global warming?



## IN U.S

- In 1993, energy tax based on heat content proposed by President Clinton
- In the 1990s, energy activists in Minnesota .
- Boulder (as mentioned above)



## DISCUSSION QUESTION

- Why U.S is slow in controlling carbon emissions compared to other advanced countries?



# DEBATE

- Split the class into two groups:
  - Group 1: carbon trading supporters
  - Group 2: carbon tax supporters
- Discuss the pros and cons of these two approaches to control carbon emission.



# THE END

- Any additional questions or comments?
- Thank you for attention and cooperation!

