Carbon, Energy, and Carbon Credit Markets

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Outline

- How did the idea of carbon trading get started?
- What is traded?
- Why do credits have value?
- What is happening in the US?
- Why are prices different between Europe and the US?
- How can a firm create credits?

How did Carbon Markets get Started?

- United Nations Framework Convention on Climate Change (UNFCCC)

- Kyoto Protocol
  - Idea of carbon credit trading
  - Came into effect February 16th, 2005
  - 175 parties have ratified the protocol
  - 36 countries and the European Economic Community are required to reduce greenhouse gases
  - US NOT bound by the Kyoto protocol

What is traded?

- Many greenhouse gases e.g. carbon dioxide (CO2), methane, nitrous oxide.
  - Converted to CO2e i.e. CO2 equivalent
- Credits specified as tonnes of CO2e

Gas	Global Warming Potential	Gas	Global Warming Potential
Carbon Dioxide	1	HFC[1]-23	12,000
Methane	23	HFC-125	3,400
Nitrous Oxide	296	HFC-134a	1,300
Perfluoromethane (CF_4)	5,700	HFC-143a	4,300
Perfluoroethane (C_2F_6)	11,900	HFC-152a	120
Sulfur Hexafluoride (SF_6)	22,200	HFC-227ea	3,500
		HFC-236fa	9,400

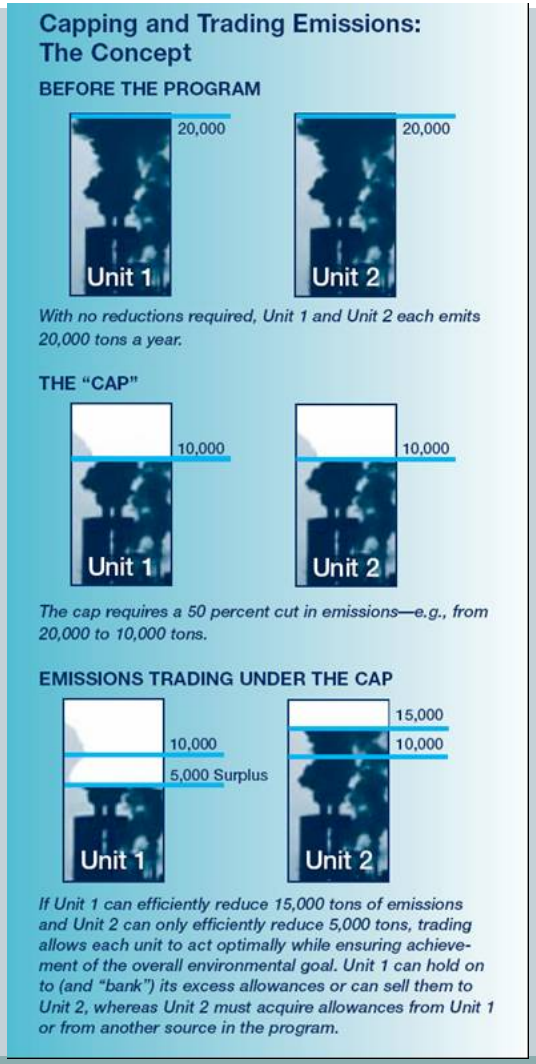
Source: Intergovernmental Panel on Climate Change. 2001. *Climate Change 2001: The Scientific Basis*. Cambridge University Press, Cambridge, UK.

Example of conversion

- 1 tonne of methane is equivalent to 23 tonnes of CO2
  - 1tonne methane = 23 tonnes CO2e

- 1 tonne of nitrous oxide is equivalent to 296 tonnes of CO2
  - 1 tonne nitrous oxide = 296 tonnes CO2e

Cap and Trade System



- Set a cap on emissions
- Allocate credit allowances
- Monitor emissions during compliance period
- Surrender credit allowances at end of compliance period
- Fines/penalties if emissions > credits

Source: EPA. 2003. Tools of the Trade: A Guide to Designing and Operating a Cap and Trade Program for Pollution Control. EPA430-B-03-002.

Who Buys and Who Sells Credits?

- During compliance period companies trade credits

- BUY CREDITS IF
  - Costs of emissions reduction > credit price
- SELL CREDITS IF
  - Costs of emissions reduction < credit price

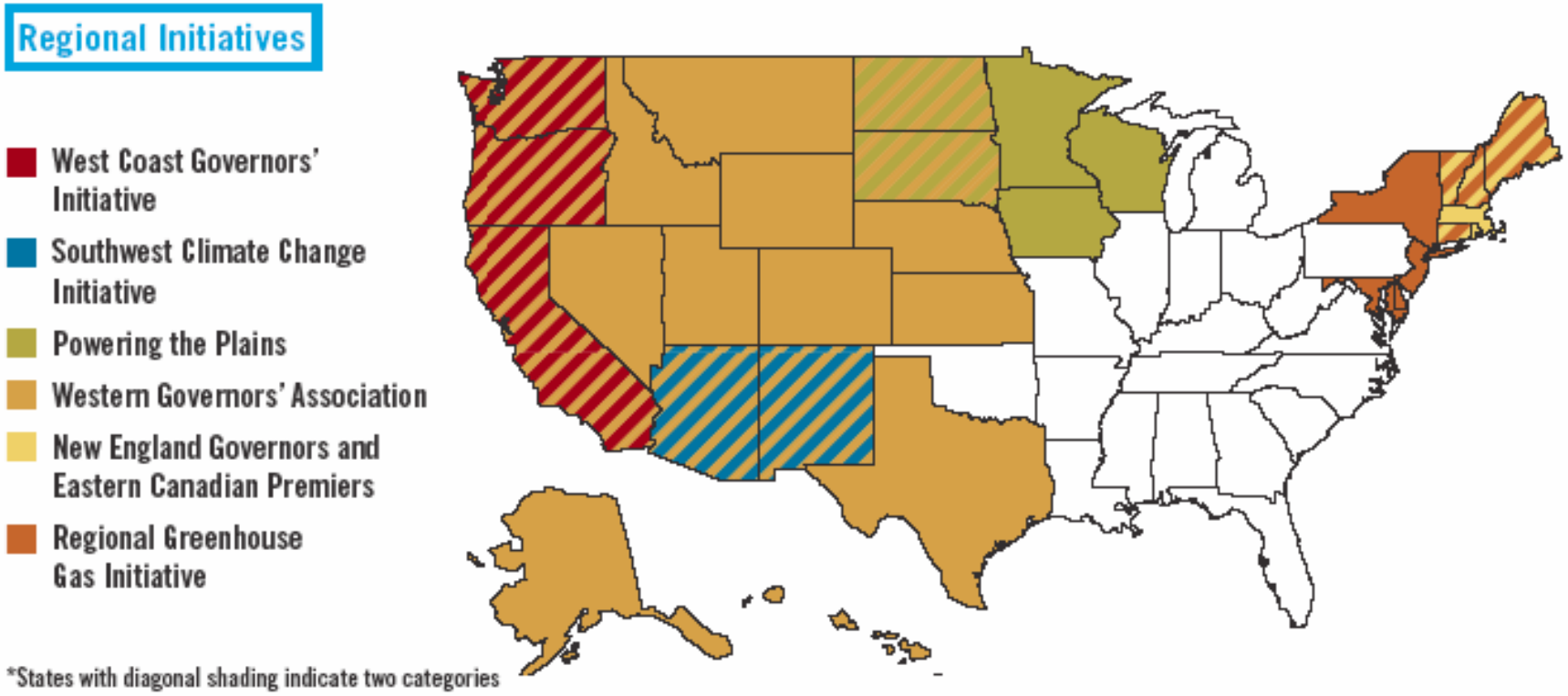
ICE ECX CFI DATA SEPTEMBER 2007

Volumes in tonnes of CO2 (EU Allowances)									
Contract Month		Monthly Traded High (€)	Monthly Traded Low (€)	Month End Settlement (€)	Move (€)	Move %	Average Implied Volatility %	Total Volume ('000)	Open Interest ('000)
Dec-07	Futures	0.10	0.05	0.08	-0.02	-20%		3,497	49,996
	Options						0.26%	0	2,000
Dec-08	Futures	22.09	19.35	21.68	+2.28	+10.5		68,752	62,483
	Options						50.28%	9,200	21,180
Dec-09	Futures	21.26	20.73	22.13	+2.15	+10.8		3,481	25,011
	Options						48.77%	1,700	2,500
Dec-10	Futures	22.76	21.43	22.58	+1.99	+9.7		3,740	9,152
	Options						47.75%	0	50
Dec-11	Futures	23.30	22.01	23.04	+1.85	+8.7		2,892	4,475
	Options						46.75%	0	50
Dec-12	Futures	23.61	22.40	23.63	+1.85	+8.5		6,199	9,403
	Options						45.75%	0	50
Totals	Futures							88,561	160,520
	Options							10,900	25,830
ADV*	Futures							4,973	
	Options							545	

*ADV = Average Daily Volume

Source: European Climate Exchange. Market Update. September 2007.

State Initiatives within the US



Source: Pew Center on Global Climate Change. 2007. Climate Change 101: State Action

Voluntary Exchanges within US

- Chicago Climate Exchange (CCX)

- California Climate Exchange (CaCX)
  - AB32 trading regulations in California

Market prices for credits

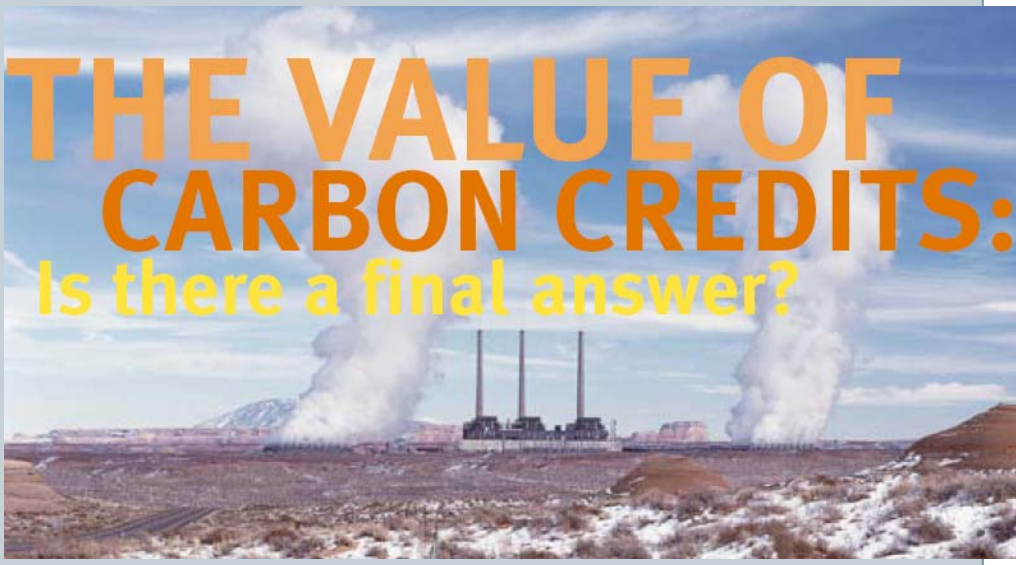
- Approximate price range in US market (2007)
  - $3.30/tonne CO_{2e} to $4.05/tonne CO_{2e}
- Approximate price range in EU market (2007)
  - $22/tonne CO_{2e} to $30.30/tonne CO_{2e}
- Why are prices different between EU and US?
  - Demand and supply!
  - no trading between the two markets

Factors affecting Credit Prices

Demand and Supply Factors	Carbon Credit Market Impacts: Demand Effect	Supply Effect	Price Effect
GHG and Energy Policy			
GHG reduction rules targets	I		I
Per-credit subsidy for credit purchase	I		I
Clean Development Mechanism	D		D
Clean Development Mechanism		?	?
Increased energy use efficiency	D	I	D
Subsidies for reduction or sequestration		I	D
Restrictions on credit production		D	I
Energy Prices			
Use of non-carbon based energy	D		D
Relative price increase of carbon intensive energy	D	I	D
Relative price decrease of carbon intensive energy	I	D	I
Technology and Input Cost			
New energy and GHG efficient technology	D		D
Subsidies and tax credits for adoption	D		D
Lower cost reduction technology		I	D
Higher cost reduction technology		D	I
Lower input costs of reduction or sequestration		I	D
Higher input costs of reduction or sequestration		D	I
Demand and Profitability of Carbon Neutral Products			
Increase in demand	I		I
Decrease in demand	D		D
Relative increase in profitability		D	I
Relative decrease in profitability		I	D
Climate Changes			
Increased carbon based energy demand	I		I
Decreased carbon based energy demand	D		D
Productive Capacity of Agriculture			
Declining capacity to sequester GHG		D	I

D= Decrease, I = Increase

I=increase
D=decrease
?=not enough information



Developed from information within: Williams, J.R., J. M. Peterson, and S. Mooney. 2005. The Value of Carbon Credits: Is There a Final Answer? *Journal of Soil and Water Conservation* 60(2):36A-40A.

How can Credits be Created? (1)

- Many different ways
  - Each market has specific guidelines for constitutes a credit
    - NOTE – credits on the CCX are not subject to the same guidelines as credits under the Kyoto mechanism
- Common projects
  - Emissions reductions
    - less energy use, new industrial technologies
    - Capture landfill gases
  - Terrestrial sequestration
    - Carbon sequestration in soils
    - Carbon sequestration in forest biomass (trees)
  - Geologic Sequestration (carbon capture and storage)

How can Credits be Created? (2)

- By switching to practices or technologies that emit fewer GHGs (or sequester more C) that the technology you are using at present

Example of C-credit Creation

- Currently engaged in conventional till on an acre of land
  - Rate of soil C sequestration is 0.1 MT CO2e/year
  - This is "business as usual"
- Switch to no-till on that acre
  - Rate of soil C sequestration is 0.6 MT CO2e/year
- Now you have a change from "business as usual"
- **Carbon available for credit sales = 0.6 – 0.1 = 0.5 tonnes CO2e/year**

Carbon Economics: when to change practices to generate carbon credits?

$$\frac{\Delta CO_{2e}}{Cost\ incurred\ changing\ practices}$$

= Cost of producing 1 carbon credit

IF

Cost of producing each credit < Credit price

Then producer should change practices and create more C-credits

Important – all credits are equal

- Credits from agriculture, forestry and range must compete in the market place with credits created from other sources.
- Credits from terrestrial systems are likely to be a small part of the market.
- Buyers will (in general) only be looking at price
- Industries that can sell credits at low prices will benefit the most
- THE COST OF CREATING CREDITS determines how much is supplied (and by who) at each possible market price

Quantity of C Sequestered

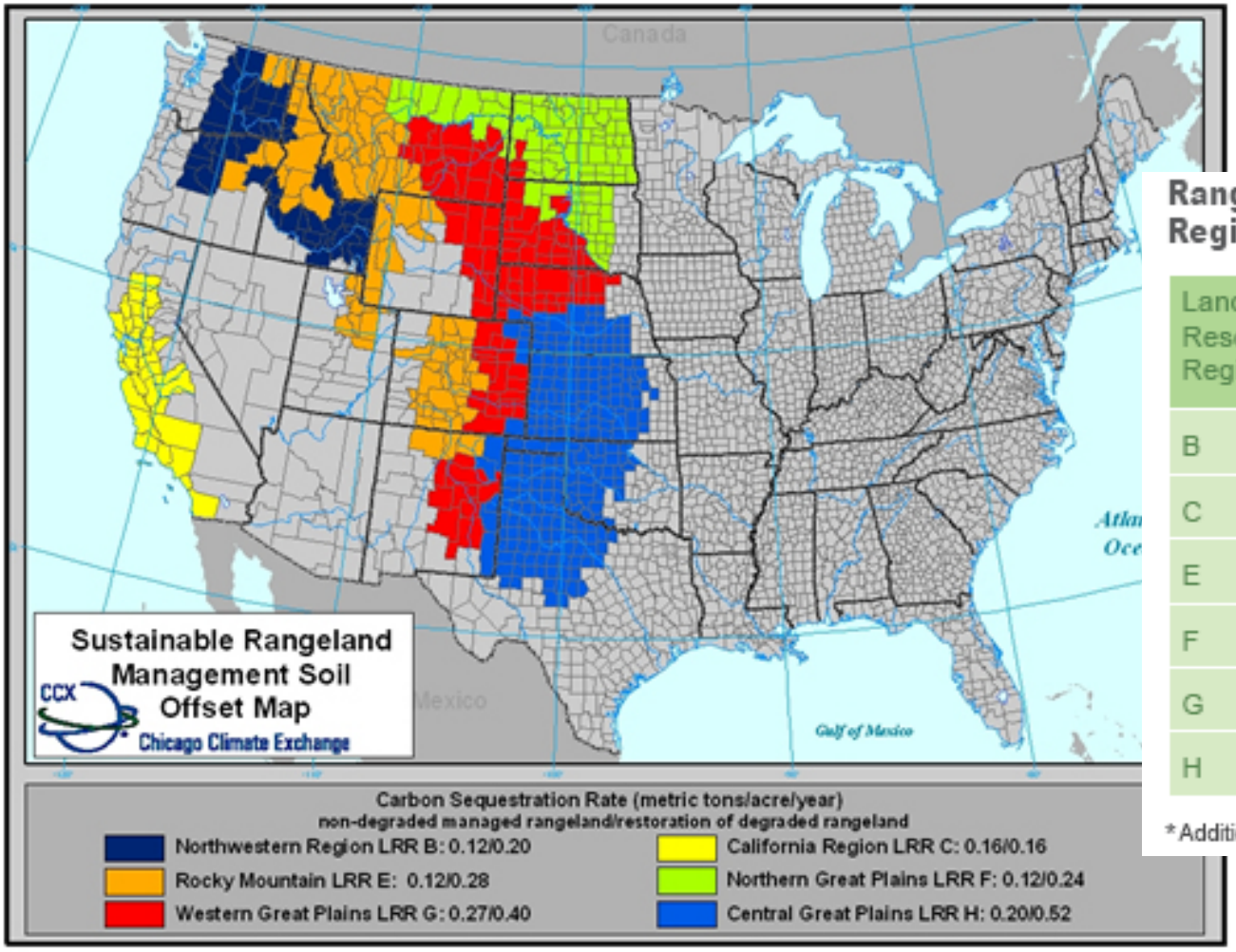
- Dependent on two factors
  - Biophysical potential
  - Economic cost to producer

Three landowners within Kansas

Landowner	1	2	3
Physical potential	10 tonnes CO2e/year	15 tonnes CO2e/year	20 tonnes CO2e/year

Landowner	1	2	3
Cost of creating credit	$5/tonne CO2e	$18/tonne CO2e	$12/tonne CO2e

Rangeland - Payment for practice - CCX



Rangeland Rates and Eligible Regions*

Land Resource Region	Previously Degraded	Improved Manage-ment
B	0.20	0.12
C	0.16	0.16
E	0.28	0.12
F	0.24	0.12
G	0.40	0.27
H	0.52	0.20

*Additional regions may be added based on expert input.

Source: Chicago Climate Exchange. 2007. Rangeland Soil Carbon Management Offsets.

For more Information

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