



Subnational Carbon Governance in the US – focus on land use

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ENVS

March 8th, 2012

Quick review: Which of the following is
a carbon sink?

a)



b)

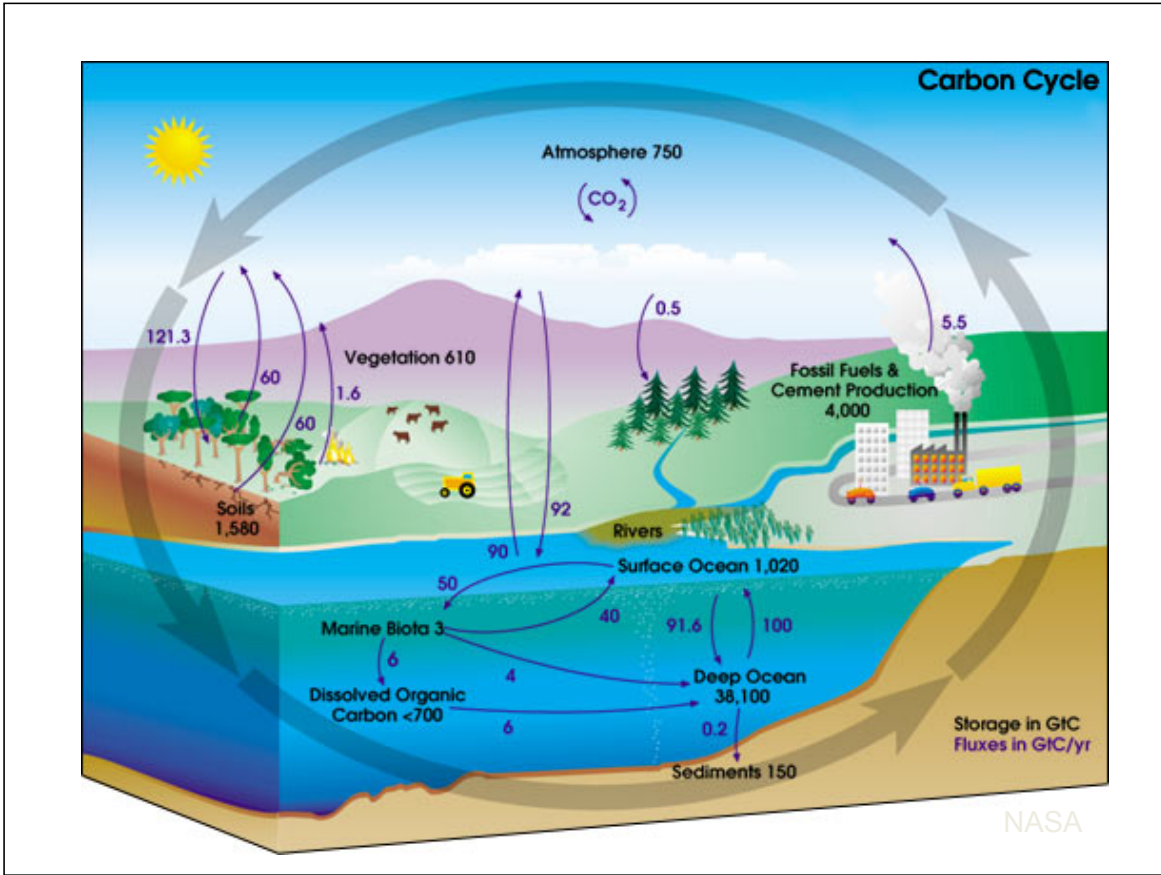


c)

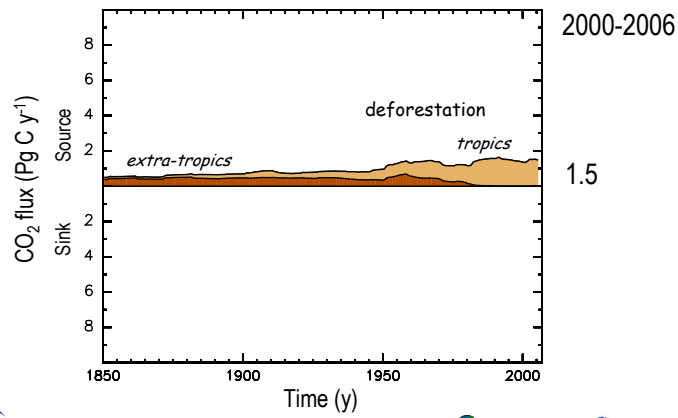


d)





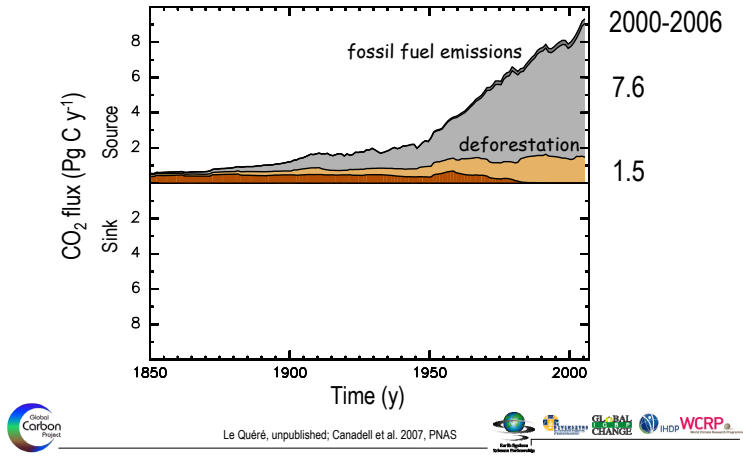
Perturbation of Global Carbon Budget (1850-2006)



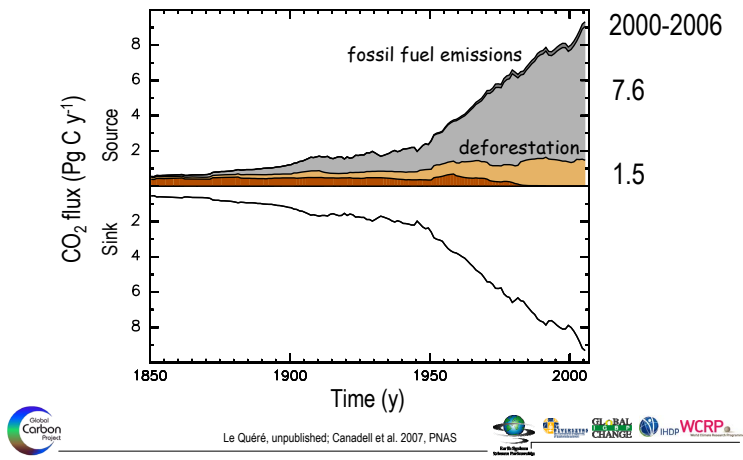
Le Quéré, unpublished; Canadell et al. 2007, PNAS



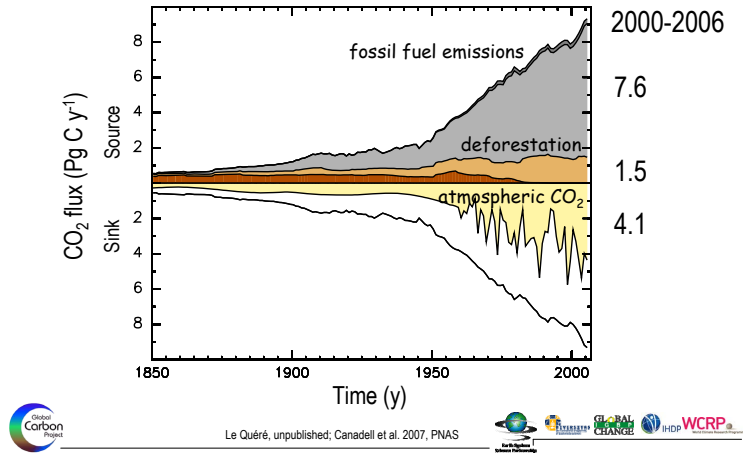
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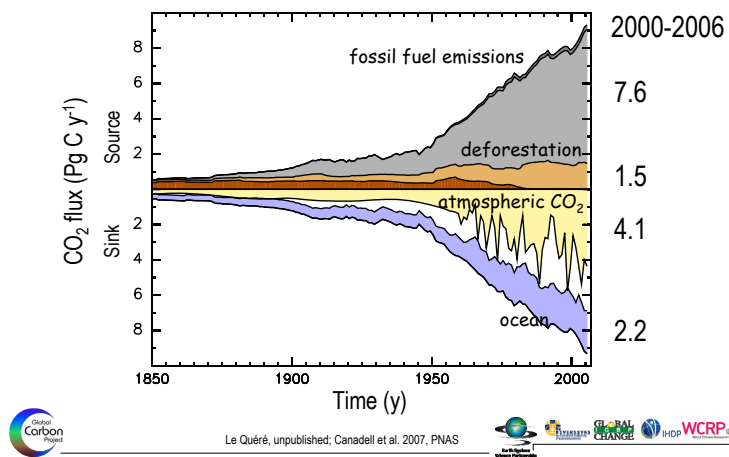
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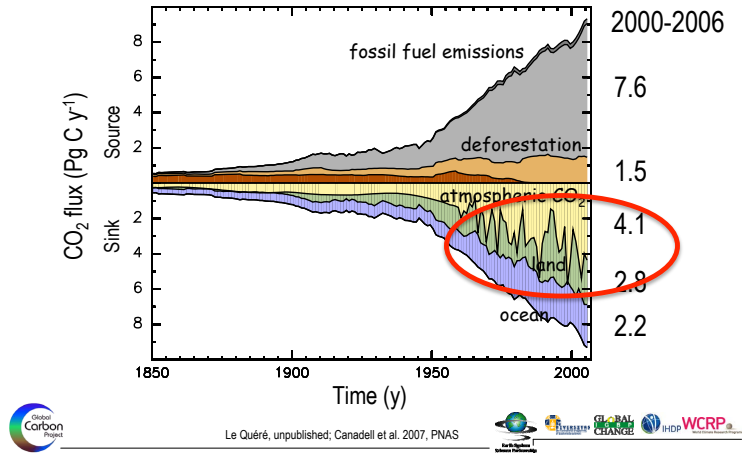
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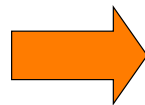
Perturbation of Global Carbon Budget (1850-2006)



An Opportunity?

Inadvertent carbon management

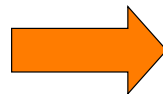
- Existing for millennia
- Will continue to dominate C management
- Depends on land type, land use, actors, markets, policy



**FUTURE
??**

Carbon Governance?

- Both deliberate and inadvertent
- Rules TBD
- Effective across scales
- Role of public policy
- Role of markets



Deliberate carbon management

- Increasing interest in past 20 yrs
- Small scale
- Pilot projects
- Voluntary efforts

Carbon Governance

- “The planning, influencing and conducting of the policy and affairs of institutions that aim to minimize the amount of carbon dioxide released to the atmosphere or maximize the amount of carbon stored stably away from the atmosphere.”
- Governance does **not** always = government
- Effective carbon governance is being able to **control** the amount of carbon in the atmosphere.

What kinds of governance mechanisms can you think of?

Carbon sequestration

- Terrestrial
 - Management practices
 - Land conservation/restoration
- Oceanic
 - Ocean fertilization
 - Deep ocean injection
- Geologic
 - Injection into confined geologic medium (e.g. aquifer)
 - Reaction to form new stable mineral



Big claims for terrestrial C sequestration

- 70-221 MMT (million metric tonnes) additional C in agricultural soils
- 214 MMT additional C stored in forests
- Economic estimates
 - 1-44 MMT per year @\$10/T
 - 10-70 MMT per year @\$50/T

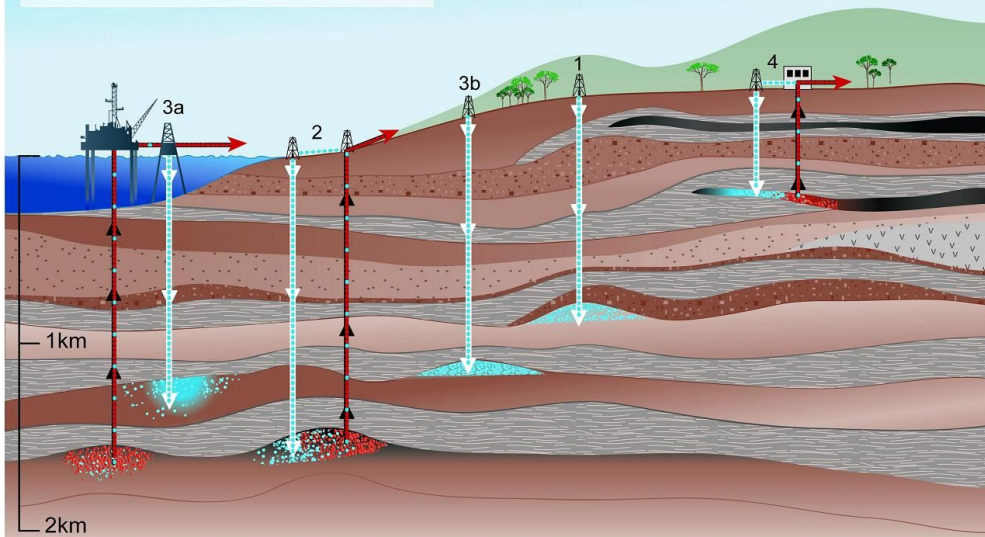
Terrestrial Sequestration: Forestry and Agriculture Practices



Methods for storing CO₂ in deep underground geological formations

Overview of Geological Storage Options

- 1 Depleted oil and gas reservoirs
- 2 Use of CO₂ in enhanced oil and gas recovery
- 3 Deep saline formations — (a) offshore (b) onshore
- 4 Use of CO₂ in enhanced coal bed methane recovery



SRCCS Figure TS-7

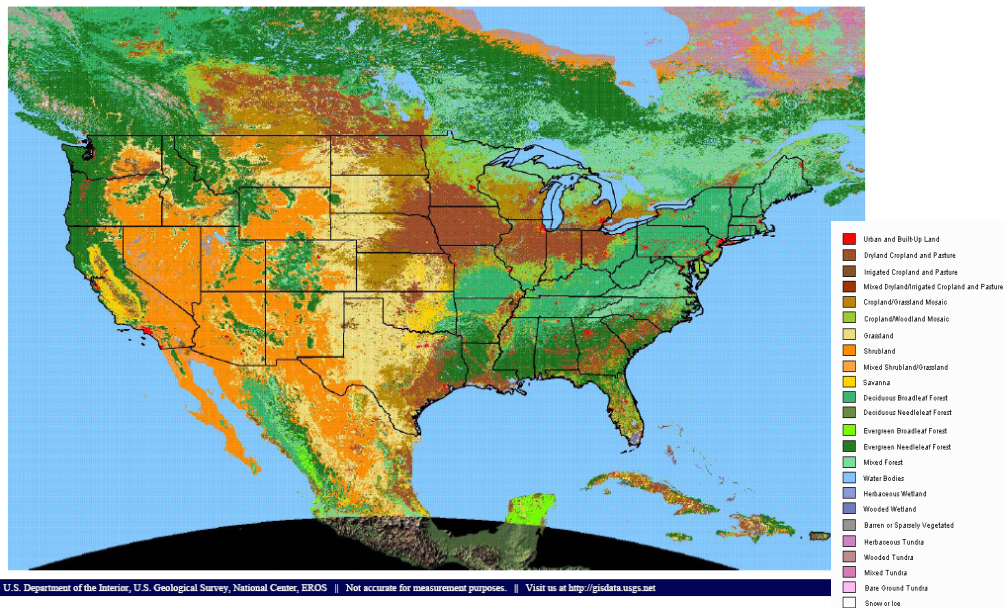
Carbon governance through land use

- Diverse landscapes and land uses
- Highly distributed control/ ownership
- Not managed for climate or carbon storage as main purpose
- Multiple actors at multiple scales

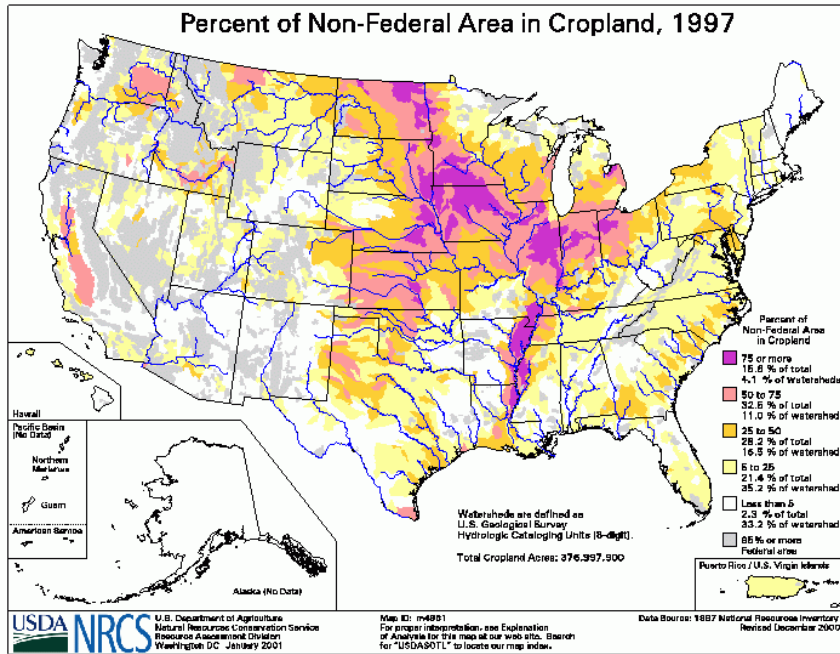


Diverse Landscapes and Land Uses

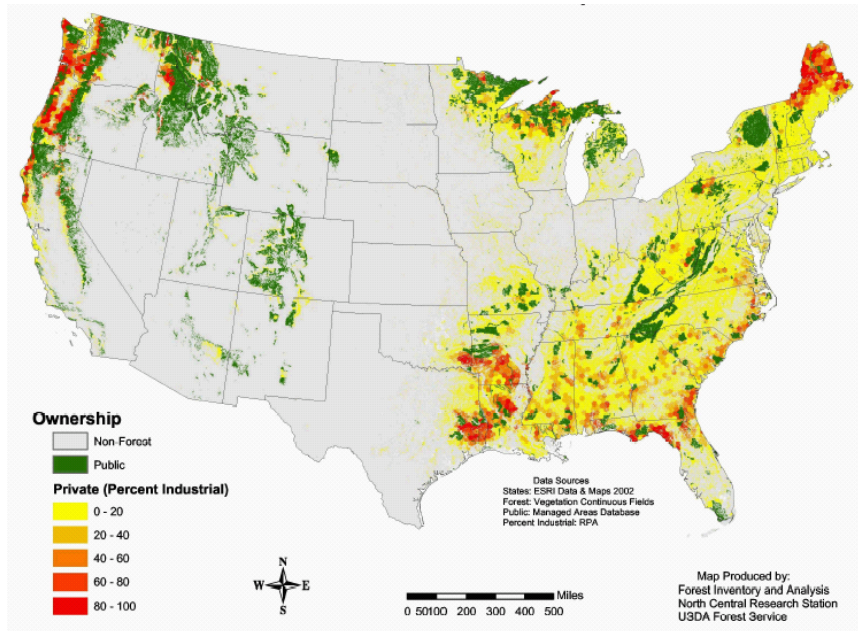
US land cover



Private Cropland

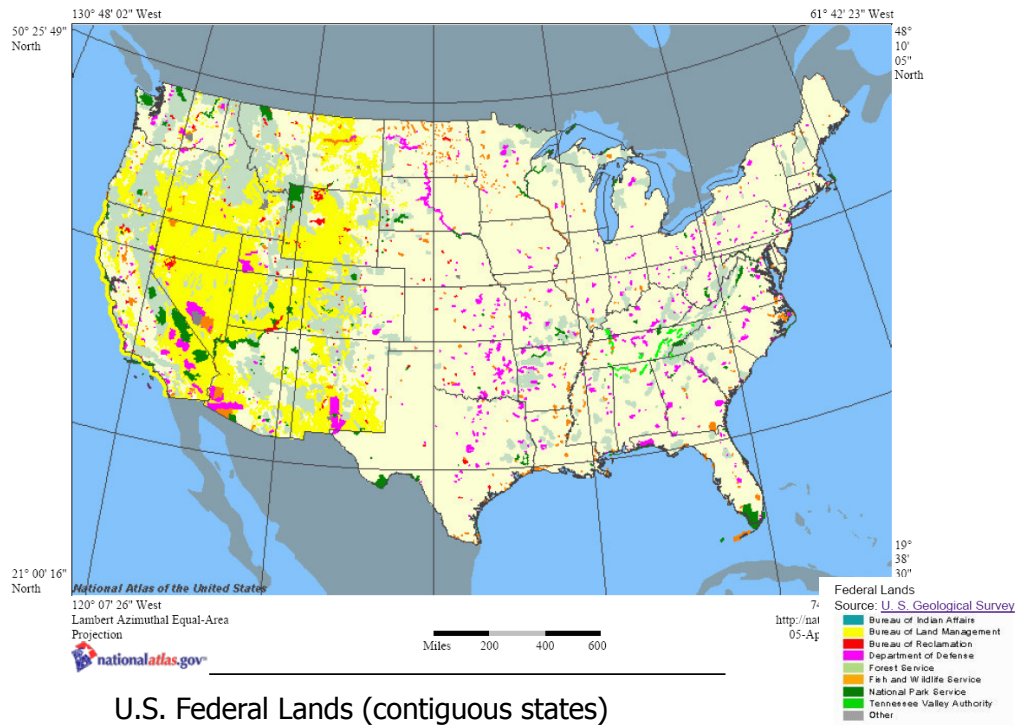


Public and Private Forest ownership



Source: [National Report on Forest Resources](#)

Land Ownership- National Public



Potential Carbon Decision Makers



A wide array of potential users at a variety of scales:

- Land users (agriculture, forestry, urban development)
- Energy providers (utilities, fuel producers)
- Policy makers (local, state, federal)
- Specialized sectors (carbon traders, NGOs)

What interests would these groups have?

What other things (besides carbon) do we manage land for now?





Commonalities

- No decision maker has a “climate protection” mandate
- No-one is managing for carbon exclusively:
 - Multiple interests and incentives
 - Multiple goals
 - Multiple scales
- Private sector decisions dominated by “responses to economic opportunities as mediated by institutional factors” (Lambin et al. 2001)

Voluntary markets

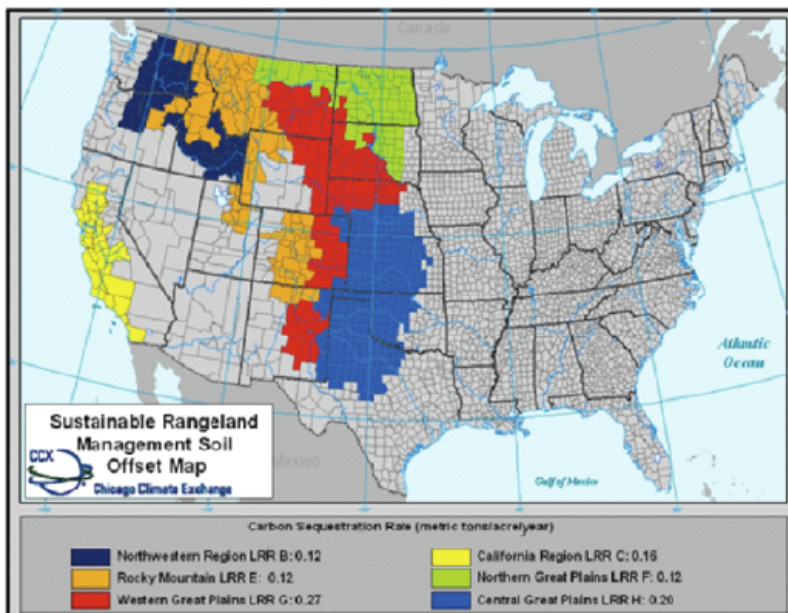
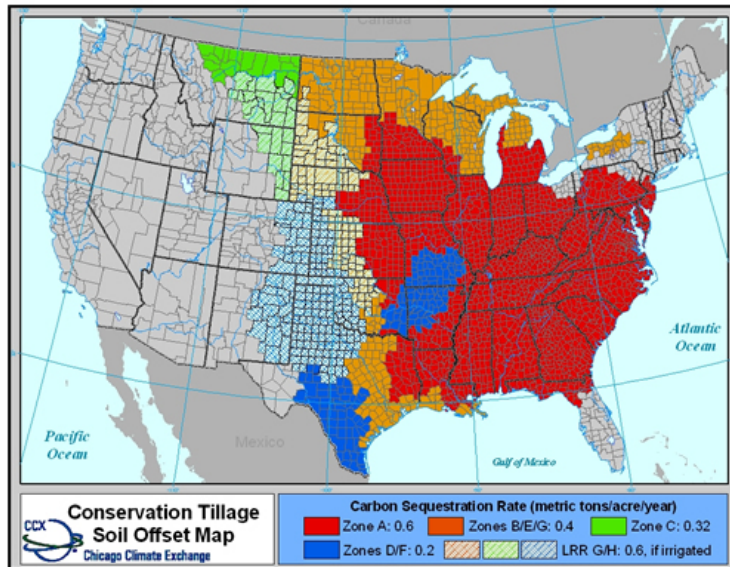
Voluntary Policies, local scale

Private Sector Examples:

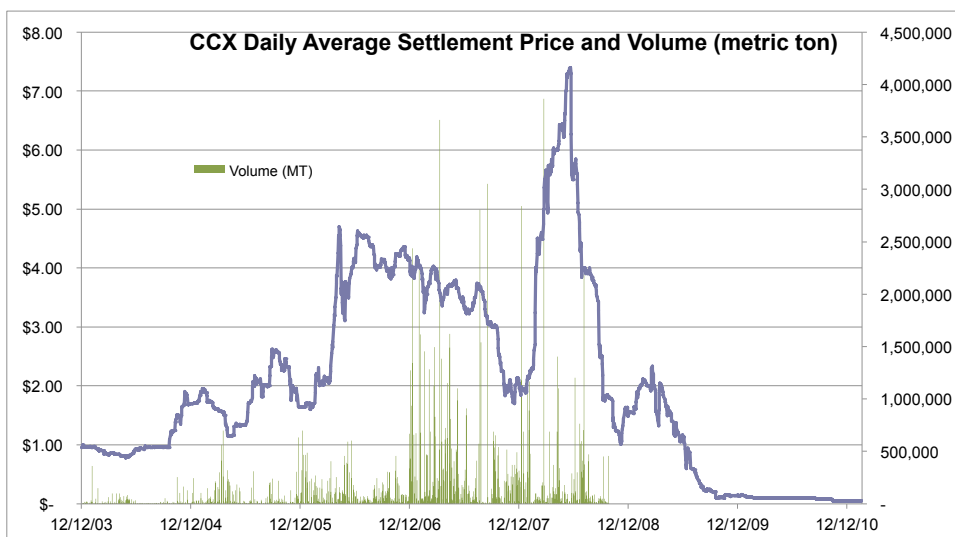
- The Climate Trust, Oregon
 - Non profit broker of offset projects, both energy and sequestration
- Chicago Climate Exchange
 - Market-based emission reduction and trading program – now ceased trading
- World Bank Prototype Carbon Fund
 - Experimental, pilot production of Emission Reductions within the framework of Joint Implementation (JI) and the Clean Development Mechanism (CDM) – a global trading program.
- Many individual projects done as agreements between parties

Carbon awareness- private sector

- Mixed response to voluntary market engagement
 - Difficulty of changing practices
 - Low financial incentive
 - Questioning efficacy
 - “anything to help me keep the farm going”
- In Colorado, Farmer’s Unions enrolled farmers in CCX-linked program and the State had a plan as well– but, as of 2011, CCX stopped.



Chicago Climate Exchange (Voluntary market)



Price and volume reported in metric tons CO2

← Around 10 cents a ton

Source: <http://www.chicagoclimatex.com/market/data/summary.jsf>

Sale of Chicago Climate Exchange to ICE Reinforces Weak Carbon Market

By JOEL KIRKLAND of [ClimateWire](#)
Published: May 3, 2010

Richard Sandor spent the past decade peddling a big idea: that capitalism has a solution for global warming. The trading house he launched in 2003, the Chicago Climate Exchange, would be the locomotive pulling an American environmental revolution into the 21st century as smokestack industries bought and sold a commodity called greenhouse gas emission allowances. Carbon futures and options, so his theory went, would turn financial speculators into tree-huggers.

More News From ClimateWire

- [Obama Administration Advances Cape Wind, but Challenges Remain](#)
- [U.N. Advisers Push Annual \\$35b-\\$40b Global Plan to Expand Energy Use and Reduce Carbon](#)
- [Predicting Wind Power's Growth -- an Art That Needs More Science](#)
- [Immigration Debate May Be on Sidelines for a While, Obama Says](#)
- [Sen. Graham Has Backing at Home, but Not on Climate](#)

Green Inc.

On Friday, Sandor and the other shareholders of parent company Climate Exchange cashed out of this big idea for about \$600 million. The IntercontinentalExchange (ICE), an electronic futures and derivatives platform based in Atlanta and London, announced it had agreed to purchase the three exchanges, the Chicago Climate Exchange, Chicago Climate Futures Exchange and European Climate Exchange.

The combination brings the still-small U.S. carbon market closer to the profitable world of global over-the-counter (OTC) energy trading, which ICE specializes in. It also consolidates carbon emissions trading under the tents of two major commodity exchanges, ICE and CME Group, which operates the New York Mercantile Exchange's nascent platform for carbon trading, the Green Exchange.

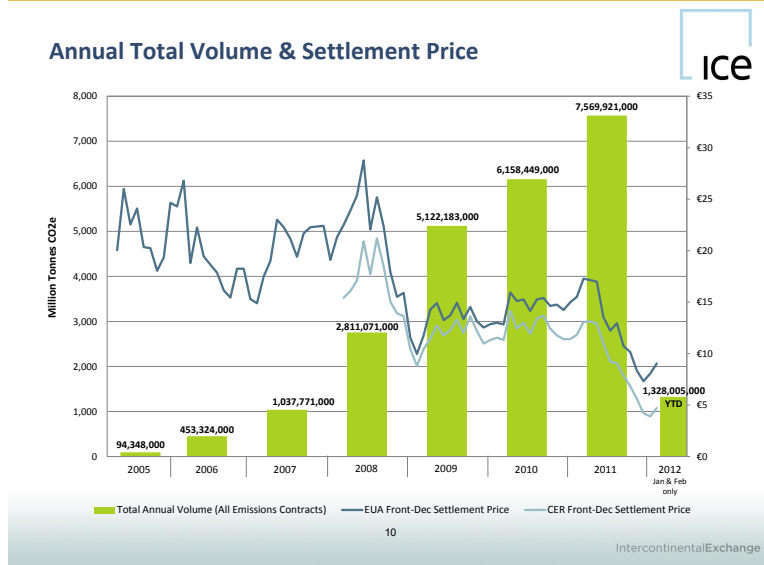
"The combination of Climate Exchange's emissions markets and ICE's futures and OTC energy markets is an important and logical strategic

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- 📄 SINGLE PAGE

NEVER LET ME GO NOW PLAYING WATCH TRAILER

NY Times

European Carbon Market – not voluntary



International Continental Exchange 60

REUTERS

» Print

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California approves carbon market rules

Fri, Oct 21 2011

By Rory Carroll

SACRAMENTO (Reuters) - California regulators on Thursday approved final regulations for a carbon market that is one of the biggest U.S. responses to climate change.

The state believes the market for greenhouse gases, which starts in 2013, will let it address global warming in a low-cost way and become the center of alternative energy industries, like solar, although some businesses fear higher energy prices.

The most populous U.S. state is moving ahead with the plan years after federal regulators rejected a similar idea for the nation, partly on concerns of the effect on businesses.

The California Air Resources Board voted 8-0 to adopt the market regulations, which officials said are critical to the state's goal of cutting carbon emissions to 1990 levels by 2020 -- about a 22 percent reduction from forecasted business-as-usual output.

Power companies and factories will be able to trade a gradually decreasing number of permits to emit carbon dioxide and other greenhouse gases under the so-called cap-and-trade plan, which counts on market forces leading companies to find the cheapest way to cut emissions.

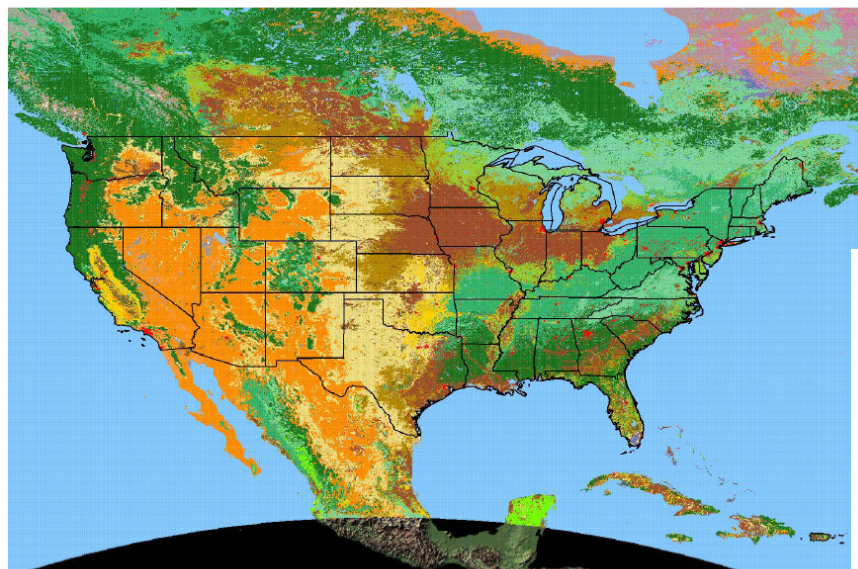
About 350 companies representing 600 California factories and oil refineries must begin complying with the program in 2013.

By 2015, when transportation fuels are brought under the cap, the system will cover 85 percent of the California economy, the eighth largest in the world.



Thinking about Scale

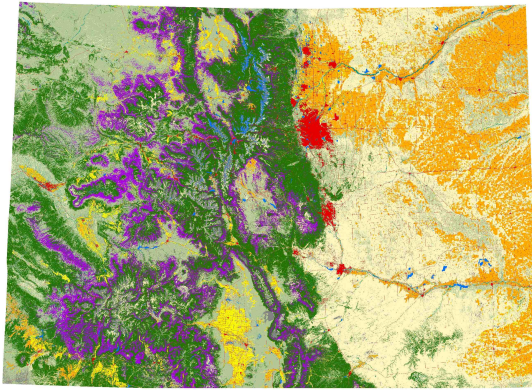
US land cover



U.S. Department of the Interior, U.S. Geological Survey, National Center, EROS | Not accurate for measurement purposes. | Visit us at <http://gladdata.usgs.net>

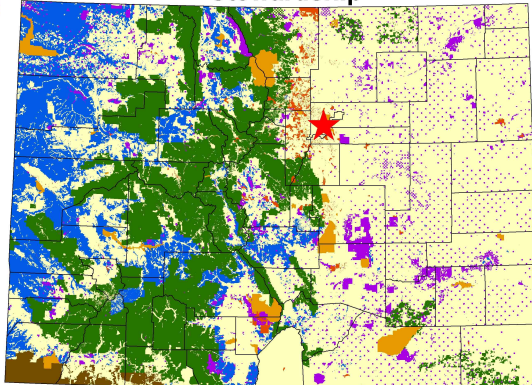
- Urban and Built-Up Land
- Dryland Cropland and Pasture
- Highland Cropland and Pasture
- Mixed Dryland/Highland Cropland and Pasture
- Cropland/Grassland Mosaic
- Cropland/Woodland Mosaic
- Grassland
- Shrubland
- Mixed Shrubland/Grassland
- Savanna
- Deciduous Broadleaf Forest
- Deciduous Needleleaf Forest
- Evergreen Broadleaf Forest
- Evergreen Needleleaf Forest
- Mixed Forest
- Water Bodies
- Herbaceous Wetland
- Wooded Wetland
- Barren or Sparsely Vegetated
- Herbaceous Tundra
- Wooded Tundra
- Mixed Tundra
- Bare Ground Tundra
- Snow or Ice

Land Cover



- Water/Snow/Ice
- Developed
- Barren/Sparsely Vegetated
- Agriculture-Pasture/Hay
- Agriculture-Cultivated Crops & Irrigated Agriculture
- Forest - Deciduous
- Forest - Coniferous
- Shrubland
- Grasslands
- Riparian/Wetlands

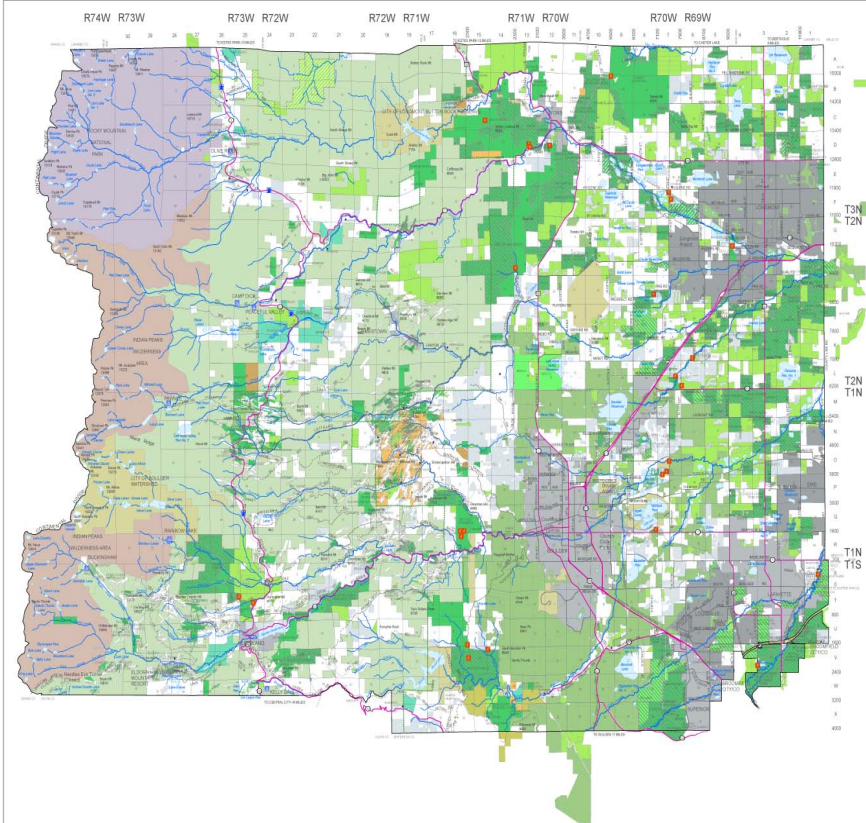
Stewardship



- Denver
- county boundaries
- Bureau of Land Management
- U.S. Forest Service
- Private
- State
- Other Federal Land
- Native American Reservation
- City/County/Other Districts



0 25 50 100 Miles



OCTOBER 2009 BOULDER COUNTY OPEN SPACE

- U.S. / State Highway
- Northwest Parkway
- Arterial
- Collector
- Local Access
- Jeep Trail
- County Open Space
- Joint County/City Open Space
- County Conservation Easement
- Small Reservations & Reserves (No. 1000000000)
- Private Property (No. Public Access)
- County Option Parcels
- County Closed Areas
- City Parks and Open Space
- Indian Peaks Wilderness
- USFS Land
- BLM Land
- Rocky Mountain National Park
- Other Public Lands
- State Land Board
- State Parks
- Private Conservation Easements
- Incorporated Area
- Subdivision or Platted Area
- Roosevelt National Forest Boundary
- Mountain Peaks
- Settlement
- Trailhead
- USFS Campground
- Scenic Byways



1:50,000
0 1 2 Miles



Example influences on Federal landowner decision making

Global	Policy
National	Regs, Congress. authority, mission, economic interests
State	Resource management goals, fire
County/Regional	Economic interests, recreation, regional authority (districts)
City	Quality of life

Example influences on private landowners

Global	Commodity markets, climate, policy
National	Subsidies, incentives, regulations, water compact
State	Water, environmental, population growth
County	Zoning, local policies, cultural trends
City	Zoning, local policy

Leakage

- Problem of displacing undesirable activity elsewhere; e.g. if forest is planted in one area, thereby sequestering carbon, but demand for agricultural land results in removal of forest in another location
- Estimated amounts can be significant, depending on activity and region (Murray et al. 2002)

The problem of scale for carbon governance

- To be effective, carbon governance must be consistent across scales
 - Must account for leakage
- Variety of policy scales involved
- If C information is to inform decisions about carbon governance, potential problem of scale mismatch (e.g. Cash and Moser 2000)

Environmental effects and linkages

- Are there “win-win” sequestration options? E.g. reduced tillage practices
- Full system must be considered; water use, pesticides, generation of other GHGs
- Biodiversity, food webs
- Precautionary principle for oceans?
- Decisions to manage the C cycle cannot be made in isolation



Policy problems of carbon sinks

- Quantification
- Additionality/Separation
- Permanence
- Leakage
- Unintended consequences
- Competing or conflicting values

Permanence

- For how long is carbon stored?
 - Terrestrial sequestration vulnerable to natural and human land management
 - Ocean sequestration accelerates natural uptake but still comes to a new equilibrium-- not permanently removed from contact with the atmosphere
 - Geologic disposal could be most permanent-- issue of leakage rate and public acceptance
- Some sequestration could “buy time” towards longer term solutions
- Unique monitoring challenges

Additionality

- Is the measured carbon storage additional to what would have happened otherwise, and can the deliberate actions be quantified?
 - Baseline
 - Documenting mechanisms
 - “tracking carbon” difficult

1. Diversity and distribution of decision makers

- Policies can target either public or private lands, or both but must be consistent
- If policy emphasizes education/ information strategy, enormous job to reach all important stakeholders
- Since majority of land users are private owners, market forces dominate
- Private sector trading may succeed on individual project level but remains to be evaluated

2. Commodity that people do not need or relate to

- Demand for land services other than C continues to increase
- Real possibility of leakage – preservation of carbon in one location with activity displaced elsewhere
- Implies payments for maintaining sinks as well as for creating or enhancing them
- In some cases, may be positive co-benefits

3. Technically challenging to measure and value

- Baseline difficult to establish
- C sequestration depends on many factors
- Estimates of costs per ton thus far vary widely
- C storage heterogeneous- monitoring costs can be high
- Some issues beyond science capabilities (e.g. separation)
- C sequestration outcome many years hence uncertain (and difficult to value)

4. Long time scale problem

- Long-term management requires trust in constancy of institution providing incentive (e.g. holding timber without cutting)
- Markets, population and drivers of land use are dynamic
- Carbon sequestration vulnerable to natural causes (e.g. fire) and changing demands for land use—permanence an issue
- A role for sequestration to “buy time”?
- Institutional rules must span over generations

5. “Governance without government” across scales?

- Voluntary and/or Controlled
- Informational and/or direct reduction strategies
- In absence of regulatory framework, voluntary incentives will compete against other potential uses for the land
- Market for credits only work in scarcity
- No incentive to make accounting and valuing credits rigorous – danger of low quality trades