

Silver Springs LLC

An Environmental Education Company

- Games-based learning for carbon markets
- Training on carbon emissions offsets
- Forest ecosystem management

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Norwegian Glacier Museum, Fjærland

“We are the first generation to influence global climate and the last generation to escape its consequences”



J.A. Dowdeswell

Kangerdlussuaq Glacier, Greenland

What *is* Climate Change?

- More heat waves, higher drought frequency
- Redistribution of precipitation
- Higher frequency of extreme weather events

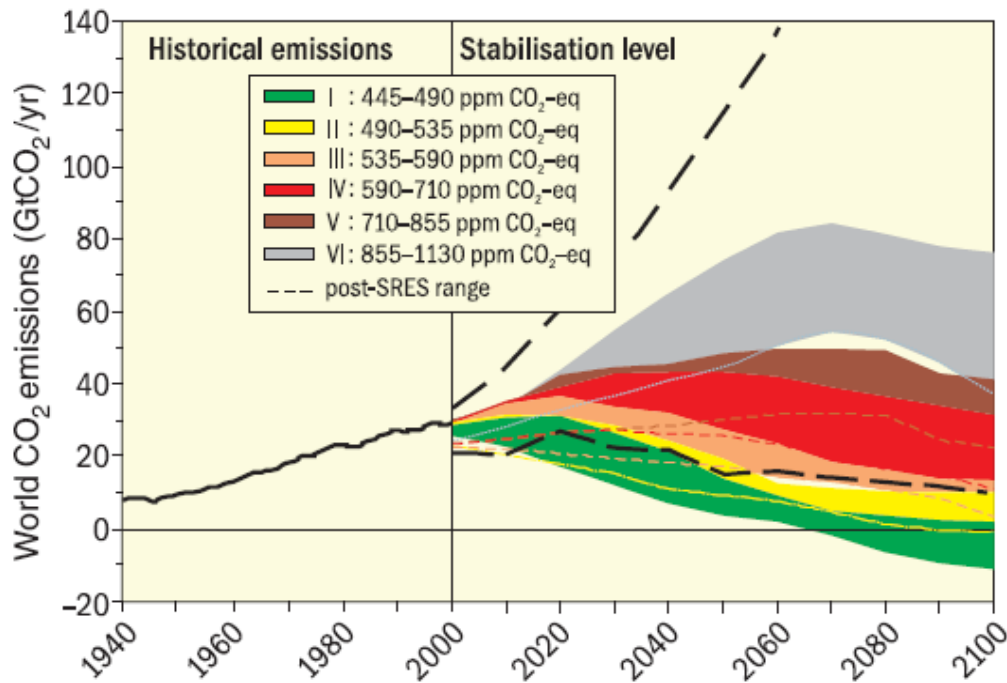
- Heavy rains, high wind speeds, strong storms

Sources: Scientific American (2007)
Intergovernmental Panel on Climate Change (IPCC) <http://www.ipcc.ch/>

Response to Climate Change

Mitigation: Slow the process of global climate change by lowering the level of greenhouse gases in the atmosphere. But this will not be enough...

Adaptation: Reduce vulnerability to hazard



Stabilization

Scenario I: 450 ppm ceiling

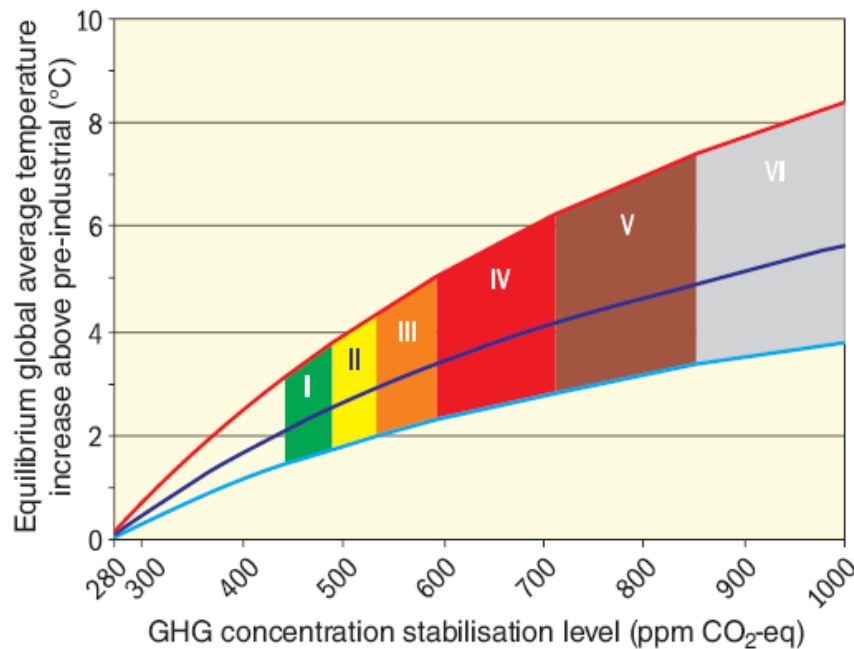
A pessimistic scenario ■

CO₂ emissions must peak between 2000 – 2015

This corresponds to a rise in global temperature 2.0 to 2.4 C

- and to a rise in sea level 0.4 to 1.4 m

Growth rate for global atmospheric CO₂ for 2000-2006 was 1.93 ppm per year



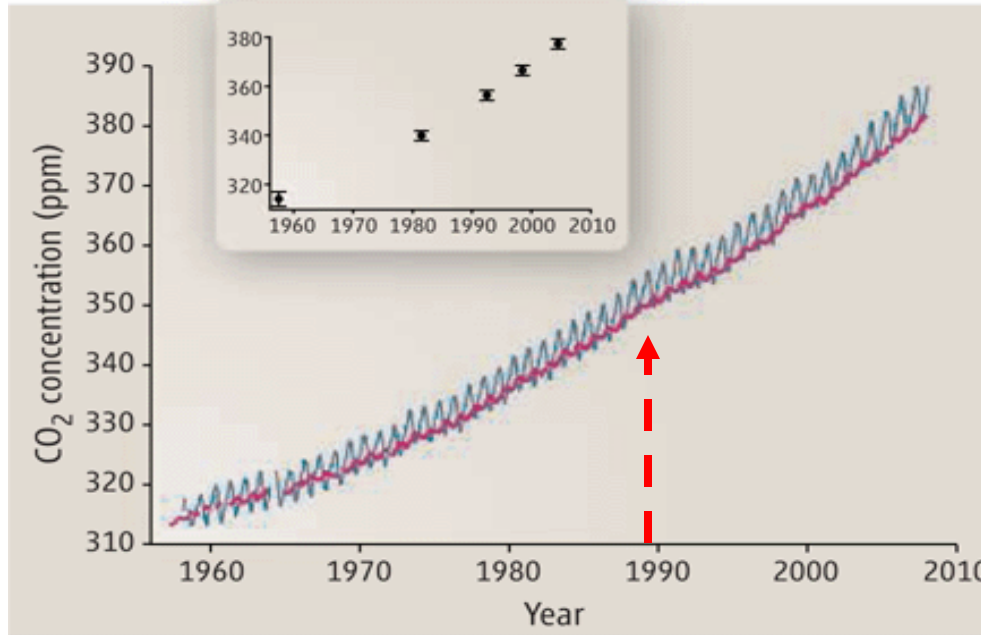
Figures taken from
IPCC Report November 2007

<http://www.ipcc.ch/pdf/assessment-report/ar4>

Stern N 2006 Stern Review: Economics of Climate Change.
Cambridge University Press.

Reduce global CO₂ emissions by 60 to 80% over 1990 levels

Source: Keeling (2008) *Science* 319: 1771-1772



Growth rate for global atmospheric CO₂ for 2000-2006 ~ 1.93 ppm per year

IPCC Report November 2007

<http://www.ipcc.ch/pdf/assessment-report/ar4>

Stern N 2006 Stern Review: Economics of Climate Change. Cambridge University Press.

Earth's climate sensitive to total CO₂ burden

- Policy relevant to all emissions sources
- Emissions traded across all sectors
- Worldwide trading potential

^{1/} Chameides W. and M. Oppenheimer (2007) Science 315: 670.

Accelerating Increase in Global CO₂ emissions

Shift in Land Use Changes (15%)

Deforestation, forest fires in tropical latitudes

Brazilian Amazon, Southeast Asia, Congo

REDD: Reduced Emissions from Degradation, Deforestation

Fossil Fuel Emissions (85%)

U.S. largest historical emitter

China highest emissions from 2000-2004

Policy Needs: Low Carbon Emissions Economy

- Set a price signal for carbon emissions
- Connect alternative energy to power grid
- Get new technology to market
- Adapt to scarcity

Policy for Mitigating GHG emissions

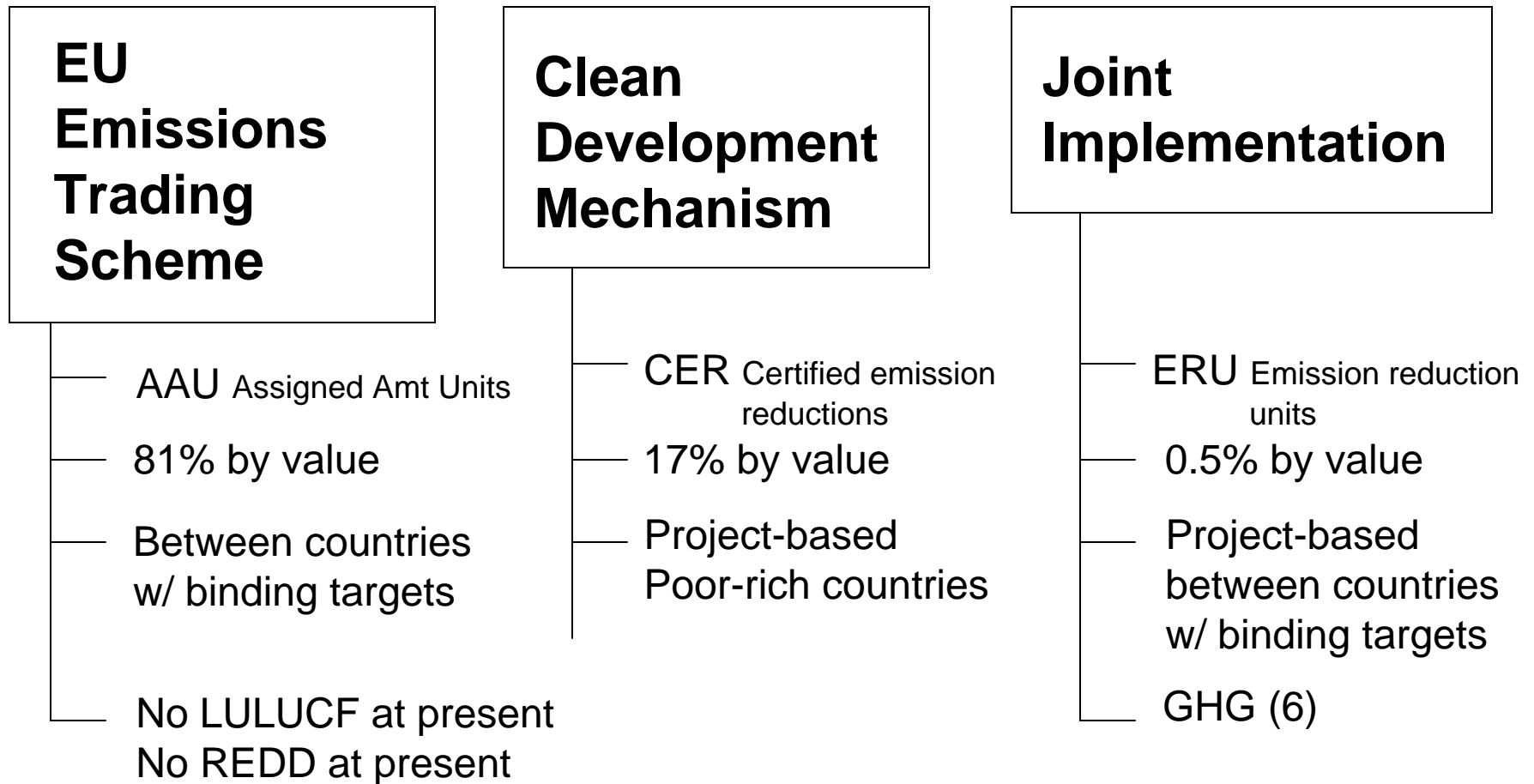
Evolving U.S. Policy

- Historical Cap-and-Trade Concept
- Energy Bill 2007
- Boxer-Lieberman-Warner, Doggett HR 6316
- Copenhagen COP15 2009

Kyoto Protocol's Flexible Mechanisms

- EU-Emissions Trading Scheme
- Clean Development Mechanism
- Joint Implementation

Three Flexible Mechanisms of the Kyoto Protocol to lower GHG emissions



Regional Greenhouse Gas Initiative (RGGI)

Prime directive: Reductions, stringent cap
Start: September 25 2008
Governance: Electric Power Plants 25 MW
Offsets: Five categories, no LULUCF
Cap 4% over 2004 emissions



<http://www.rggi.org/>

Stabilizing phase 2009-2014 + annual decline phase

100% allowances auctioned in most cases
Auction open to all bidders, not just power plants
Funds for renewable energy, early reduction

Can only use offsets totalling 3.3% to reduce GHG obligations
Safety valve; if invoked, then offset limits rise to 5 or 10%
Each state gets CO₂ allocations whether needs them or not

Window of Opportunity: Design Forestry Offsets Program(s)

Dec 2007

Bali Indonesia COP-13:

COP-15 agreement, delay on REDD

Dec 2008

European Parliament:

Trade tropical forestry offsets in EU-ETS?

More U.S. Legislation, Executive Branch action

Dec 2009

<http://www.cop15.dk/en>

COP-15 Copenhagen Nov 30 to Dec 11 2009

New Global Agreement: GHG emissions targets

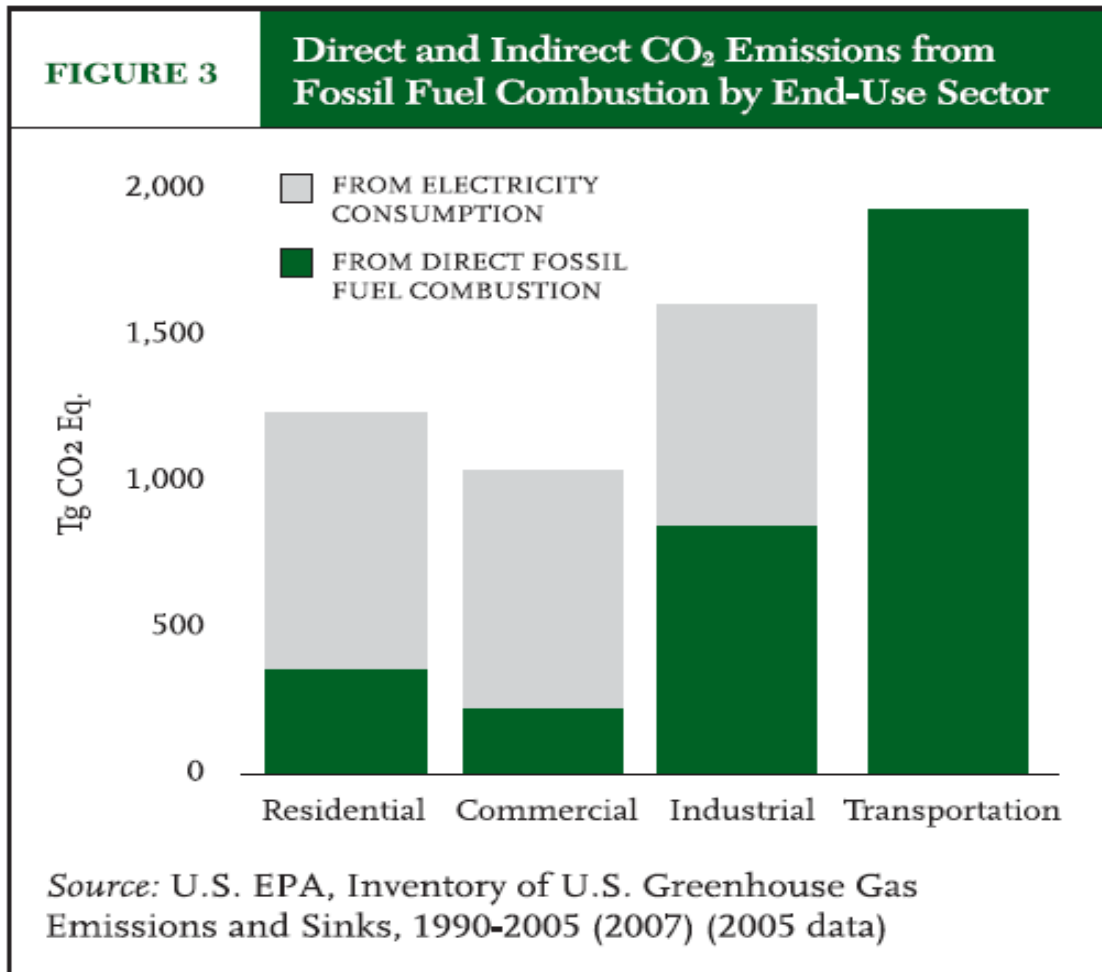
“A price signal for carbon alone is not enough...” [to get to a low carbon emissions economy]

Jeffrey Sachs Scientific American April 2008

Solar-thermal power in desert locations used to boil water for the steam-turbine generation of electricity, depends on solving other problems:

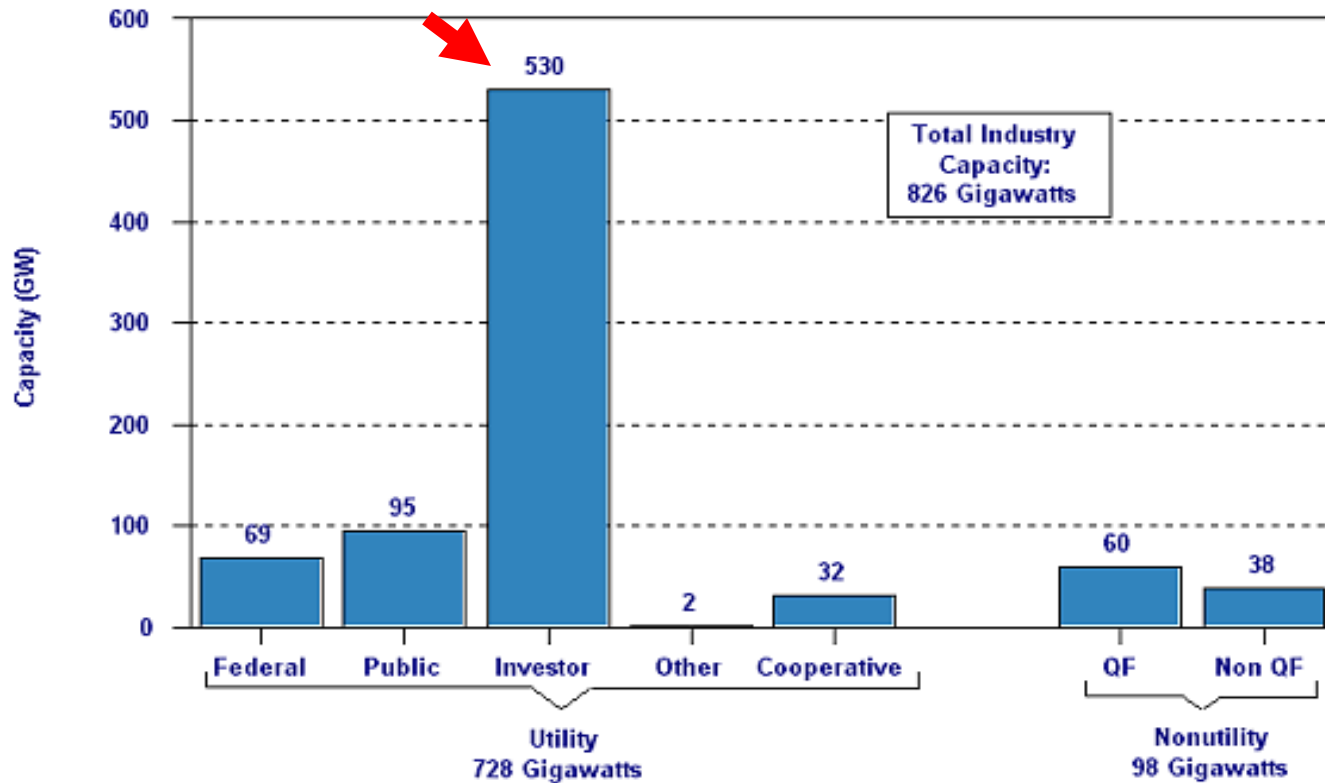
- Direct installation of a new high-voltage, direct-current (DC) transmission grid to carry power over the long distances from the desert to other locations.
- Or without sending to grid, then solve R&D question of nighttime storage of power

CO₂ emissions from U.S. electricity sector



A total of 3170 U.S. electricity providers
 8% are investor-owned type yet produce ~ 75% of total capacity
 Operate as a franchised (regulated) service monopoly in North Carolina

Figure 3. Electric Industry Generating Nameplate Capacity by Type, 1998



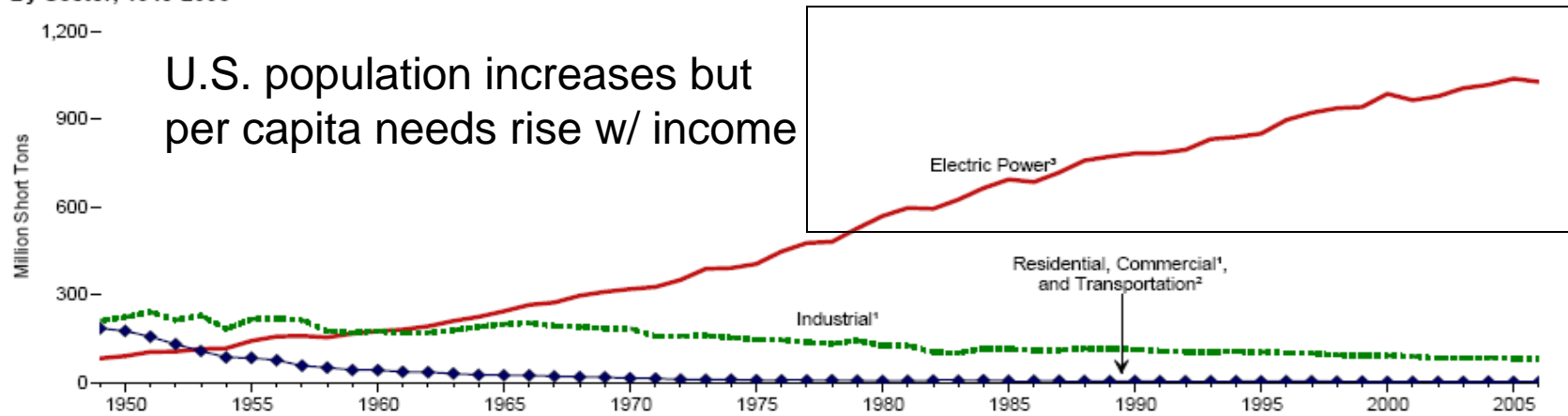
Source: Energy Information Administration, • Utility: *Inventory of Electric Utility Power Plants in the United States 1999*, Table E3, page 344; • Nonutility: *Electric Power Annual 1998 Volume II*, Table 55, page 91.

<http://www.eia.doe.gov/cneaf/electricity/page/prim2/fig3.gif>

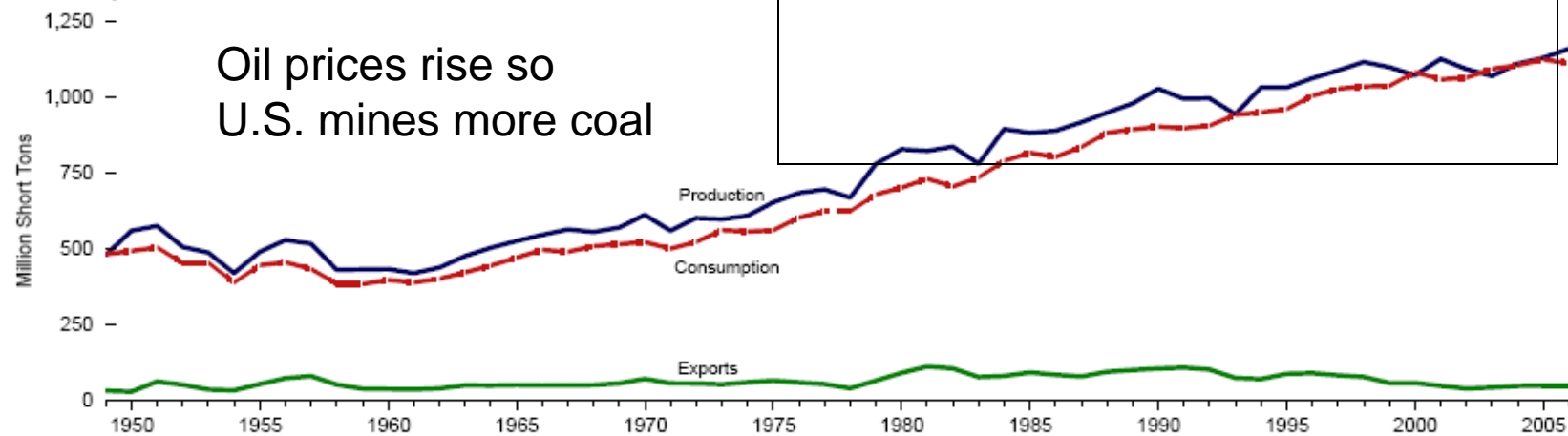
Answer to 1970's oil crisis? Use more coal

Figure 7.3 Coal Consumption by Sector

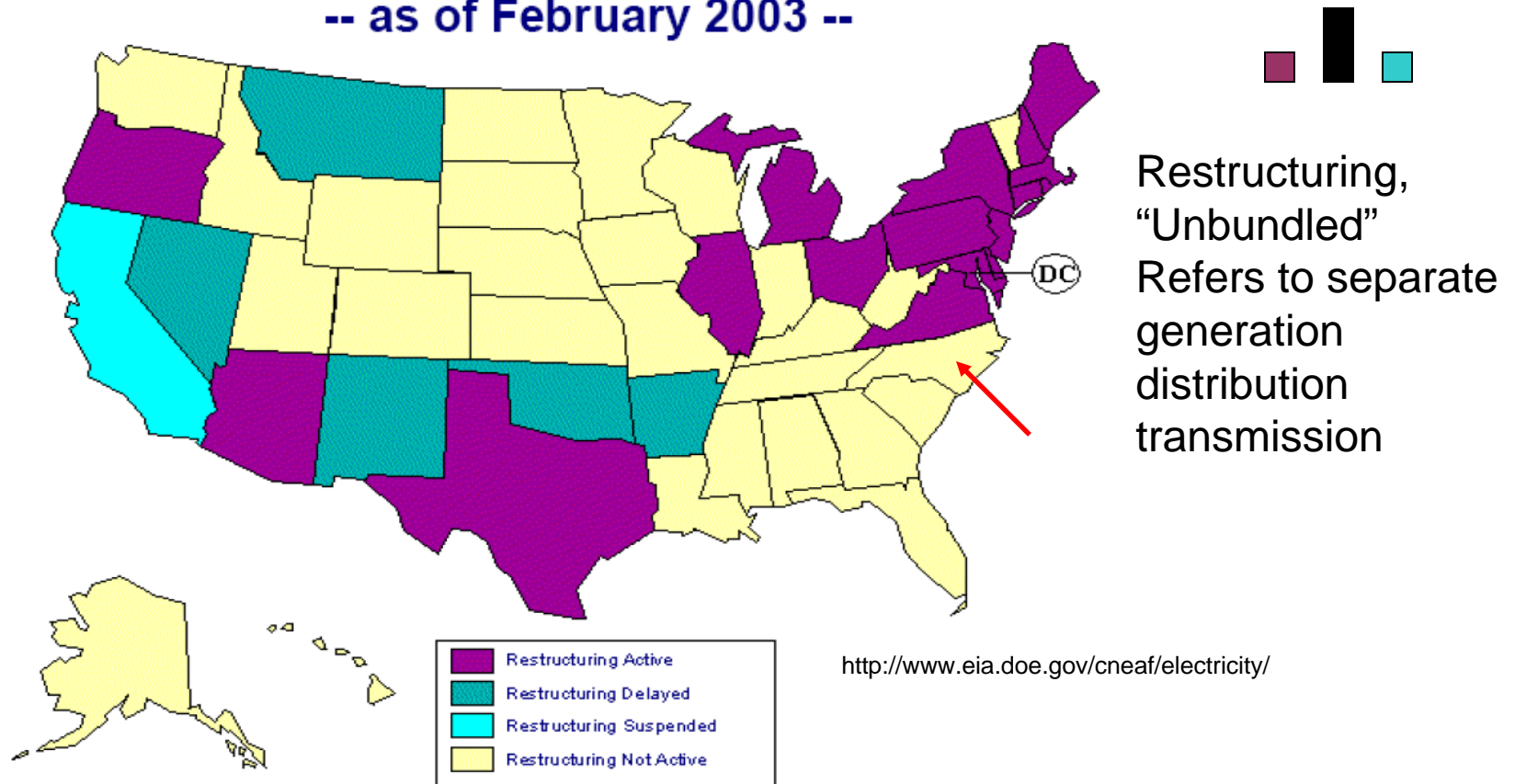
By Sector, 1949-2006



Overview, 1949-2006



Status of State Electric Industry Restructuring Activity -- as of February 2003 --



Basics: Costly mistakes for investor-owned electricity providers

Public Utility Regulatory Policy Act (1978) PURPA

Companies signed long-term contracts at higher prices than market

Nuclear power plants more costly than forecasted, "stranded debt"

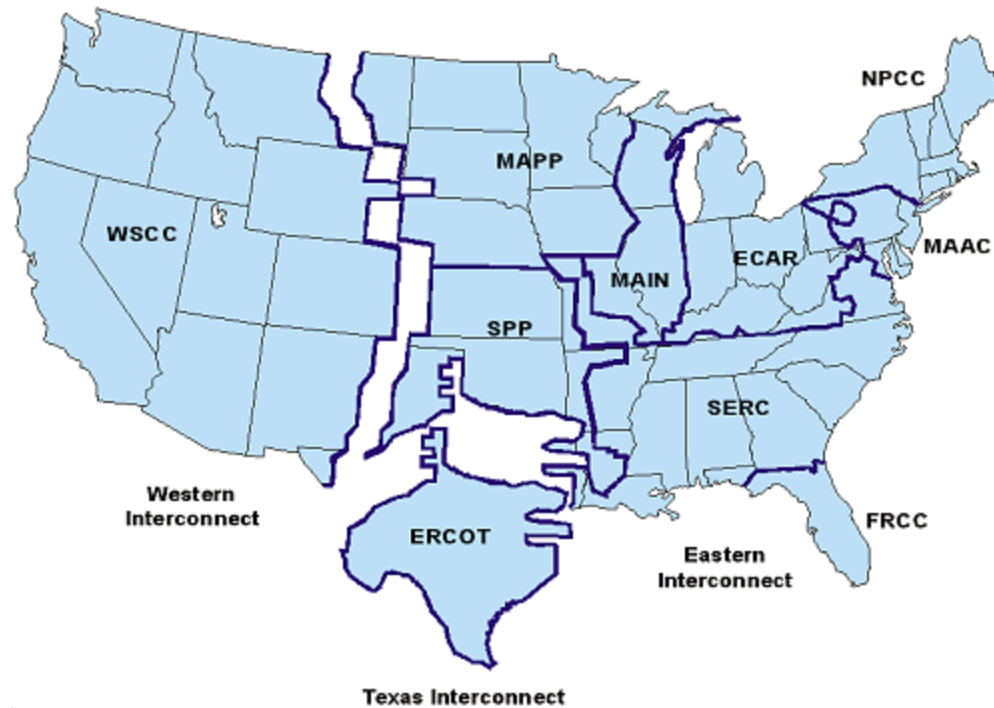
Deregulation/restructuring came with "stranded debt", was halted midway

Some companies now serve both deregulated and regulated states (AEP)

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Three US continental power grids (not one national grid)
Eastern (8 regions), Western (1 region), Texas Interconnect
Western and Texas linked with Mexico, Eastern and Western linked to Canada



Alaska has an interconnected grid system, but it connects only Anchorage, Fairbanks, and the Kenai Peninsula. Much of the rest of the state depends on small diesel generators, although there are a few minigrids in the state as well. Hawaii also depends on minigrids to serve each island's inhabitants.

Source: http://www.eere.energy.gov/de/us_power_grids.html

Alternative Energy

Right now means
hydroelectric or nuclear

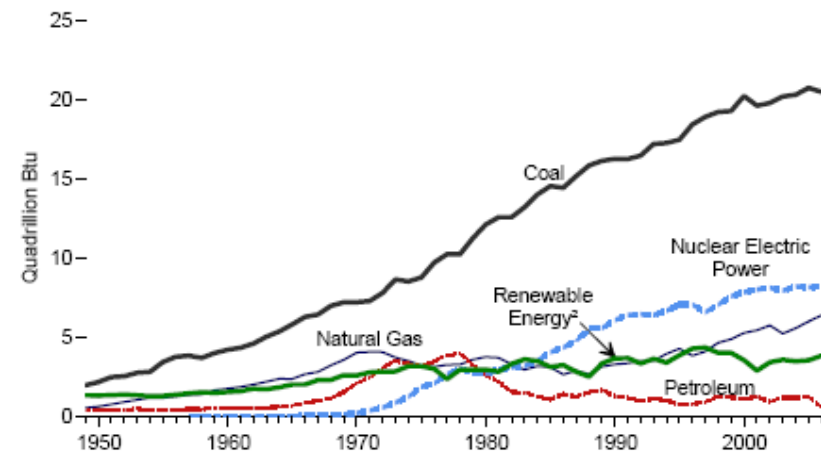
What about other sources?

1) Remote generation lacks
costly transmission lines

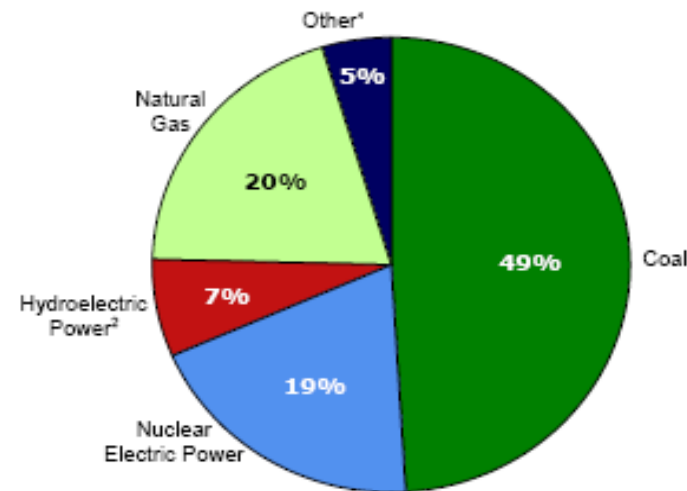
2) No long-term contracts to
spur new infrastructure
investment

3) Regional choices,
no one portfolio fits all

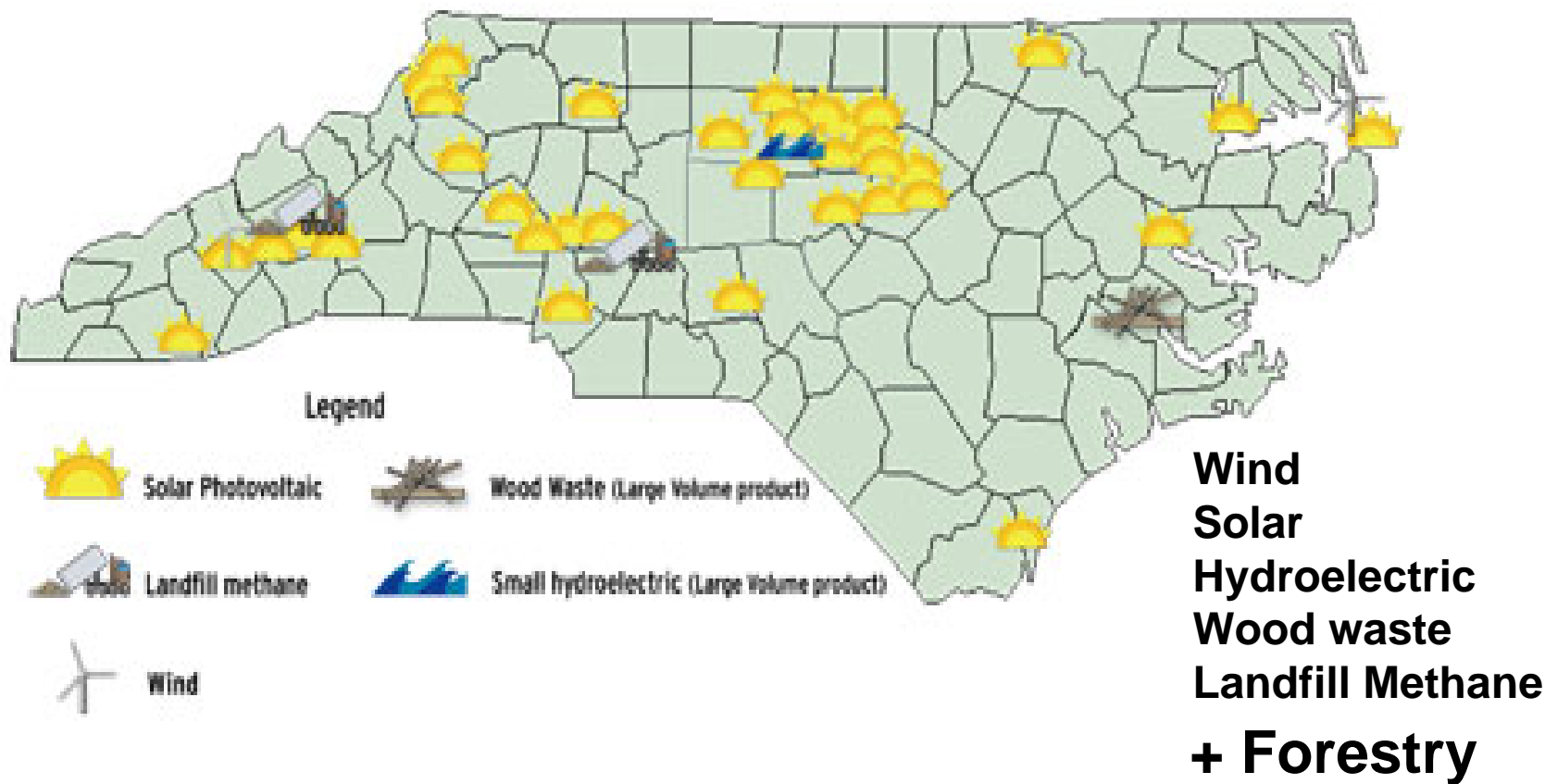
Electric Power Sector, 1949-2006



By Source, 2006



North Carolina GreenPower Voluntary Carbon Offsets Program (2008)



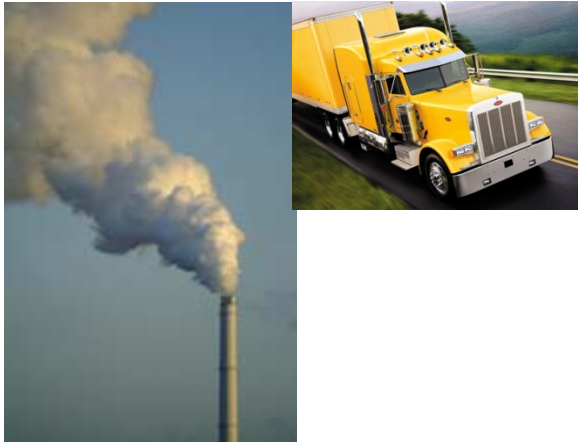
Source: <http://www.ncgreenpower.org/resources/producers.html>

**Regional
Forestry
Offsets**

Global Market
Other Types of Offsets
International Forests

**Domestic
REDD**

Developing Countries
Deforestation REDD
Halt 15% Emissions



**Burning,
combustion:
CO₂ emissions**



**Photosynthesis:
CO₂ uptake**



**Timber:
CO₂ storage**



Setting Price Signal for Carbon: Controversial Use of Forest Sequestration

“One of the largest uncertainties in predicting climate change, second only to what people will do, is what forests will do....

Relying on trees to mitigate climate change is not a good long-term strategy.”

Stephens BB et al. (2007) *Science* 316: 1732.

Strengths

- EU-ETS decision
- U.S. regulatory ups price signal
- Neighboring RGGI market
- Other linked carbon markets

- NC Green Power Voluntary Offsets, CCX

- H.R. 6830 (Rep. Shuler) Carbon Cooperative Zones
federal + state + private forestlands

- Large NC forest ownerships
Weyerhaeuser Company

Design a
NC forestry offset
program?

Weaknesses

- Certain costs, uncertain income
Opportunity cost high
Liability, risks high
- Fed regulatory ceiling for global offsets
Voluntary market sells at lower price
Excess global supply = weak demand for US offsets
- Institutional capacity
Who are small landowners with highest risk?
- Forestry offsets viewed as low-cost distraction, loophole,
No feed-in tariff laws, higher NC electricity costs later?

Design a
NC forestry offset
program?

Table 1. Carbon Credit Worksheet for Mrs. Newberry's 42-acre pine plantation. (values may be rounded down to the nearest whole number by the associate aggregator)

	a	b	c	d	e
	Year	Age of stand	Tons per acre	Total Tons for 42 acres	Value (assume \$4 per credit)
1	2003	7	2.45	102.9	411.6
2	2004	8	2.45	102.9	411.6
3	2005	9	2.45	102.9	411.6
4	2006	10	2.45	102.9	411.6
5	2007	11	6.87	288.54	1154.16
6	2008	12	6.87	288.54	1154.16
7	2009	13	6.87	288.54	1154.16
8	2010	14	6.87	288.54	1154.16
9	Total Gross Value			1565.76	6263.04
10	Less 20% for Carbon Reserve Pool				1,252.61
11	Less 10% Aggregator (IFB) fee				626.30
12	Less 10% Associate Aggregator fee				626.30
13	Less 3% Verification fee				187.89
14	Less CCX exchange fee (17 cents/ton)				266.18
15	Total net amount to landowner prior to December 31, 2010				3,303.76
16	Total net amount after 20% reimbursement on Jan 1, 2011				1,252.61
17	Total Net Amount to Landowner				4,556.37

More analyses:
 Risk-adjusted ROI
 Different aggregators
 Annual cash layout
 Consultant fees
 Area-adjusted costs
 Opportunity cost(s)
 Penalty scenario
 Inheritance