

CO2 Today and Tomorrow

June 11, 2007



Boulder, Colorado Approves 'Carbon Tax' in Effort to Reduce Gas Emissions

Al Gore wins an Oscar

***"What Insurers Should Do About Climate Change"
- Wall Street Journal Online - June 3, 2007"***

Insurers are likely to soon take a leadership role in reducing the risks of climate change as companies become more liable for damage related to it.

The authors of a study jointly published by [the Stanford Environmental Law Journal](#) and the [Stanford Journal of International Law](#) sketch out several ways that companies who disproportionately contribute to global warming could be held responsible for its damage as the science of global warming becomes clearer.

The most common example is owners of property damaged by a warmer world's extreme weather suing companies that disproportionately emitted greenhouse gases.

As well as paying out on insurance covering such liability claims, insurers will have to pay for several kinds of damage related to global warming, the authors say. They'll have to pay for car crashes on wet roads and ski resorts that insure themselves against warm winters short on snow.

FP&L does not get permits for 2 ultra-supercritical power plants!

The Governor limits CO2 from coal plants to those of gas plants or the power from these plants cannot be used in California

The poles are melting

DOE is spending millions in carbon sequestration technologies and it is budgeting even more for the next few years



Getty Images

Glaciers are melting everywhere

Ten major corporations, including Bank of America, DuPont and General Electric, join with environmental groups to call for a nationwide cap on greenhouse gas emissions



President Bush's Timeline

"An Evolution in Thinking" - Wall Street Journal - June 1, 2007

President Bush's evolving views on climate change:

- **2000:** As a presidential candidate, Mr. Bush pledges to cap carbon dioxide emissions from U.S. power plants.
- **June 2001:** In a Rose Garden speech, Mr. Bush acknowledges global warming is a problem, but says the Kyoto accord is "fatally flawed" and its targets are "arbitrary."
- **February 2002:** Mr. Bush announces "Clear Skies Initiative" to cut power-plant emissions of nitrogen oxides, sulfur dioxide and mercury, and a plan to cut the ratio of greenhouse gas emissions to economic output.
- **November 2006:** Democrats sweep to victory in congressional elections, taking control of both the House and Senate, and vow to make energy and environment issues a top priority.
- **January 2007:** California Gov. Arnold Schwarzenegger mandates a cut in carbon levels by at least 10% by 2020, leading a charge by states to seek curbs in emissions causing global warming.
- **April 3, 2007:** The U.S. Supreme Court rules that the U.S. does have authority to regulate CO2 emissions under the Clean Air Act, contrary to the White House position.
- **May 2007:** Mr. Bush orders up new rules aimed at increasing automobile fuel efficiency and the use of alternative fuels like ethanol.

President Bush's Timeline

"An Evolution in Thinking" - Wall Street Journal - June 1, 2007

- **On Thursday, May 31, 2007**, Mr. Bush called for 15 leading nations identified as major emitters of greenhouse gases, including the U.S., China, India and major European countries, to meet later this year. He said he wanted them to come up with a global goal for carbon emissions but decide themselves how to reach it.

Even President Bush Is Proceeding To Address Climate Change and CO2!!!

***“EU Welcomes U.S. Climate Proposal” - Associated Press
June 1, 2007 7:32 a.m.***

- HELSINKI, Finland -- The European Union on Friday welcomed U.S. President George W. Bush's climate change proposal, saying it was "groundbreaking" and could pave the way for a global agreement on reducing emissions.
- EU Energy Commissioner Andris Piebalgs said Mr. Bush's speech was "extremely important and very welcome news," particularly for the Group of Eight meeting next week. "I very much now would like the G-8 to use this momentum ... to conclude an agreement," he said.
- On Thursday, May 31, 2007, Mr. Bush called for 15 leading nations identified as major emitters of greenhouse gases, including the U.S., China, India and major European countries, to meet later this year. He said he wanted them to come up with a global goal for carbon emissions but decide themselves how to reach it.

January 2007: Ten major corporations, including Bank of America, DuPont and General Electric, join with environmental groups to call for a nationwide cap on greenhouse gas emissions.

- The executives' plan would slow the growth in greenhouse gases over the next five years, then reverse that growth and cut annual emissions by 70 percent to 90 percent of today's levels in 15 years.
- Jeffrey Immelt, chairman of General Electric, pointing to initiatives in California and a group of Northeastern states, said "this is happening already." In addition to Immelt and Sterba, the group included the chief executives of Lehman Brothers Holdings, PG&E, Alcoa, Caterpillar, BP America, Duke Energy, DuPont and FPL Group.

Bush's New Position on Climate Change

"Bush's Climate Change" - May 31, 2007 5:02 p.m.

- President Bush, who is set to jet off for an international summit next week, unveiled a significant change in his posture on climate change today. But some critics say his proposal mistakes scheduling meetings for having a plan.
- The president [is calling for a series of discussions among the world's economic powers to establish global targets for reducing emissions of greenhouse gases](#), in an important shift in tone for an administration that has long played defense on the question of what to do about global warming. "The United States takes this issue seriously," Mr. Bush said, saying that his approach will "contribute to the important dialogue" that is expected to happen at next week's summit of Group of Eight leaders in Germany. Under the president's plan the 15 heaviest producers of greenhouse gases, including the U.S., India, and China, would establish a target for reducing emissions. Then each country would set about developing their own means to reach the goal. The plan is meant to serve as a successor to the Kyoto climate-change accord, which expires in 2012, and which Mr. Bush wouldn't support because he believes that meeting its demands would be too damaging to the American economy. Under the 1997 Kyoto pact, industrialized countries were required to reduce greenhouse emissions to 1990 levels by 2012. The Clinton administration played a big role in negotiating that agreement, but the U.S.'s subsequent refusal to ratify it has alienated many of its allies.

What is happening??

- **Agreement has been reached among scientists as to the fact that climate is changing (warming up) in most regions of the world**
- **No real agreement among scientists on what are the culprit(s):**
 - Humankind and the industrial revolution
 - Natural cycle of existing forces
 - Lack of volcanic activity
 - Radiation
 - Others
 - All of the above

It Does Not Matter

- **The power industry, particularly the coal based power plants are getting the brunt of the issue regardless of the facts**
- **Perception is reality**

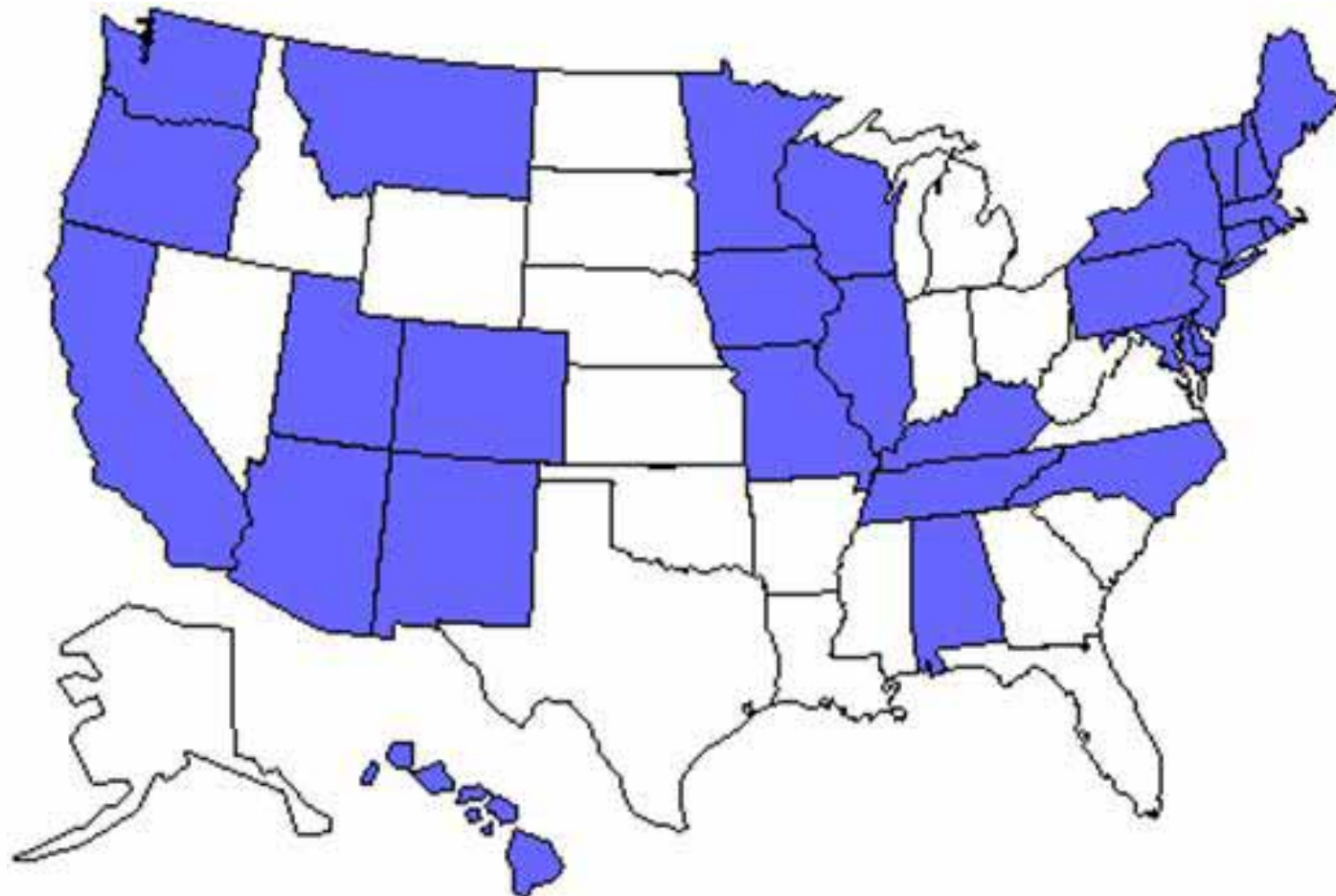
Conclusion:

We must address CO2 in any event

What Does It Mean To Us in the Power Industry TODAY

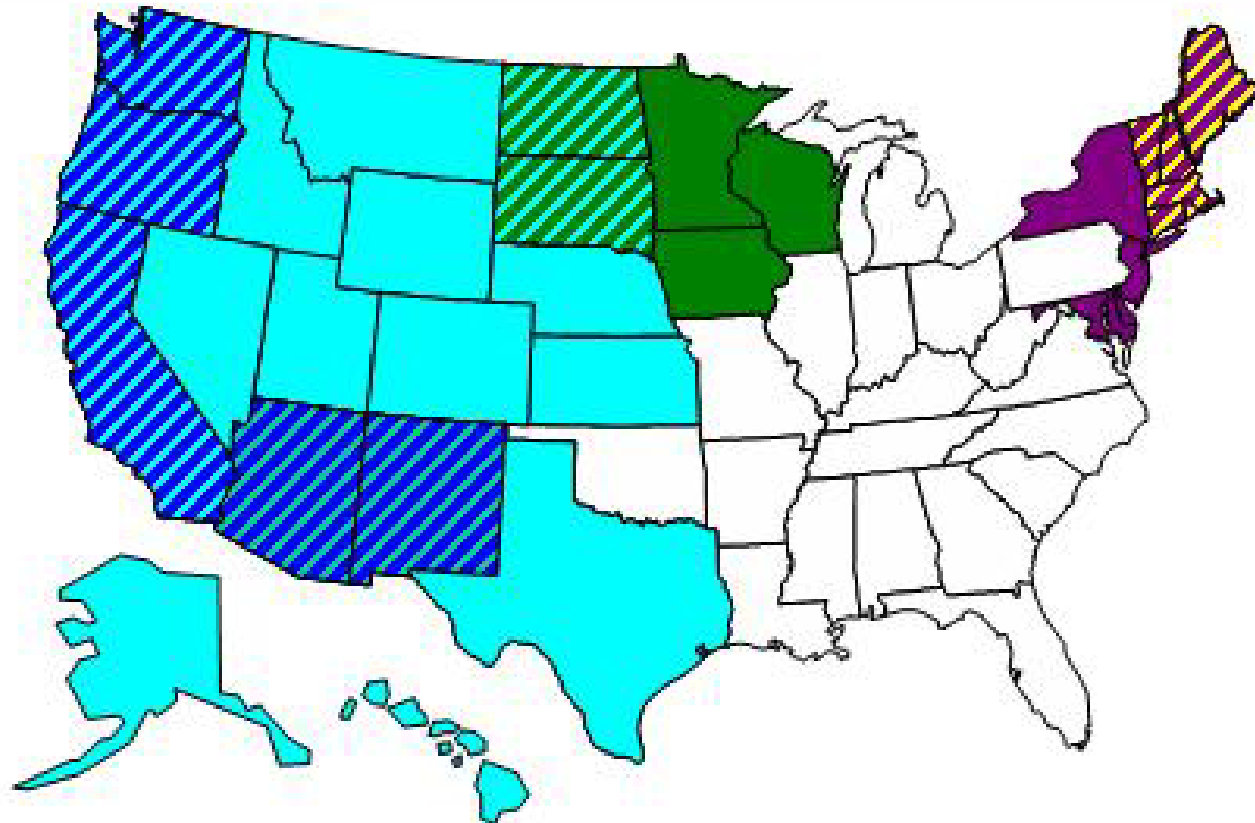
- **Each state is enacting some sort of climate policy regarding CO2 and other greenhouse gases**
- **CO2 restrictions will become an issue in air permits as EPA addresses CO2 per the US Supreme Court Decision in the last couple of months**
- **Most probably, tradable credits will come into being via a cap and trade system**
- **However, a carbon tax may be also included**

State Implementation Plans



 Completed Climate Action Plans

Regional Initiatives



 **Western Regional
Climate Action
Initiative**

 **Powering the Plains**

 **NEG-ECP**

 **WGA**

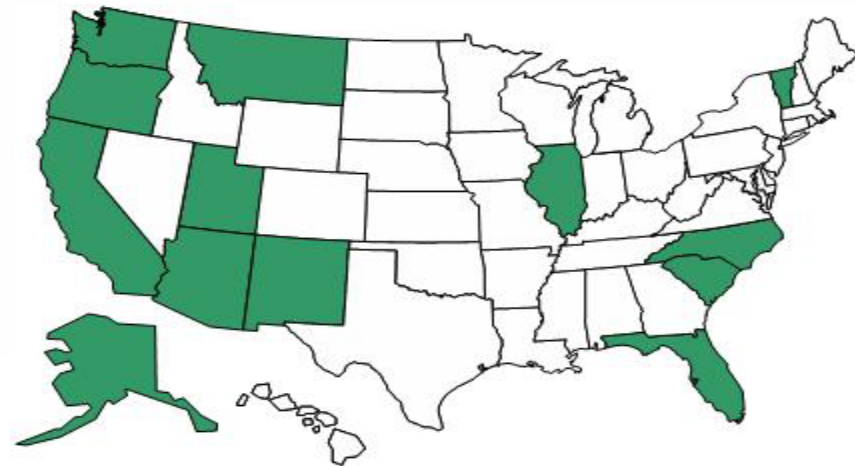
 **RGGI**

Active Climate Legislative Commissions and Executive Branch Advisory Groups

AK: *Climate Impact Assessment Commission* established in May 2006 by the Legislature to assess the impacts and costs of climate change to Alaska and develop recommendations for preventative measures that can be implemented by Alaskan communities and governments.

AZ: *Climate Change Advisory Group* established in February 2005 by executive order to produce an inventory of Arizona's greenhouse gas emissions and develop recommendations to reduce Arizona's greenhouse gas emissions.

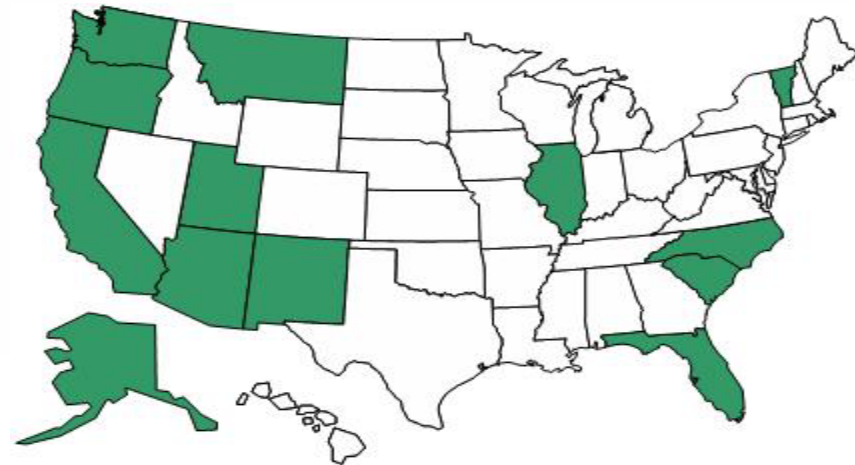
CA: *Climate Change Advisory Committee* established in 2004 by the California Energy Commission to provide advice and recommendations on a comprehensive equitable and cost-effective climate change strategy for California. *Climate Action Team* established in June 2005 by executive order to implement global warming emission reduction programs and report on the progress made toward meeting the state GHG emission reduction targets.



Active Climate Legislative Commissions and Executive Branch Advisory Groups

MT: *Climate Change Advisory Council* established in April 2006 by the Department of Environmental Quality, as requested by Governor Brian Schweitzer, to: recommend strategies to reduce and sequester greenhouse gas emissions, promote economic growth, and develop a Climate Change Action Plan by July 2007.

NM: *Climate Change Action Council* established in June 2005 by executive order to review and provide recommendations to the Governor's office regarding climate change policy. *Climate Change Advisory Group* established in June 2005 by executive order to present a report to the Climate Change Action Council by December 2006, which will include: proposals to achieve the state GHG emissions reduction targets and associated costs and benefits; an inventory of historical and forecasted GHG emissions in New Mexico and of existing and planned GHG emission reduction actions in the state; findings on initiatives to create meaningful regional and national policy to address climate change.

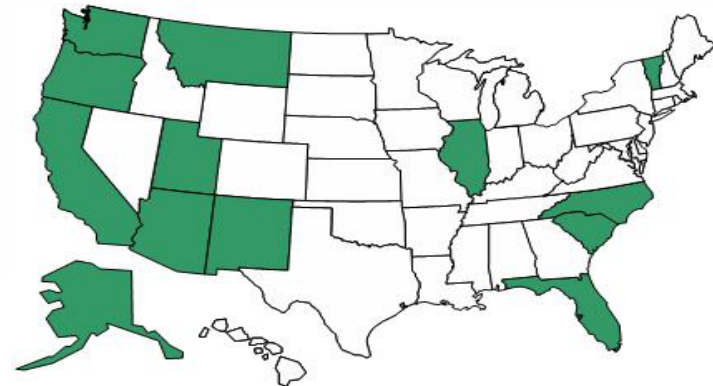


Active Climate Legislative Commissions and Executive Branch Advisory Groups

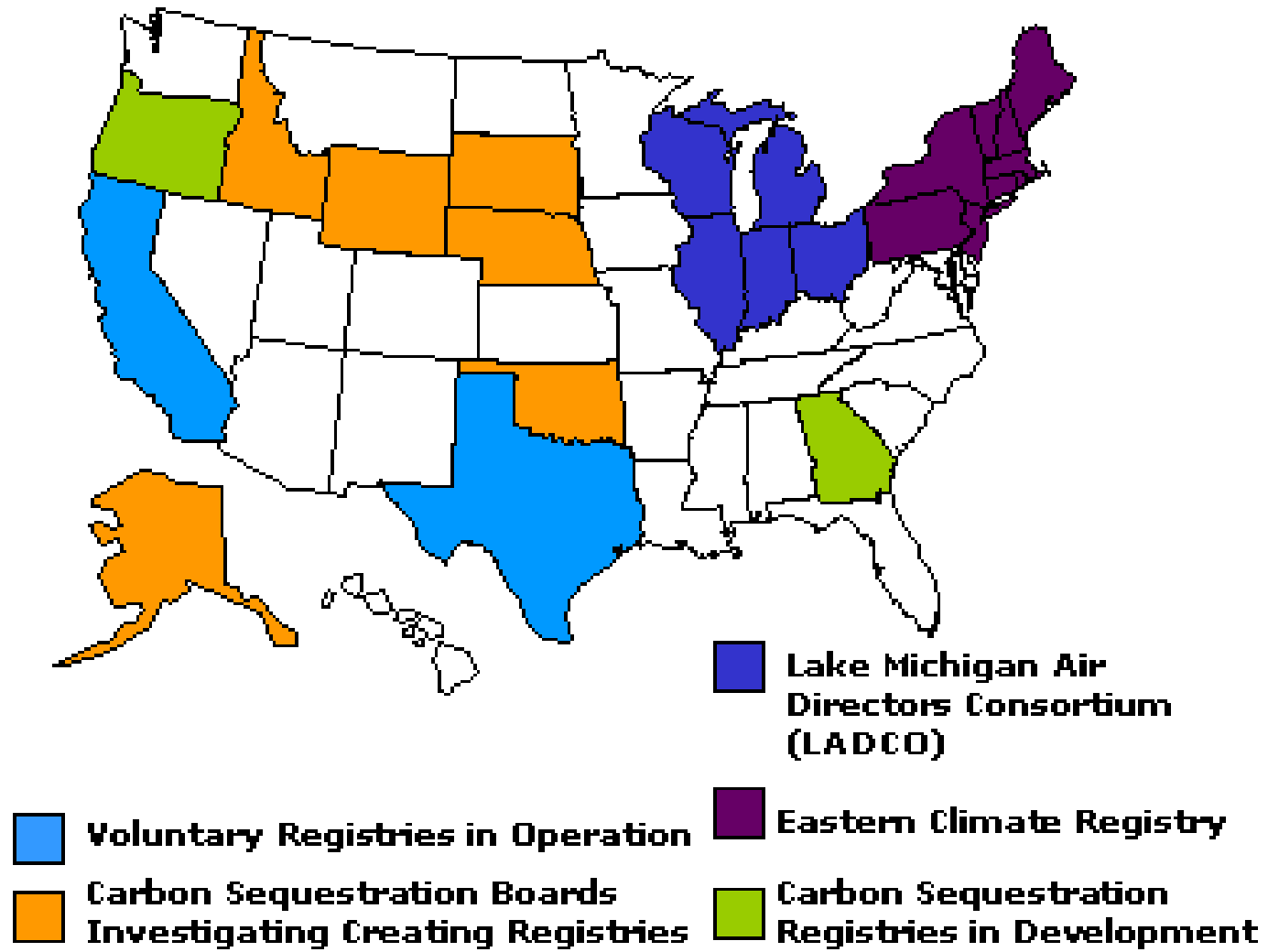
OR: *Climate Change Integration Group* appointed in June 2006 by the Governor to track the State's progress on greenhouse gas emission reductions, and explore new opportunities for research on the mitigation of, and adaptation to, climate change in Oregon and the Pacific Northwest.

UT: *Governor's Blue Ribbon Advisory Council on Climate Change* established August 2006 to assess the policy options available to Utah for addressing climate change. The council will be made up of representatives from government, industry, environmental, and community groups and is charged with considering the science, economics, and policy around climate change. The council is to report its findings and recommendations to the governor in the Fall of 2007.

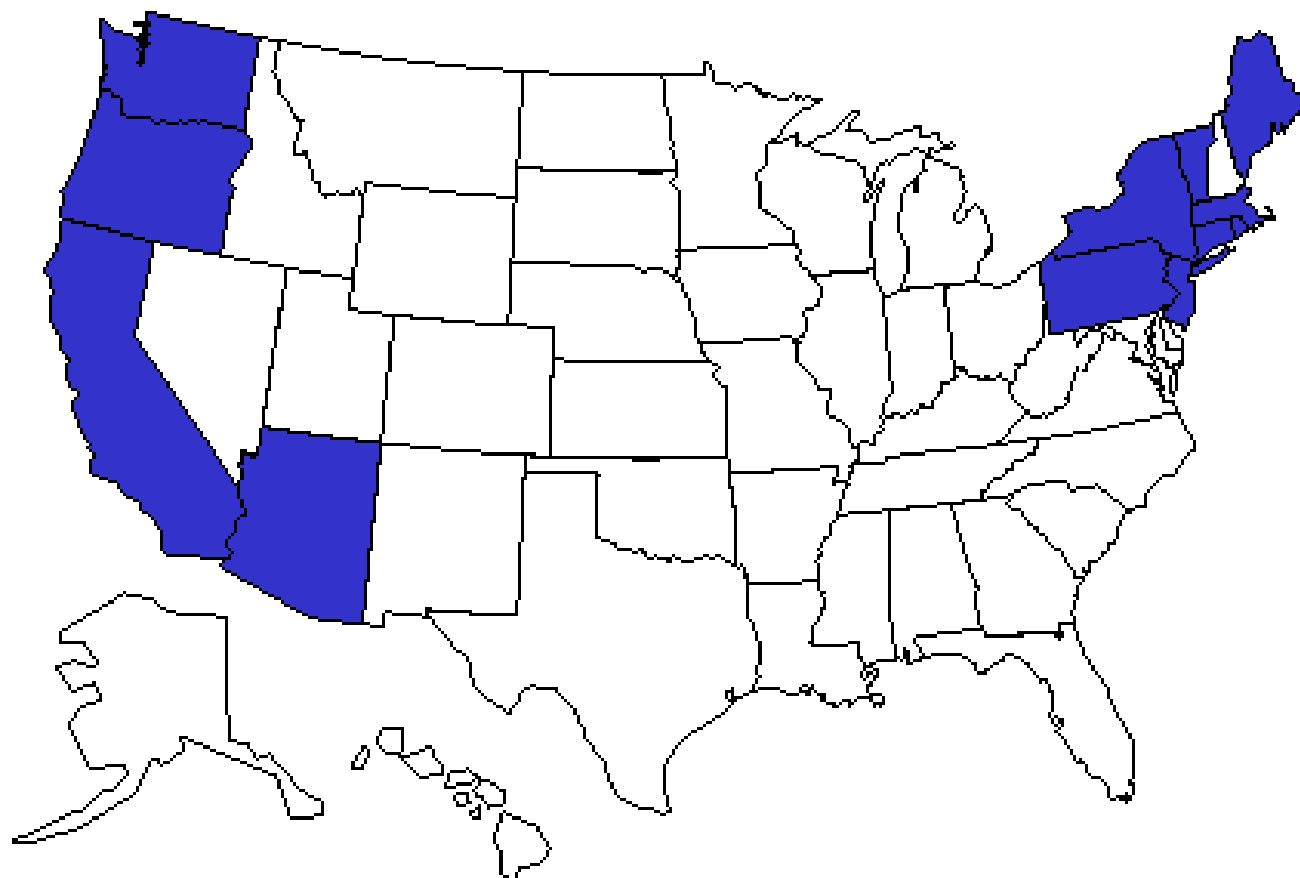
WA: *Washington Climate Change Challenge* initiated February 2007 by executive order and directing the Washington departments of Ecology and Community, Trade and Economic Development to lead a task force composed of representatives from business, community, and environmental groups in developing strategies for how Washington can achieve its climate goals.



GHG Reporting and Registries

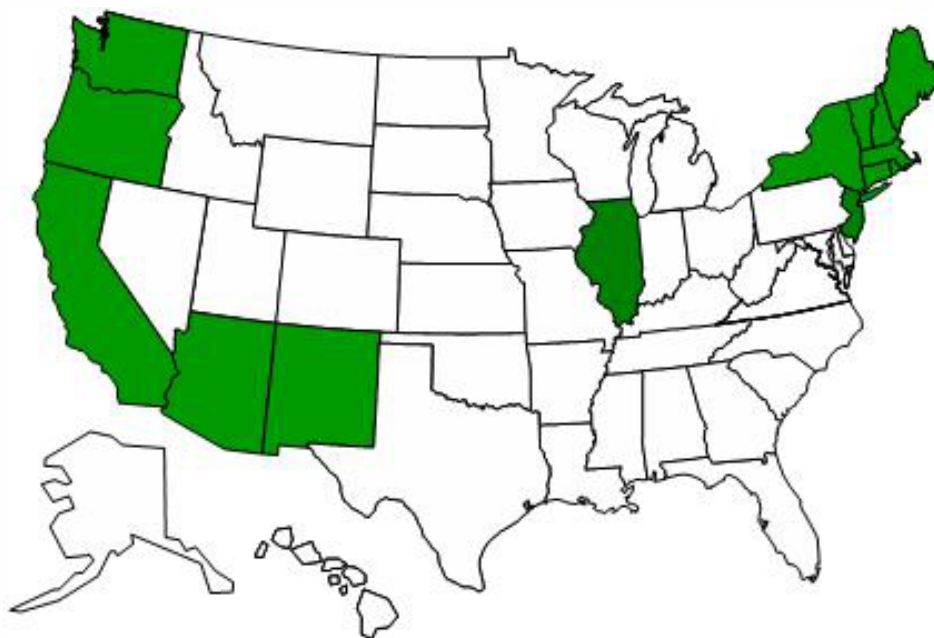


Poised to Adopt CA Vehicle GHG Standards



**■ States Poised to Follow California's
GHG Emissions Standards for Vehicles**

GHG Emission Targets



AZ: 2000 levels by 2020; 50% below 2000 levels by 2040

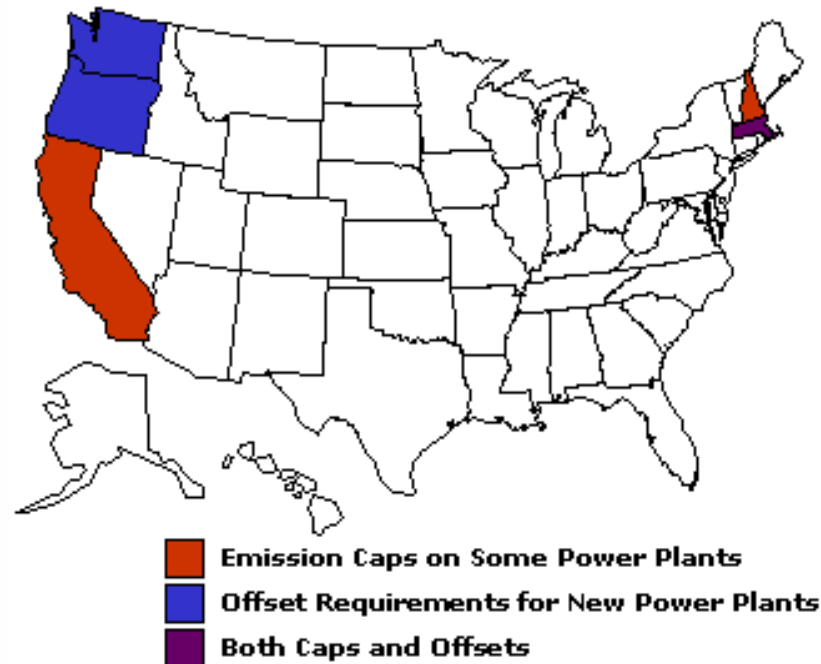
CA: 2000 levels by 2010; 1990 levels by 2020; 80% below 1990 levels by 2050

NM: 2000 levels by 2012; 10% below 2000 levels by 2020; 75% below 2000 levels by 2050

OR: Stabilize by 2010; 10% below 1990 levels by 2020; 75% below 1990 levels by 2050

WA: 1990 levels by 2020; 25% below 1990 levels by 2035; 50% below 1990 levels by 2050

Emission Caps/Offset Requirements



CA: Caps emissions from electricity retailers and, over the longer term, from natural gas utilities as well.

OR: Requires new power plants to offset approximately 17 percent of anticipated CO₂ emissions.

WA: Requires new power plants to offset approximately 20 percent of anticipated CO₂ emissions.

What can we do today?

- **Cannot afford to ignore the issue**
 - It is and will be a major issue during the presidential election campaign
 - The media will maintain it as a major issue
 - Power plants are being targeted already by environmentalists, presidential candidates, various states and the media
 - Some major companies and utilities are embracing regulation of CO₂ or some sort of regulation over climate change
 - Regulations will come - it is a matter of time

What can we do today?

- **Take some proactive steps in improving your carbon footprint (at minimum cost) and **make public** the steps you are taking**
- **Participate in public discussions on the costs to the consumer of the various alternatives being discussed in your state. Ignoring it will affect your business even more negatively since you will not have a voice in its final outcome**
- **Start with your existing power plants**

What can we do today?

- **Start with your existing power plant plans**
 - Use biofuels as secondary fuels as much as you can in aux boilers, diesel gen sets back ups, etc
 - Burn biomass or tires when you can and if you can, without affecting the reliability of your boilers
 - Fine tune your boilers control systems, these alone could provide you up to 5% improvement in efficiency and thus savings in fuel with less CO2 thus being released
 - Evaluate upgrades in turbines designed to improve efficiency, thus saving fuel for the same Mw generation
 - Look for ways to eliminate as much as possible CO2 releases
- **As you do this, publicize it to your consumers and how much is costing them. The low hanging fruit is going to be much more effective than later steps which will cost much more and have less of an effect**

What can we do in the future?

- **Start looking green with your existing power plants**
 - Use biofuels as secondary fuels as much as you can in aux boilers, diesel gen set back ups, etc
 - Burn biomass or tires when you can and if you can, without affecting the reliability of your boilers. This is particularly good for those of you with CFBs
 - Evaluate new generation technologies which may be retrofitted in the future
 - **There will be a carbon tax—position yourself in the market**
 - Look for ways to eliminate as much as possible CO2 releases
 - Develop a CO2 strategy for your organization
- **As you do this, publicize it to your consumers and **how much it is costing them**. The low hanging fruit is going to be much more effective than later steps which will cost much more and have less of an effect**

What can we do in the future?

- **Your future power plants**
 - Use biofuels as secondary fuels as much as you can in aux boilers, diesel gen set back ups, etc
 - Add renewables to your generation mixture.
 - Continue to look at new generation technologies and back end control systems which are more efficient
 - Make the power plant design **Carbon Capture Ready** within a reasonable cost
 - **There will be a carbon tax—position yourself in the market**
 - Look for ways to eliminate as much as possible CO2 releases
 - Develop a CO2 strategy for your organization
- **As you do some of these things, publicize to your consumers the real challenges and **how much it is costing them in their pockets**. The low hanging fruit is going to be much more effective than later steps which will cost much more and have less of an effect**

MIT Study – February, 2007

Table 3.1 Representative Performance And Economics For Air-Blown PC Generating Technologies

	SUBCRITICAL PC		SUPERCRITICAL PC		ULTRA-SUPERCRITICAL PC		SUBCRITICAL CFB ⁶	
	W/O CAPTURE	W/ CAPTURE	W/O CAPTURE	W/ CAPTURE	W/O CAPTURE	W/ CAPTURE	W/O CAPTURE	W/ CAPTURE
PERFORMANCE								
Heat rate (1), Btu/kW _e -h	9,950	13,600	8,870	11,700	7,880	10,000	9,810	13,400
Generating efficiency (HHV)	34.3%	25.1%	38.5%	29.3%	43.3%	34.1%	34.8%	25.5%
Coal feed, kg/h	208,000	284,000	185,000	243,000	164,000	209,000	297,000	406,000
CO ₂ emitted, kg/h	466,000	63,600	415,000	54,500	369,000	46,800	517,000	70,700
CO ₂ captured at 90%, kg/h (2)	0	573,000	0	491,000	0	422,000	0	36,000
CO ₂ emitted, g/kW _e -h	931	127	830	109	738	94	1030	141
COSTS								
Total Plant Cost, \$/kW _e (3)	1,280	2,230	1,330	2,140	1,360	2,090	1,330	2,270
Inv. Charge, c/kW _e -h @ 15.1% (4)	2.60	4.52	2.70	4.34	2.76	4.24	2.70	4.60
Fuel, c/kW _e -h @ \$1.50/MMBtu	1.49	2.04	1.33	1.75	1.18	1.50	0.98	1.34
O&M, c/kW _e -h	0.75	1.60	0.75	1.60	0.75	1.60	1.00	1.85
COE, c/kW_e-h	4.84	8.16	4.78	7.69	4.69	7.34	4.68	7.79
Cost of CO ₂ avoided ⁵ vs. same technology w/o capture, \$/tonne	41.3		40.4		41.1		39.7	
Cost of CO ₂ avoided ⁵ vs. supercritical w/o capture, \$/tonne	48.2		40.4		34.8		42.8	

Basis: 500 MW_e net output. Illinois # 6 coal (61.2% wt C, HHV = 25,350 kJ/kg), 85% capacity factor

(1) efficiency = 3414 Btu/kW_e-h/(heat rate);

(2) 90% removal used for all capture cases

(3) Based on design studies and estimates done between 2000 & 2004, a period of cost stability, updated to 2005\$ using CPI inflation rate. 2007 cost would be higher because of recent rapid increases in engineering and construction costs, up 25 to 30% since 2004.

(4) Annual carrying charge of 15.1% from EPRI-TAG methodology for a U.S. utility investing in U.S. capital markets; based on 55% debt @ 6.5%, 45% equity @ 11.5%, 38% tax rate, 2% inflation rate, 3 year construction period, 20 year book life, applied to total plant cost to calculate investment charge

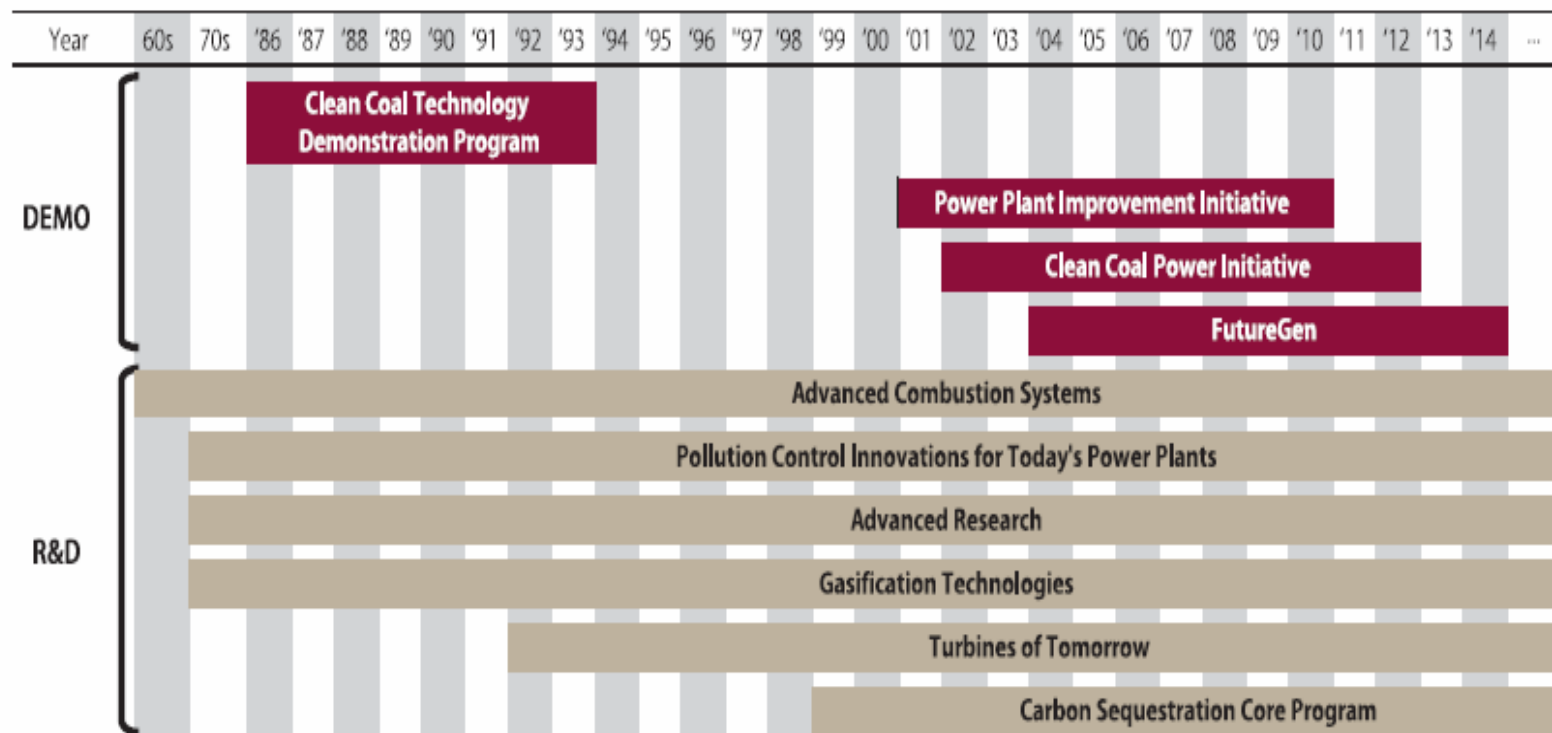
(5) Does not include costs associated with transportation and injection/storage

(6) CFB burning lignite with HHV = 17,400 kJ/kg and costing \$1.00/million Btu



DOE Advanced Coal Technologies

Figure 6.1 DOE RD&D Activity for Advanced Coal Technologies Program



From Standard and Poor's Report

Lingering Uncertainties

In response to growing public concern about climate change, the public power market is bracing for possible moves by the U.S. Congress to address greenhouse

gas emissions. Given the range of options and costs survey respondents are currently modeling, CO2 reduction will likely represent a significant technological and financial challenge to the public power industry.

Standard & Poor's has begun to assess public power utilities' exposure to the potential new regulation in light of their operational and financial profiles, and we are focusing on management's efforts to evaluate the range of remedial options at its disposal.

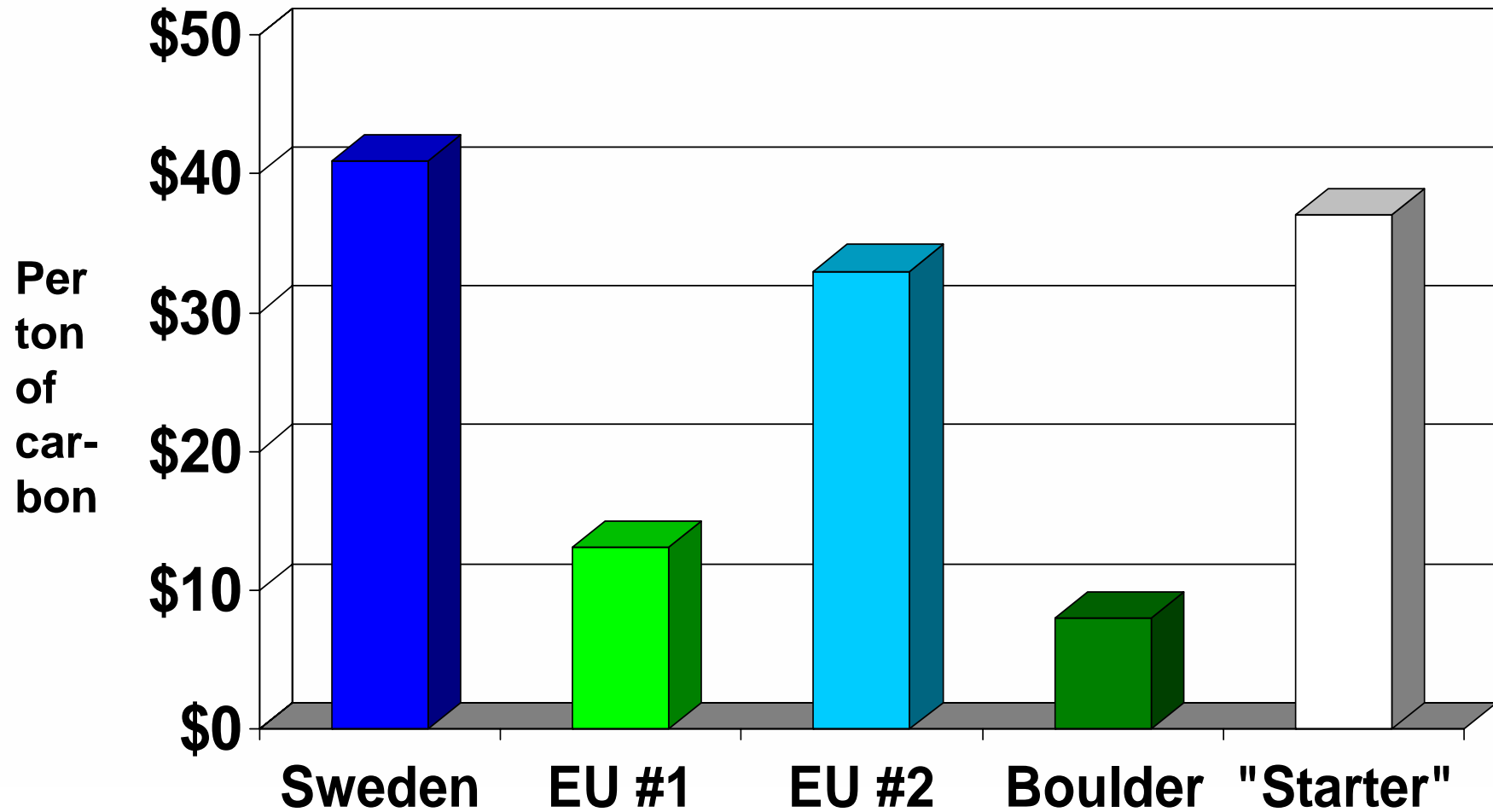
However, we have yet to factor into ratings the costs of addressing potential regulation given the uncertainties. **CW**

Standard & Poor's CreditWeek | May 23, 2007



Existing Carbon Taxes

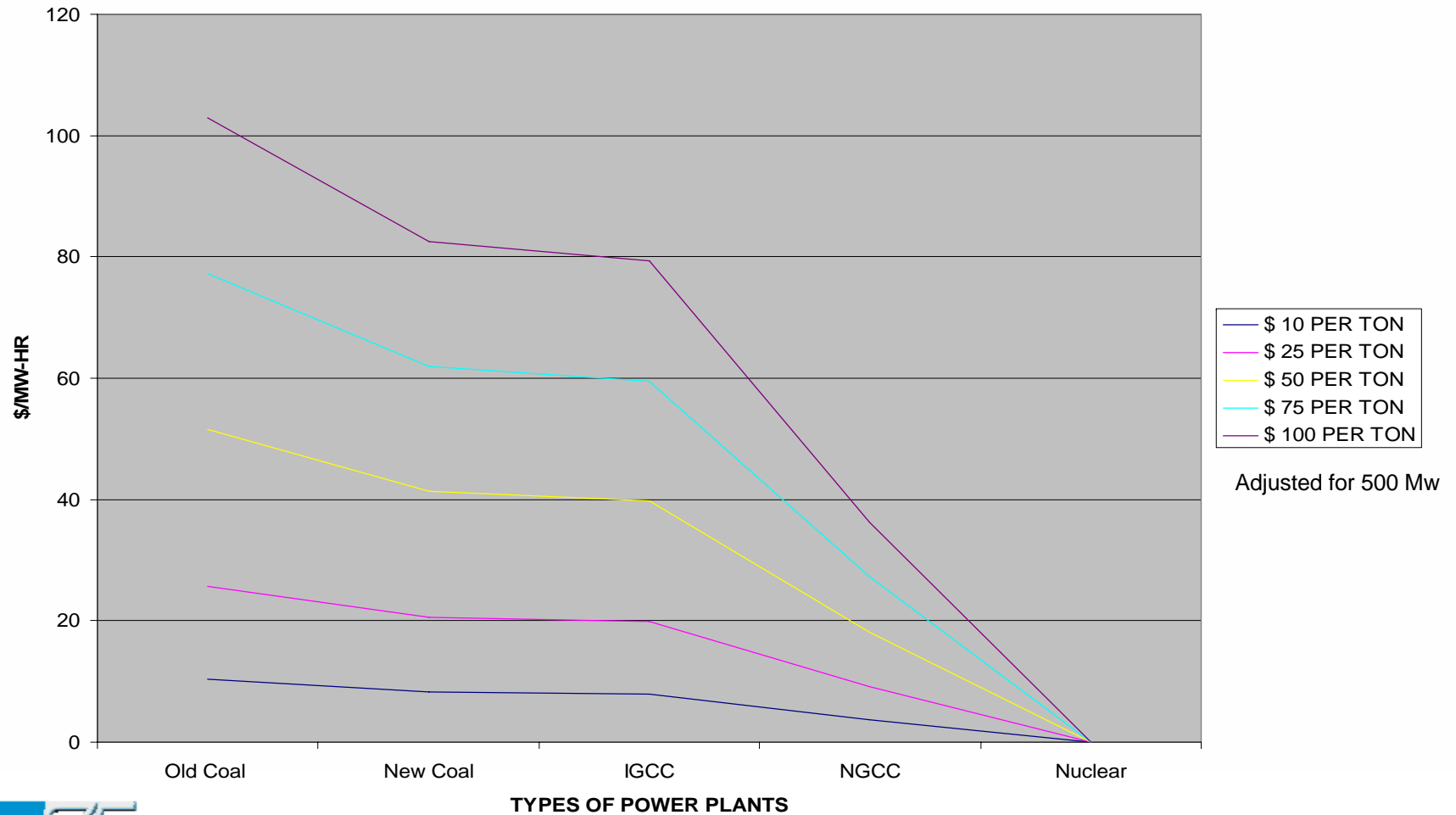
(1st-year Starter Tax shown for comparison)



Courtesy of the Carbon Tax Center

Potential Carbon Tax Impact

CARBON TAX IMPACT



Capture Ready

A capture-ready plant is a facility design that would allow the optimal performance of retrofitted capture technology at relatively minimal cost and with minimal impact on the plant operations of the facility in the future

Conclusions

- Regardless of the real cause of the climate change—we have to address CO2 in some fashion
- There are no panaceas
- Need to develop strategies for your specific situation and locale - **Develop a CO2 strategy for your organization**
- You can start now with your existing fleet and taking small steps which develop credibility with your stakeholders and customers
- Need to voice the **cost versus the benefits** at the local level
- Local educational programs are critical to maintain an informed public with the right information to make decisions that affect future generation of Americans