Carbon Capture and Sequestration: Assessing Liability and Property Regimes

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Presented at Hennepin County Bar Association
April 23 2009

Overview

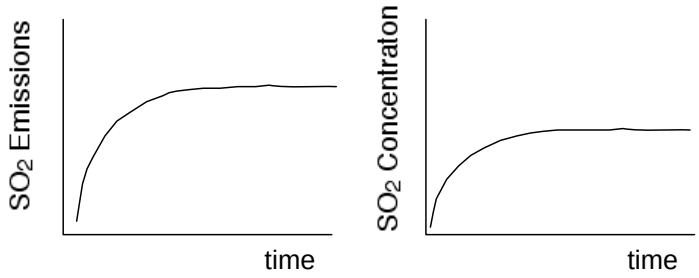
- Shifting federal frame
- Overarching challenges for CCS deployment: regulatory and legal considerations
- Key legal questions for CCS across the lifecycle
- Focus on liability
- CCSReg Project and Interim Report
- Proposals for managing long-term liability

Obama Budget 2010

p. 21 Begin a Comprehensive Approach to Transform Our Energy Supply and Slow Global Warming. The Administration is developing a comprehensive energy and climate change plan to invest in clean energy, end our addiction to oil, address the global climate crisis, and create new American jobs that cannot be outsourced. After enactment of the Budget, the Administration will work expeditiously with key stakeholders and the Congress to develop an economy-wide emissions reduction program to reduce greenhouse gas emissions approximately 14 percent below 2005 levels by 2020, and approximately 83 percent below 2005 levels by 2050.

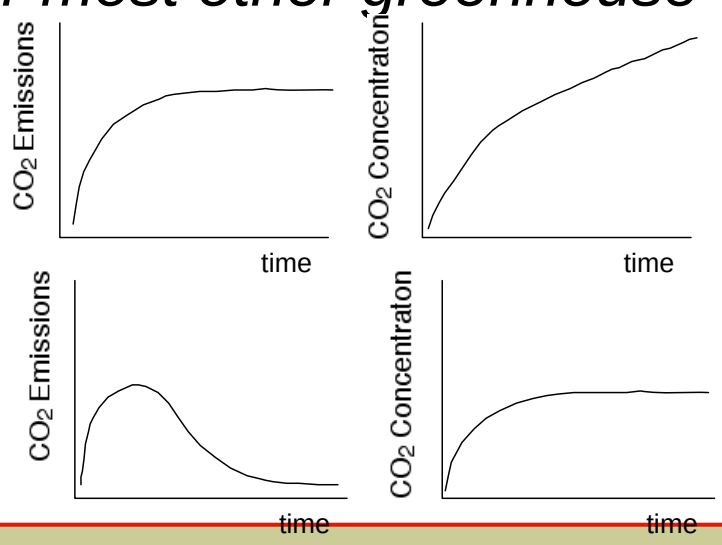
GHGs are not like conventional pollutants

Conventional pollutants (SO_2 or NO_x) have an atmospheric residence time of just a few hours or days. Stabilizing emissions of these pollutants results in stabilizing their concentration.



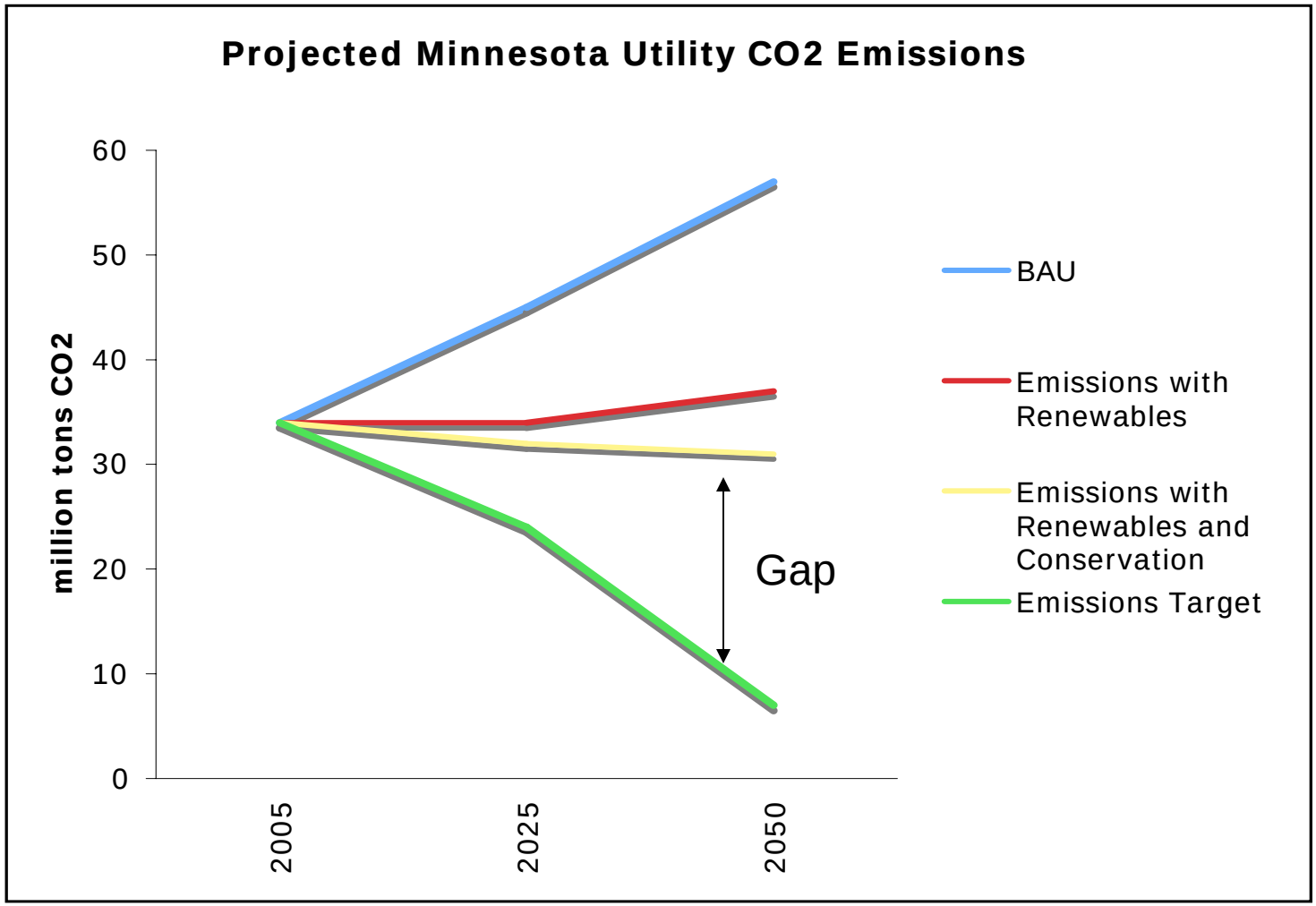
This is not true of carbon dioxide or most other greenhouse gases.

As CO_2 lasts ~70 years in the atmosphere, stabilizing atmospheric *concentrations* of CO_2 will require reductions in current emissions *by at least and order of magnitude (~80%).*



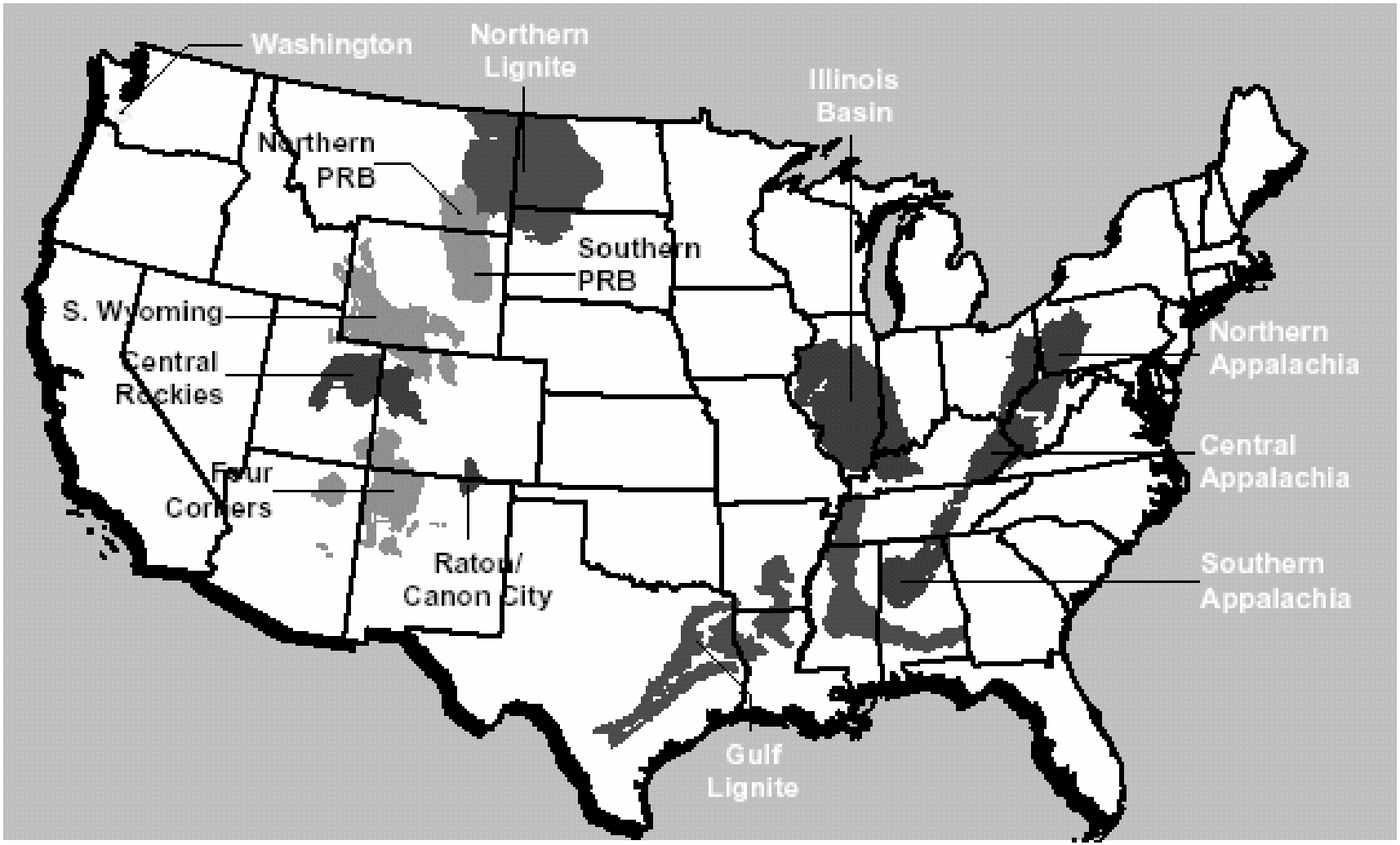
Source: Morgan, 2006

Why more is needed for stabilization



Source: Pollak, 2007

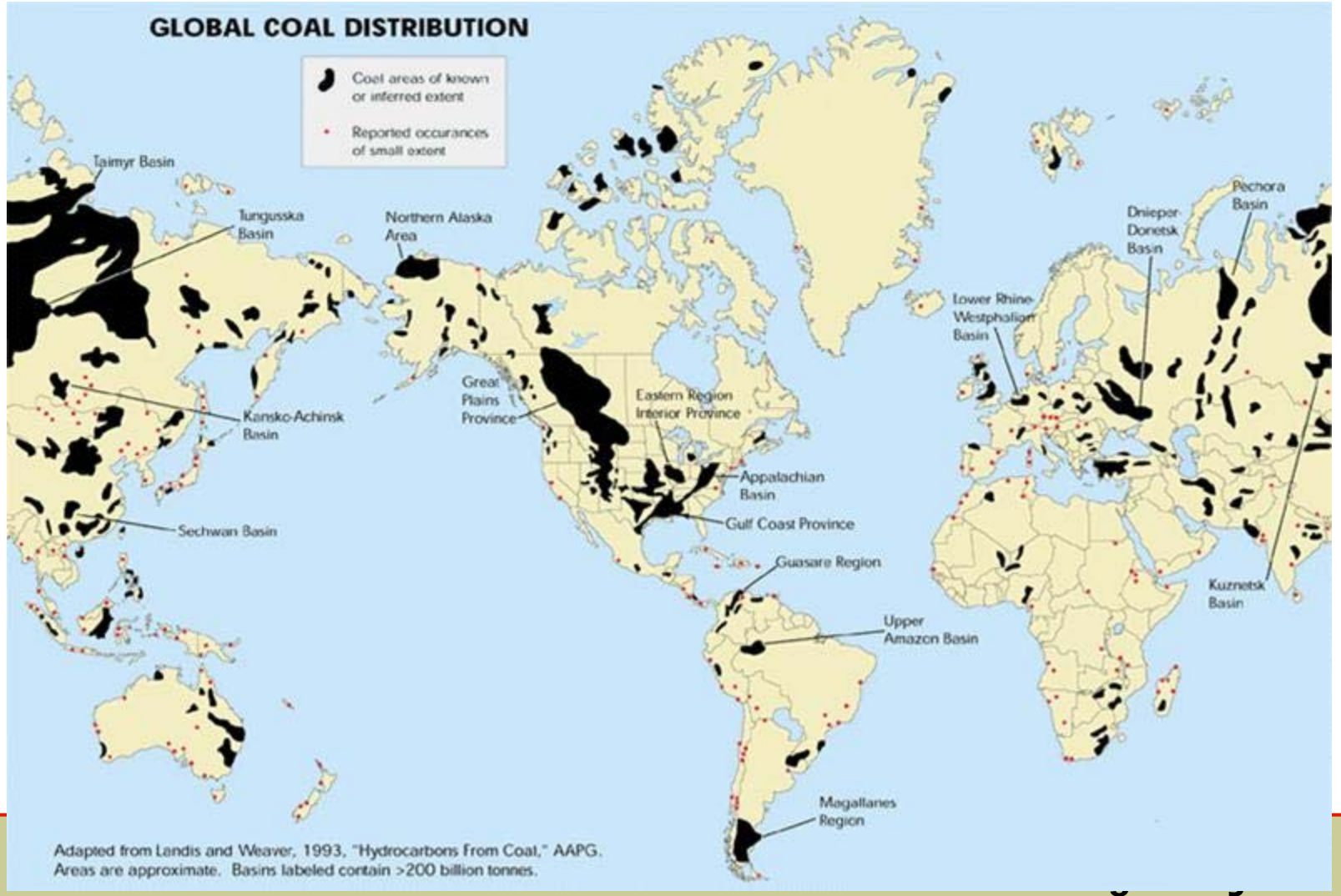
Plentiful U.S. Coal Supply



Source: Platts: http://www.platts.com/Coal/Resources/News%20Features/coal%20prices/map5.xml

Source: PowerMAP

Plentiful World Coal Supply



Source: http://www.acr-alberta.com/carbon.htm

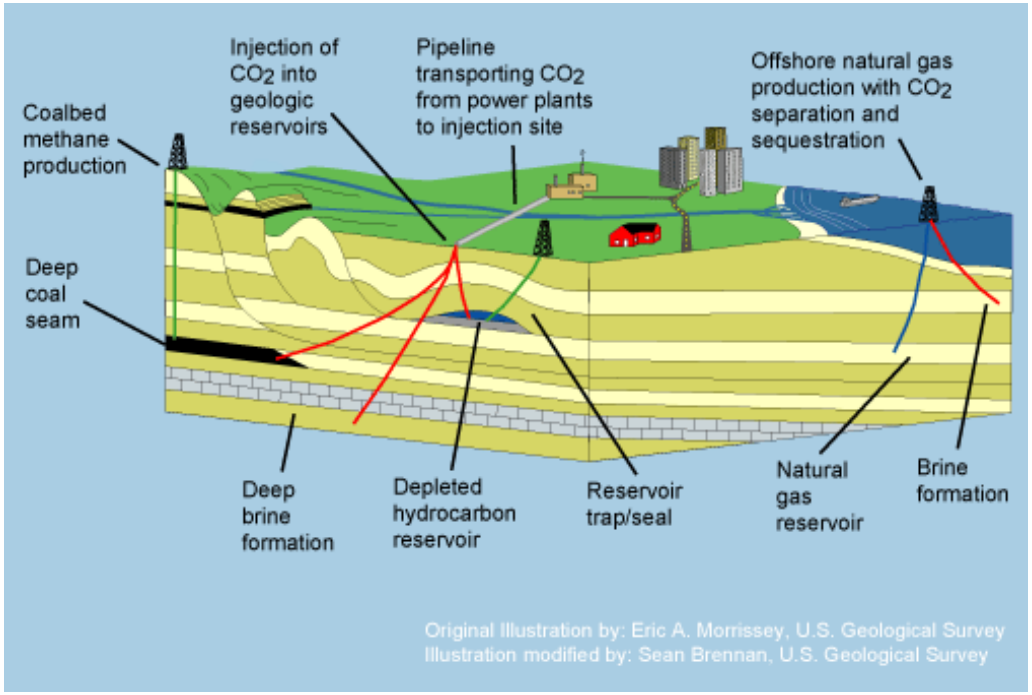
Obama Budget 2010 (3)

p. 22 Develop Low-Carbon Emission Technologies.
“ The Recovery Act provides funding to meet the President’s campaign commitment to build five commercial scale coal-fired plants with carbon capture and storage technology through public-private partnerships. The Energy Department will also scale up its demonstration projects for geologic storage for carbon dioxide. Combined, this funding will set the foundation for significant efforts to mitigate greenhouse gas emissions from coal-fired power plants.”

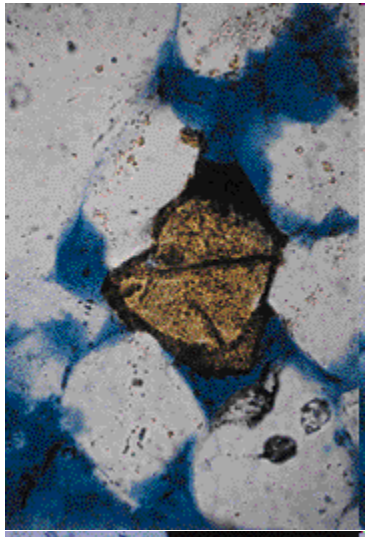
(plus 3.4B$ in the Recovery Act for CCS)

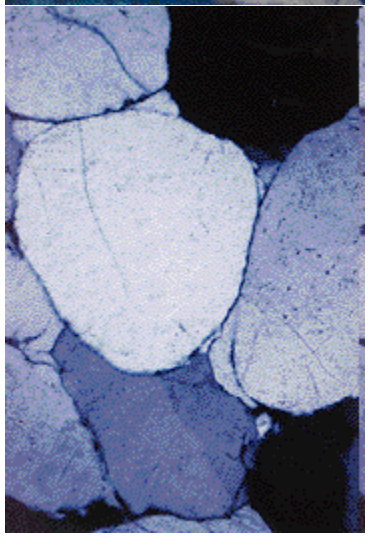
Basics of geologic storage

- CO_2 is injected as a supercritical fluid into high permeability zones of sedimentary basins
- CO_2 is more buoyant than receiving fluids and will be trapped between low-permeability confining layers
- Over longer times, dissolution (tens-hundreds of years) and mineralization (thousands to hundreds of thousands of years)
- Natural CO_2 reservoirs have stored CO_2 for hundreds of thousands of years
- Regional hydrodynamic flows over long time-frames (tens of thousands to millions of years)

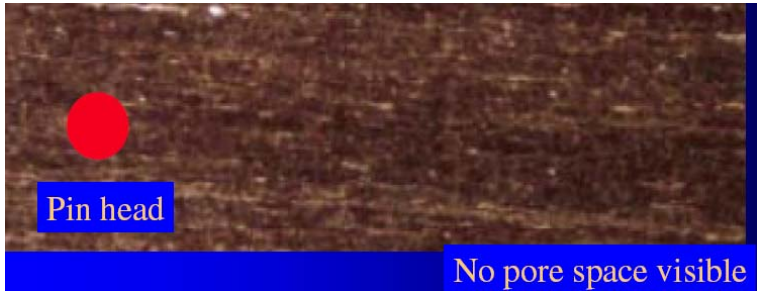


Source: USGS, 2004

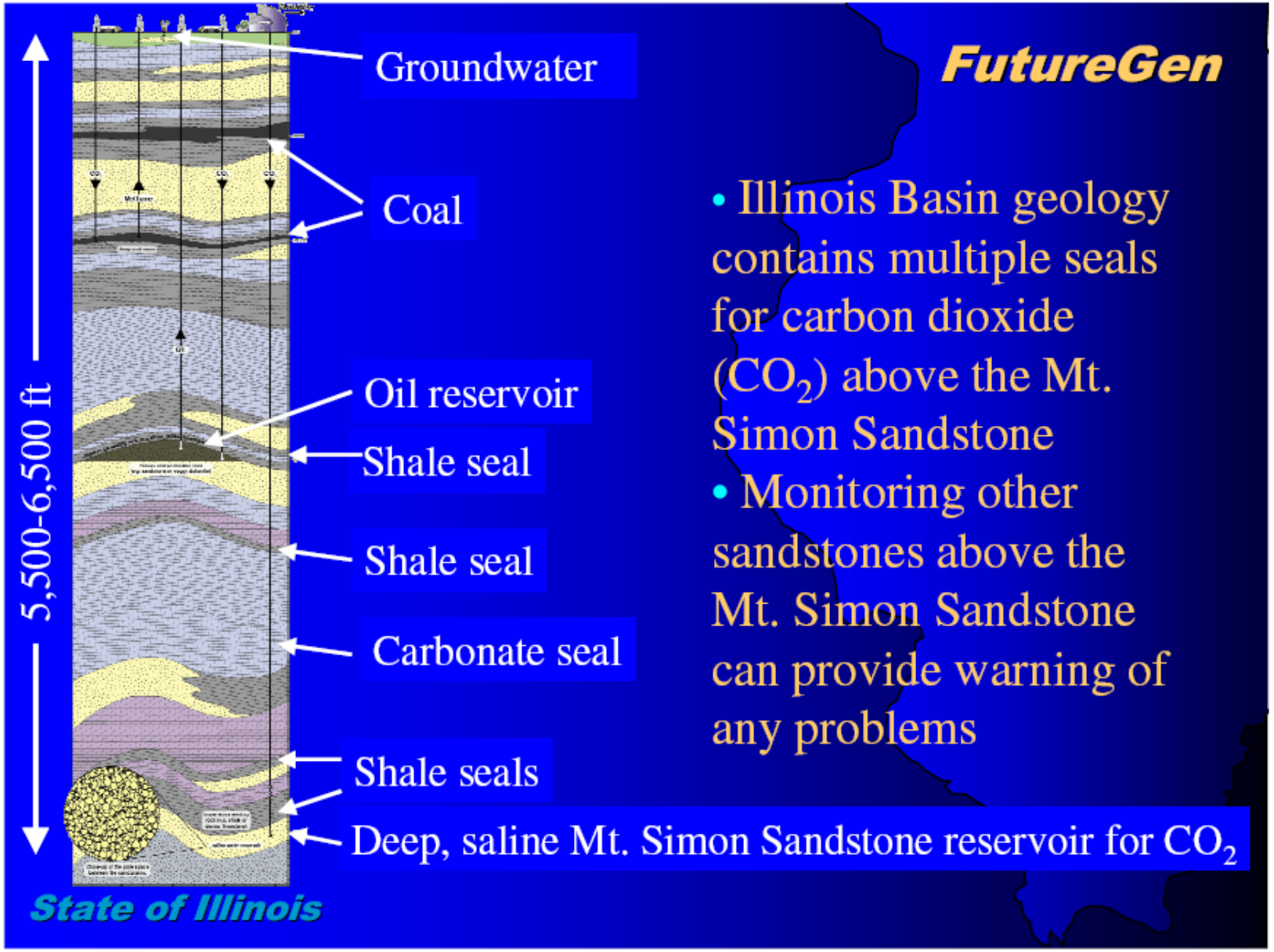




Illinois Sandstone Pore Space

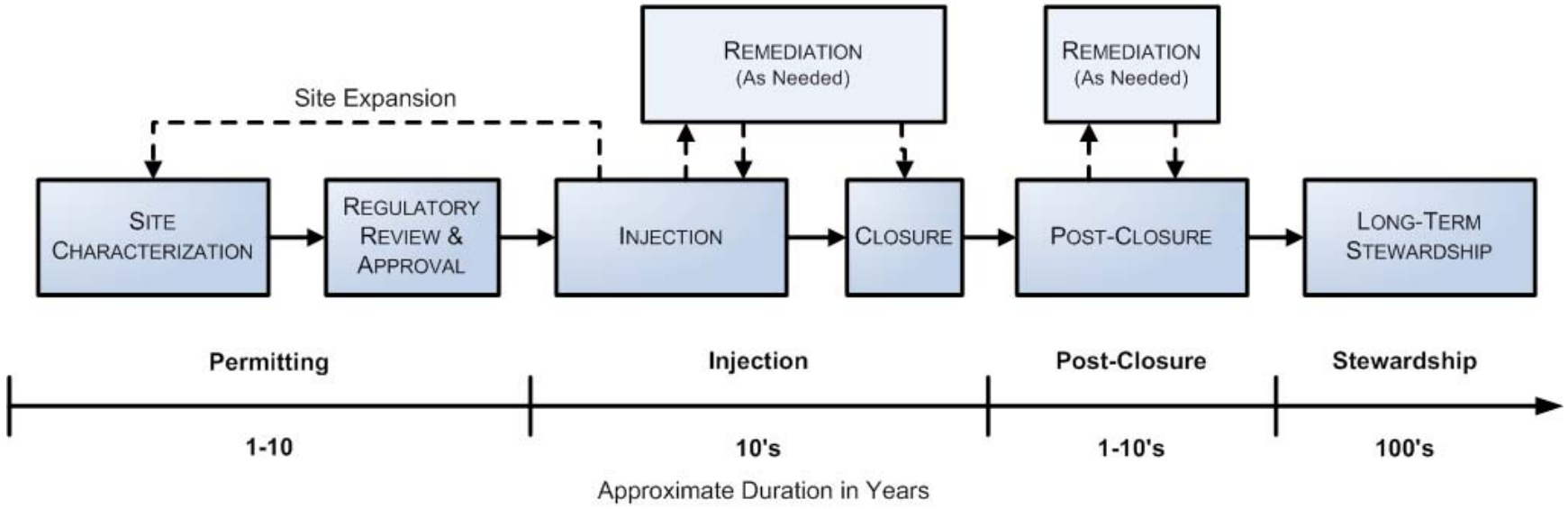


Source: http://energy.usgs.gov/factsheets/Illinois/illinois.basin.html, http://blog.wired.com/wiredscience/2009/02/carbonstorage.html, Finley 2006



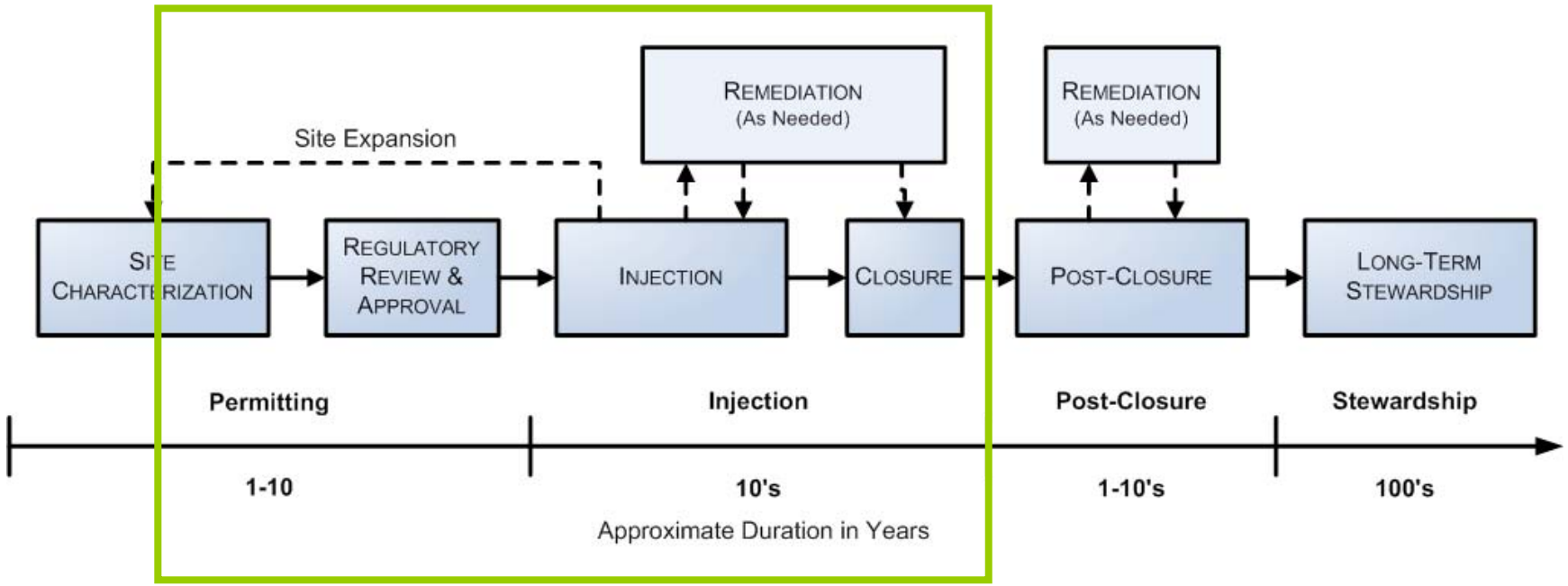
http://blog.wired.com/wiredscience/2009/02/carbonstorage.html

Four Stages of Regulation over the CCS Lifecycle



Source: Rubin et al. 2007

4 Stages of Regulation over the Lifecycle of CCS

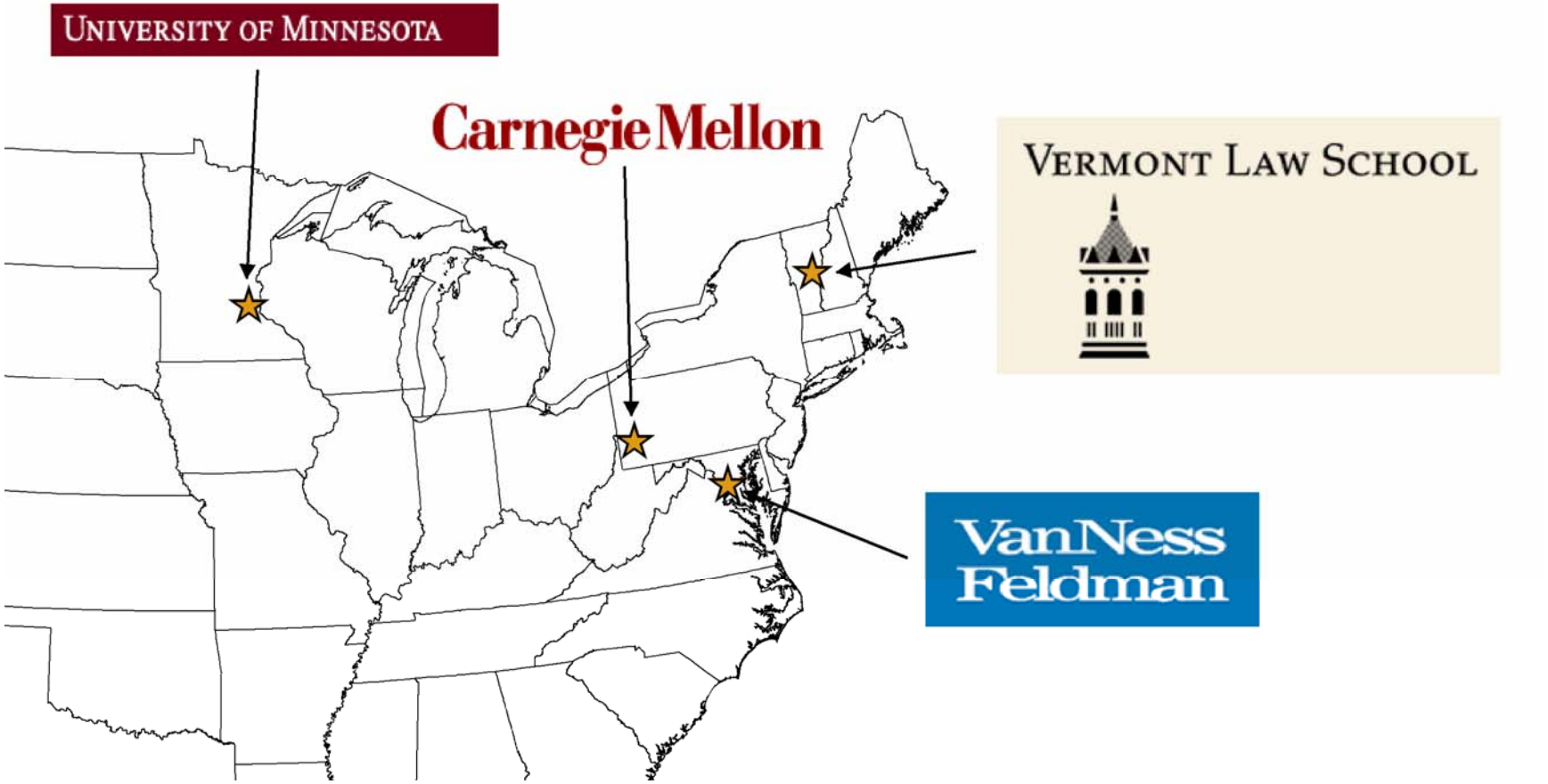


Source: Rubin et al. 2007

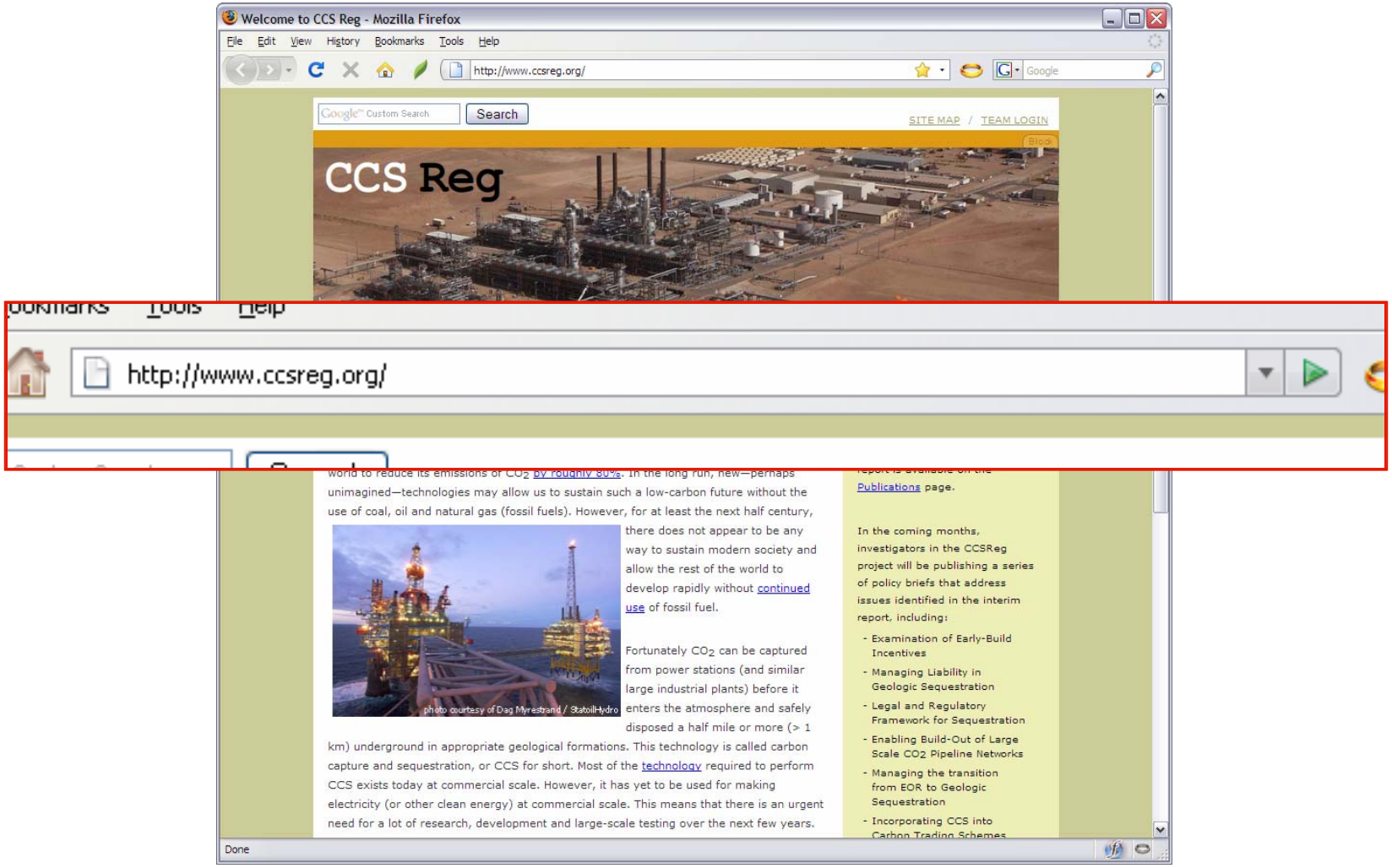
Proposed regulations do not manage:

- Property rights
  - Mineral, water, subsurface
- Leakage to the surface
- Long-term stewardship/transfer of responsibility
  - Financial responsibility
- Integration with larger climate policy
  - Crediting CCS
    - Upstream v. downstream
  - Incentives for CCS with early low carbon prices
    - Bonus allowance/fee for CCS

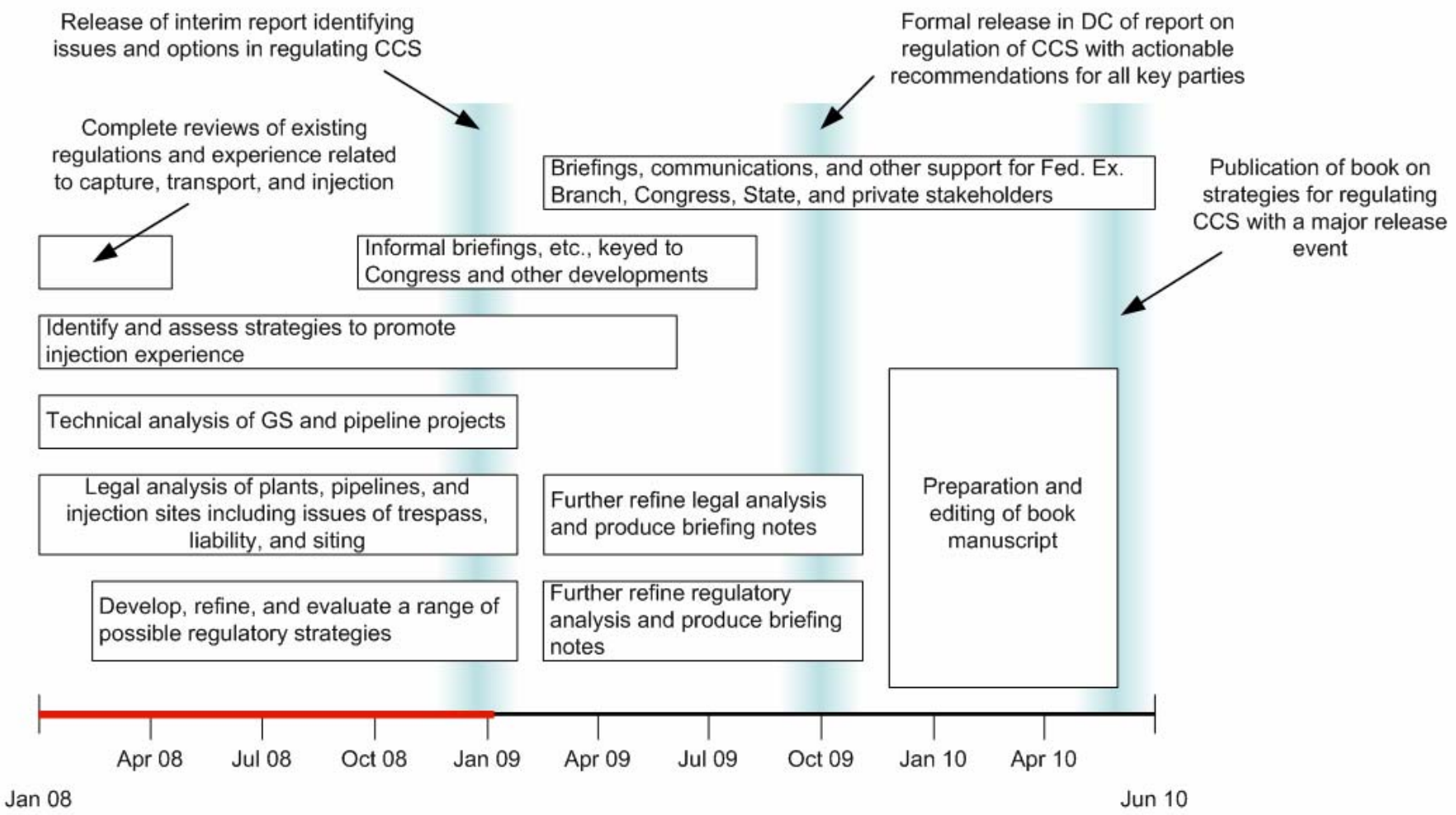
CCSReg Project Collaborators



CCSReg Project Website



CCSReg Project Timeline



Project Advisory Board

While these folks are kindly providing advice and guidance, neither they nor their organizations are responsible for the content of the interim report.

Name	Title	Organization
Carl O. Bauer	Director, National Energy Technology Laboratory	U.S. Department of Energy
Armond Cohen	Executive Director	Clean Air Task Force
Brad Crabtree	Program Director	Great Plains Institute
Dr. Ottmar Edenhofer	Co-Director, Sustainable Solutions Research Track	Potsdam Institute for Climate Impact Research
David Fleischaker	Secretary of Energy	State of Okalahoma
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Tom Kerr	Senior Energy Analyst	International Energy Agency
Ernest J. Moniz	Director, Laboratory for Energy and Environment and Director, MIT Energy Initiative	MIT
Paul O'Neill	Former Secretary of the Treasury, CEO of Alcoa	
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Brian Hannegan	Vice President, Environment and Generation	Electric Power Research Institute
Henry A. Courtright	Senior Vice President, Member and External Relations	Electric Power Research Institute
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Key legal questions for CCS

Property Rights

- Who owns subsurface pore space?
- Can the rights to sequester CO_2 in the pore space be transferred to another party?
- Who owns the injected CO_2?

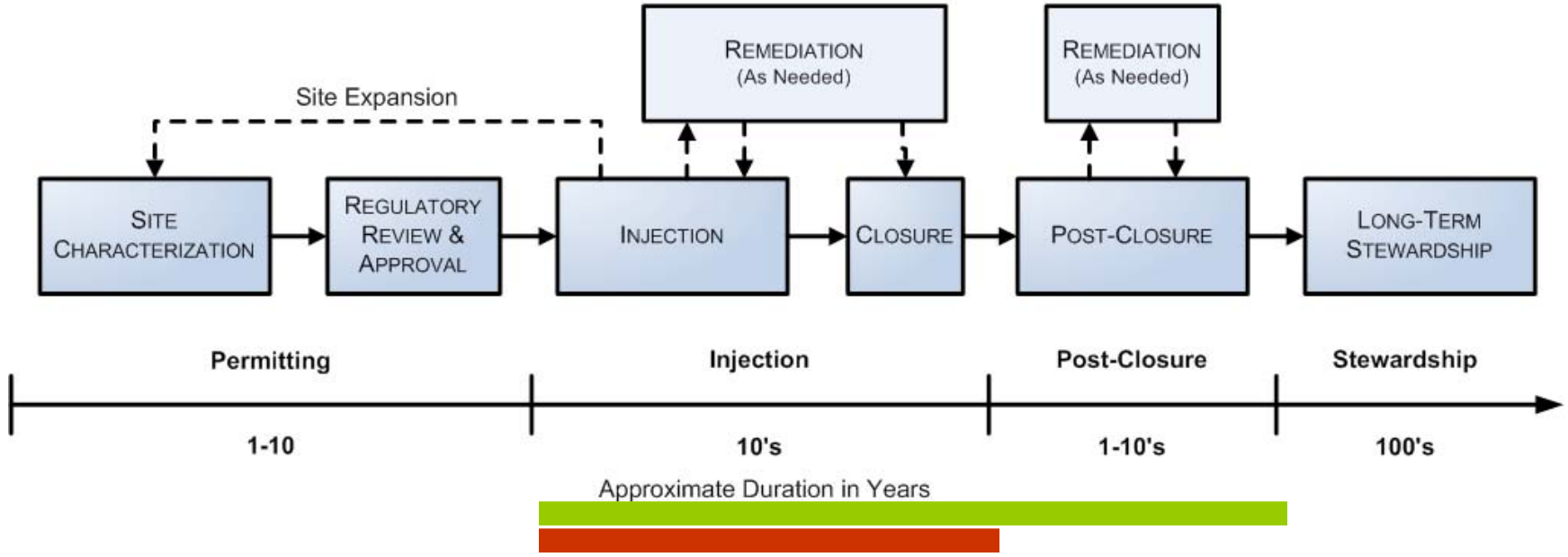
- Liability
  - How can liability be managed and partitioned over a CCS project lifecycle?
  - How can large and legal storage reservoirs be created?
    - Two approaches:
      - Compensation schemes for pore space use/purchase
      - Truncating subsurface ownership

Liability and CCS

- Alex Klass will speak here

Covering the costs of long-term stewardship

Integrating adaptive governance into site operation



Insurance/bond for liability in case of default

Fee on injected CO_2 to cover long-term stewardship via a private or public fund

Mechanisms for managing long-term liability

- Goal: Create incentives for good site selection, responsible site operations, and, secure storage
- Recognizing that:
  - No private firm can be responsible indefinitely
  - Operational data will help to manage risk
- Possibilities for commercial CCS projects
  - Assumption: data is available to develop and manage risk from initial pre-commercial deployment
  - Private insurance, bonds, pooling mechanisms
  - Joint public-private compensation systems coupled with tort law
  - Tradeoffs between federal and state roles

A Two-Stage Approach

10. Rather than finalize all regulatory details now, we argue for a "two-stage" approach in which a Presidential-Congressional Commission monitors experience with 10 to 15 projects and then recommends how to handle specific details on the basis of this experience. *(Ch. 4 and Ch. 11)*

Table of Contents

Over the coming few months…

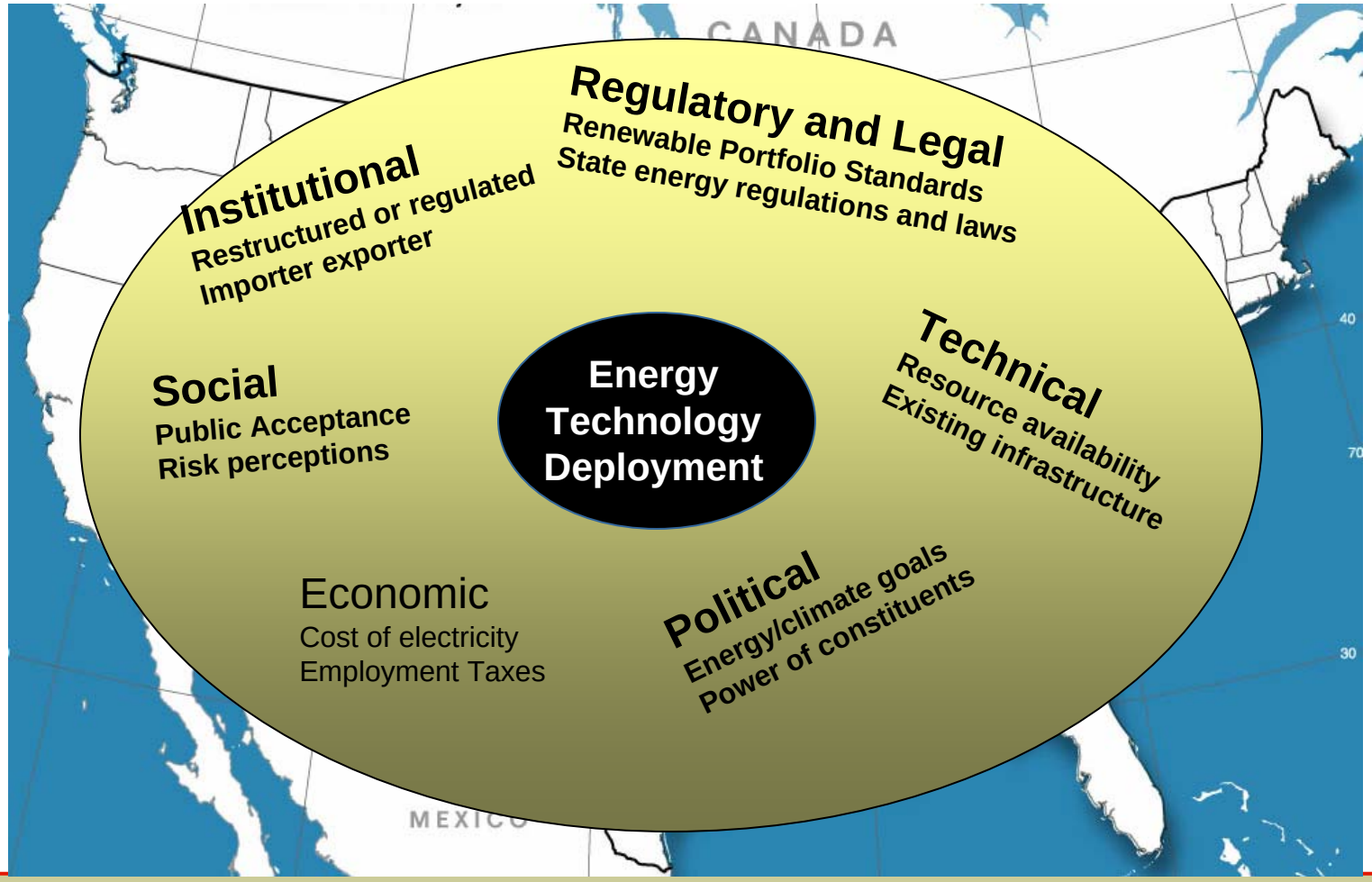
…we plan a variety of briefings and other events to gather additional input.

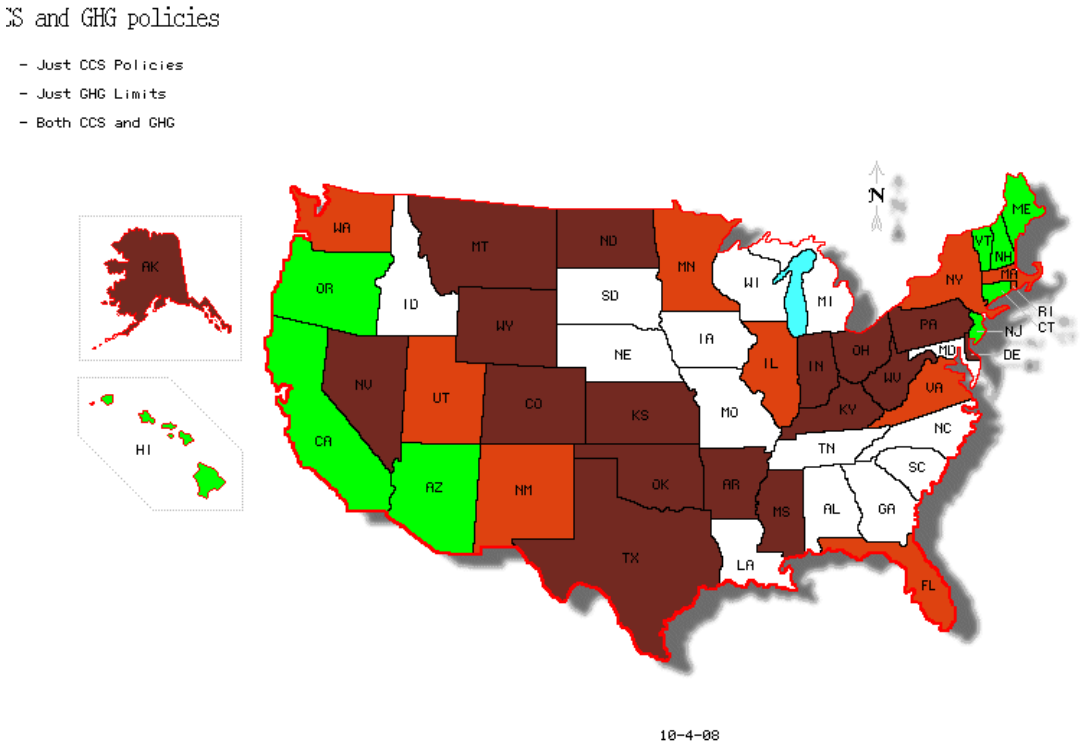
We will be developing prescriptive briefing notes on:

- Examination of Early-Build Incentives
- Managing Liability in Geologic Sequestration
- Legal and Regulatory Framework for Sequestration
- Enabling Build-Out of Large Scale CO_2 Pipeline Networks
- Managing the transition from EOR to Geologic Sequestration
- Incorporating CCS into Carbon Trading Schemes
- Removing Barriers to Commercial Deployment

On May 7 and 8, we'll hold a face-to-face project meeting to review policy recommendations across the issues addressed above.

CCS Regulation at the State Level





CCS policy only

GHG limits only

Both CCS policy and GHG limits

Neither CCS policy nor GHG limits

Source: Pollak, Johnson and Wilson

CCS means different things in different states

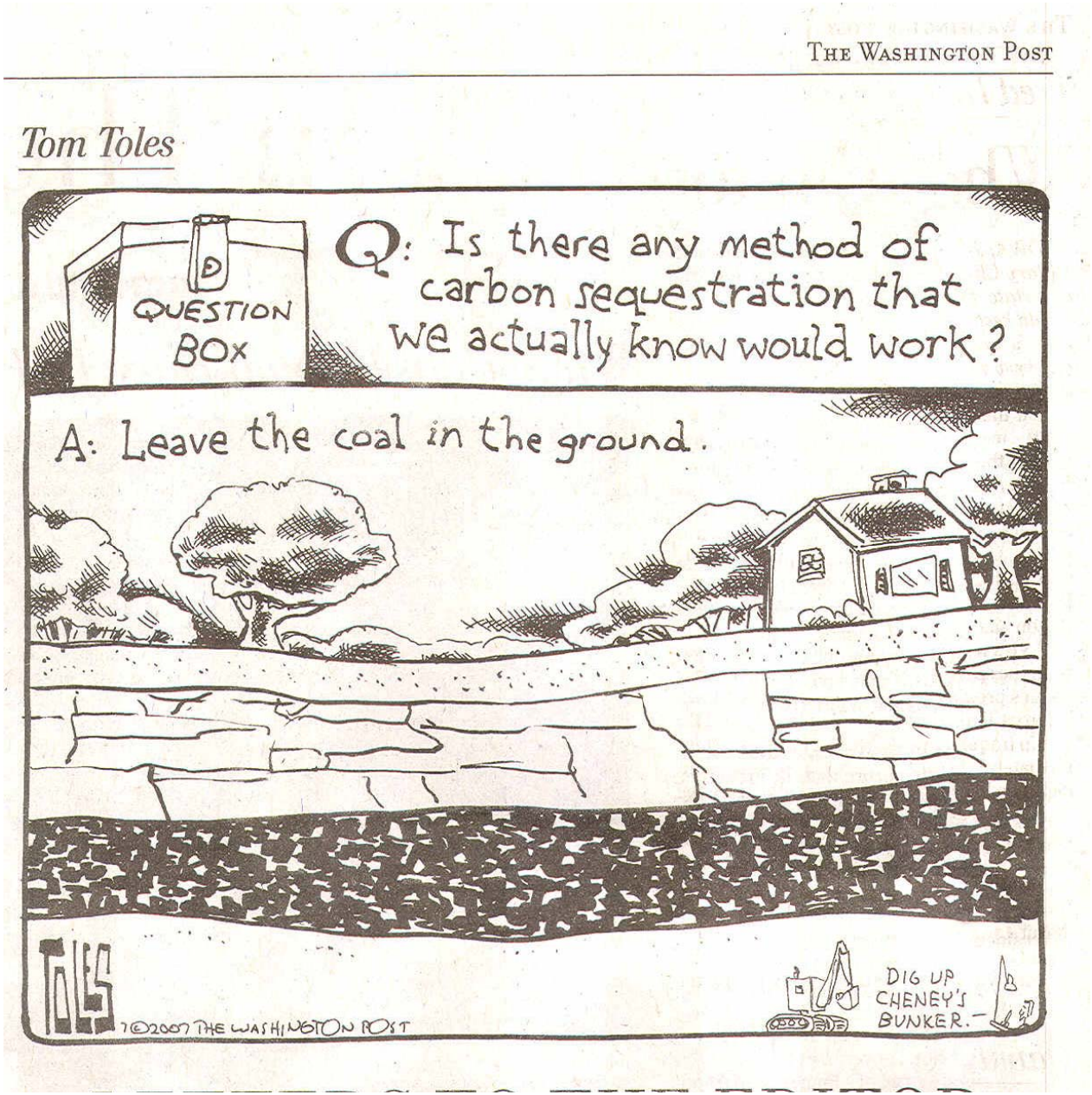
	Coal resources	EOR	GS site	Climate policy
Massachusetts	N	N	N	Y
Minnesota	N	N	N, Next door	Y
Texas	Y	Y	Y	N
Montana	Y!	Y	Y	N

Conclusions

- Liability over the CCS lifecycle pretty well covered with the exception of long-term liability
- Role of existing environmental regulations and laws
- Chicken and egg: industrial organization and structuring long-term liability
- Different interests in different states
- The only reason for large-scale CCS is deep emissions reductions

Overarching Challenges for CCS Deployment in the U.S.

- CCS fit into emerging U.S. climate policy at the state and federal level
- Adapt existing regulations or re-create a comprehensive framework
- Need to balance flexibility and certainty with new regulations
- Balancing potential local harm with global harm from climate change
- Complex and changing political climate



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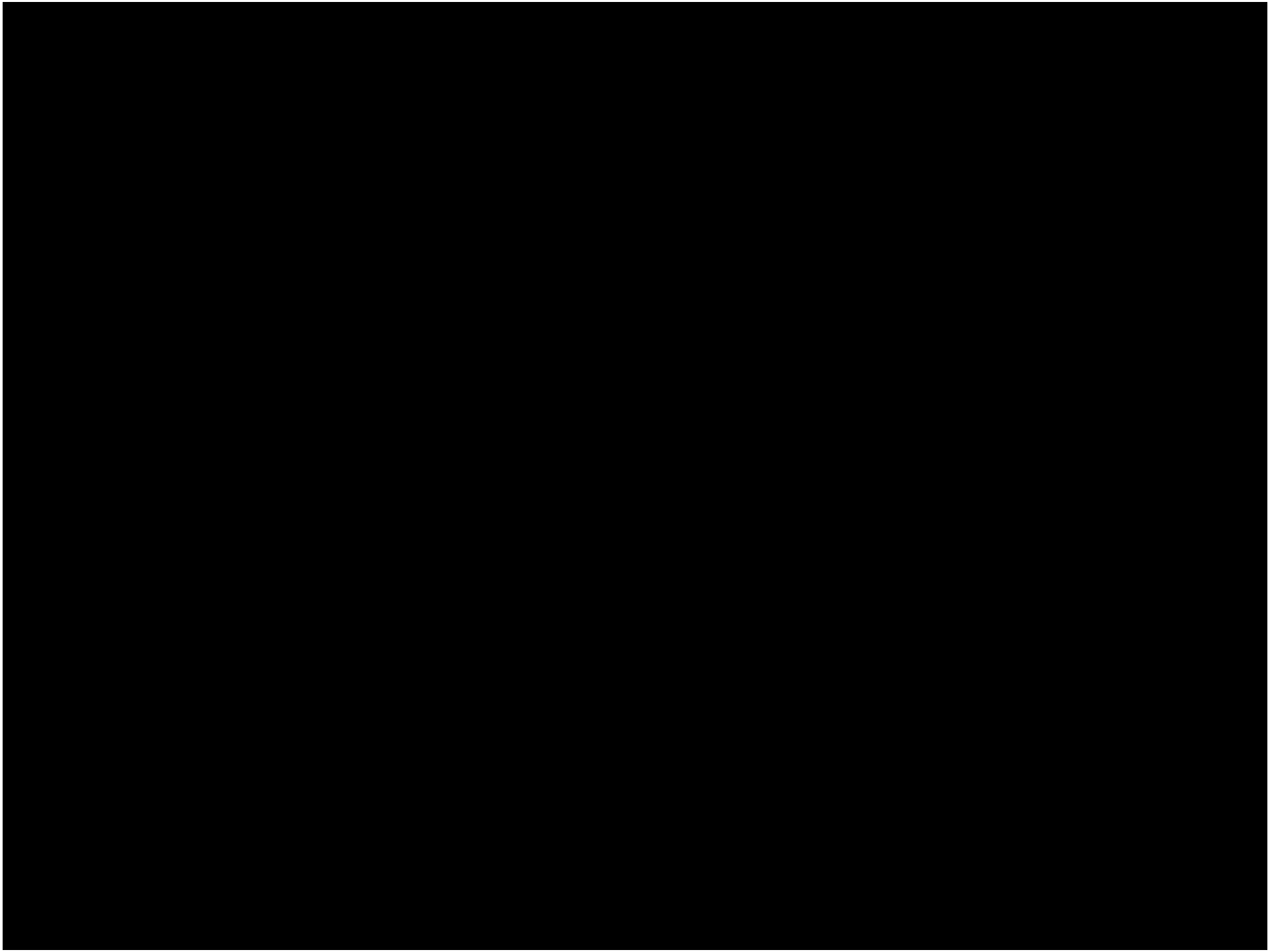
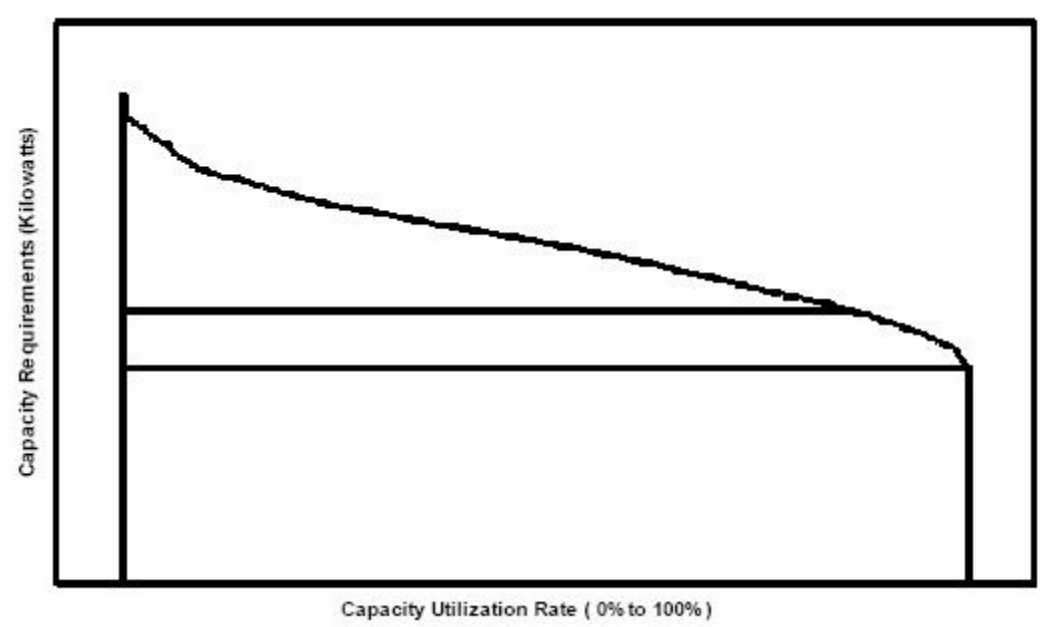
Source: Washington Post, July 16, 2007



Load Duration Curve



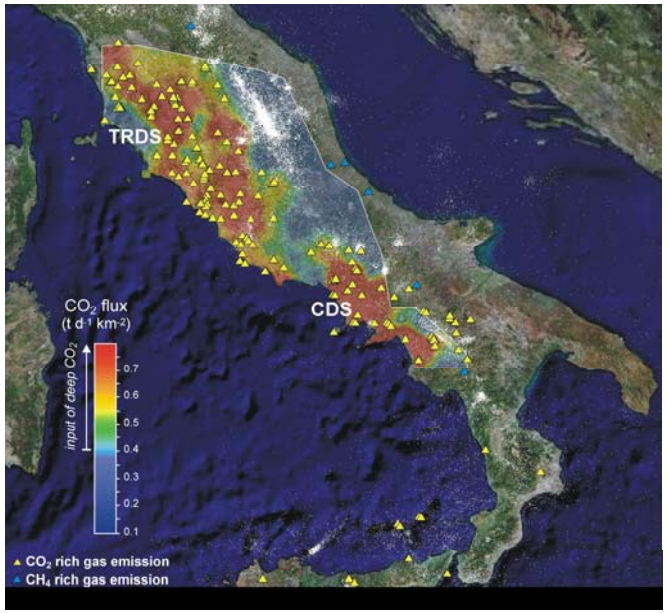
Source: http://en.wikipedia.org/wiki/Load_duration_curve

11 Key Points from the Interim Report

1. There is no feasible way for the U.S. to achieve a 50-80% reduction in emissions of carbon dioxide by mid-century without carbon capture and sequestration (CCS) as part of a portfolio of low-carbon technologies (such as energy efficiency, renewables, and nuclear). *(Ch. 1)*
2. All the technologies required for capture, transport, and geologic sequestration of CO_2 exist at commercial scale, but have yet to be integrated and applied to the control of CO_2 emissions. *(Ch. 2 and Ch. 4)*

Low Risk

3. Geoscientists believe that the risks associated with sequestration are modest and can be readily managed. A number of natural analogs suggest that, if seepage of CO_2 to the surface occurs, risks to humans will be minimal. *(Box 4.5)*



Pipelines

4. Wide-spread adoption of CCS will require a large pipeline infrastructure for which an adequate regulatory framework does not yet exist. We recommend that Congress resolve this issue in the near future to provide project sponsors with greater regulatory certainty in time for deployment of the first commercial-scale CCS projects. *(Ch. 3)*

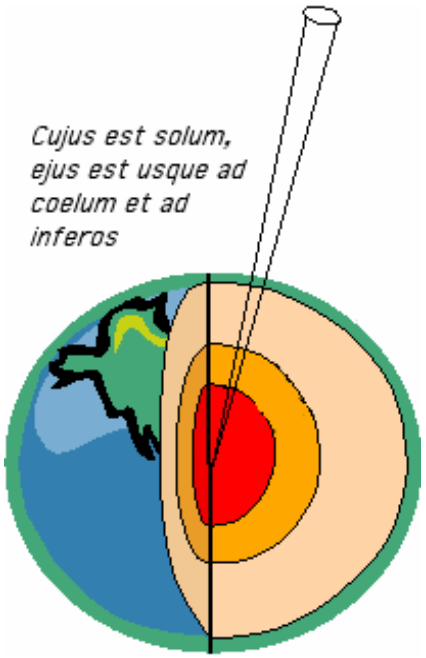
Limits to EPA Class VI proposal

5. Because the EPA proposed rule for regulating CCS has been developed under authority provided by the Safe Drinking Water Act, it does not address the two issues that we consider most critical:
   - Legal access to and use of appropriate deep geological formations for sequestration *(Ch. 5)*;
   - Adequate financial, regulatory, and liability arrangements for long-term stewardship of sequestration sites after they have been closed *(Ch. 7)*.

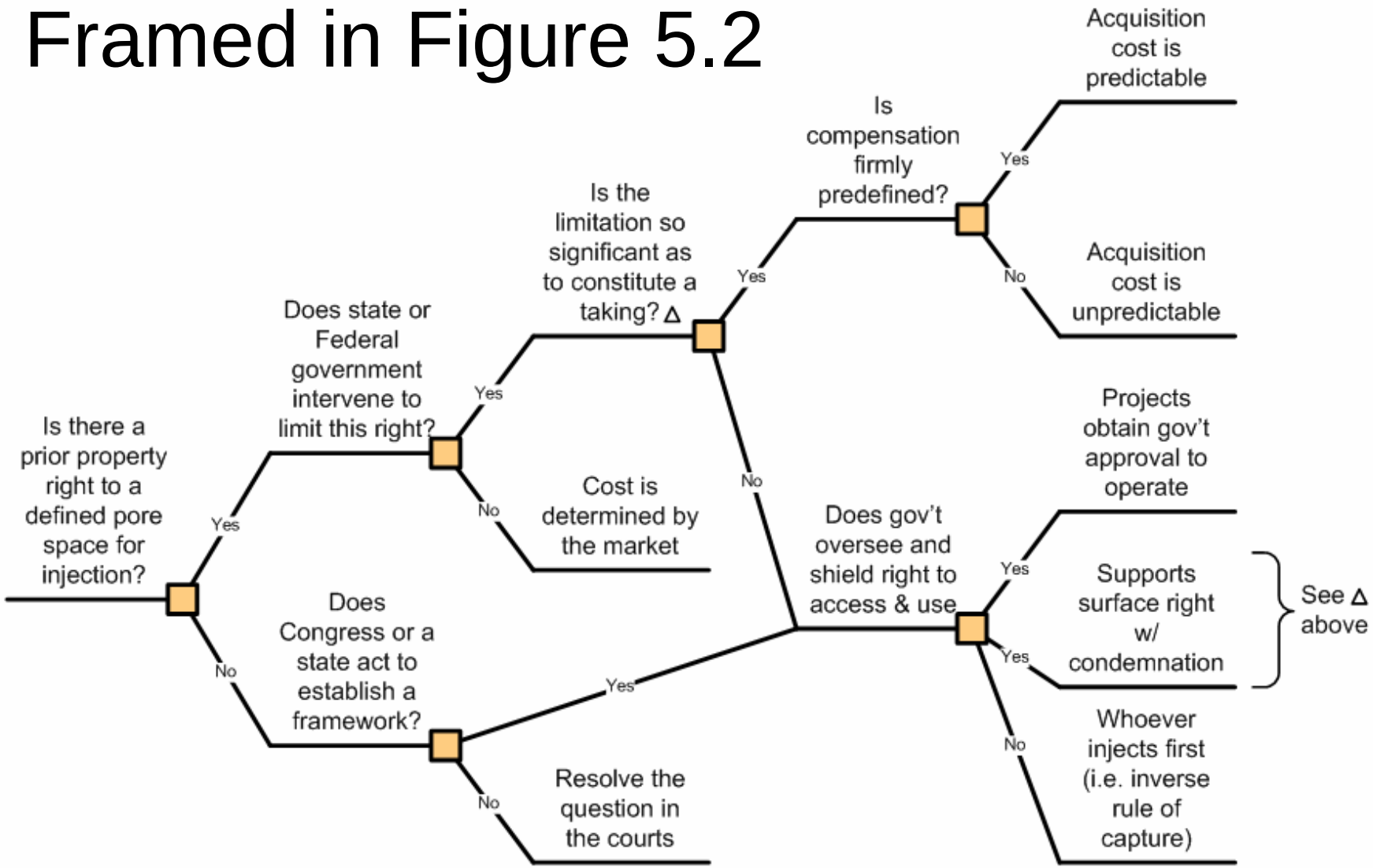
Access to Pore Space

6. In much of the world (Europe, Australia, Canada, etc.) governments own deep-subsurface resources, making access for CCS straightforward. In much of the U.S., ownership rights are undefined.

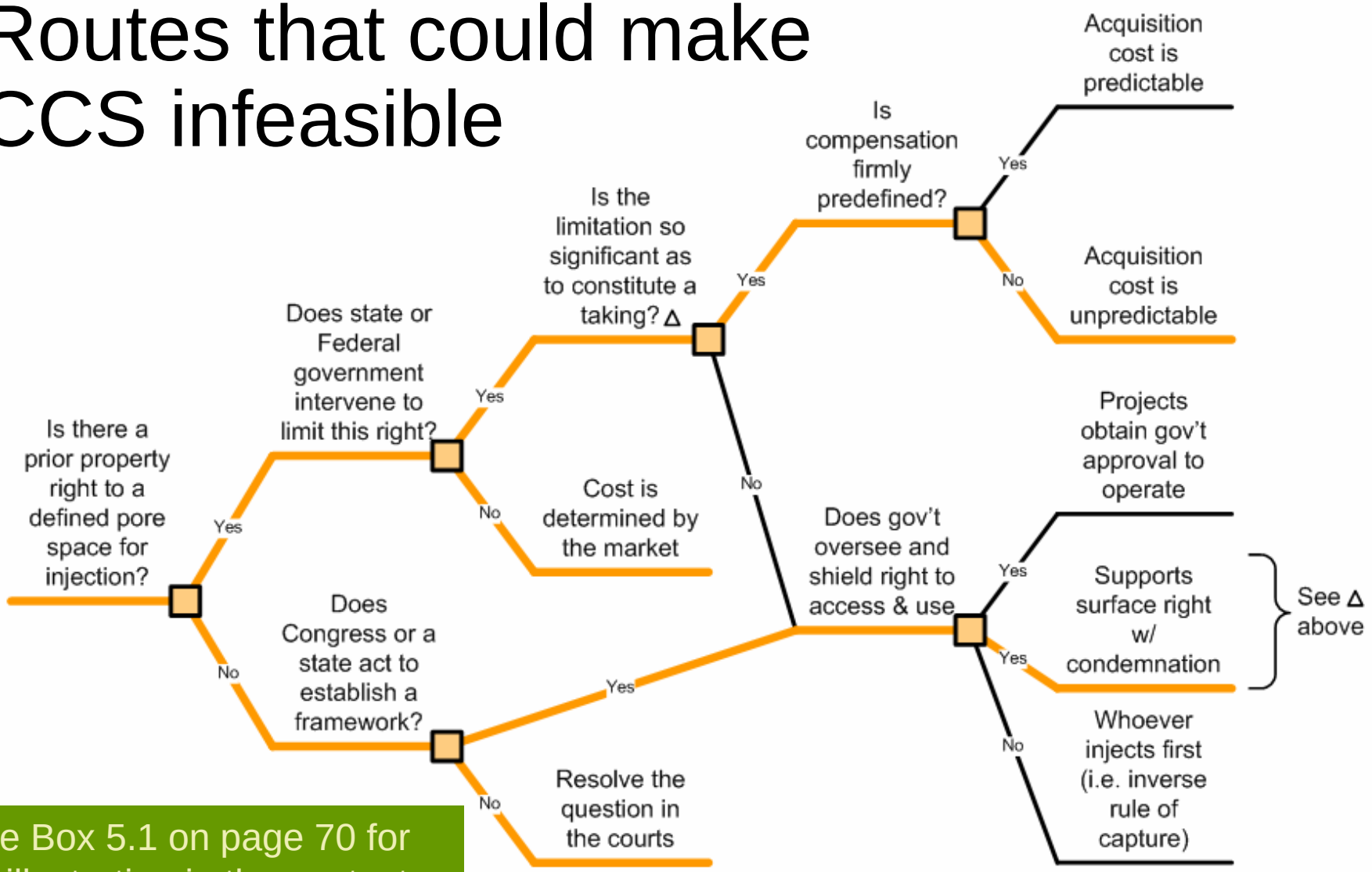
   We outline several ways in which this ambiguity might be resolved, many of which could make CCS economically infeasible. Our current thinking is that a federal solution is likely to be superior to a state-by-state solution or resolution in the courts. (*Ch. 5)*



Pore Space Options are Framed in Figure 5.2



Routes that could make CCS infeasible

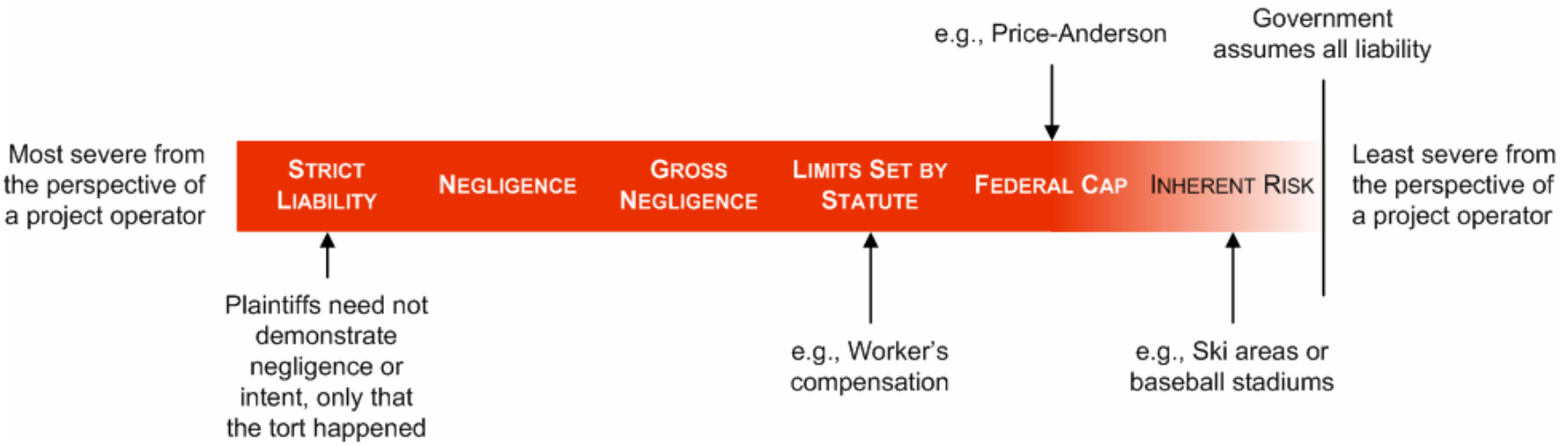


See Box 5.1 on page 70 for an illustration in the context of Pennsylvania.

Our current inclination is to recommend a substantial Federal role in providing access to deep pore space for use in CCS.

Liability

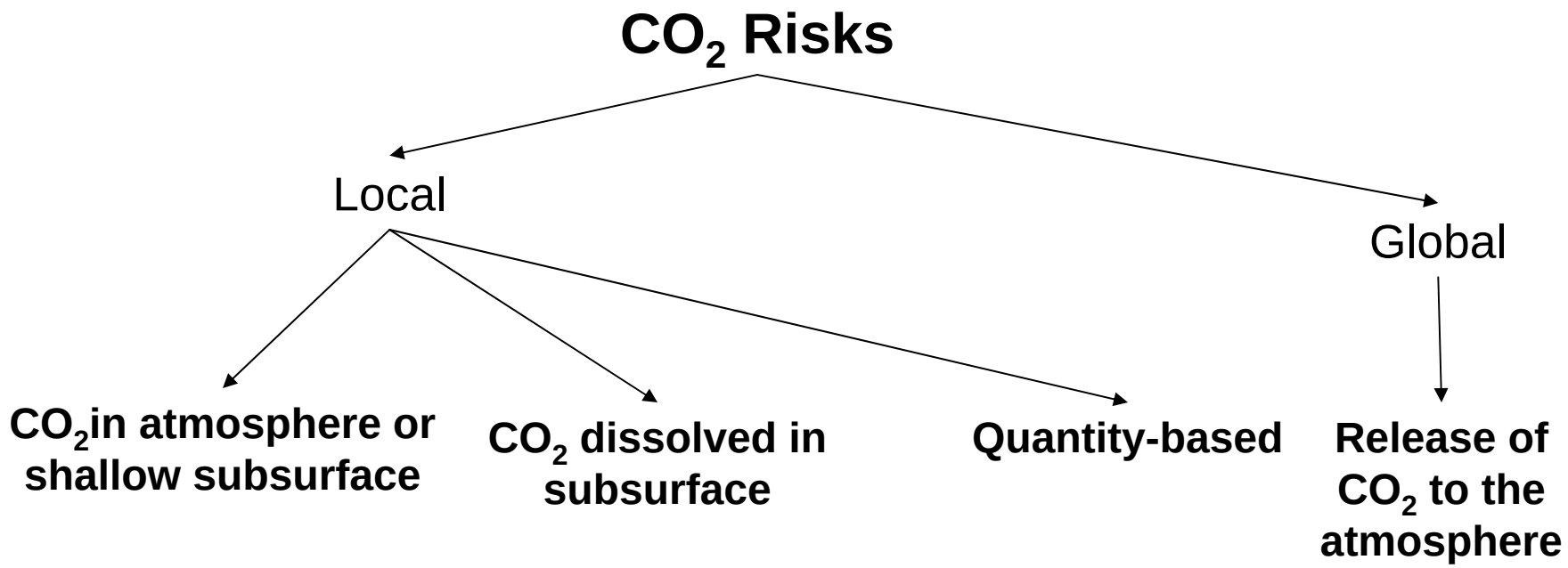
9. Liability through the injection phase of a project can probably be managed with the same mechanisms employed by other large-industrial projects. Less conventional mechanisms, probably involving government, will be needed for long-term stewardship. *(Ch. 8)*



Broader Issues

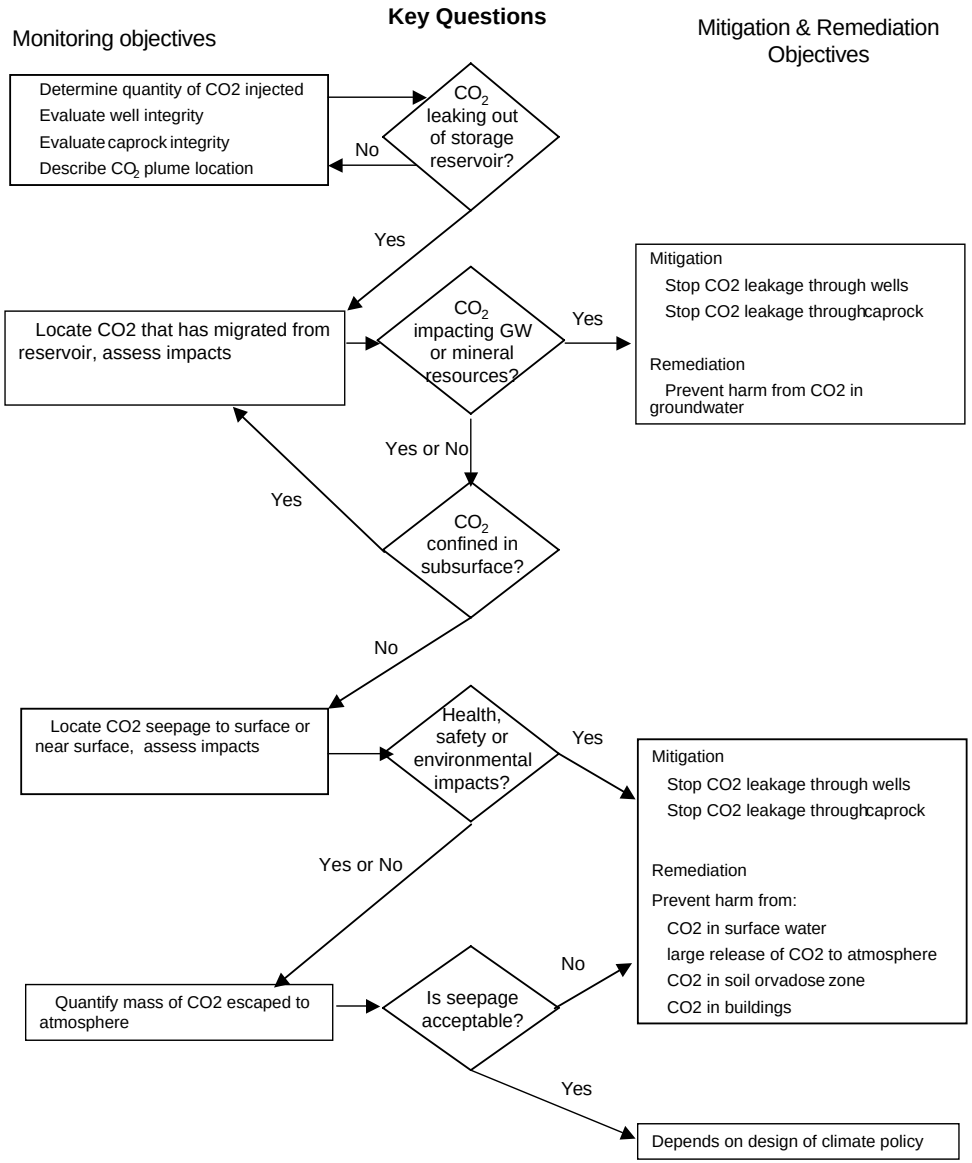
11. If CCS is to be adopted on the necessarily substantial scale, an attractive and predictable commercial environment must be created *(Ch. 9)*. It must also be compatible with any future national emissions control regime for greenhouse gases. *(Ch. 10)*

Potential environmental, health & safety risks from geologic storage



Source: Wilson, Johnson and Keith, ES&T 2003

Monitoring, Mitigating, and Remediating CO_2 leakage from Geological Sequestration



Boucher Bill—Carbon Capture and Storage Early Deployment Act , HR 6258, 110th Congress

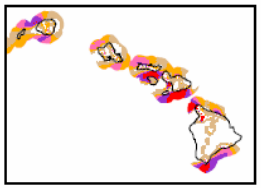
- Trust fund for commercial CCS projects
- Would have raised funds by assessing wire charges per kilowatt hour on electricity delivered to retail customers that is generated by coal (at $0.00043/kWh), natural gas (at $0.00022/kWh), and oil (at $0.00032/kWh)
- Would raise 10-20B$ for commercial-scale CCS (Pew estimates cost to be ~30B$)
- 15 year sunset clause

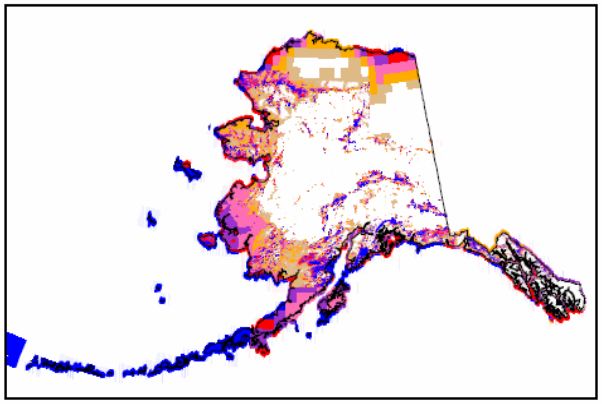
Performance Standards

- CA: SB 1368 established an emission performance standard of 1100 pounds of CO2 per Megawatt-hour for electricity procured by local publicly owned utilities, whether it is generated within state borders or imported from plants in other states. The standard applies to all new long-term electricity contracts after June 30, 2007.

United States - Wind Resource Map

This map shows the annual average wind power estimates at 50 meters above the surface of the United States. It is a combination of high resolution and low resolution datasets produced by NREL and other organizations. The data was screened to eliminate areas unlikely to be developed onshore due to land use or environmental issues. In many states, the wind resource on this map is visually enhanced to better show the distribution on ridge crests and other features.





Wind Power Classification

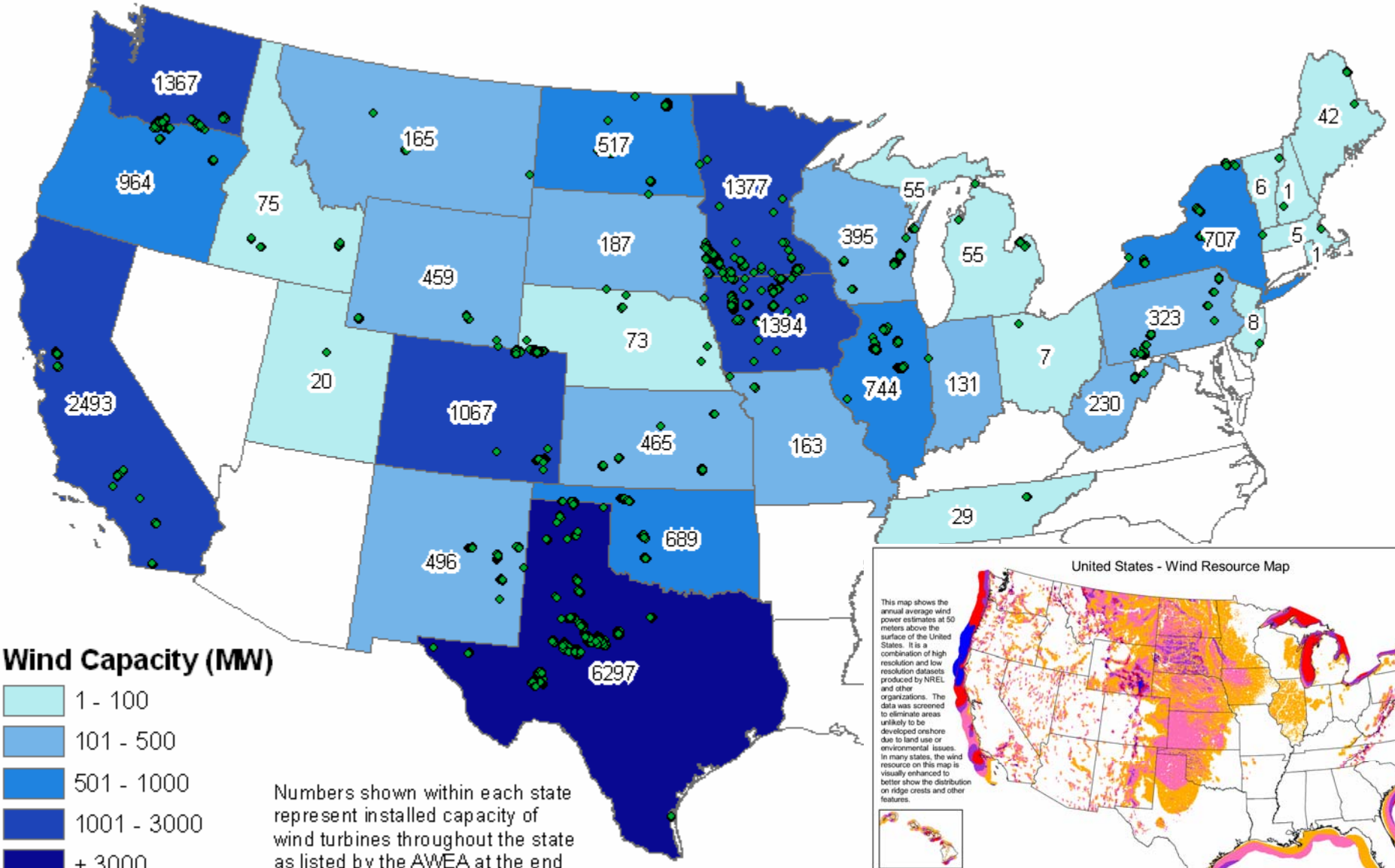
Wind Power Class	Resource Potential	Wind Power Density at 50 m W/m^2	Wind Speed [a] at 50 m m/s	Wind Speed [a] at 50 m mph
3	Fair	300 - 400	6.4 - 7.0	14.3 - 15.7
4	Good	400 - 500	7.0 - 7.5	15.7 - 16.8
5	Excellent	500 - 600	7.5 - 8.0	16.8 - 17.9
6	Outstanding	600 - 800	8.0 - 8.8	17.9 - 19.7
7	Superb	800 - 1600	8.8 - 11.1	19.7 - 24.8

[a] Wind speeds are based on a Weibull k value of 2.0

U.S. Department of Energy
National Renewable Energy Laboratory

23-JAN-2008 1.1.3

United States - Wind Capacity and Turbine Distribution (2008)



Wind Capacity (MW)

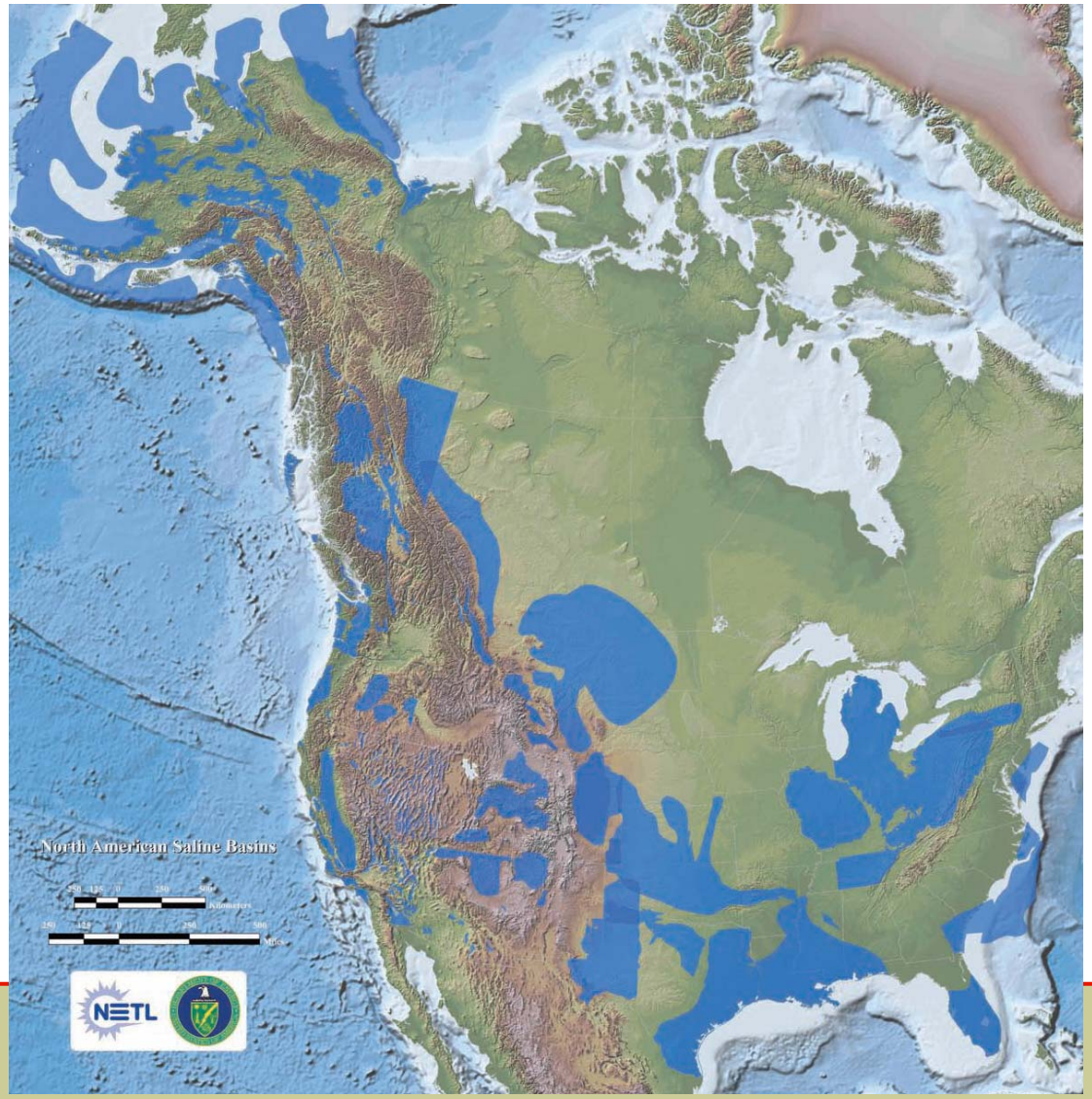
- 1 - 100
- 101 - 500
- 501 - 1000
- 1001 - 3000
- + 3000
- No capacity
- Wind Turbine

Numbers shown within each state represent installed capacity of wind turbines throughout the state as listed by the AWEA at the end of Q3 2007.

Wind turbines shown are >200 ft.

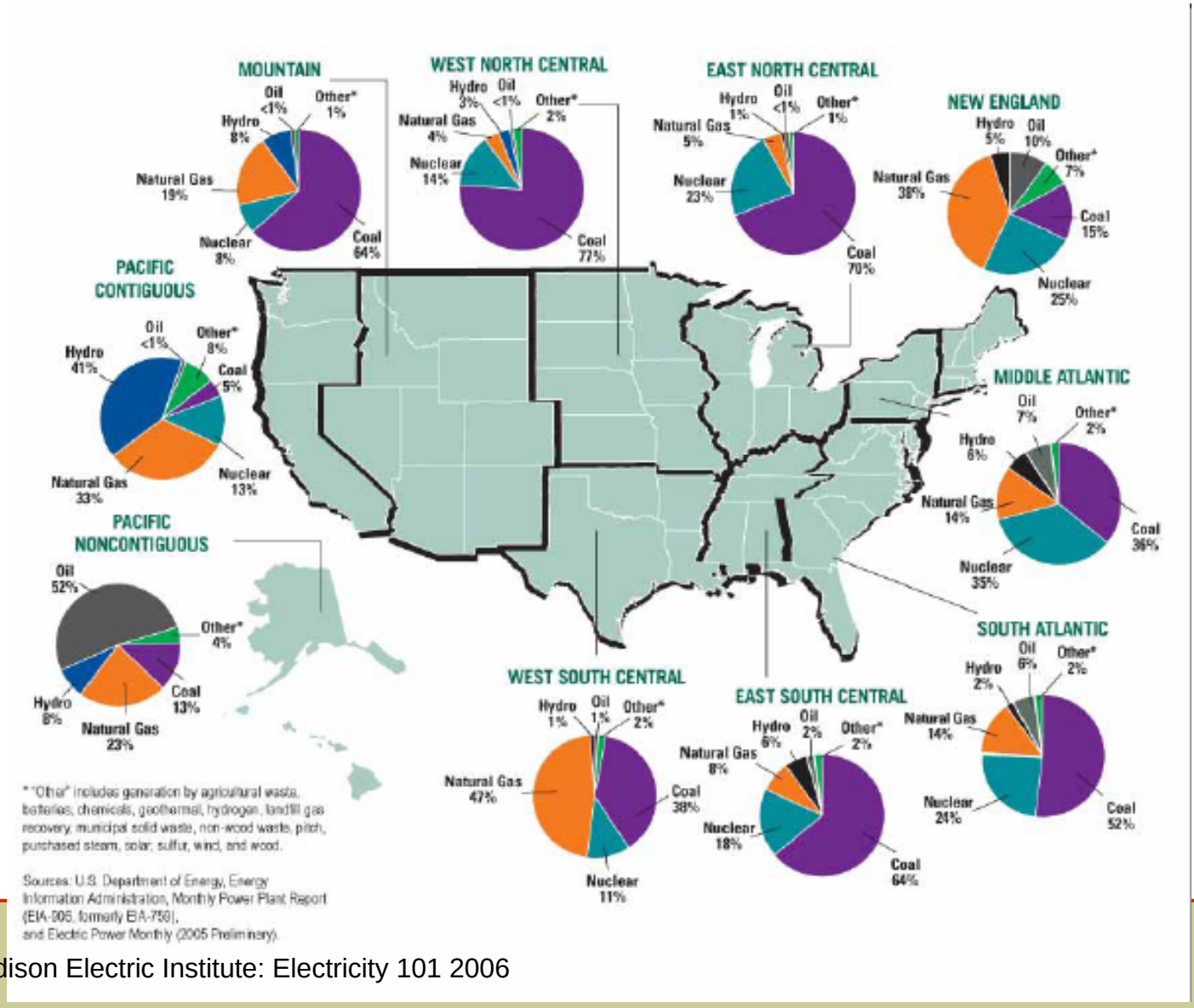
0 125

North American Saline Aquifers



Source: DOE National Carbon Atlas

Importance of Coal



Source: Edison Electric Institute: Electricity 101 2006

State Geological Sequestration Policies

State	Policy	Year	Description
KS	HB 2419	2007	Agency to set rules for GS. Trust fund for long-term stewardship. Tax incentives for GS
	KAR 82-3-1100 et seq	Under review	Requirements for CO2 storage facility operating permits
MA	SB 2768	2008	Agency to set sequestration definitions and standards
NM	EO 2006-69	2006	Agency to study regulatory requirements for GS
OK	SB 1765	2008	Task force to make recommendations on CCS.
UT	SB 202	2008	Task force to recommend rules for GS
WA	ESSB 6001	2007	Agency to set rules for GS. GS can be used to meet GHG reduction goals
	WAC 173-218-115	2008	Revises state UIC rules for GS
	WAC 173-407-110	2008	Sets performance standard for GS
WY	HB 0089	2008	Pore space is property of surface owner
	HB 0090	2008	Agency to propose GS permit rules. Working group to recommend financial assurance and post-closure care requirements

State Geological Sequestration Laws Enacted

State	Bill	Year	Agency to set permitting rules	Porespace ownership	CO2 ownership	Liability during operat-ions	Long-term liability	Mineral rights primacy	EOR exempt	CO2 a commodity	Eminent domain for GS	Uniti-zation
IL	SB1704	2007					State for FutureGen					
KS	HB2419	2007	yes				State		yes			
MA	SB 2768	2008	yes									
OK	SB1765	2008	study group							yes		
TX	HB149	2006			State for FutureGen		State for FutureGen					
WA	ESSB 600	2007	yes									
WY	HB 89	2008		surface owner				yes				
WY	HB 90	2008	yes						yes			
WY	HB 57	2009						yes				
WY	HB 58	2009			injector	injector						

Source: Melisa Pollak 3/4/09

Sequestration Legislation Proposed in 2009

State	Bill	Agency to set permitting rules	Porespace ownership	CO2 ownership	Liability during opera-tions	Long-term liability	Mineral rights primacy	EOR exempt	CO2 a commo-dity	Eminent domain for GS	Uniti-zation
MT	SB 66 (tabled)	yes	surface owner, may be severed				yes				
MT	SB 498	yes			operator	yes	yes	yes	yes		yes
MT	HB 502	yes	state(except federal or tribal land)	state			yes	yes, also natural gas storage			
ND	SB 2095	yes		storage operator	operator	yes	yes	yes	yes		yes
ND	SB 2139		surface owner, can not be severed								
NM	SB 208		surface owner, may be severed	injector	owner of pore space not liable		yes	yes			
OK	SB610	yes					yes	yes, also natural gas storage	yes	yes	
TX	HB 1796			state for offshore GS	state for offshore GS					yes for offshore GS	
WV	SB396 HB 2860	yes	surface owner, may be severed				yes	yes			
WY	HB 56						Mineral rights owners must consent to GS				

Source:Melisa Pollak 3/4/09

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