



# The Virginia Center for Coal and Energy Research (VCCER): Initiatives, Challenges and Opportunities

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# Overview

- Mission of the VCCER
- Current Projects and Initiatives
- Opportunities under Carbon Management
- Research Status of Carbon Capture and Storage (CCS)
- Conclusions

***Note: A number of references were used to develop this presentation. A reference list can be provided by the author on request.***

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# The VCCER (<http://www.energy.vt.edu/>)

- The Virginia General Assembly established the VCCER in 1977 as an “***interdisciplinary study, research, information and resource facility for the Commonwealth.***”
  - The VCCER was charged to support research, educational and public policy programs in coal and energy within the Commonwealth
  - Center includes three broad missions:
    - conduct research on interdisciplinary coal and energy issues
    - coordinate coal and energy research at Virginia Tech and statewide
    - disseminate coal and energy research information to users in the Commonwealth
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The legislation enacted in 2006 to create the Virginia Energy Plan (SB262) also added a function to the center to assist with the development of the Plan:

- *“Virginia Energy Plan. Establishes an energy policy for the Commonwealth and directs the Division of Energy of the Department of Mines, Minerals and Energy, in consultation with the State Corporation Commission, Department of Environmental Quality, and Virginia Center for Coal and Energy Research, to prepare, by July 1, 2007, a ten-year comprehensive Virginia Energy Plan to implement the Commonwealth's energy policy.*
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## SB 262 also provided:

- *(iv) establish a Clean Coal Technology Research Fund, to be administered by the Virginia Center for Coal and Energy Research and used to finance research initiatives at state institutions of higher education and to encourage qualified state educational institutions to apply for federal grants to finance a center of excellence for advancing new clean coal technologies*

Funding to meet this mandate was never appropriated

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# VCCER Budget

- Budget never matched the broad VCCER mission and charges
  - The base allocation for core Center activities has continued to fall every year, except for the 2000-2002 biennium when, via a budget amendment, some relief was provided by allocating additional funds
  - State budget in FY 2008 was \$165,577 (it was \$165,180 in FY1988)!
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# What about our neighbors?

(from published FY 2008 data)

- VCCER:
    - General Funds: \$166K
    - FTE Positions: 1.5 Faculty FTE and 1.5 Staff
  - Kentucky Center for Applied Energy Research, University of Kentucky:
    - General Funds: \$5million
    - FTE Positions: 118
  - The National Research Center for Coal & Energy, West Virginia University:
    - Programs total between \$14 million to \$16 annually and are funded from state, federal, and private sources.
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# Projects at the VCCER

- Areas of study (and funding) include:
    - Energy statistics and modeling
    - Socio-economic effects of energy and coal development
    - Environmental impacts of coal and energy
    - Sustainable development of energy and mineral resources
    - Carbon management and sequestration
    - Optimization of mining systems
    - Mine health and safety
    - Coal bed methane extraction and utilization
    - Energy infrastructure
    - Innovative training programs using virtual reality.
  - The Center also has strong interests in issues concerning global energy development, greenhouse gas emissions and international education/outreach/training programs
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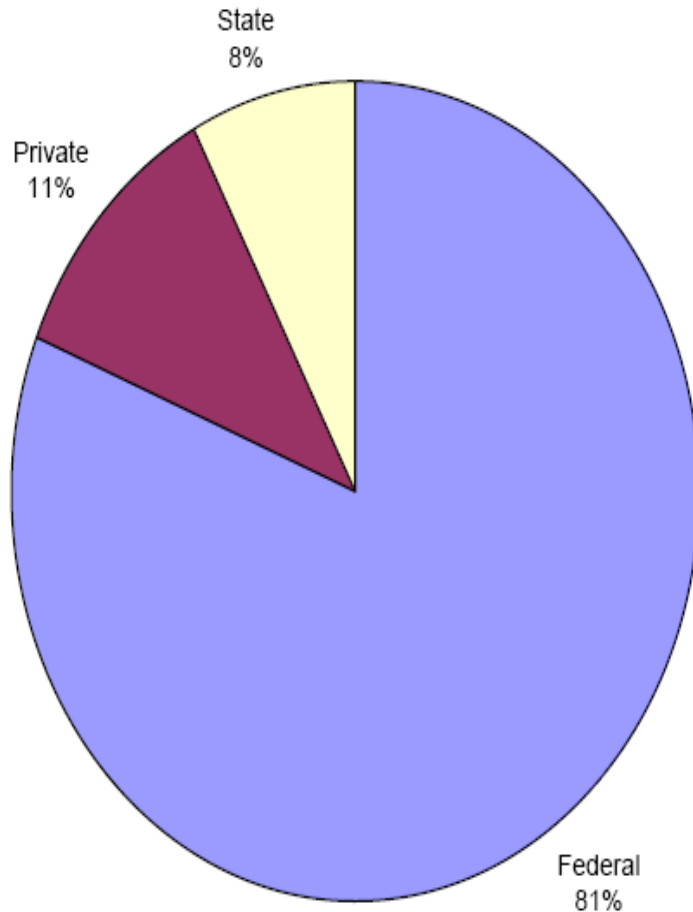
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# Main Research Sponsors

- U.S. Department of Energy/NETL
  - Southern States Energy Board
  - National Institutes for Occupational Safety and Health
  - Office of Surface Mining
  - U.S. Environmental Protection Agency
  - National Commission on Energy Policy
  - Virginia Department of Mines, Minerals and Energy
  - Numerous energy companies and organizations
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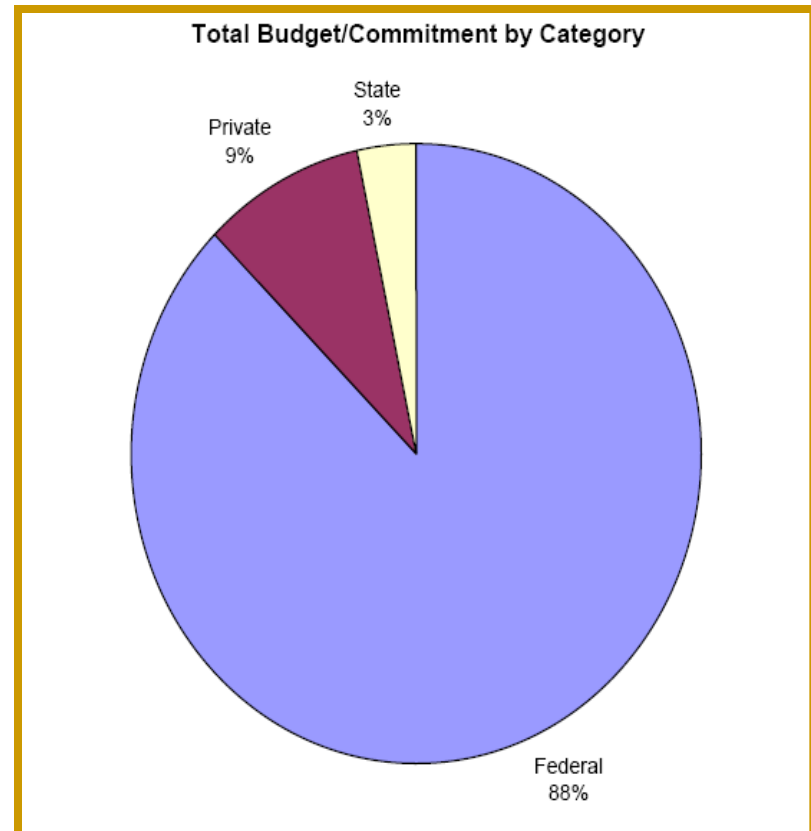
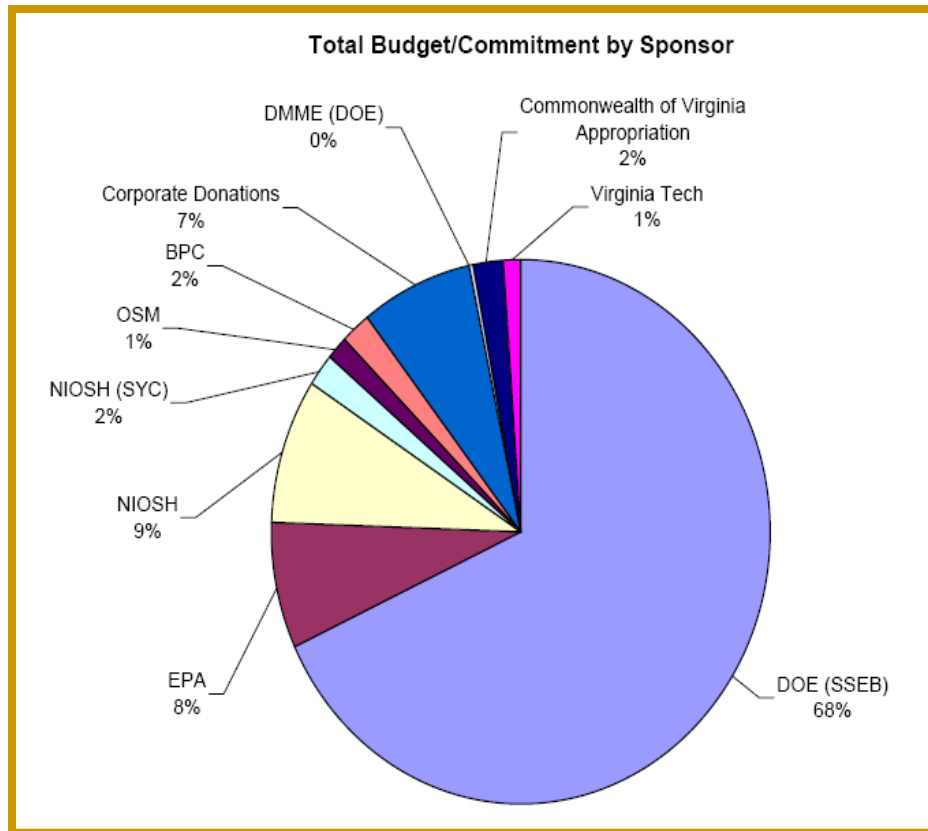
# Funding Summary

FY 2008 Budget by Category



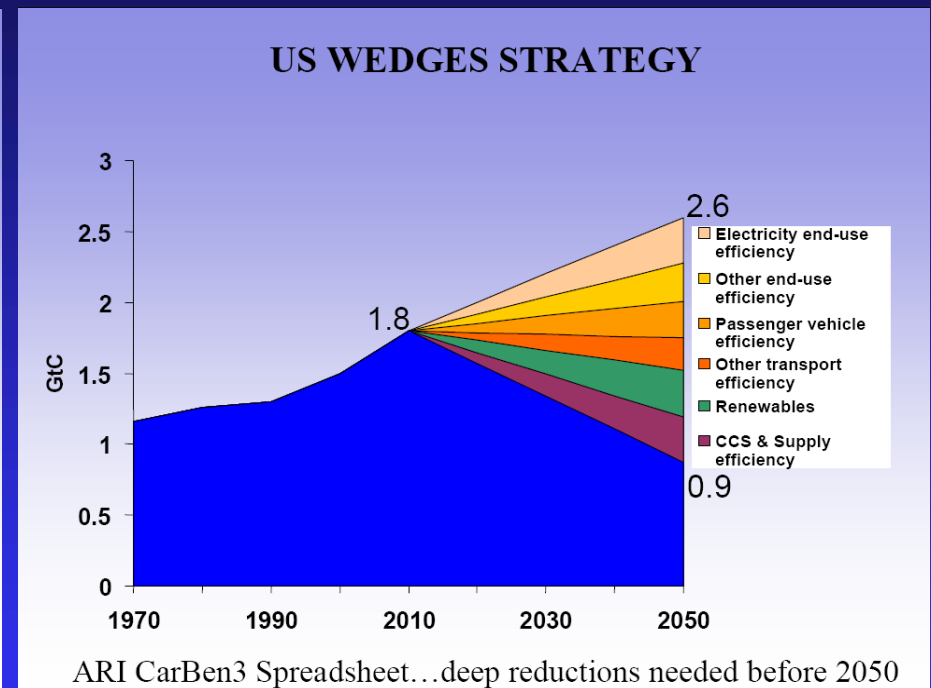
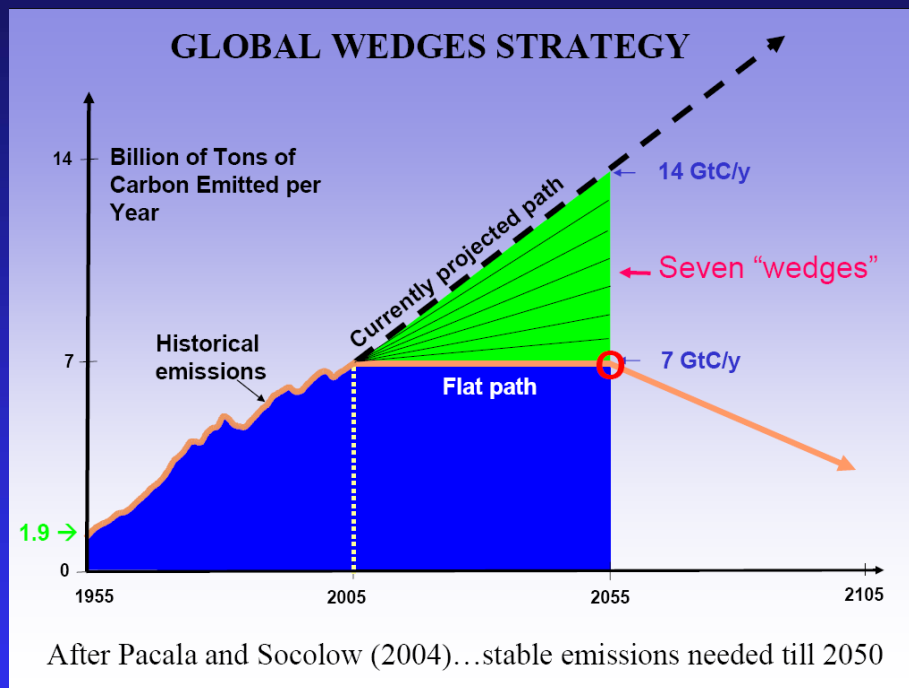
- 2008 Budget:
  - State: \$165,577
  - VT: \$27,964
  - R&D: \$1,918,762
  - Industry: \$530,000

# Total Budget Commitment



**Current R&D Committeemen in Multi-Year Projects: \$8 million**

*“...CO<sub>2</sub> capture and sequestration is the critical enabling technology that would reduce CO<sub>2</sub> emissions significantly while also allowing coal to meet the world’s pressing energy needs” (MIT, 2007)*



*“Even under the most optimistic scenarios for energy efficiency gains and the greater use of low- or no-carbon fuels, sequestration will likely be essential if the world is to stabilize atmospheric concentrations of greenhouse gases at acceptable levels” (DOE Website)*

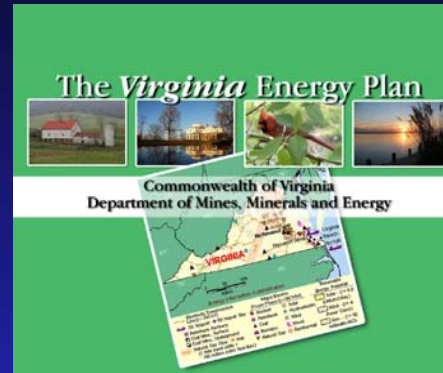
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# Broad Community Support for CCS

- **Environmental Community – NRDC and EDF**
    - *“Carbon Capture and Storage (CCS): Let’s Just Do It!”*
  - **The Electric Generation Industry - Major Utilities/EPRI**
    - *“...Deploy capture and storage technologies at most new coal-based generating plants by 2020”*
  - **National Governors Association**
    - *“...Incentivize CCS Technologies”*
  - **IOGCC**
    - *“...the most immediate and viable strategies available for mitigating the release of CO<sub>2</sub> ”*
  - **EPA**
    - *“...by harnessing the power of geologic sequestration technology, we are entering a new age of clean energy”*
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# The Virginia Energy Plan (2007)

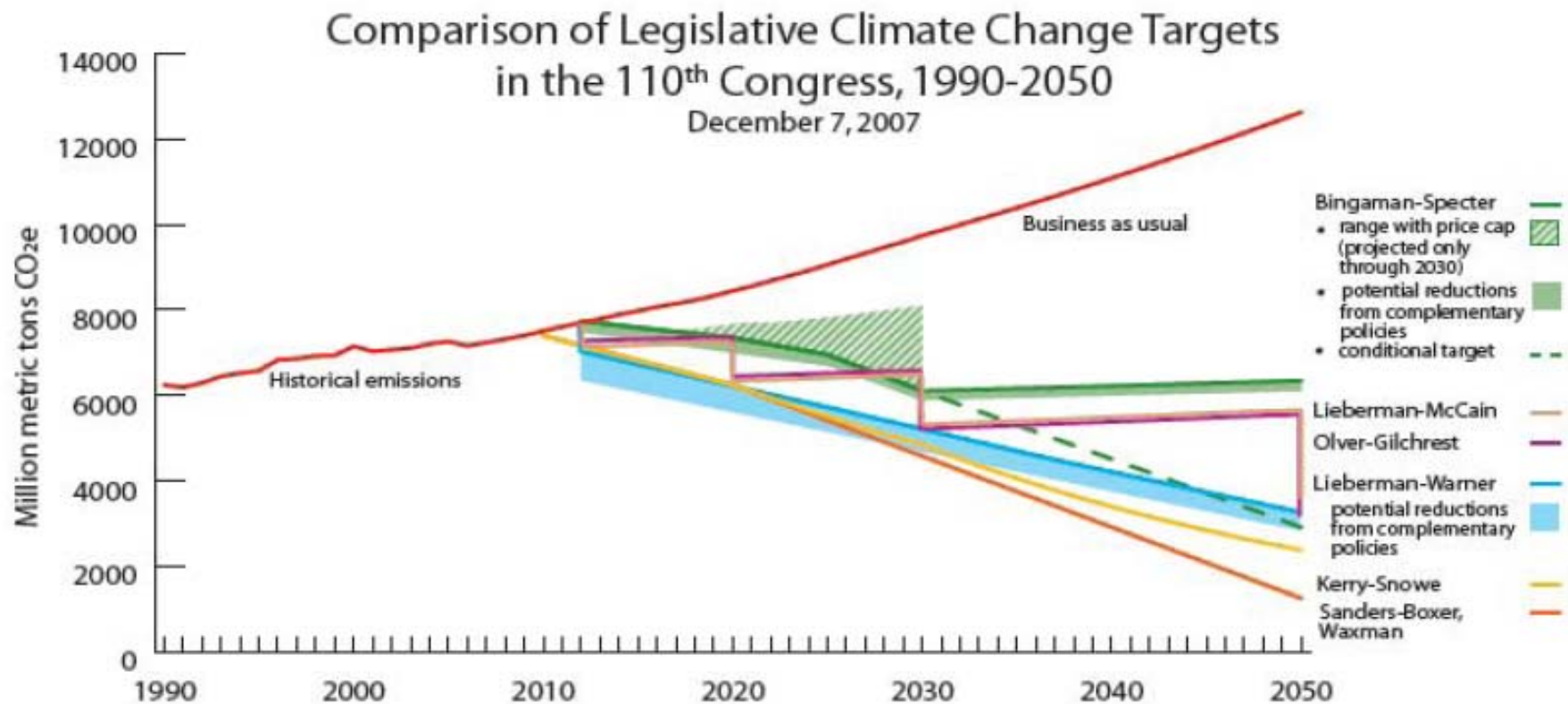
*Carbon dioxide emissions rose in Virginia by approximately 34 percent from 1990 to 2004, a rate nearly twice the national average. This increase results, in part, from growth in Virginia's economy and development patterns that have produced sprawl and long commutes.*



Virginia has the opportunity to sequester carbon in unminable coal seams. A recent report from the Virginia Center for Coal and Energy Research (VCCER) provides detailed information on this opportunity.<sup>21</sup> Preliminary conclusions indicate that coal in the Central Appalachian Basin has significant sequestration potential, particularly in Buchanan, Dickenson, and Wise Counties. An estimated 7.33 trillion

Virginia Tech, a partner in the Southeast Regional Carbon Sequestration Partnership (SECARB), has researched and developed data on Virginia's potential and is testing carbon capture and storage technology in Virginia's coal seams. The project has the potential to implement a ten-year pilot to capture a million tons of carbon dioxide per year in Virginia. It also could increase the production of coalbed methane from the coal seams, increasing the efficiency of these operations (see Chapter 6).

# US Climate Change Targets in Congress (Source: World Resources Institute)



- CCS is a prominent part in many bills and amendments!
- Boucher Bill: Accelerate commercial availability of CCS technology

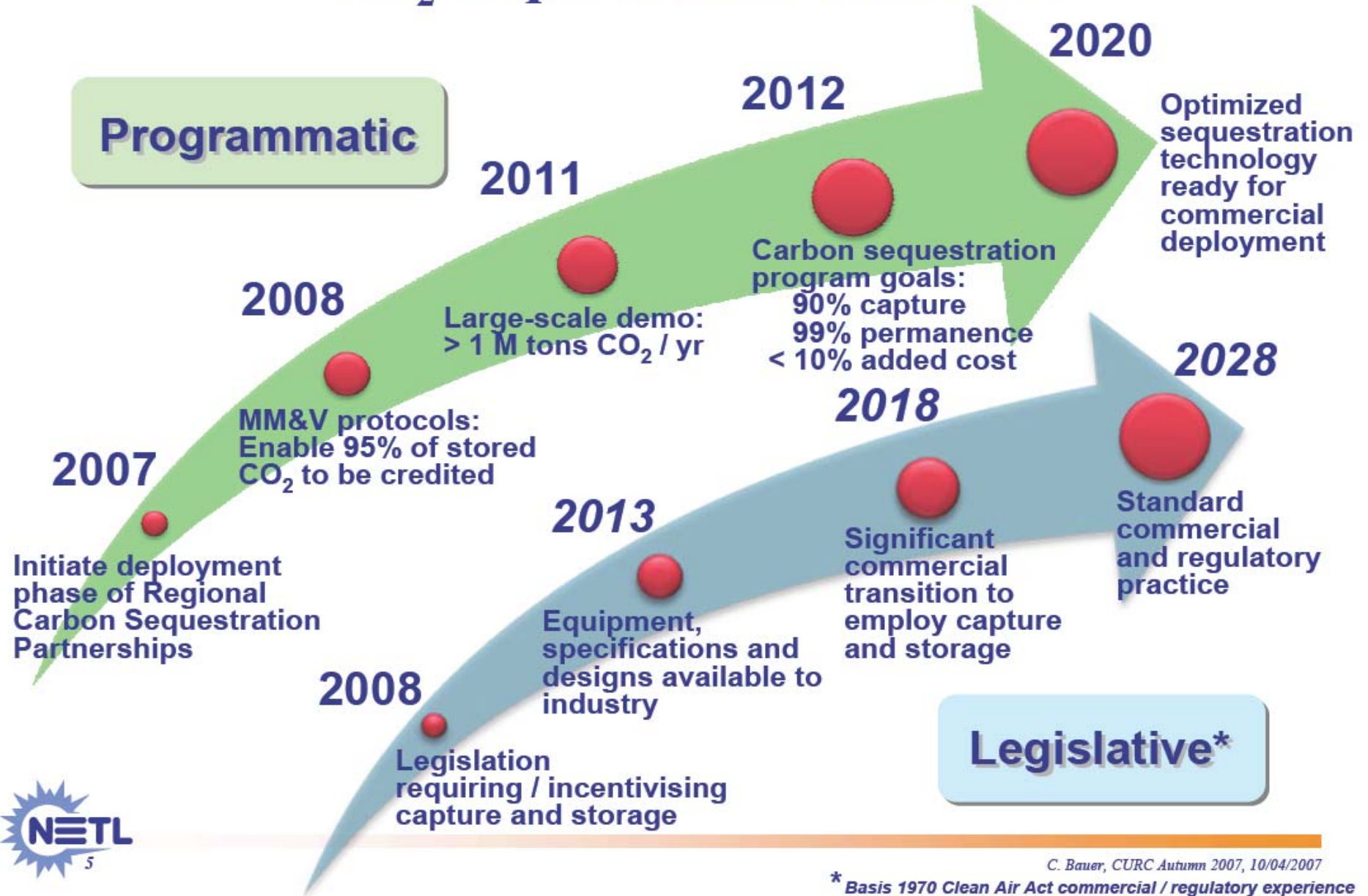
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# Impact of Legislation

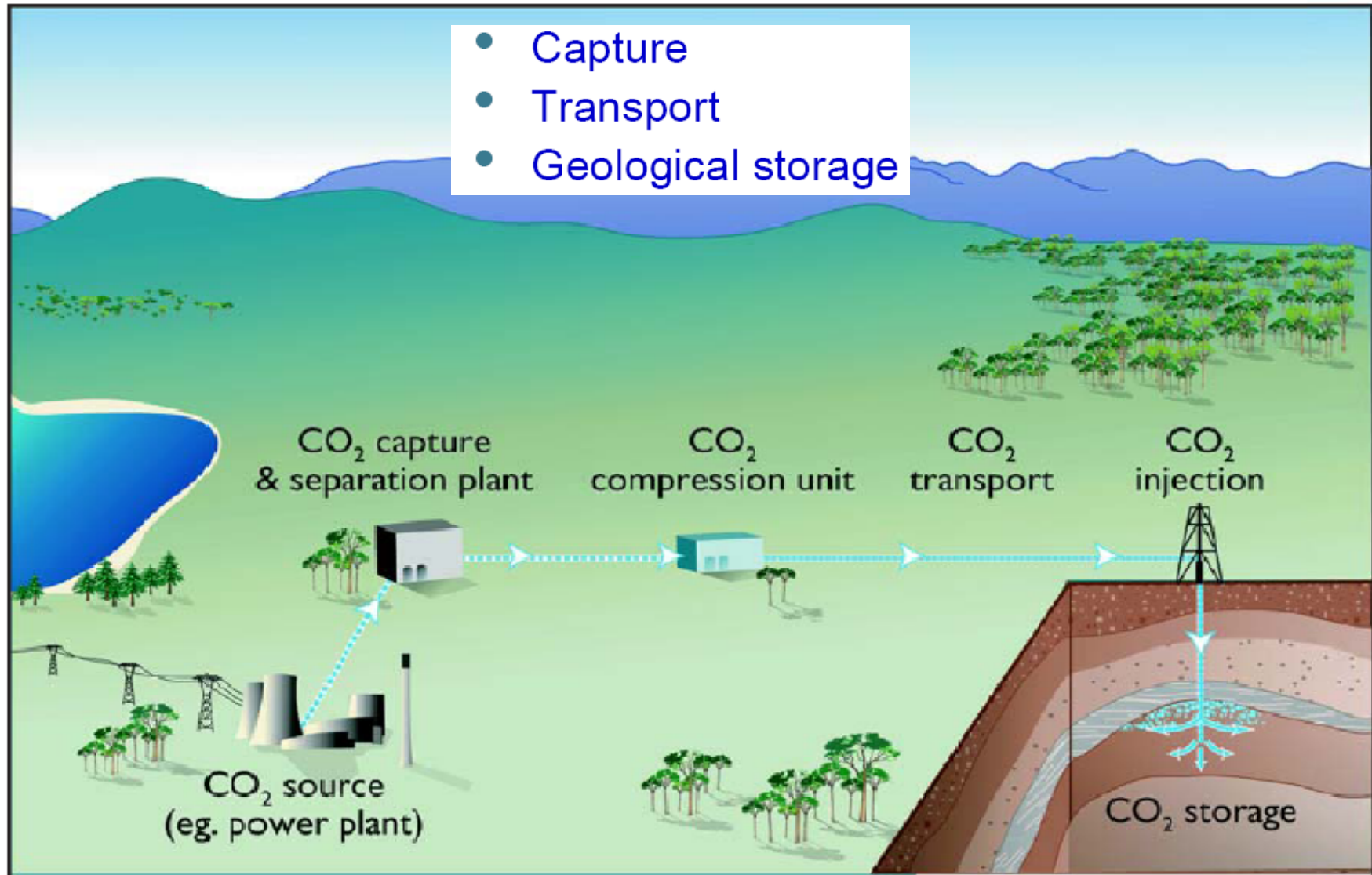
- Requires a careful assessment of economic, social and environmental impacts (the formal definition of “sustainable development”)
  - Policies that are based on technologies under development may not be realized if such R&D is not properly funded
  - Implementation of policies may require financial incentives, infrastructure investments and legal/regulatory reform - often all of the above!
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# CO<sub>2</sub> Sequestration Timelines

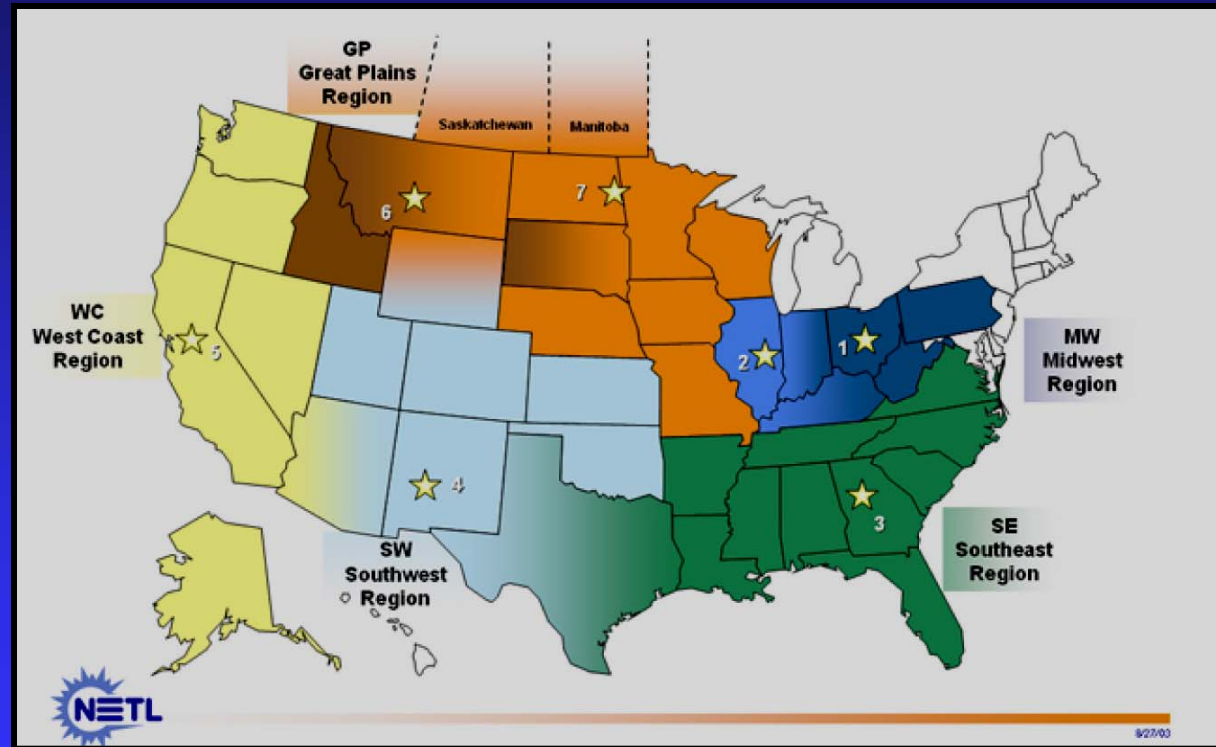


# CCS Research Status



# DOE- Regional Carbon Sequestration Partnerships

- 7 Regional Partnerships
- Partnerships include +240 organizations in 40 states, three Indian Nations and two Canadian Provinces



Virginia Participates in SECARB, a Partnership Managed by the Southern States Energy Board

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# Carbon Storage (Sequestration) Options

- **Geologic Sequestration**

- Oil/natural gas reservoirs
- Saline aquifers
- Unminable coal seams

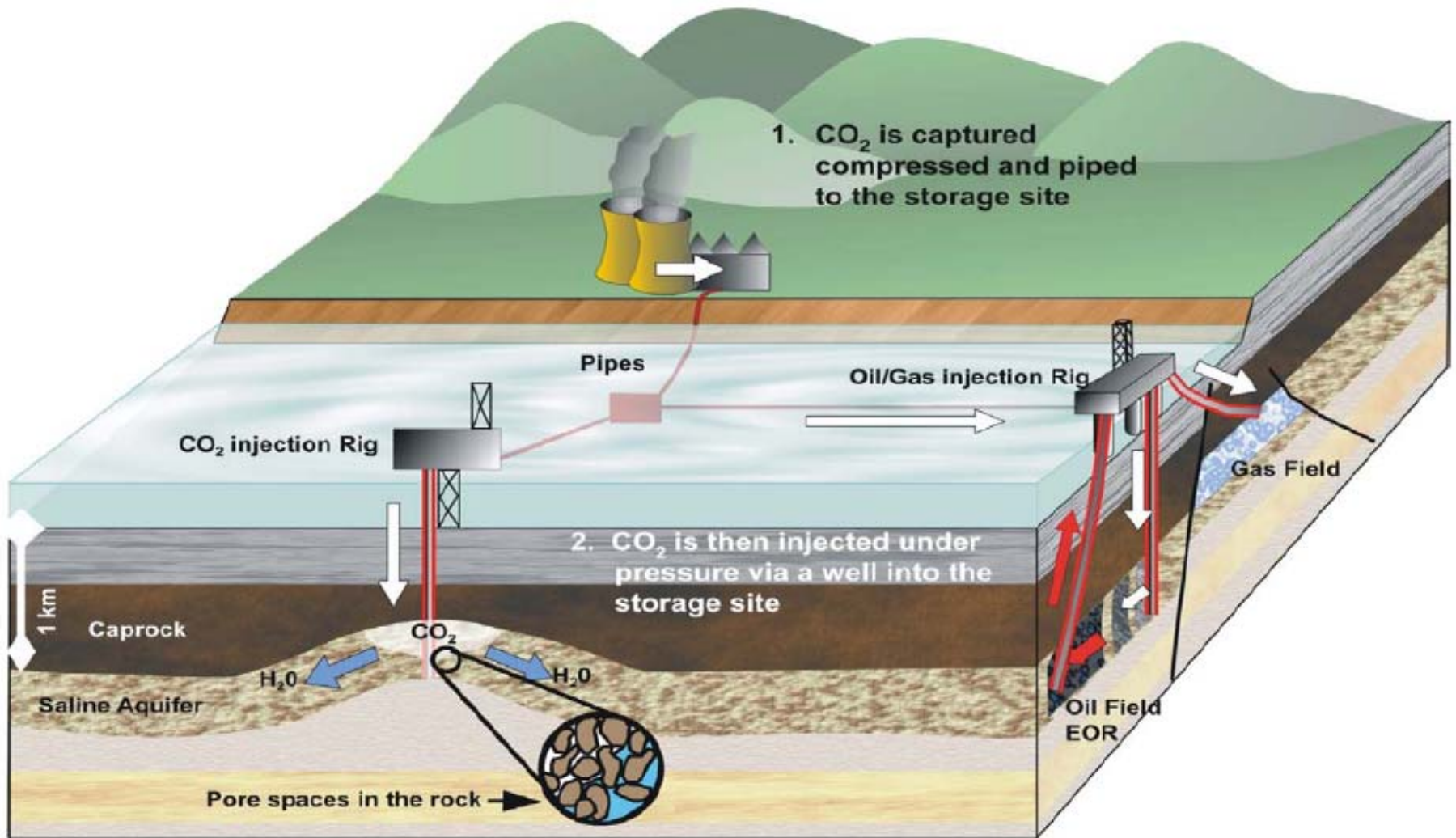
- **Ocean Sequestration**

- **Terrestrial Sequestration**

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# Geologic Storage



# Project Phases

**Phase I: Completed**  
**Geological Characterization and Initial Feasibility Study**  
**(2004–2005)**

**Phase II: On-Going**  
**Expand Study Area, Reservoir Modeling, Pilot CO<sub>2</sub>**  
**Injection Test (1,000 tons of CO<sub>2</sub>, Evaluation of**  
**Potential (2005–2009)**

**Phase III: Planning Stage**  
**7-10 Year Injection, Monitoring and Verification of**  
**a Large CO<sub>2</sub> Test (1mil tons of CO<sub>2</sub>) (2007–2017?)**

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# SECARB Coal Group Research Team

- Southern States Energy Board
  - VCCER/Virginia Tech
  - Marshall Miller and Associates
  - Geological Survey of Alabama
  - Consol Energy
  - University of Alabama
  - Southern Company
  - Kentucky Geological Survey
  - Advanced Resources Inter
  - Eastern Coal Council
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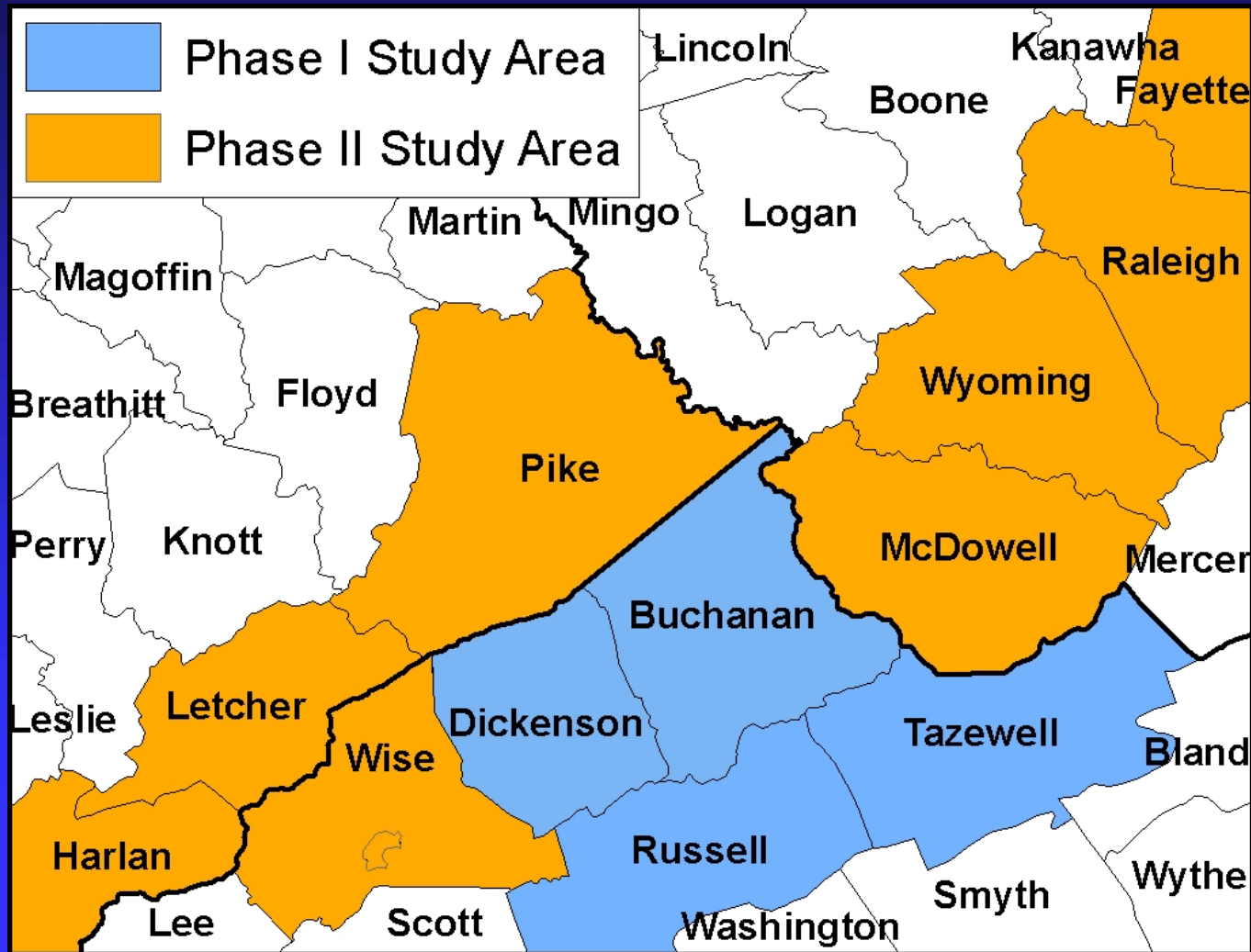
# SECARB Coal Group - Phase II Partners

## (Cost Share, Data, Wells)

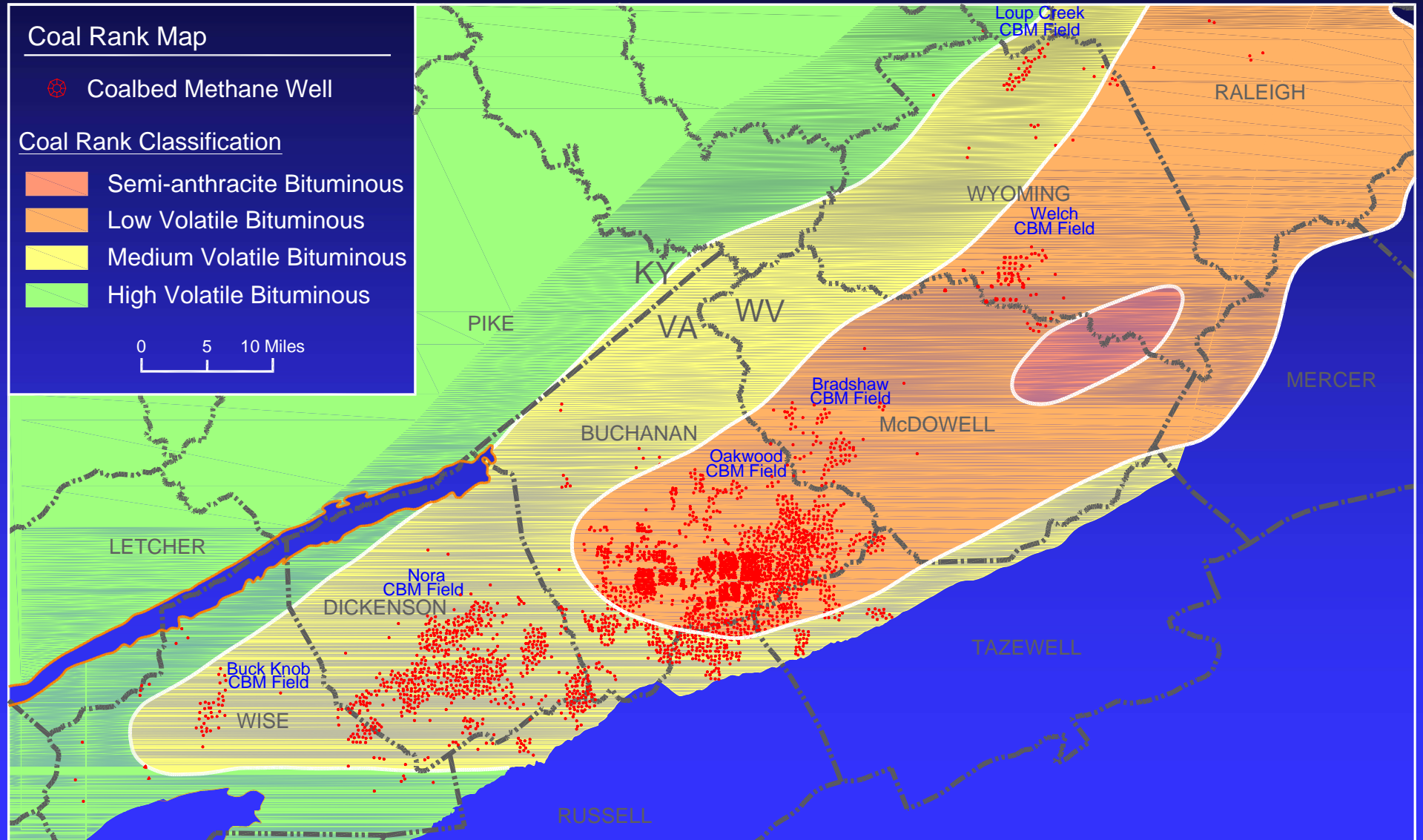
- Alawest
  - Alpha Natural Resources
  - AMVEST
  - Buckhorn Coal
  - CCP2 Project
  - CDX Gas
  - CNX Gas
  - CONSOL Energy
  - Cumberland Resources
  - Dart Oil & Gas
  - Denbury Resources
  - Dominion E&P
  - Dominion Resources
  - EPRI
  - Equitable Production
  - Clean Energy Technology Inst (MSU)
  - GeoMet
  - McJunkin Appalachian
  - Norfolk Southern
  - Natural Resource Partners
  - Oak Ridge National Laboratory
  - Penn Virginia
  - Pine Mountain Oil & Gas
  - Piney Land
  - Pocahontas Land
  - RMB Earth Science Consultants
  - Univ. British Columbia
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# Central Appalachian Basin: Phase I & II Characterization Study Area



# Coal Rank Map



# SECARB Coal Group – Phase II

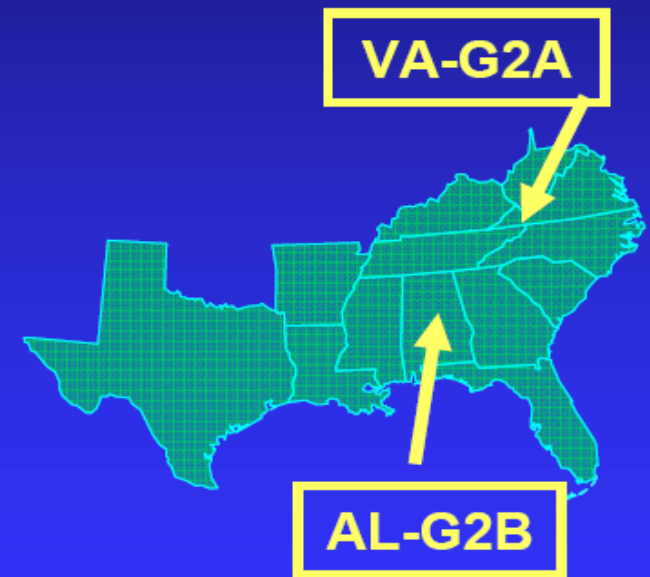
- **Phase I:** Feasibility study, completed September 2005
- **Phase II** (October 2005 – September 2009):
  - ◆ \$4.4 million from DOE and \$1.1 million (20%) cost sharing from research team and industrial partners

## Sequestration and ECBM recovery:

- Over 1 billion tons of feasible CO<sub>2</sub> capacity in the targeted areas
- Over 2.5 Tcf ECBM potential

## Target areas:

- Central Appalachian Basin, G<sub>2-A</sub>
- Black Warrior Basin, G<sub>2-B</sub>
- Pilot injections: 1,000 tons of CO<sub>2</sub>





# Virginia Pilot Test Site

## Ground Breaking August 18, 2008!

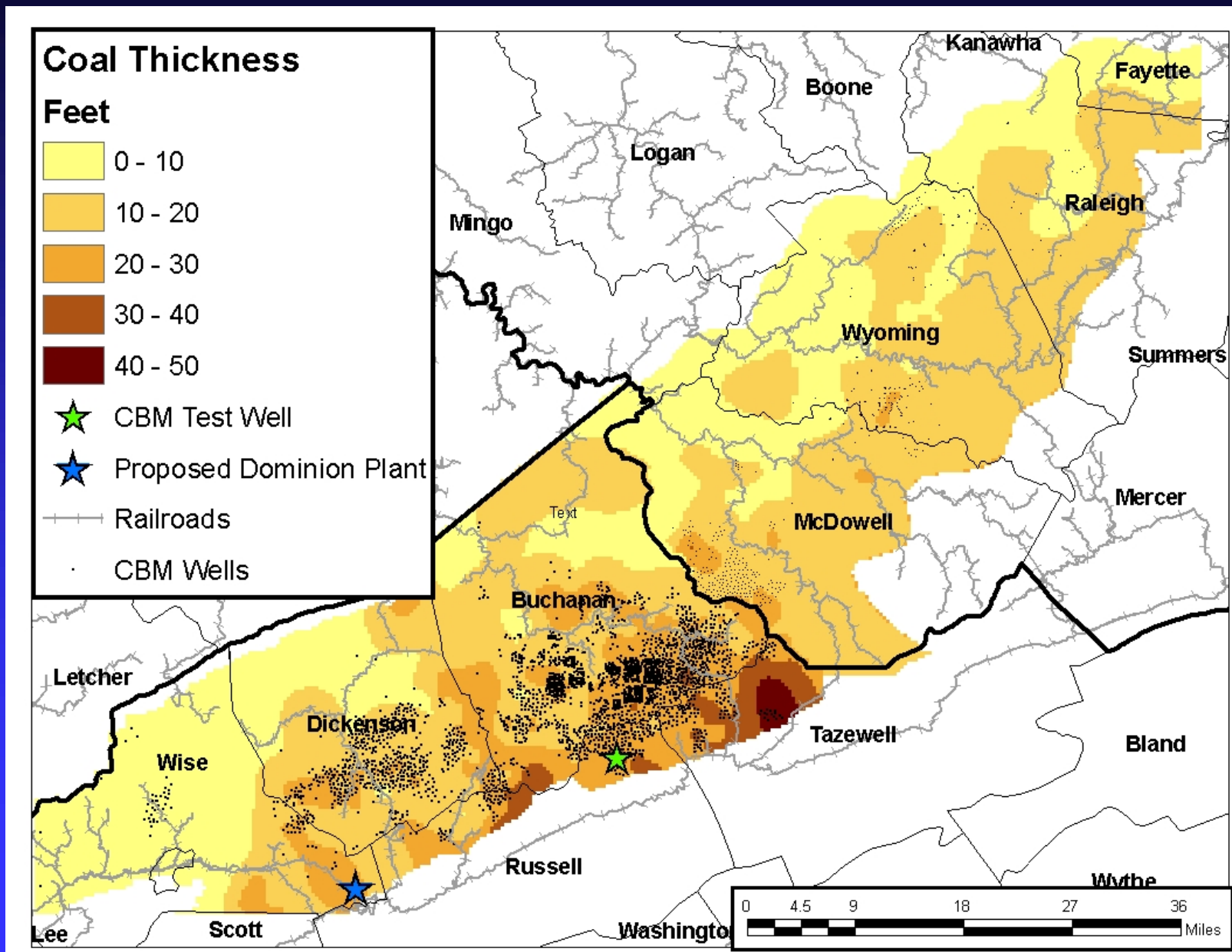


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# Test Schedule

- Site selection (Completed): 04/07 – 12/07
  - Approvals and Permitting: 02/08 – 09/08
  - Soil Gas Monitoring: 03/08 – 09/09
  - Coring: 08/08 – 10/08
  - Formation testing: 09/08 – 10/08
  - Erect Injection equipment: 10/08 – 11/08
  - Injection testing: 11/08 – 05/09
  - Site closure: 05/09 – 09/09
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# Phase II Test Site



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## **PHASE II-Task 10 (7/2008-9/2009)**

### **Extension of the SECARB Coal Group Tasks (DOE: \$1.8 mil, C/S: \$600K)**

- Expand characterization and modeling of potential coal seam sequestration sites that can be stressed with a large-volume injection test
  - Identify secondary reservoirs, including saline aquifers, depleted oil and gas fields, and Devonian Shale reservoirs, that could support or supplement a large-volume injection test
  - Develop a preliminary engineering and design plan for a large-volume test, including the potential for a stacked storage project
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## The Need for Large Volume Tests in Different Geologies

- Large scale tests are necessary to demonstrate and confirm geologic storage
  - Large-Volume tests will provide sequestration “**assurance**” to the investor community seeking to fund energy project that can be impacted by future CO<sub>2</sub>-limiting legislation
  - Absence of such tests in a region, or on a specific geologic formation, may delay sequestration demonstration and, therefore, deployment
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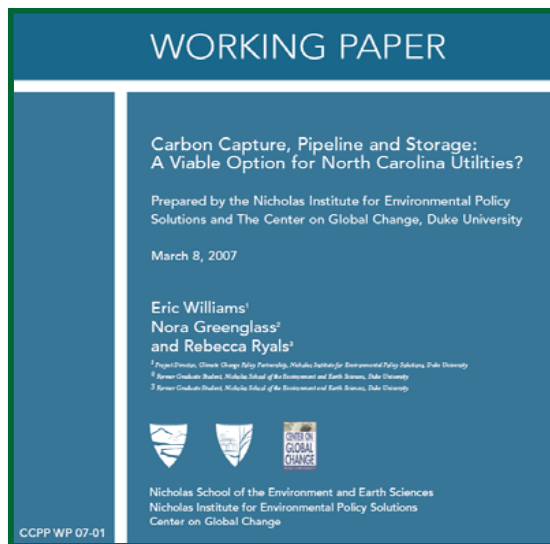
# **Cost-Share Funding is a Prerequisite and Urgently Needed**

- **VCCER/VT Next Step is a Large-Volume Test**
  - **Submit Scope and Budget 2009/10, 8 year-effort**
  - **Funding Requested : DOE = \$65 mil  
C/S = +\$40 mil**
  - **Cost-Share Commitment Must be Determined in the Next Few Months!**

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## CCS and Regional Economic Development Opportunities for Central Appalachia

- Sustain coal utilization in a carbon emission capped era
  - Utilize lower rank coals for clean coal technologies
  - Promote construction of major new facilities (e.g., generation plants, C-T-L/G and C-T-H conversion facilities, biofuels plants) in proven CO<sub>2</sub> sequestration locations, creating enormous regional economic impacts
  - Generate economic development potential associated with enhanced recovery (EOR, EGR and ECBMR) – estimated +\$4 billion due to ECBM alone
  - Expand research capabilities and R&D infrastructure at the local, regional and state level with participation of the private energy sector
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*“Geologic sequestration is  
not economically or  
technically feasible within  
North Carolina”*

- CO2 Storage sites are a Resource!
- Large-Volume Tests are Essential!

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# Conclusion

- CCS is essential if the world is to stabilize atmospheric concentrations of greenhouse gases
  - Commercial deployment of CCS requires large-scale tests to demonstrate and confirm geologic storage
  - Demonstration of CCS requires **significant** public and private funding
  - The Central Appalachian states must contribute financial resources to support CCS R&D (some are doing more than others!)
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## Recommendation to the Commonwealth:

- Virginia must invest aggressively in the development and deployment of technologies that are vital for a low carbon economy
  - CCR is a critical low carbon technology with enormous regional economic development potential
  - The work of VCCER has demonstrated that Virginia is in a unique position to become a national and even a global leader in CCS
  - For this to happen, Virginia must provide substantial and sustainable financial support to the CCS effort
  - Without such state funds to match federal funding and promote private sector engagement, a large-volume test in the region will not be realized
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