

May, 2008



Susquehanna River Basin Commission

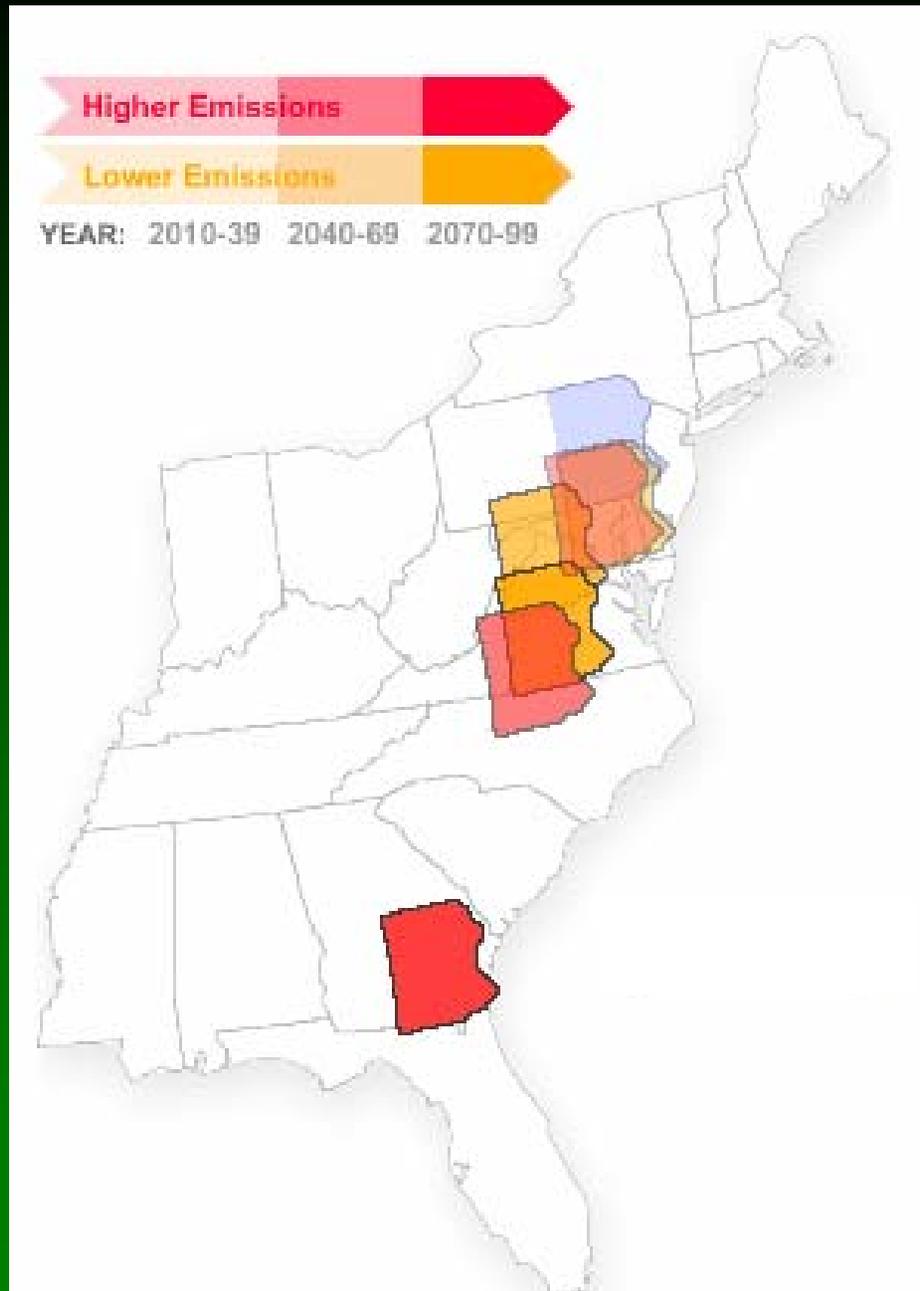
July 1, 2008



Global warming - the single biggest long-term threat to PA's existing natural heritage and the sustainability of our economy.

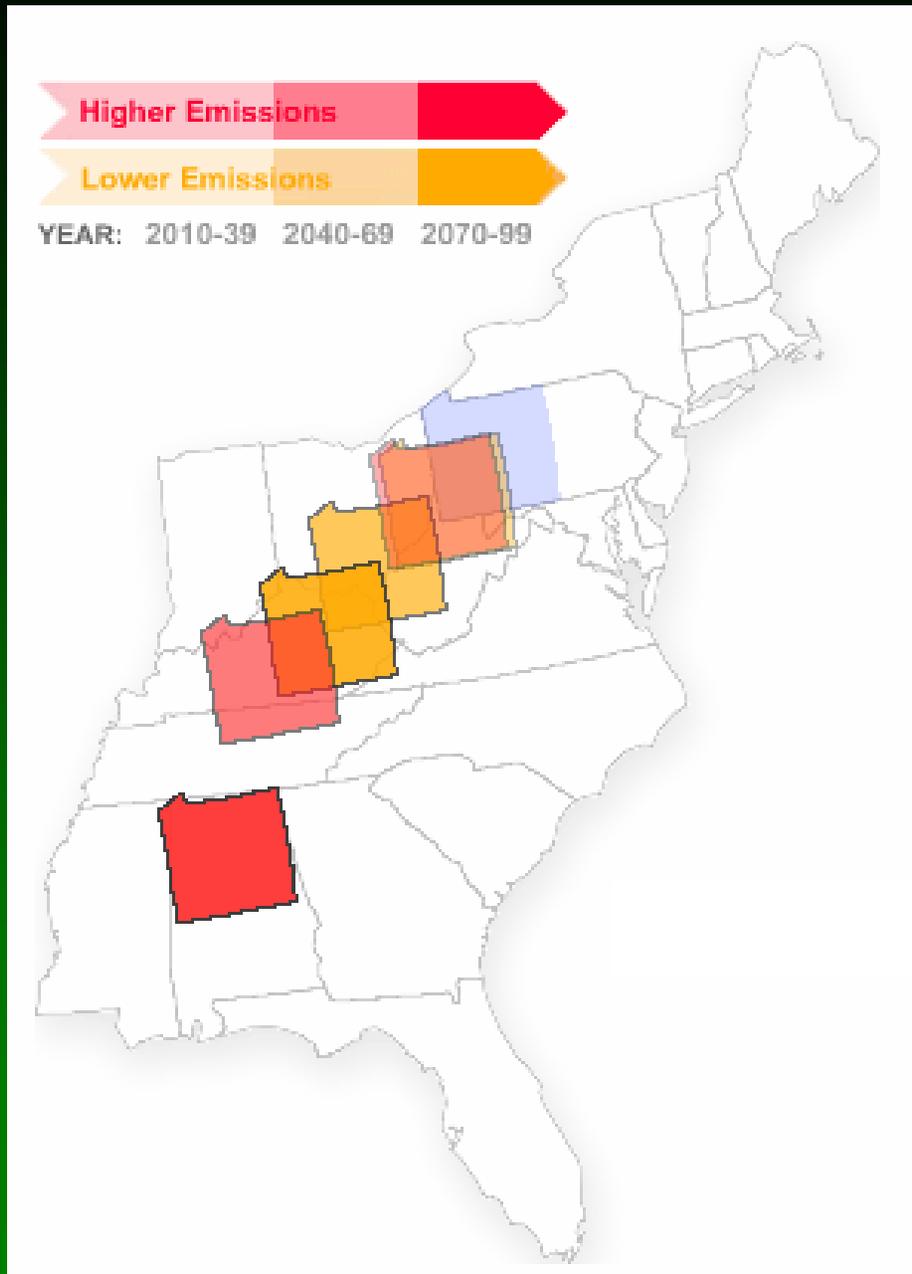
In our children's lifetimes...





**Eastern
PA:
Climate
like
southern
Georgia**





**Western
PA =
Northern
Alabama**

http://www.climatechoices.org/ne/impacts_ne/climates_westernpennsylvania.html



- More frequent, severe storms
- Increased flooding
- Loss of cold water fisheries
- Reduction in biodiversity
- Spread of more formerly-tropical diseases
- More severe heat waves
- Impacts on agriculture
- Forest composition/diversity
- Reductions in stream/river flows, lake levels, groundwater
- Curtailment of winter outdoor rec

PA is a major player

- Emits 1 percent of planet's global warming emissions
- More than 106 developing countries combined.
- 3rd among all states

DCNR CMAG: Thinking Ahead...

- National limits on carbon emissions are inevitable.
 - ◆ More than 50 percent of PA's electricity is coal-fired.
- How will PA cope?
- Competitive advantages?

CMAG Report

- 65-person stakeholder committee
 - ◆ Industry
 - ◆ Academia
 - ◆ NGOs
 - ◆ Federal/state agencies
 - ◆ DCNR stakeholders
 - ◆ DCNR staff
- 21-month study

DCNR CMAG: Big Picture

- A first step.
- Alternative scenarios to quantify, contextualize PA's potential to offset GHG emissions, provide bioenergy feedstocks.
- Options for policies/pilots that provide PA with a *competitive advantage* under carbon constraints.
- Inform state policy development over time.

Why DCNR?

- Largest PA landowner
- Sustainability mission
- 2 million+ acres can help offset PA's GHG emissions, provide biomass feedstocks
- TopoGeo partner in MRCSP

SHAPING A
SUSTAINABLE
PENNSYLVANIA



*DCNR's
Blueprint for Action*



PA's land and geological resources will be crucial to sustainable economic growth under carbon constraints.

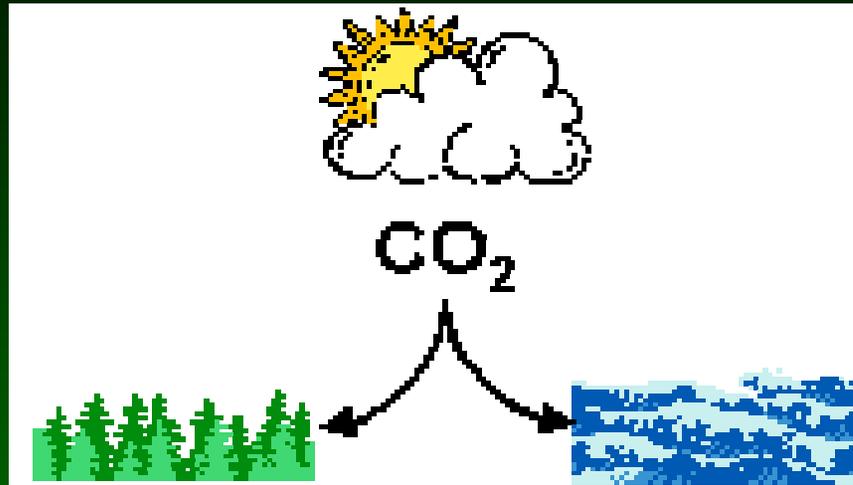
Let's define terms.



Carbon Sequestration

- Extract CO₂ from atmosphere, emission sources using:
 - ◆ Photosynthesis, soils
 - ◆ Technology - carbon capture/storage (CCS)
- Then store - or “sequester” - it in carbon “sinks.”

Carbon Sinks



Terrestrial

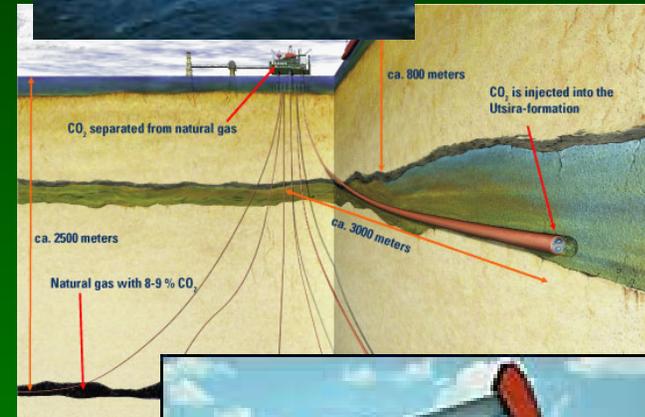
- Plants
- Grasses
- Trees
- Soils

Geological

- Underground formations
- Unmineable coal seams
 - ◆ “New” natural resources

Carbon Capture/Storage

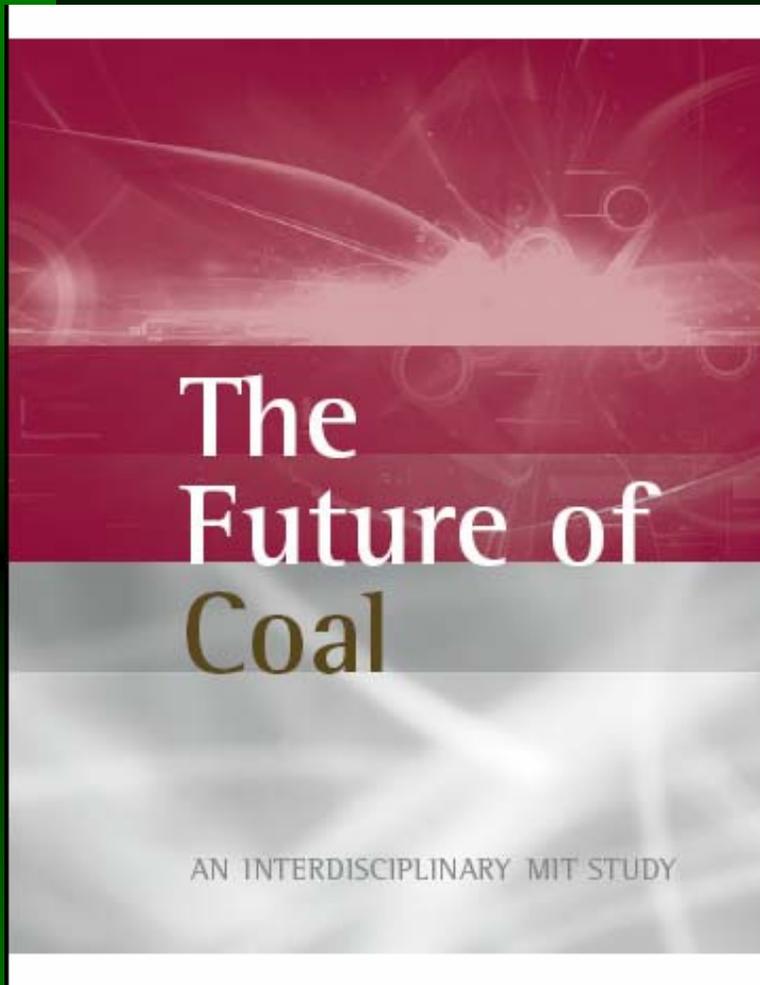
- CO₂ being captured, piped, and stored underground around the world
 - ◆ Sleipner, North Sea
 - ◆ Texas – enhanced oil recovery



CCS Hurdles

- But not at power plant scale
- Current technology costly
- Pilots needed to reduce costs
- No market or regulatory drivers - YET

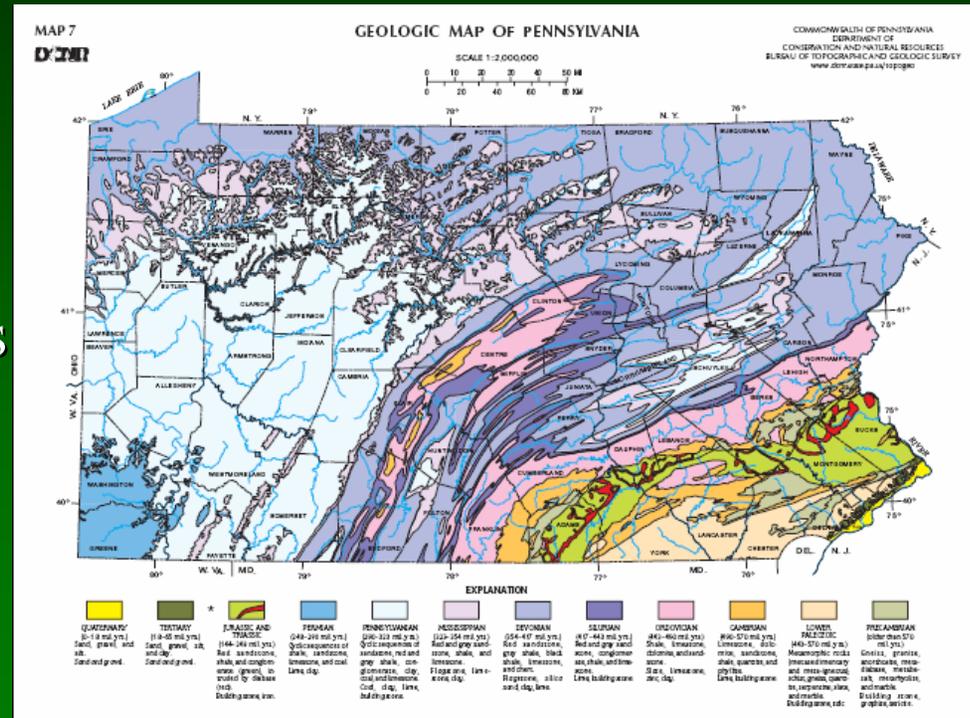




- CCS: “critical enabling technology”
 - ◆ Lower CO₂ emissions
 - ◆ Meet energy needs
- Needs to be demo’d at power plant scale

MRCSP: PA Geological Sequestration Potential

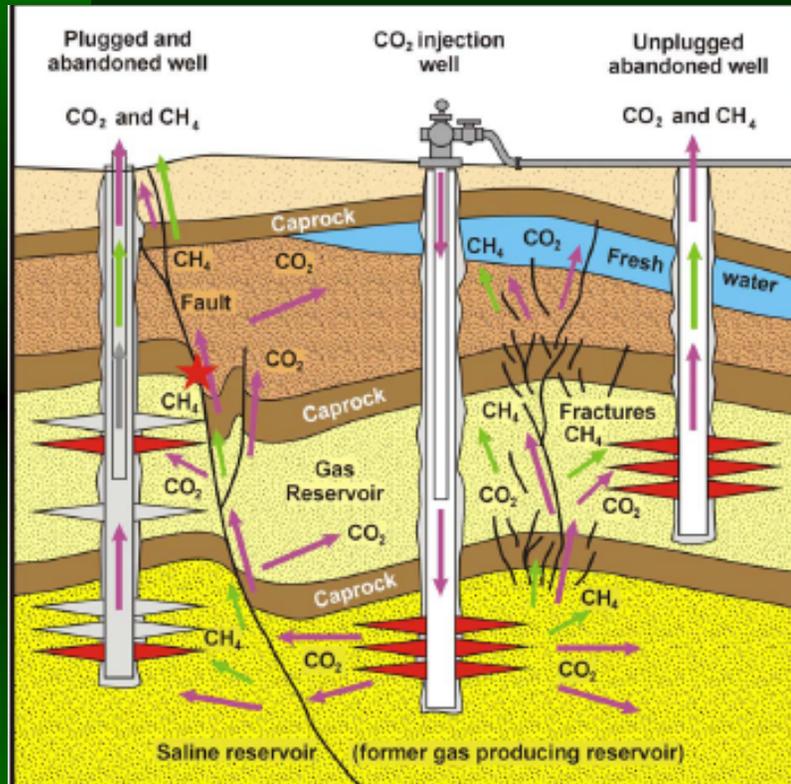
- 100+ yrs of total current emissions
 - ◆ Saline formations
 - ◆ Depleted oil/gas
 - ◆ Unmineable coal beds
 - ◆ Organic shales
- Potential competitive advantage



Realizing that advantage....

- Less economic disruption
- Maintain PA power exports
- Jobs?
 - ◆ R&D
 - ◆ Retrofit
 - ◆ Manufacturing
 - ◆ Export

Issues



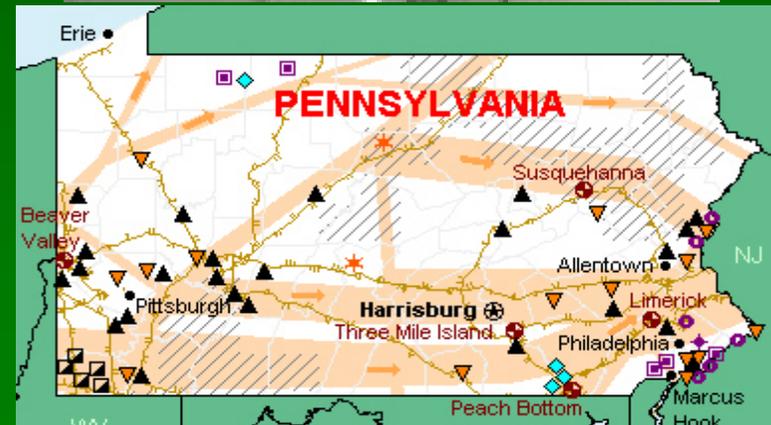
- Pore space ownership
- Liability
- Regulatory uncertainty
- Safety
- Leakage
- Seismic
- Ground H₂O
- NUMBY

Other states moving

- Texas, Illinois – public liability
- Wyoming – pore space runs with surface rights
- Kansas – tax incentives for CCS
- Ohio - \$2.3M for test well
- CA, NM, OR, WA, NY

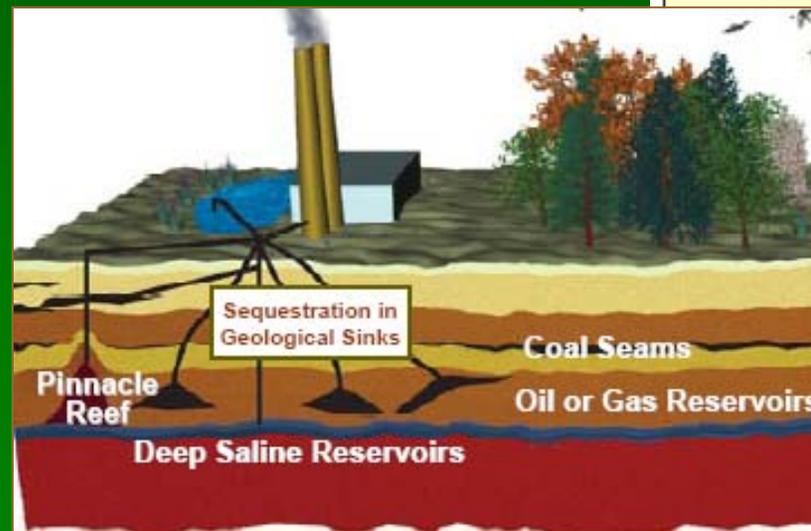
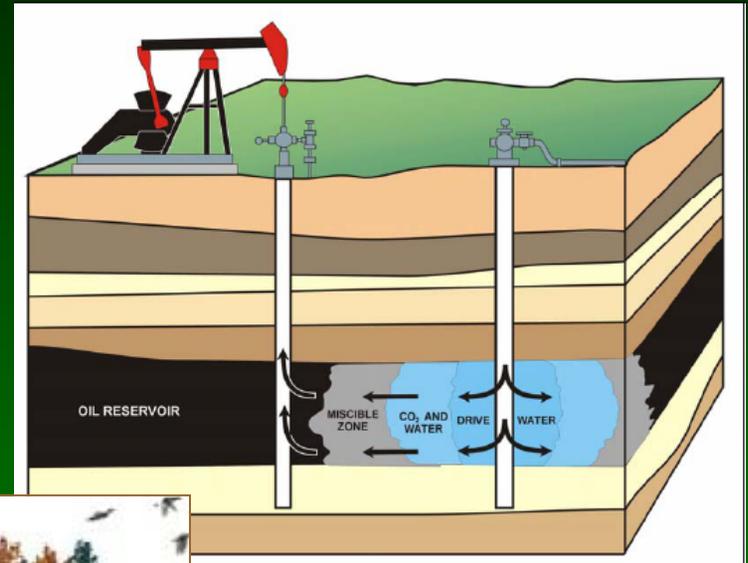
CMAG: Geological Sequestration Options

- Protocols for Siting, Operating GeoSeq Projects
 - ◆ Assess central, eastern PA
 - ◆ Scope carbon infrastructure



Geological Sequestration Options

- GeoSeq Pilot Projects (EOR?)
 - ◆ SWPA?
 - ◆ SFL?

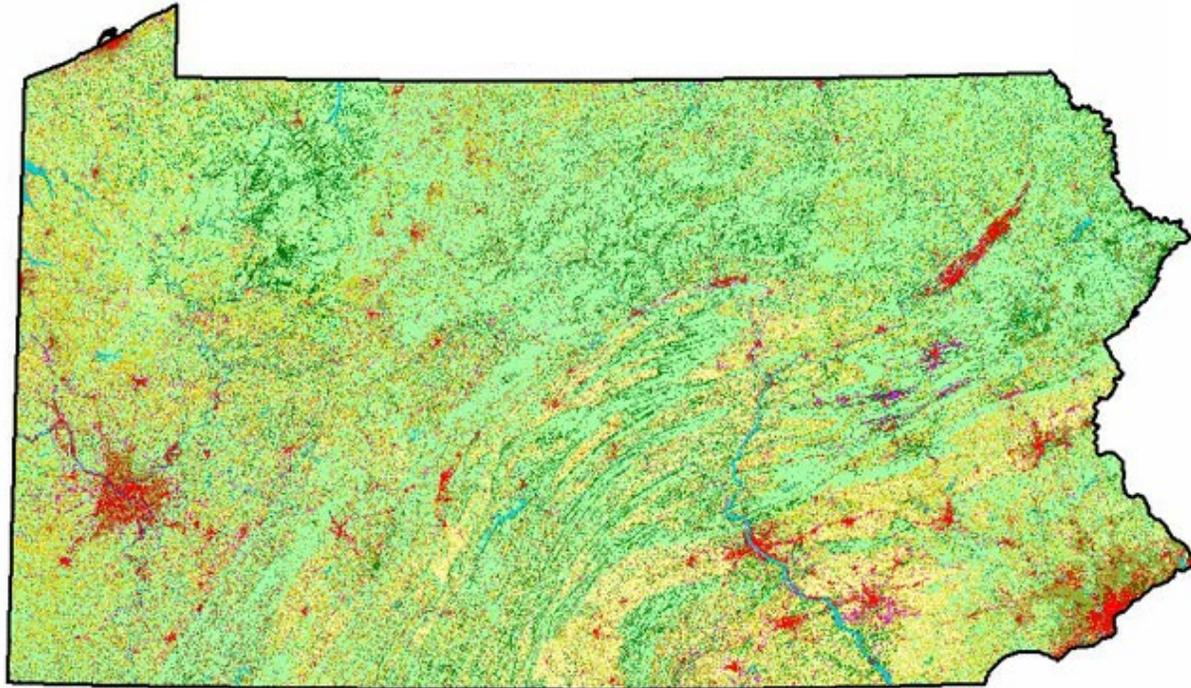


Geological Sequestration Options

- Pilot Coalbed Methane Project in NEPA



CMAG: The Role of 17 million acres of PA forests



- Annual growth of all of PA's public/private forests offsets @ **5 percent** of PA emissions.
- How to preserve and grow that capacity?



CMAG: Forest Management Options



- Plant/restore forests
- Protect, manage forests to enhance C storage
- Use more wood products
- Plant trees in urban areas

CMAG: Land Conservation

- Forest conversion to developed use - one-time surge of C emissions, and lost sequestration capacity.
- Conserving forestland base, reducing clearing, promoting working forests are effective C policies.



CMAG: Registries



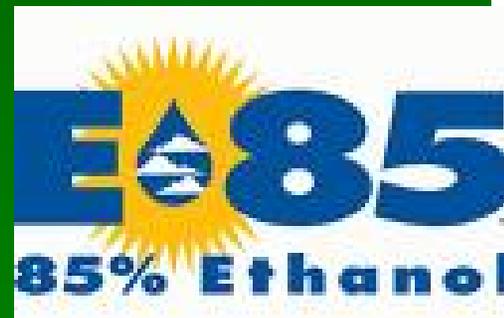
- Rules of the carbon game
 - ◆ Standard accounting, measuring of emissions, offsets
 - ◆ Encourage participation in C markets by owners of PA's terrestrial, geologic resources
 - ◆ Registry design parameters to position PA favorably.

CMAG: Forest Biomass Energy



Wood eyed for:

- Heat/power generation
 - ◆ Utility scale
 - ◆ Community scale
 - ◆ Residential
- Co-firing
- Liquid fuel
(ethanol/diesel)
production



What is Sustainable?



- Environmentally
 - ◆ Protect resource, its values

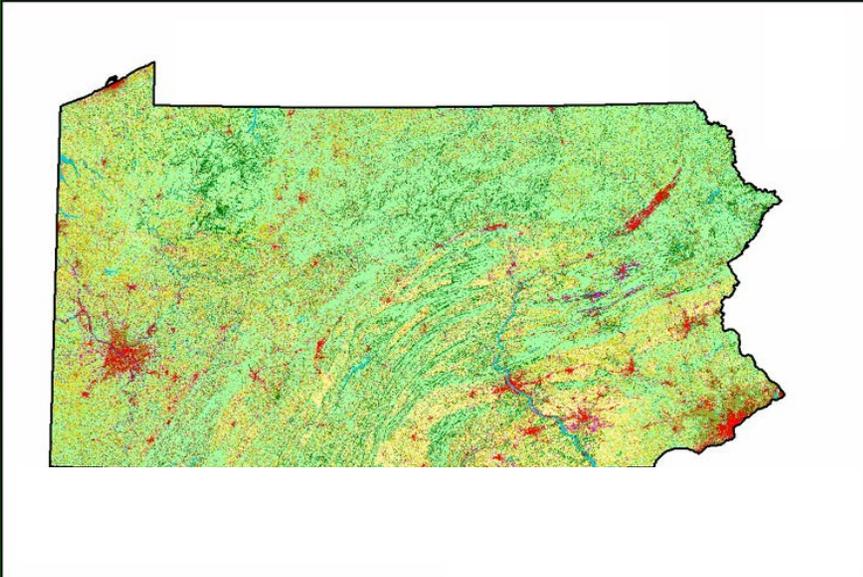


- Economically
 - ◆ Business certainty

How Much Wood Is *Really* Out There?

- One estimate - “Low-use” wood - @ 6M tons /yr sustainable supply (?)
 - ◆ = @ 6% gasoline use (BTU basis)
 - ◆ = 13% of electricity demand

Thus



How can wood supplies be enhanced?



- Short rotation crops
 - ◆ 250K acres AML
 - ◆ 2.9M acres marginal ag

Big Appetites



- 25 M gal cellulosic ethanol plant needs @ 325K tons of wood/year.
 - ◆ @5 tons/acre/yr, = 65,000 acre plantation
- Electricity needs 1,000 acres/MW

Similar Result



CMAG: Forest Biomass Policy Essentials

- Avoid inadvertently incentivizing:
 - ◆ Deforestation
 - ◆ Conversion of native forests
- Adopt a *portfolio* approach to biomass energy
- Sustainable use = Sustainable \$
- Small scale, local CHP best fit for PA

DCNR: Going Forward

- Early actor/demonstrator
- Contribute to the policy discussion
 - ◆ *Fuels for Schools and Beyond*
 - ◆ *The Climate Registry*
 - ◆ Sustainable Harvest Guidelines
 - ◆ CBC Biofuels Summit Sept. 08