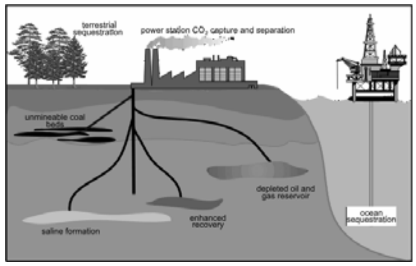
Maryland Climate Change Commission

Scientific and Technical Working Group

Consultation on Carbon Sequestration



Don Boesch

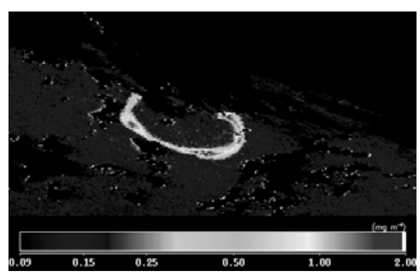
October 17, 2007

MDE

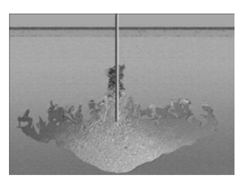
MARYLAND DEPARTMENT OF NATURAL RESOURCES

Carbon sequestration options

- **Technological: carbon capture**
- **Terrestrial: plant biomass & soils**
- **Aquatic: deep ocean**
- **Geological: depleted oil and gas reservoirs, unmineable coal seams & deep saline formations**



Plankton bloom stimulated in iron fertilization



Injection into deep ocean sediments

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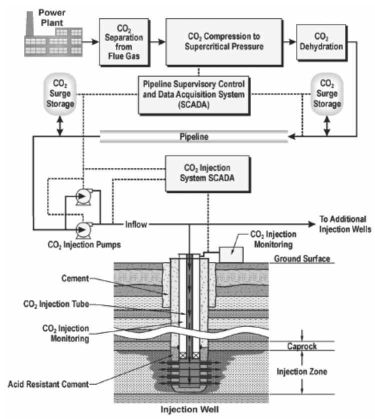
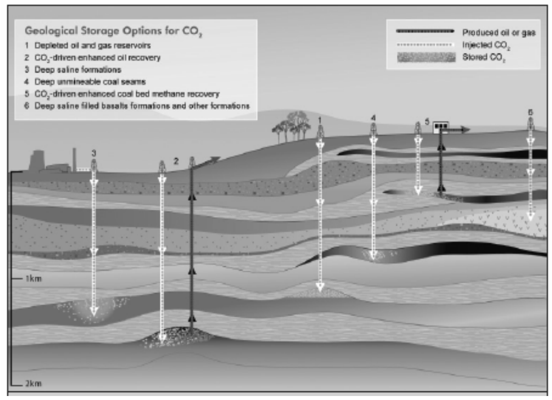
CO_2 capture and geological storage

Joint Global Change Research Institute
A Maryland center of expertise www.globalchange.umd.edu/

Integrated capture, transport & storage systems



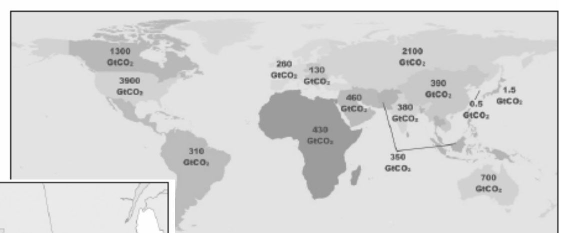


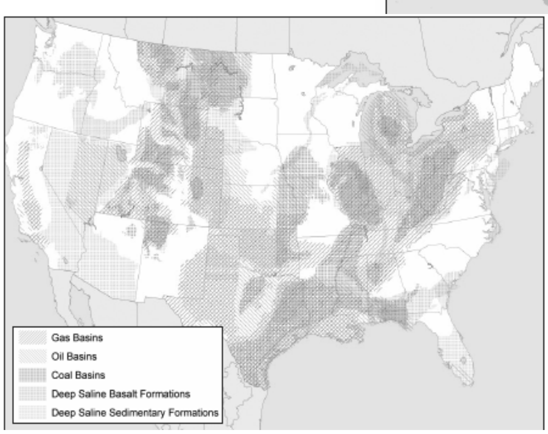
Injection into depleted oil and gas reservoirs, unmineable coal seams & deep saline formations.

www.pnl.gov/gtsp/docs/ccs_report.pdf

Geological storage sites

Enough theoretical storage capacity to meet storage needs for more than a century.





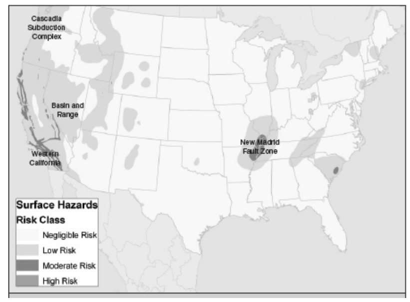
Western Maryland has gas and coal basins and the Eastern Shore has deep saline sedimentary formations that may be suitable for geological carbon sequestration.

www.pnl.gov/gtsp/docs/ccs_report.pdf

The issue of permanence

At a properly designed and managed storage site, the chance of CO_2 leakage is small:

- Seismically active areas avoided; sites selected to reduce potential escapes
- Experiments & early deployments improve effectiveness
- Measuring, monitoring and verification systems required.
- Sudden releases are unlikely: if faults and wells are secured it would take many centuries for the CO_2 to reenter the atmosphere.
- Remediation measures developed to stem any slow leakage.
- Likelihood and extend of potential CO_2 leakage slowly decreases with time as injection stops.



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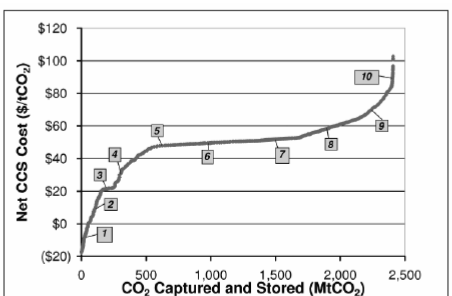
Technical and cost challenges



1	**High purity ammonia plant** / nearby (<10 miles) EOR opportunity
2	**High purity natural gas processing facility** / moderately distant (~50 miles) EOR opportunity
3	**Large, coal-fired power plant** / nearby (<10 miles) ECBM opportunity
4	**High purity hydrogen production facility** / nearby (<25 miles) depleted gas field
5	**Large, coal-fired power plant** / nearby (<25 miles) deep saline formation
6	**Coal-fired power plant** / moderately distant (<50 miles) depleted gas field
7	**Iron & steel plant** / nearby (<10 miles) deep saline formation
8	**Smaller coal-fired power plant** / nearby (<25 miles) deep saline basalt formation
9	**Cement plant** / distant (>50 miles) deep saline formation
10	**Gas-fired power plant** / distant (>50 miles) deep saline formation

www.pnl.gov/gtsp/docs/ccs_report.pdf

- Point sources include power plants, steel & cement manufacturing, etc.
- Many component technologies already exist
- Costs depend on:
  - Source & capture technology
  - Distance of CO_2 transport
  - Injection & reservoir characteristics
  - Potential economic gain (oil recovery)
- Because of development time & costs geological storage are likely to make small contributions to GHG mitigation by 2020, potentially much larger by 2050.

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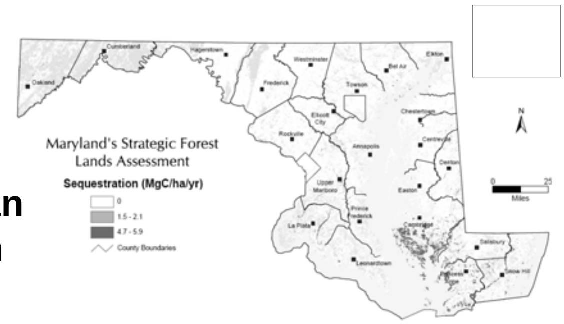
Terrestrial carbon sequestration

- **Soil organic C**
- **Forests**
- **Wetland & riparian forest restoration**



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