What to do with CO_2: The Knowns and Unknowns of Geologic Sequestration and CO_2 EOR in Greenhouse Gas Context

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What to do with CO_2 – the knowns and unknowns of geologic sequestration and CO_2 EOR in greenhouse gas context

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Presented to Austin Professional Landmen's Association
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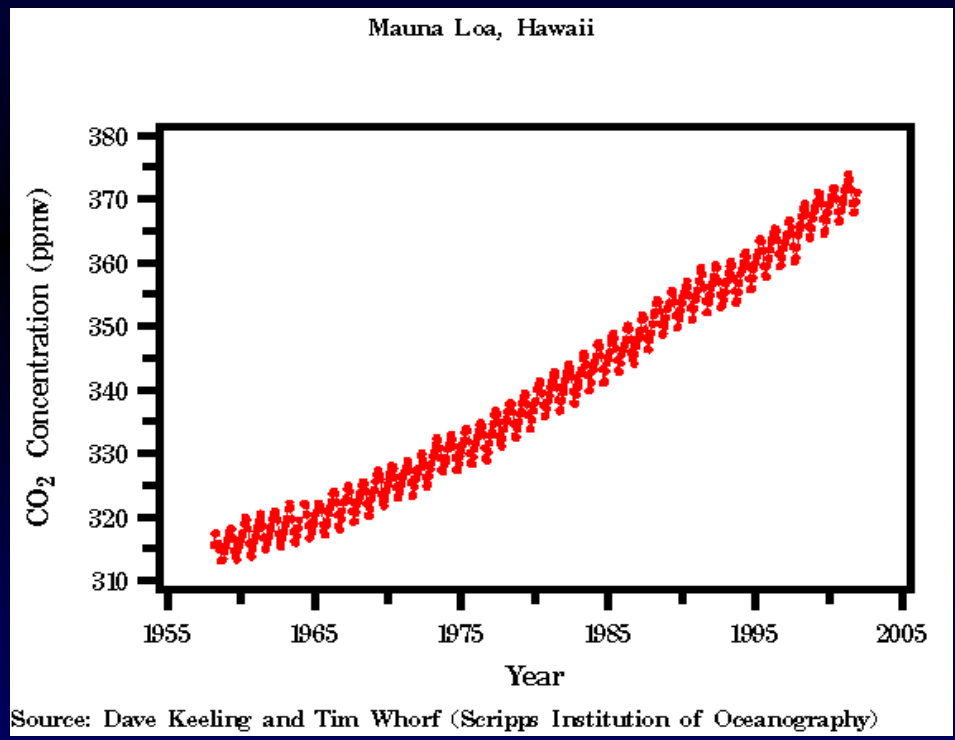
CO_2 Increasing in the Atmosphere

- CO_2 is produced by burning fossil fuels
- CO_2 has been building up in the atmosphere during the industrial revolution
- As more people world-wide improve their standard of living, the amount of CO_2 released will increase, causing additional build-up in the atmosphere

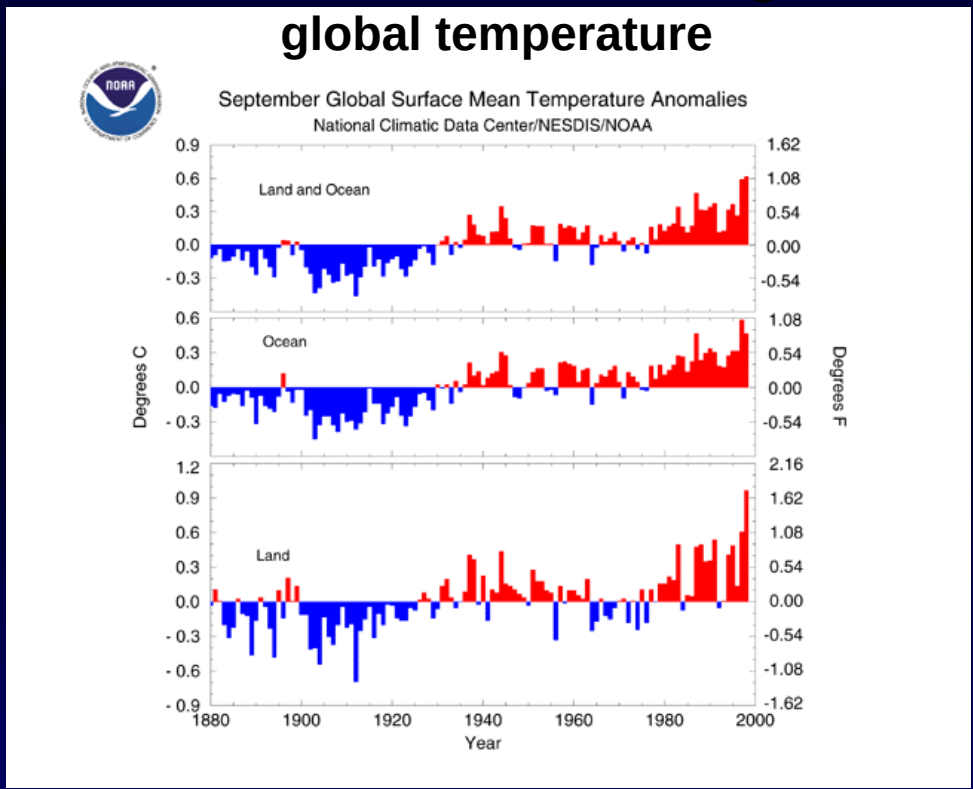
Recent increase in CO_2 concentration



Risks from CO_2 Build-up in the Atmosphere

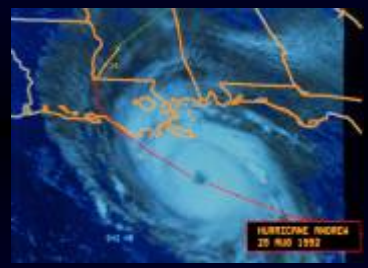
- CO_2 is one of the greenhouse gases that control how much of the solar energy that hits the Earth is retained as heat.
- Higher atmospheric concentrations of CO_2 will force the climate toward warmer average global conditions.
- Risks associated with warmer climate include coastal flooding, more severe tropical storms, desertification, and increased width of tropics.

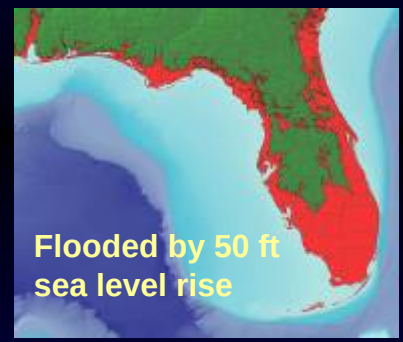
Recent increase in average global temperature



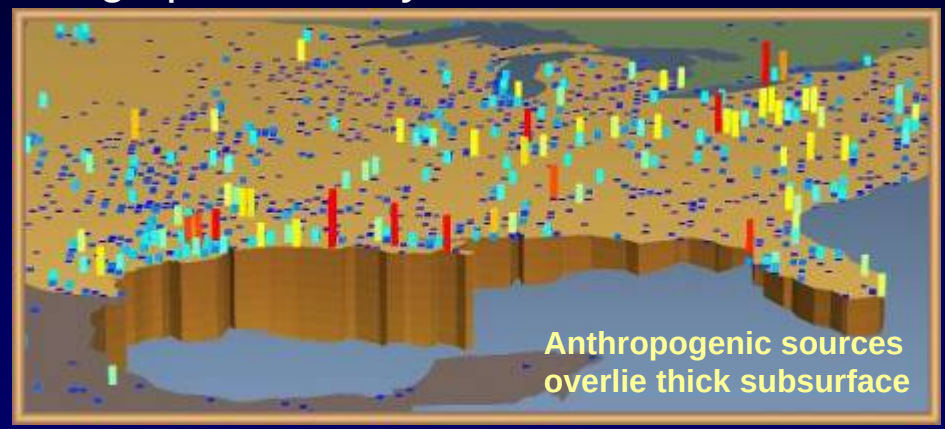
US Gulf Coast:
Unique risks from greenhouse Gas emission
Unique contribution to the solution

- Southeast US is vulnerable to damage resulting from climate change
  - Hurricane landfall around Gulf of Mexico
  - Risk of tropical species invasion
  - Much of US low relief coastline – inundation by sea level rise





Southeast has unique sequestration potential
  - Energy industry center (refinery and oil production)
  - Very well known, thick wedge of high permeability sandstones, excellent seals
  - Initiated by CO_2 EOR



SECARB lead by
Southern States Energy Board
Funded by DOE - NETL

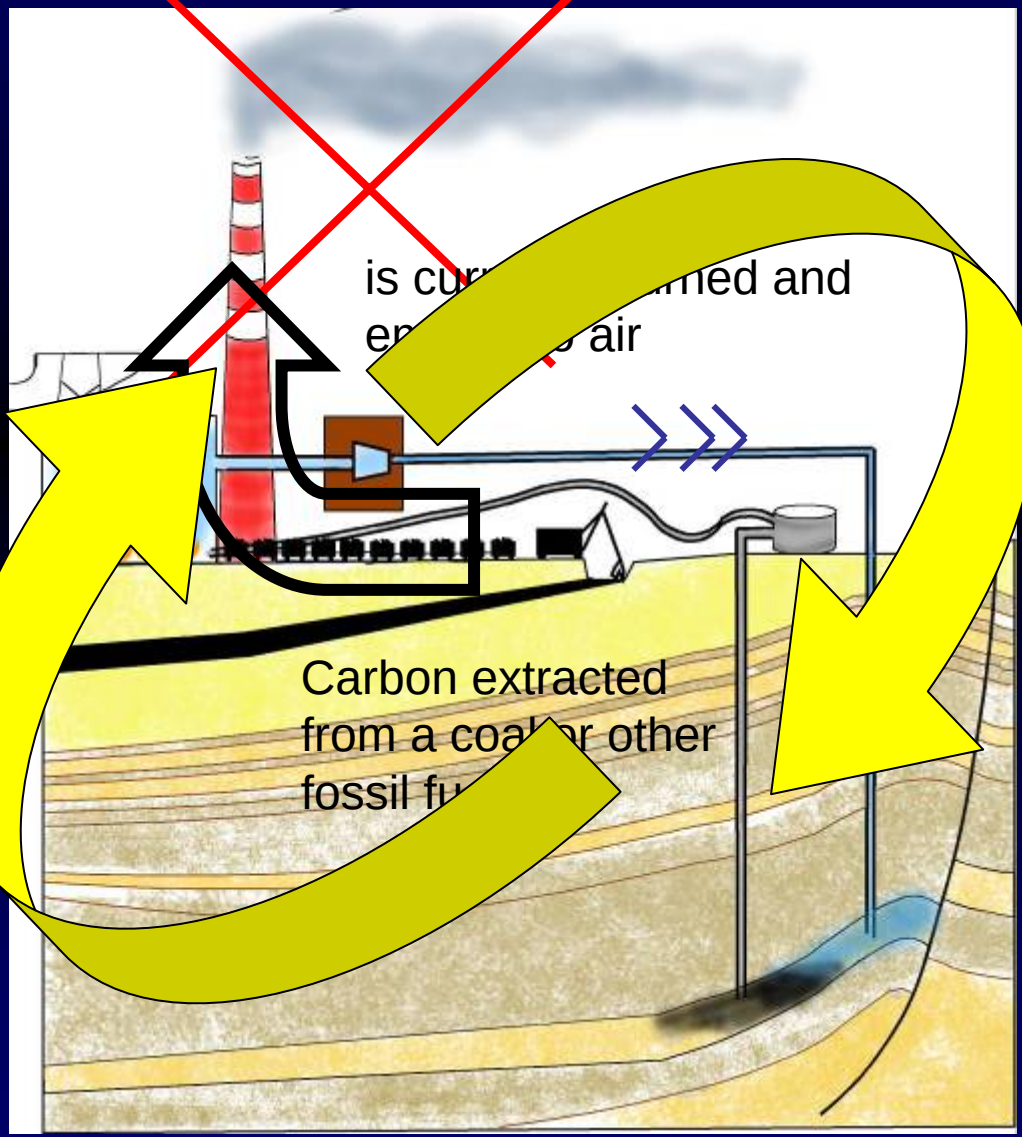
Options to Reduce CO_2 in the Atmosphere

- Conservation and energy efficiency
- Fuel switching—e.g., natural gas for coal
- Alternative energy—e.g., wind, solar, nuclear
- Terrestrial sequestration—e.g., rainforest preservation, tree farms, no-till farming.
- Ocean disposal
- Mineral sequestration
- **Geologic storage" sequestration"**
- "Novel concepts"

Which Is Best?

To reduce the large volumes of CO_2 that are now and will be in the future released to the atmosphere, multiple options must be brought to maturation.

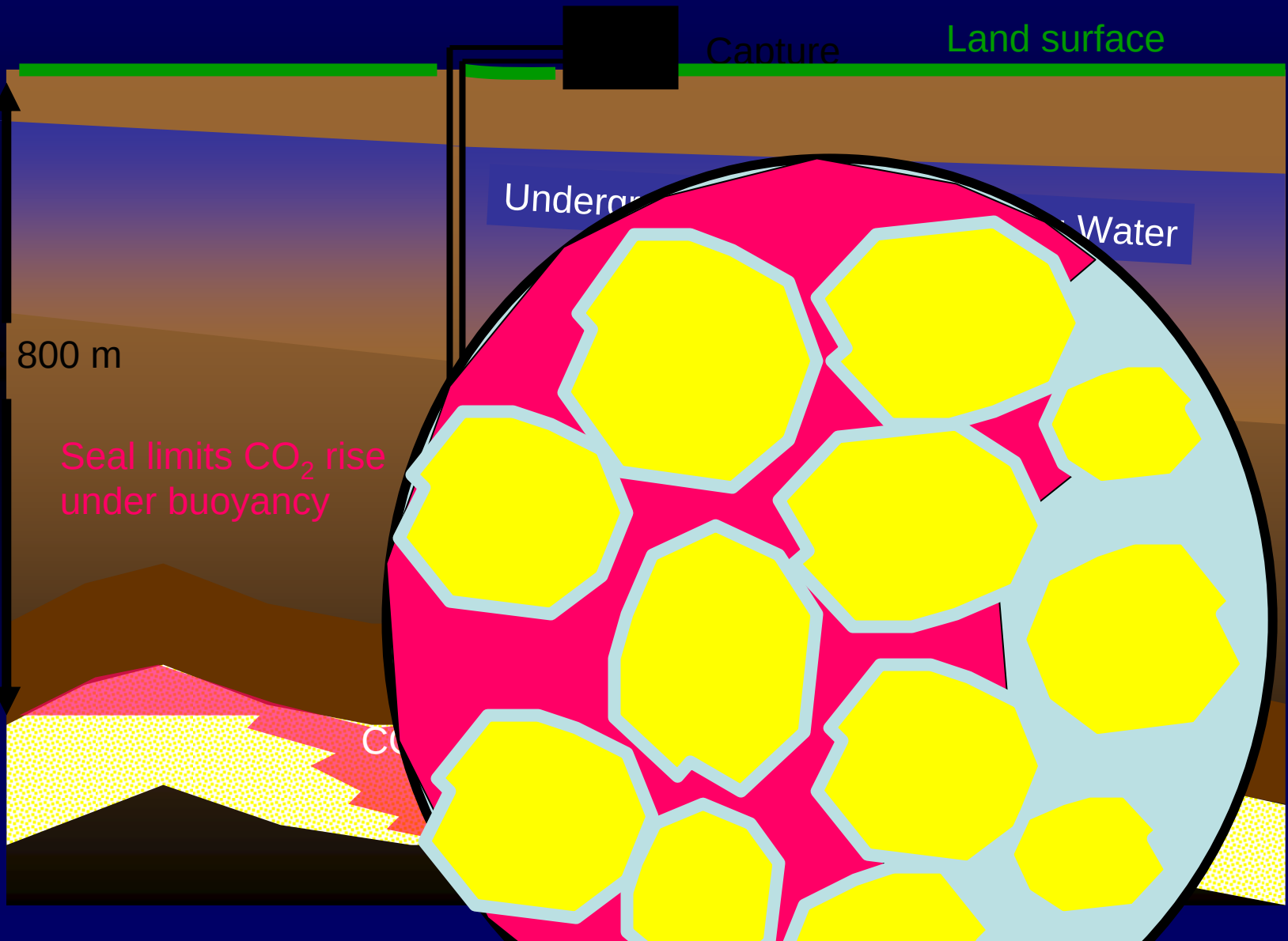
Geologic Sequestration (Storage) of Carbon – Put it back



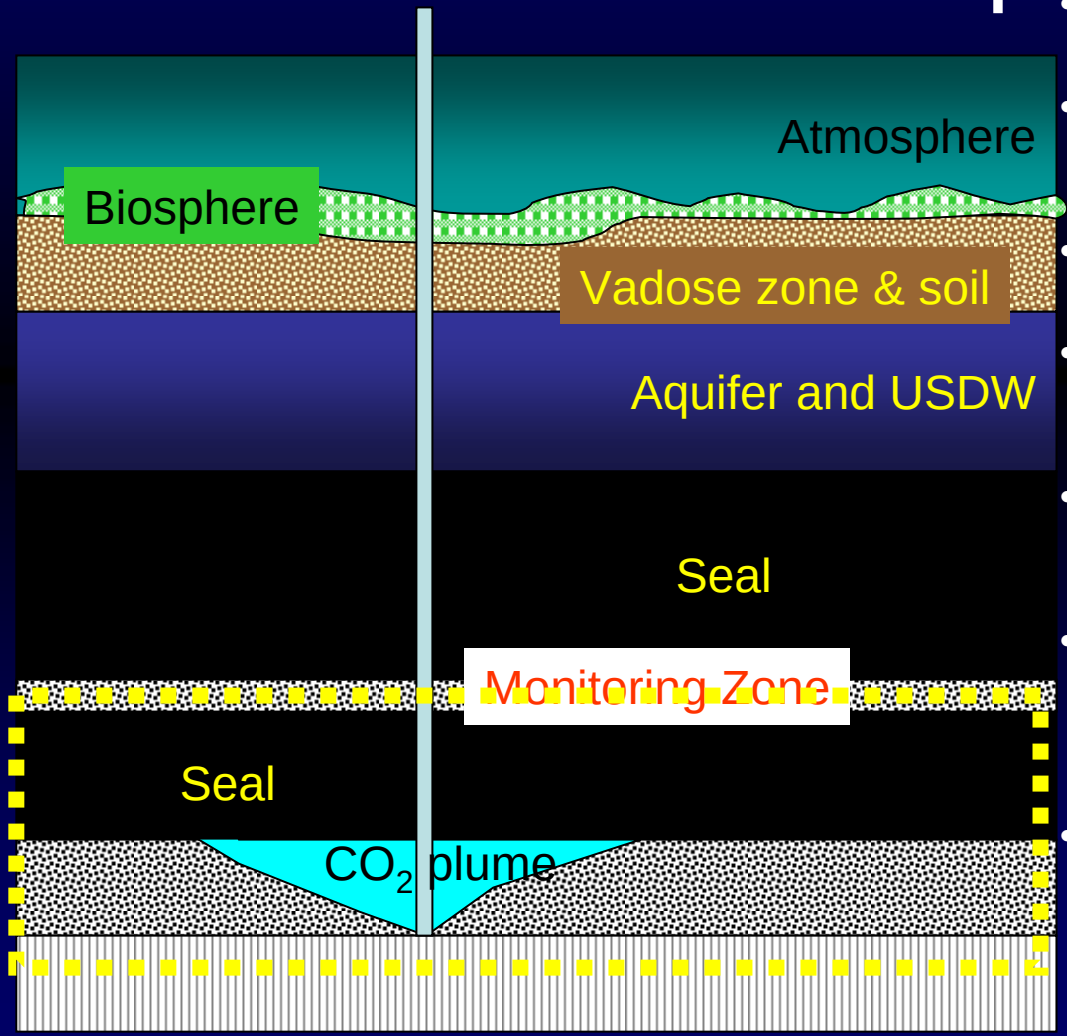
To reduce CO_2 emissions to air from point sources..

Return it to the Earth where it came from

Assuring CO_2 Stays Underground



Monitoring to Assure that CO_2 remains where it is placed



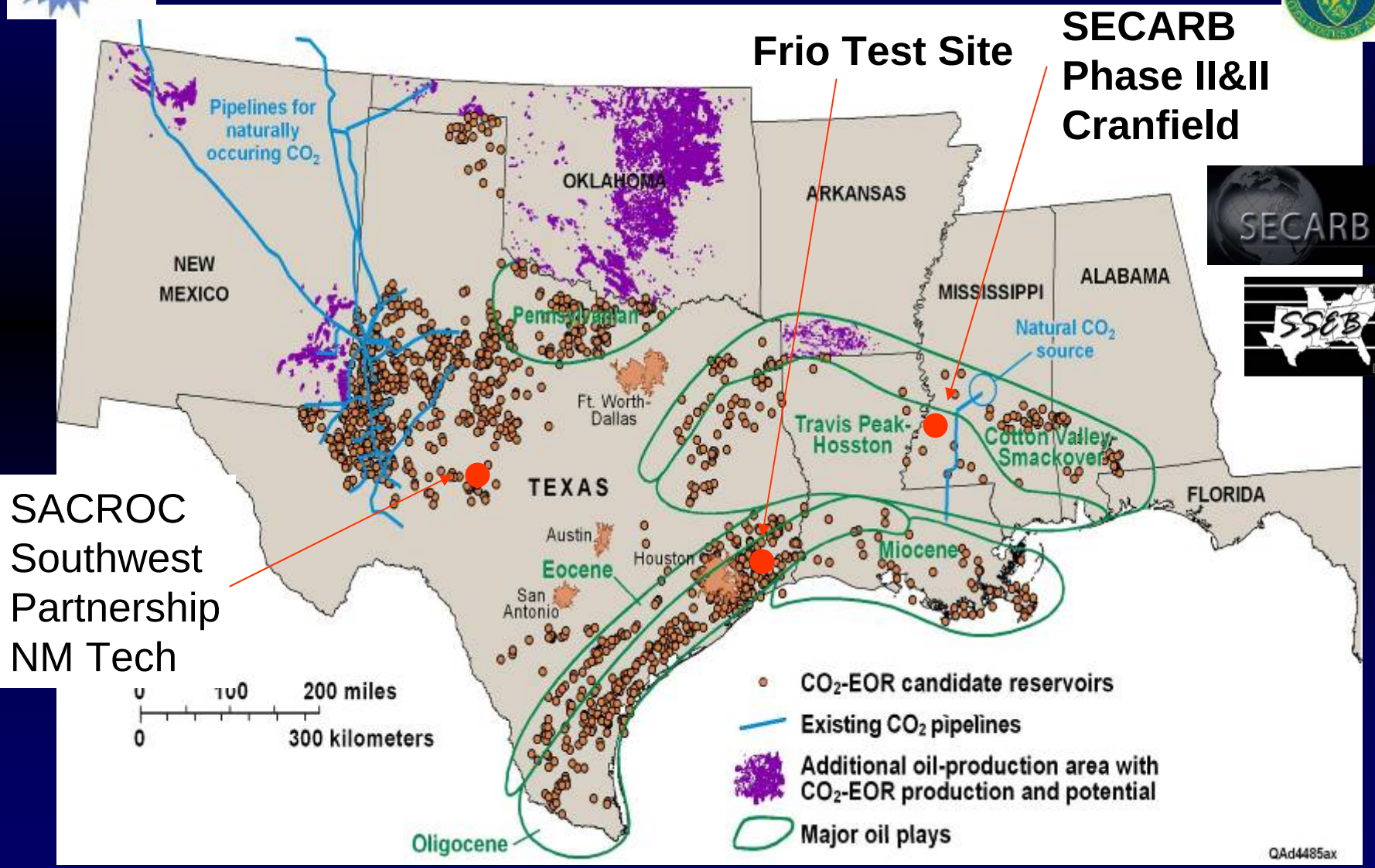
- Atmosphere
  - Ultimate receptor but dynamic
- Biosphere
  - Assurance of no damage but dynamic
- Soil and Vadose Zone
  - Integrator but dynamic
- Aquifer and USDW
  - Integrator, slightly isolated from ecological effects

Complex!

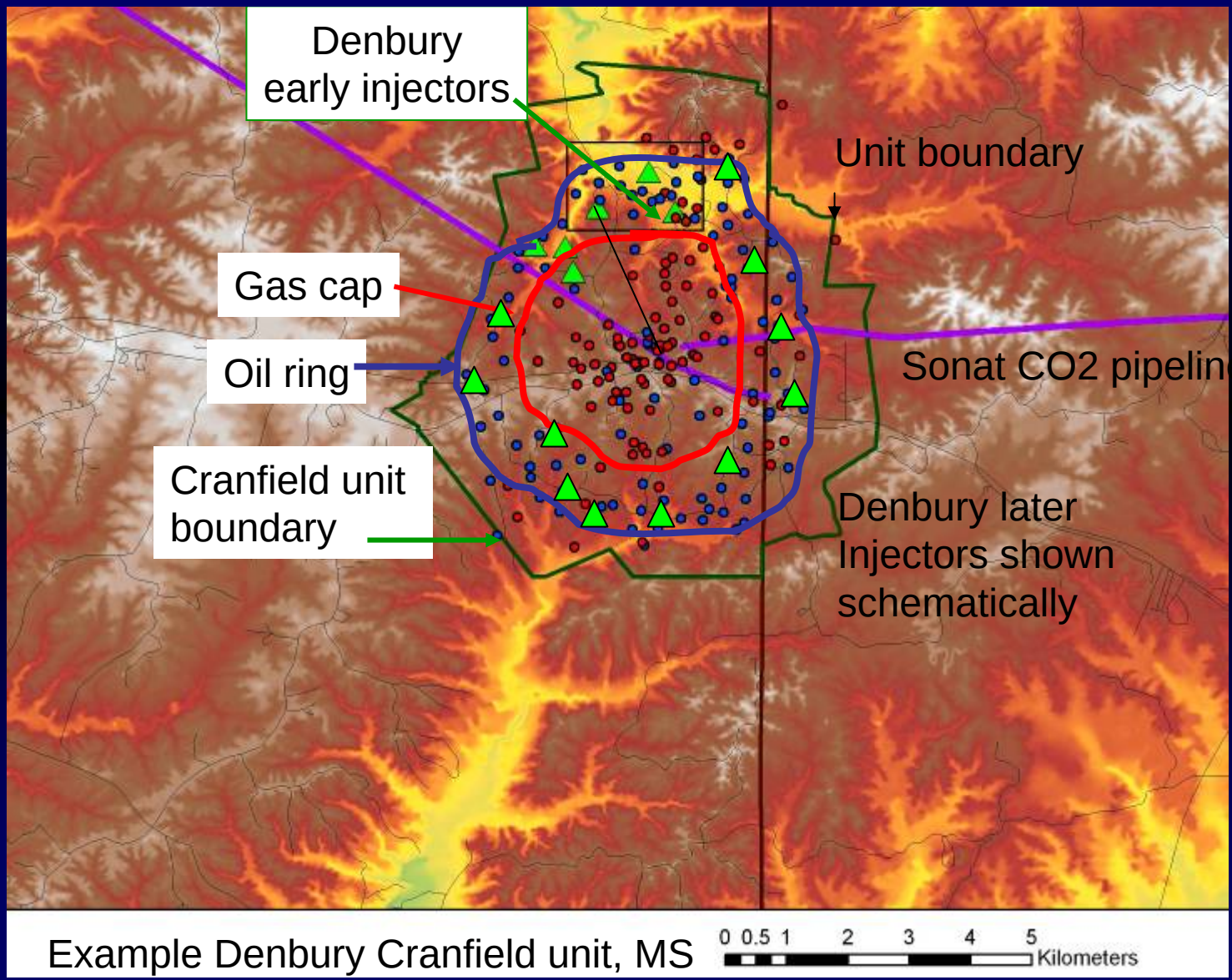
- Above injection monitoring zone
  - First indicator, monitor small signals, stable.
- In injection zone - plume
  - Oil-field type technologies. Will not identify small leaks **Complex!**
- In injection zone - outside plume
  - Assure lateral migration of CO_2 and brine is acceptable

Pressure monitoring “box”

GCCC Field Tests for Monitoring and Verification Technologies DOE NETL support

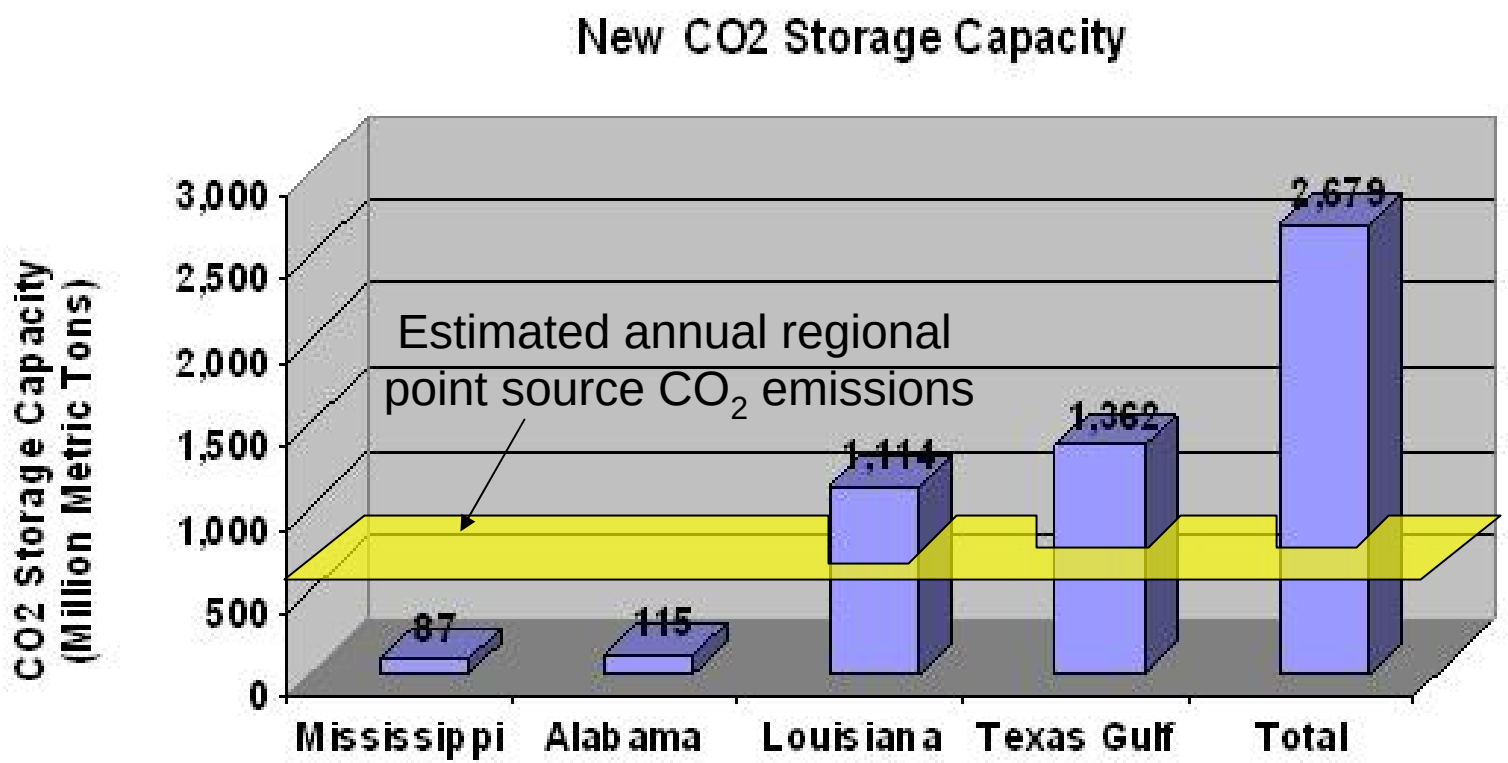


CO_2 used for EOR – bringing old fields back to life



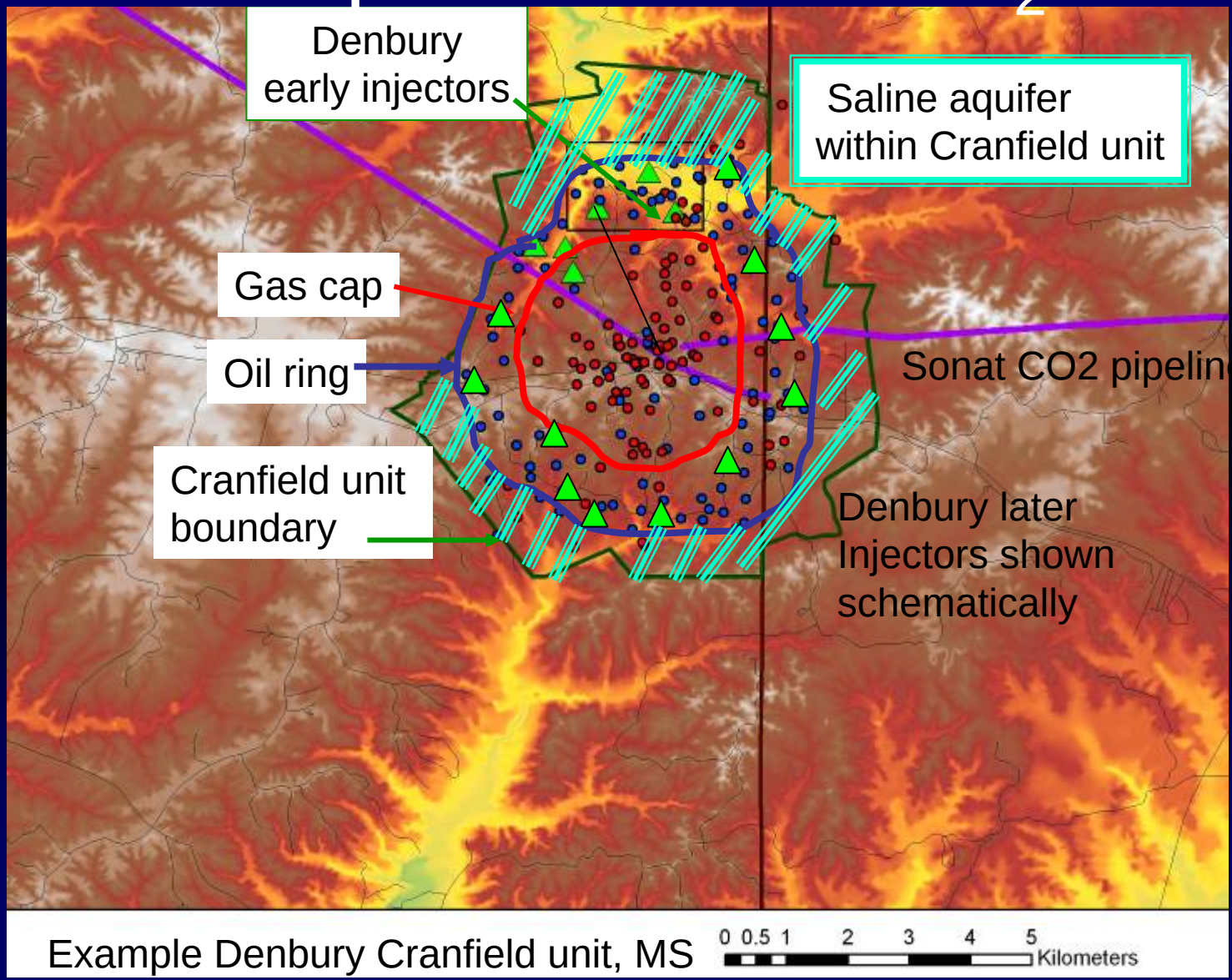
CO_2 Sequestration Capacity in Miscible Oil Reservoirs along the Gulf Coast

Bureau of Economic Geology

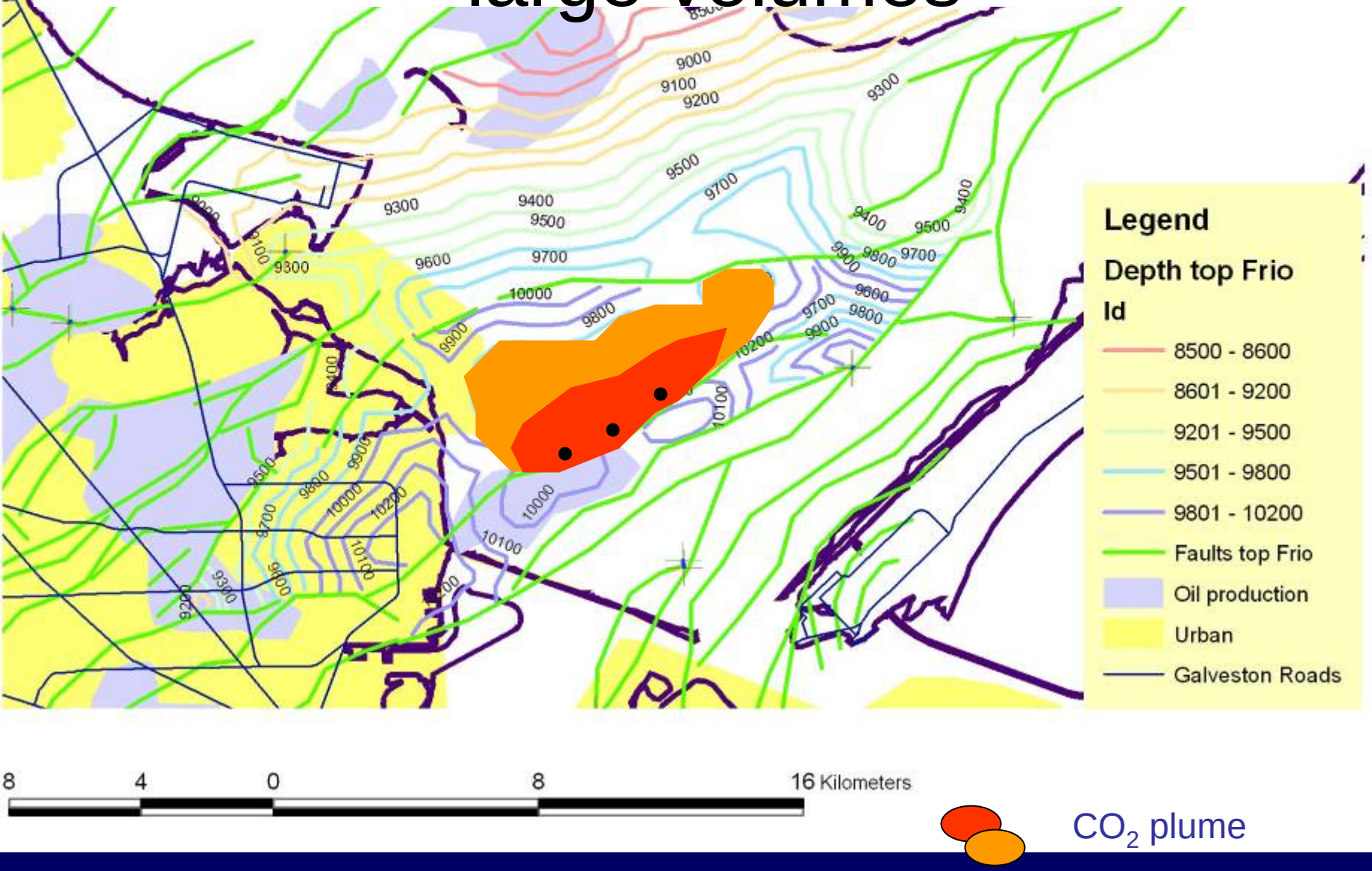


Mark Holtz 2005
NATCARB Atlas 2007

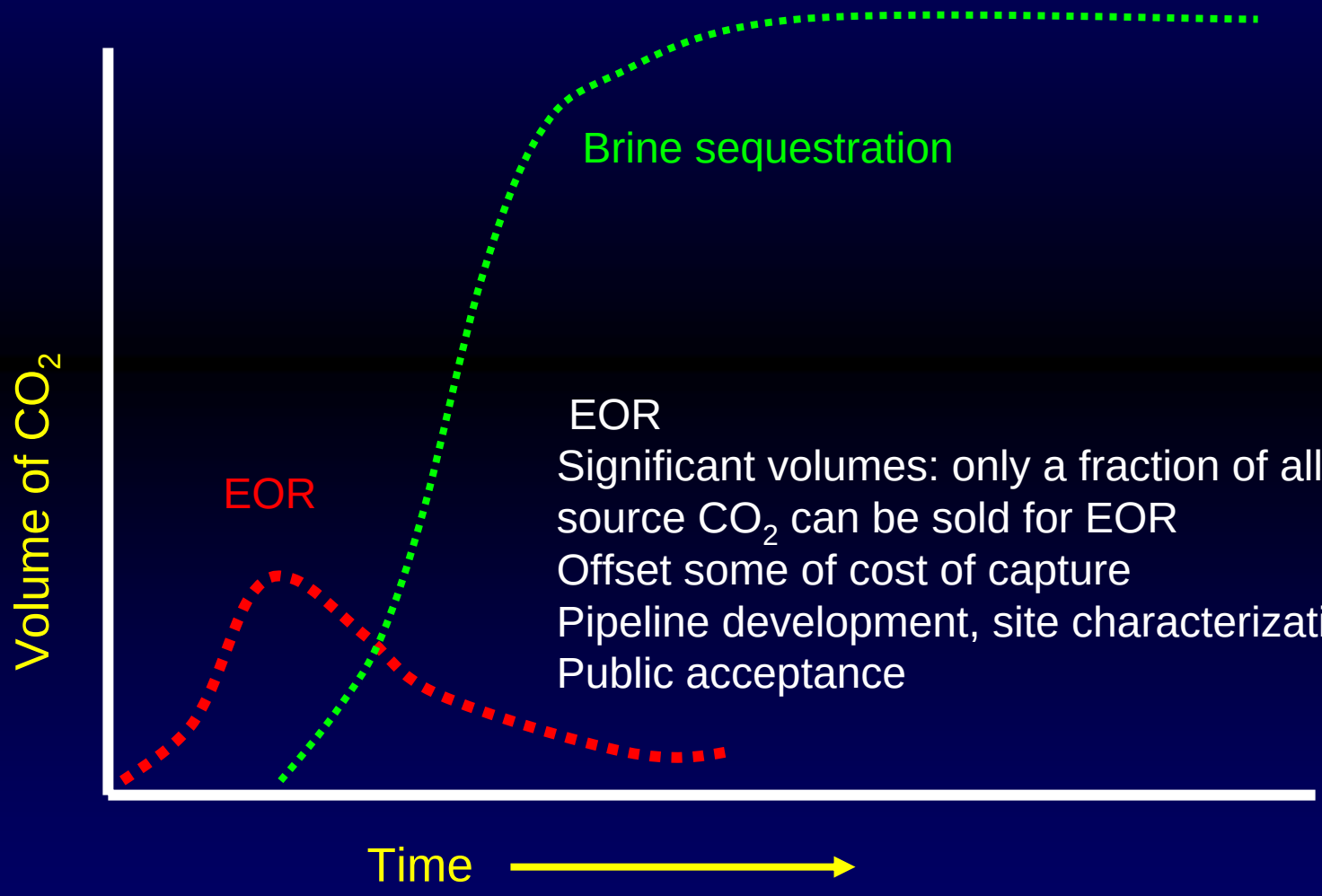
End of EOR: using space for sequestration of CO_2



Injection into a down-dip brine- very large volumes



Role of EOR in Sequestration



EOR

Significant volumes: only a fraction of all point source CO_2 can be sold for EOR

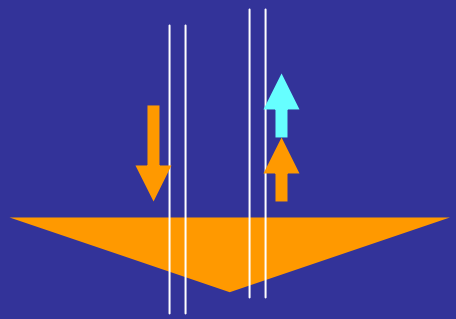
Offset some of cost of capture

Pipeline development, site characterization

Public acceptance

Evolution from EOR to storage in brine: increase in volume of subsurface used

In EOR CO_2 injection is approximately balanced by oil, CO_2, and brine production no pressure plume beyond the CO_2 injection area



CO_2 injection (no production) pressure plume extends beyond the CO_2 injection area

How does EOR compare to brine sequestration?

EOR

- Recycle with production
- Confined area
  - Trap
  - Pressure control
- Residual oil- CO_2 very soluble
- Many well penetrations = leakage risk

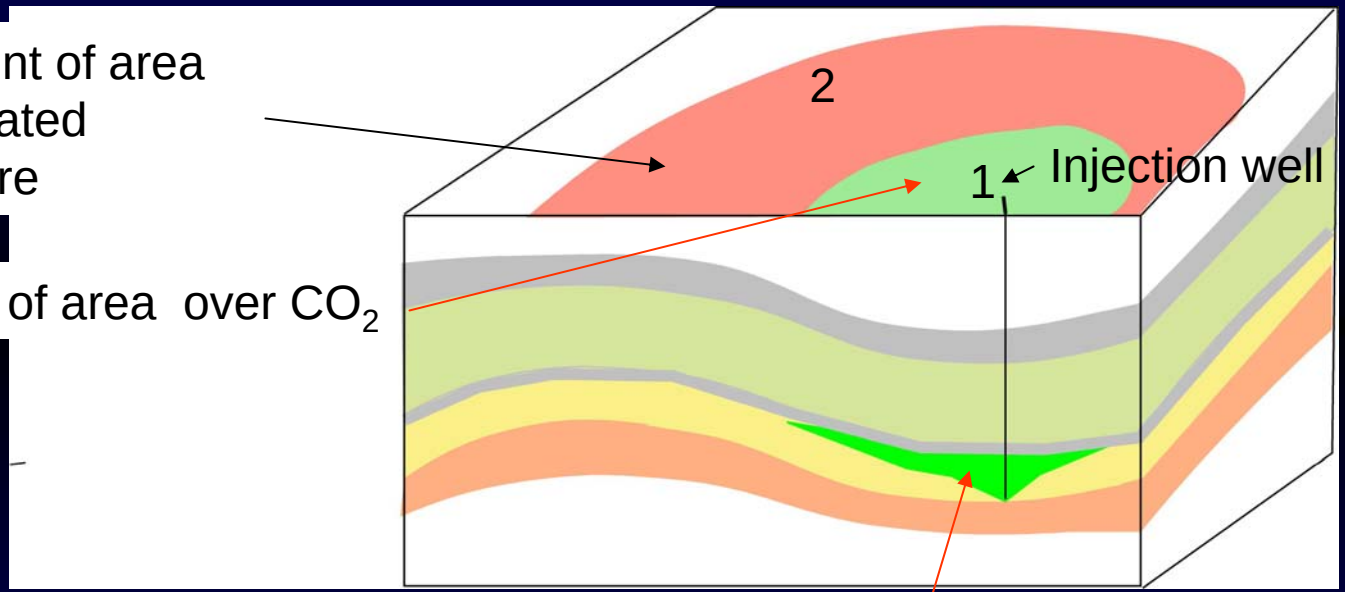
Brine Reservoir

- Pure storage
- Large area
  - May not use a trap
  - Pressure area increase
- Brine – Co2 weakly soluble
- Few well penetrations = lower confidence

Issues where Landman expertise is needed

- Ownership and process for leasing pores space
  - Early projects: CO2 EOR
  - Evolution to CO2 storage
- Who owns the pore space?
- How is permission to inject and add pressure obtained?

Two areas are involved in sequestration



What area is leased?

Monitoring Goals For Commercial Sequestration

Show that:

- Storage capacity and injectivity are sufficient for the volume via history match between observed and modeled
- CO_2 will be contained in the target formation not damage drinking water or be released to the atmosphere
- Know aerial extent of the plume elevated pressure effects compatible with other uses minimal risk to resources, humans, & ecosystem
- Advance warning of hazard allow mitigation if needed
- Public acceptance provide confidence in safe operation

Modified from J. Litynski, NETL

Gulf Coast Carbon Center (GCCC)

Gulf Coast Carbon Center

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finding the ways that work

Schlumberger