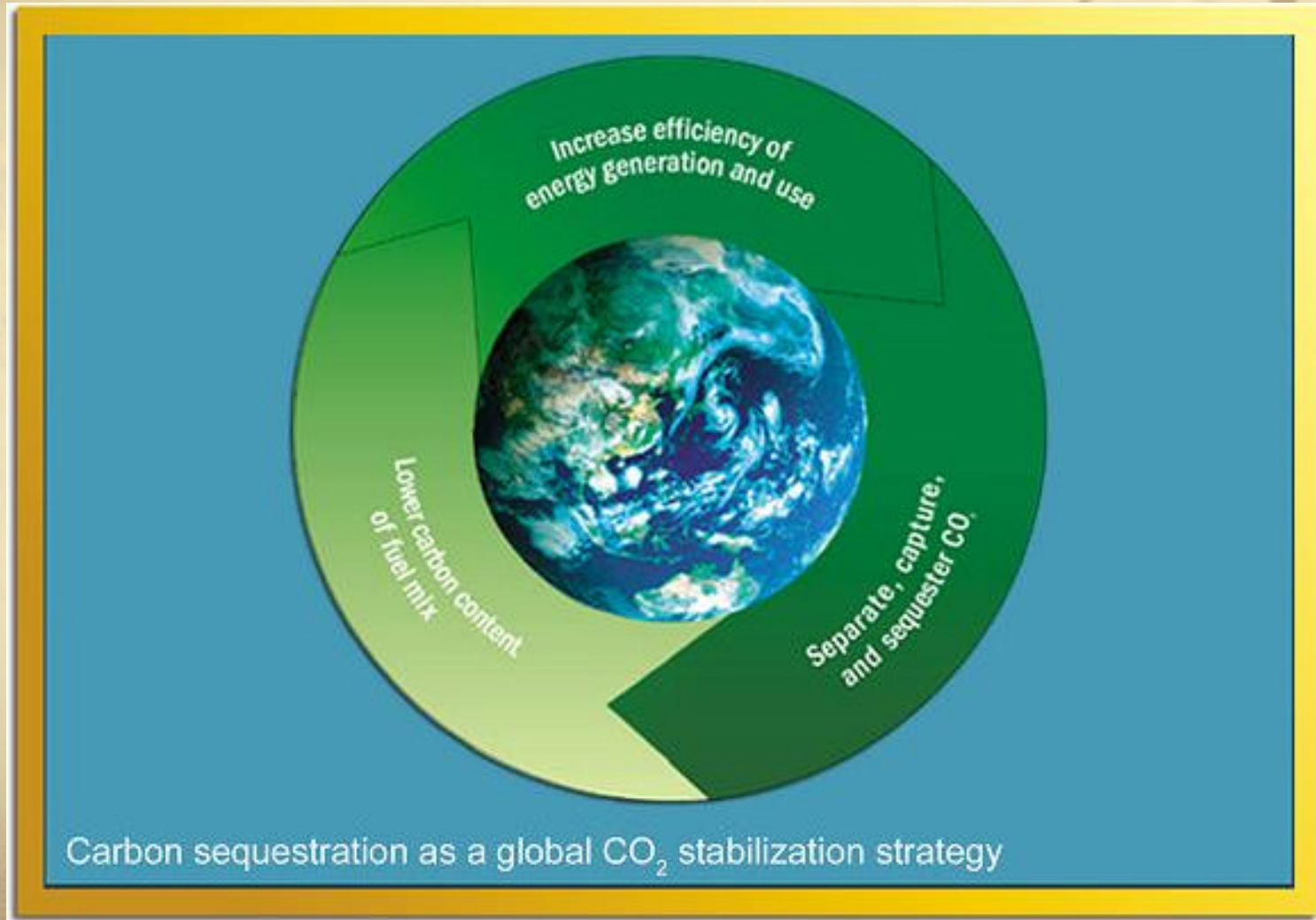
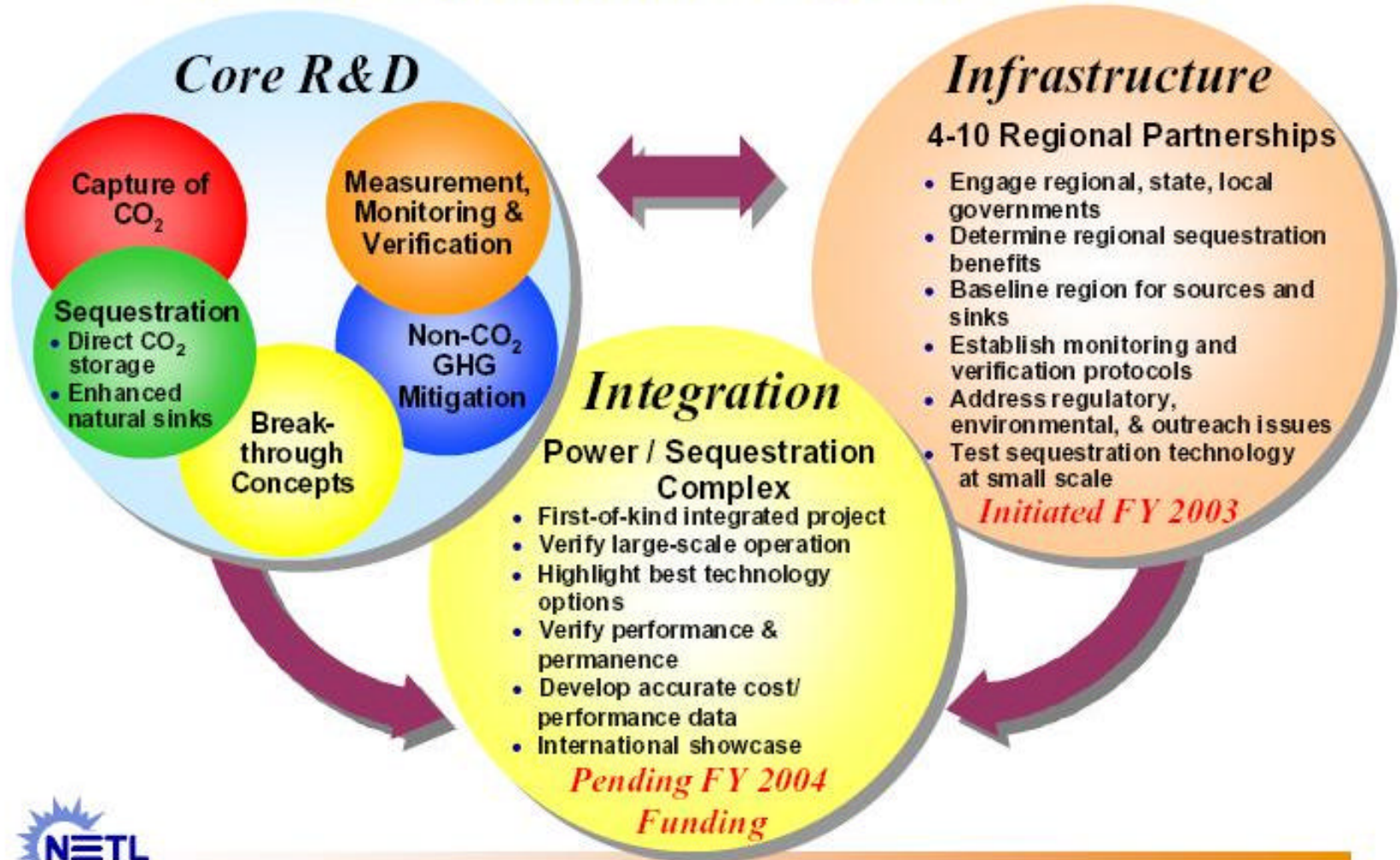


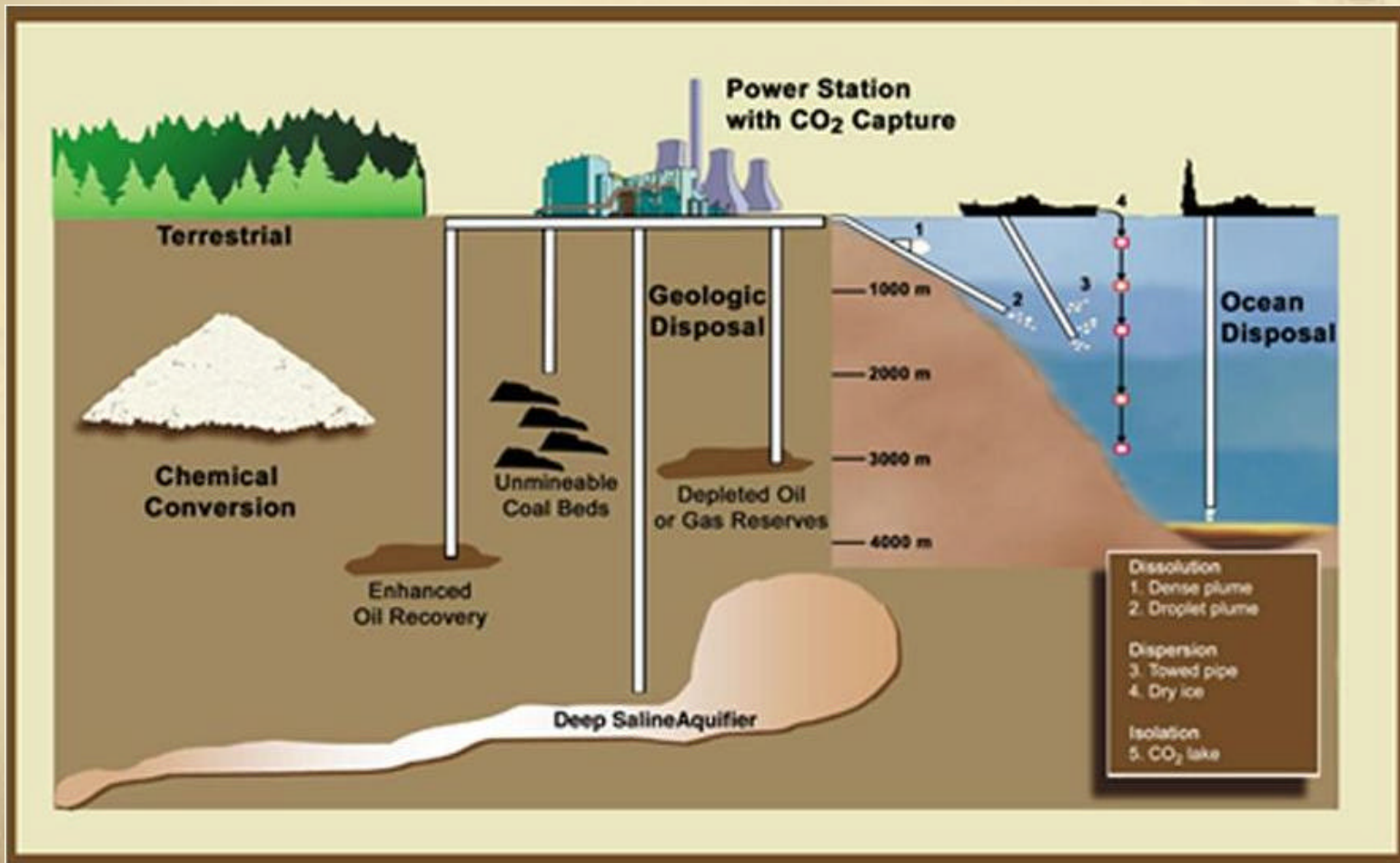
Carbon Sequestration: Novel Concepts



Carbon Sequestration Program Structure



Current Sequestration Methods



Novel Concepts

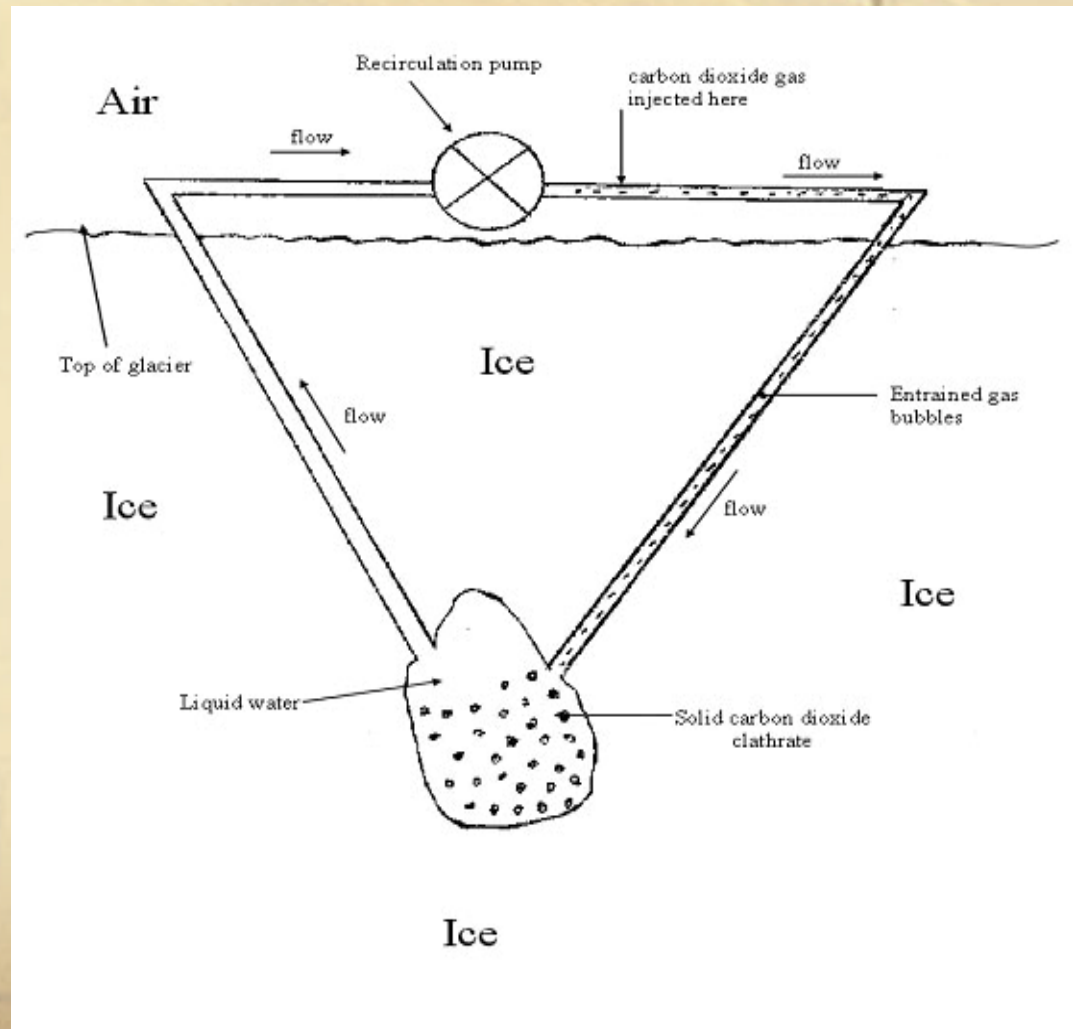
The background of the slide features a stylized globe with a grid of latitude and longitude lines. A compass rose is positioned in the upper right corner, with its needle pointing towards the top. A map of the United States is faintly visible in the lower right quadrant, overlaid on the globe's grid. The overall color palette is warm, consisting of various shades of brown, tan, and gold.

- Glacial Storage
- Biogenic Methane
- Mineralization
- Waste Streams / Recycling
- Calcium Carbonate Hydrates

Glacial Storage

David Sevier, Aqueous Logic

- Uses solid CO₂ Clathrates
- Stores Clathrates in columns of water inside glaciers, which are then refrozen
- Storage in glaciers or Arctic/Antarctic ice sheets
- Shares traits with geologic and oceanic storage
- Issues with remoteness of areas



Biogenic Methane

Energetics, Incorporated

- Inject CO₂ into depleted coal seam
- Use biological / geochemical processes to convert CO₂ into Methane
- Closed Loop Fuel System
- CO₂ recycling
- Knowledge is sketchy at best; Mostly a proposed concept.

Mineralization



- Create bicarbonate ion in water
- Combine with minerals from various sources to create stable carbonate compounds
- Permanent geologic storage (already occur naturally)
- Research being done in reaction rates
- Efforts to create continuous flow reactor

Enzymatic Catalysis

Electric Power Research Institute

- Uses enzyme carbonic anhydrase
- Biological catalyst for CO₂ – bicarbonate process
- Uses CaO (lime) or calcium in sea water
- Still in early stages

Serpentinization

Albany Research Center

- Uses Olivine or Serpentine
- Creates Magnesite
- All occur naturally, extremely stable
- Abundant resources
- Slow reaction
- Serpentine requires heat treatment to remove chemically bound water

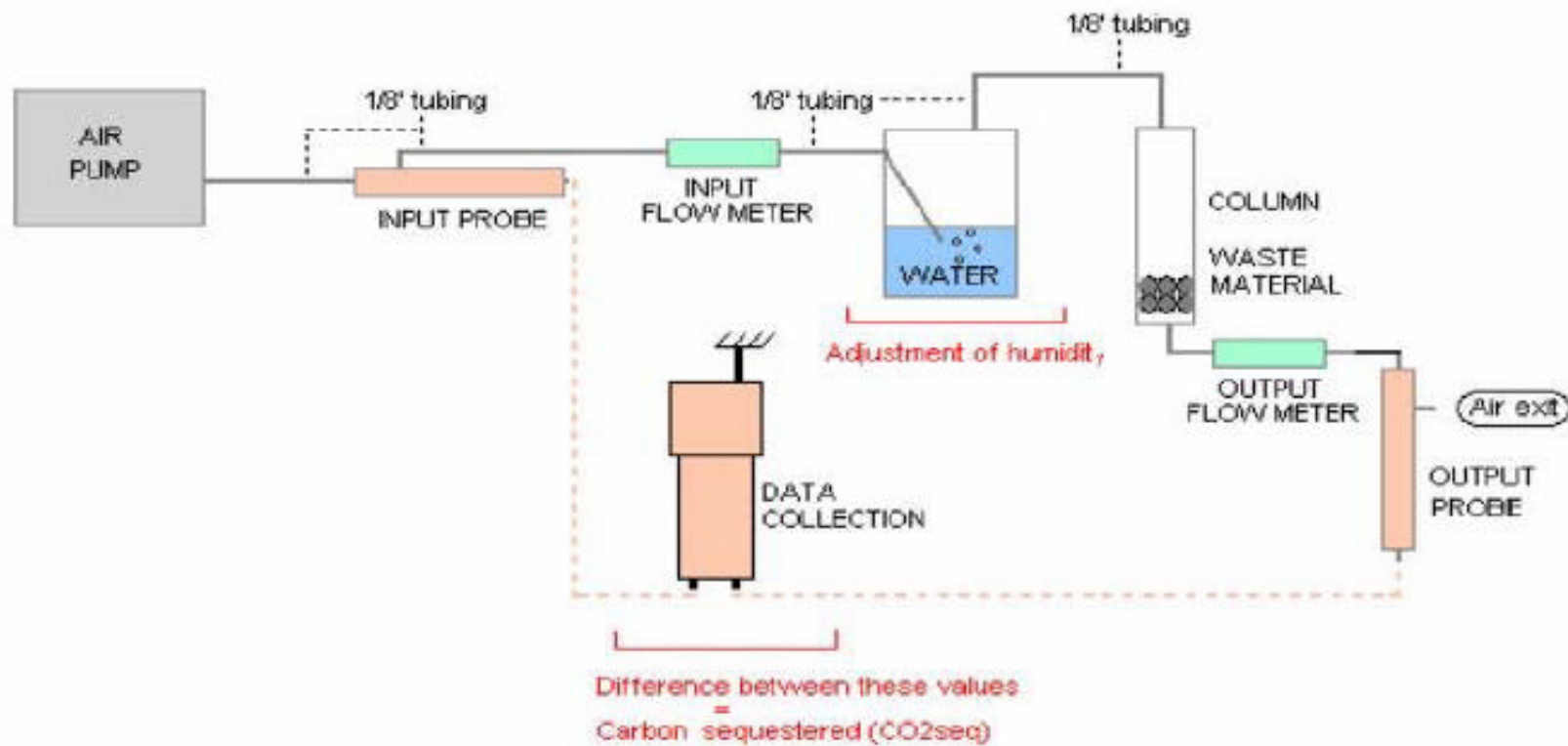
Serpentinization



Recycled Materials

- Similar to mineralization
- Combine CO₂ with CaO- or MgO- rich materials
- Crushed concrete, steel slag, coal fly ash, and Cement kiln dust
- Does not scale well – materials availability
- Can fulfill niche applications

Recycled materials (cont.)



Calcium Carbonate Hydrates

The background of the slide features a stylized globe with a grid of latitude and longitude lines. A compass rose is positioned in the upper right corner, and a satellite dish is visible in the lower right. The overall color scheme is a warm, golden-brown gradient.

Massachusetts Institute of Technology

- Form of Deep Ocean sequestration
- Hydrates being tested
- CO₂ molecules surrounded by calcium carbonate
- Sink at shallower depths
- Stable mineral compounds
- Carries same problems as Oceanic Sequestration

Ultimate Sequestration Goals

The background of the slide features a stylized globe with a grid of latitude and longitude lines, positioned in the upper right quadrant. Below the globe is a compass rose with four cardinal directions indicated by arrows. The entire background is rendered in a warm, golden-brown color palette with a subtle, textured appearance.

- Create a portfolio of Sequestration technologies
- Niche applications, large scale applications
- Affordable solution to Greenhouse Gas emission reduction

Questions?