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# **GHG Emissions Reduction Measurement and Monitoring Methodology for Carbon Capture and Storage Projects in Oil and Gas Reservoirs**

**Nicholas Martin**  
American Carbon  
Registry

**Mahesh Gundappa**  
Blue Strategies

***Stakeholder Consultation Webinar***  
***January 18, 2013***

# Outline

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- Brief background on Winrock and ACR
  - *Nicholas Martin*, Chief Technical Officer ACR
- Key points of the CCS Methodology
  - *Mahesh Gundappa*, Blue Strategies
- Q&A
  - *Mahesh Gundappa, Mike Moore, and Ray Hattenbach*, Blue Strategies
- CCS Methodology is open for public comment through January 31, 2013
  - Webinar feedback will be incorporated along with written comments



# Webinar logistics

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- To ask questions:
  - During presentation, type questions into '**Chat**' box near bottom of your webinar pane
  - Or '**Raise Hand**' (in vertical bar at left of your webinar pane) to hold your place in line to ask a question verbally
  - As a participant, your microphone will be muted until the organizers un-mute you
- Q&A period at end: we will direct written questions to appropriate person, and call on anyone with hand raised
- All public and webinar comments will be addressed and posted with methodology
- Webinar will be recorded and posted shortly to [www.americancarbonregistry.org](http://www.americancarbonregistry.org)



# Winrock International Institute for Agricultural Development

*Non-profit organization that works in the U.S. and around the world to empower the disadvantaged, increase economic opportunity, and sustain natural resources*

- Currently active in 53 countries, implementing over 100 projects with over 1,000 global staff
- Clean energy, agriculture, forestry & natural resources, ecosystem services
- Climate change is a key focus since early 1990s
  - Impacts on livelihoods and food security
  - Technical and registry services



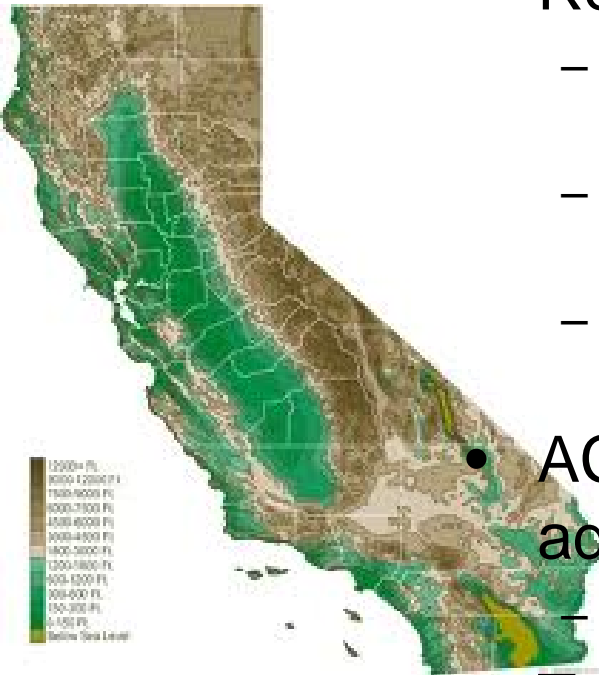
# American Carbon Registry

- **First U.S. voluntary carbon registry**
  - 37.5 MMT CO<sub>2</sub>e verified carbon reductions since 1996
  - Non-profit organization
- **Registry roles:**
  - Develop and approve carbon protocols
  - Review and register projects
  - Oversee independent verification
  - Transparently track transactions and retirements
- **2011:** 2.9 million ERTs sold, retired or contracted at average price of \$5.51/tCO<sub>2</sub>e (range \$1-14)



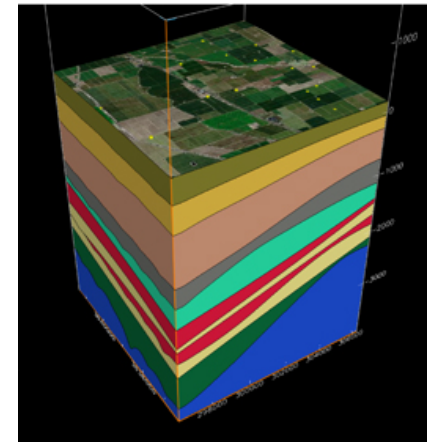
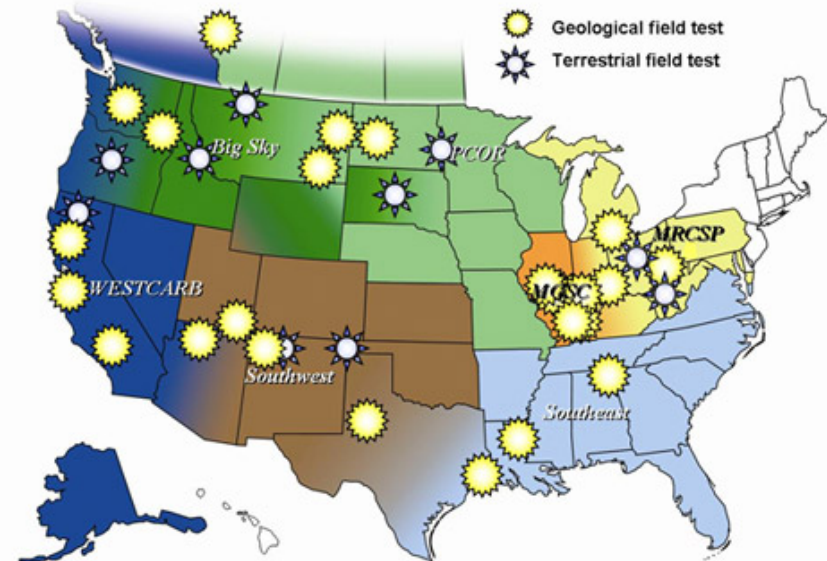
# ACR in California

- Approved in December 2012 as Offset Project Registry for the CA cap-and-trade market
  - Now registering compliance and early action offset projects under CA Air Resources Board-approved protocols
  - Listing, reporting, verification, and issuance of Registry Offset Credits and Early Action Offset Credits
  - See ACR's [California Compliance Offsets page](#) for process, forms, past webinars
- ACR protocols under review as basis for additional compliance offset protocols
  - Rice, fertilizer, livestock, wetlands... CCS?
- Ten years of research for CA Energy Commission, CAL FIRE, and WESTCARB
- Helped inform AB32 Scoping Plan



# Past work on CCS

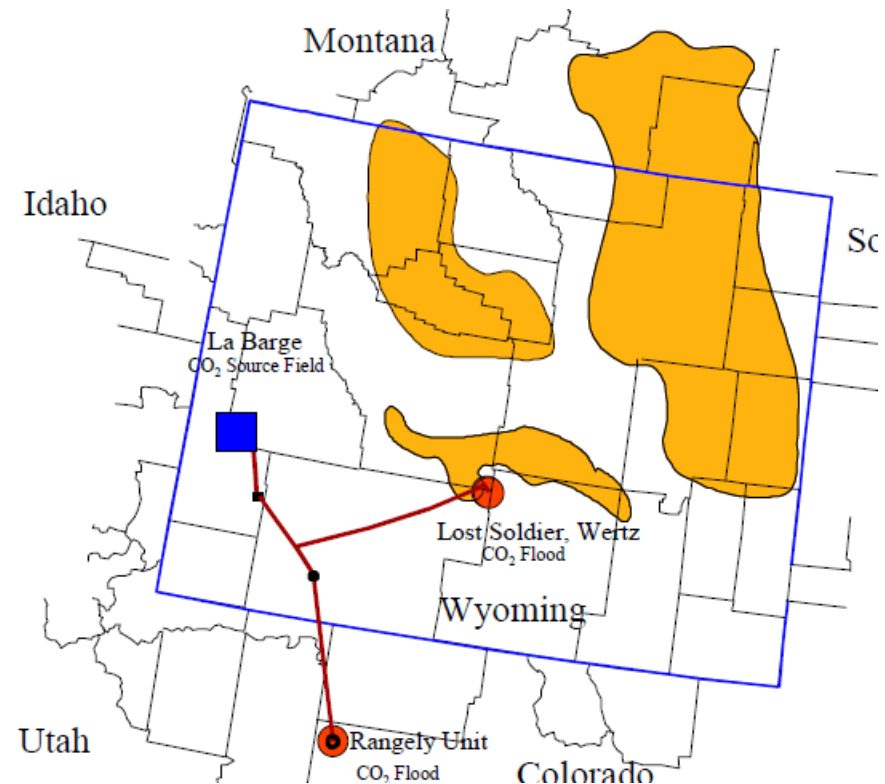
- **USDOE Regional Carbon Sequestration Partnerships**
  - Exploring geologic and terrestrial carbon sequestration opportunities in 7 regional partnerships
  - Winrock led terrestrial work in WESTCARB and SECARB
  - Geologic characterization, CO<sub>2</sub> source and sink mapping, assessment of capture technologies, cost assessment, injection field tests and pilots, public outreach and education
  - Data inputs to the [National Carbon Sequestration Database and Geographic Information System \(NATCARB\)](#)





# Past work on CCS

- **Five CCS projects registered on ACR**
  - Blue Source and Anadarko
  - CO<sub>2</sub> from natural gas processing that is being vented to atmosphere
  - Captured and used for enhanced oil recovery
  - Permanent sequestration in geologic formations
  - Projects result in large volumes of CO<sub>2</sub> sequestered that would otherwise be released





# Greenhouse Gas Emissions Reduction Measurement and Monitoring Methodology for Carbon Capture and Storage Projects in Oil and Gas Reservoirs

**American Carbon Registry Webinar**

January 18, 2013

**Mahesh Gundappa**



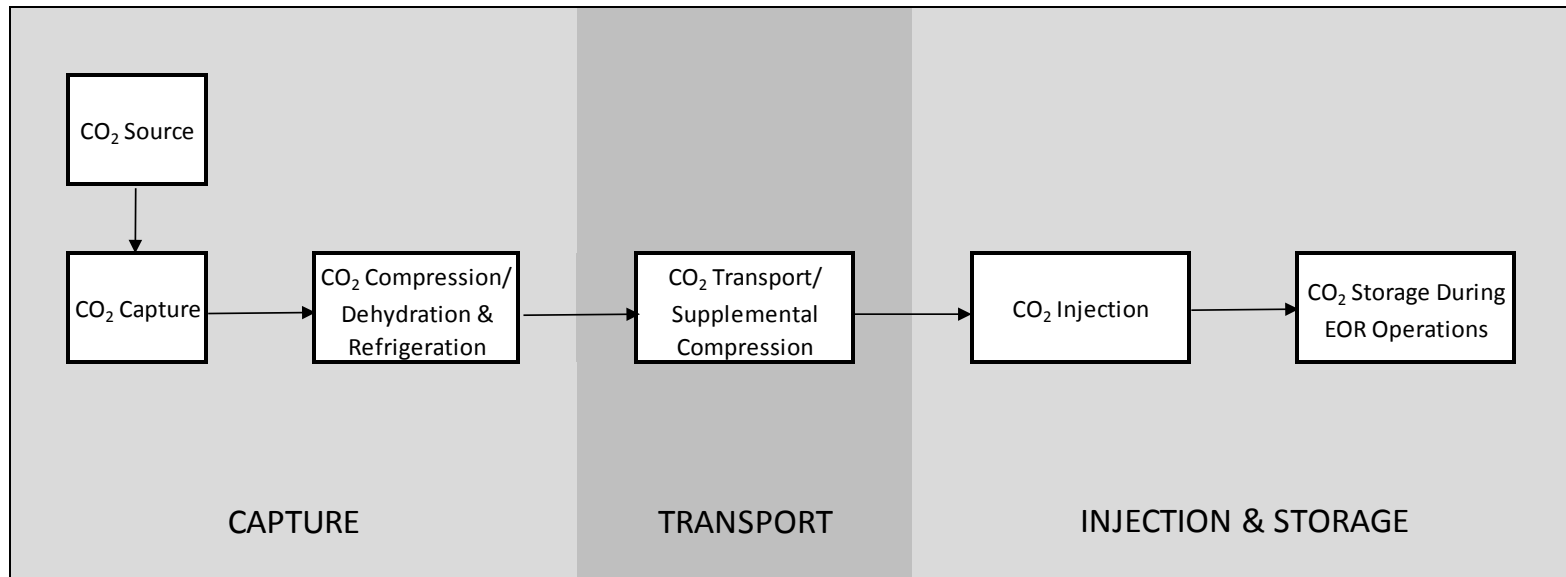
**Blue Strategies**

# Carbon Capture and Storage

- Carbon Capture and Storage (CCS)
  - Separation and capture of CO<sub>2</sub> from emissions of industrial processes or direct air capture (DAC) of atmospheric CO<sub>2</sub>
  - Captured CO<sub>2</sub> is transported for safe and permanent storage of in deep underground geologic formations

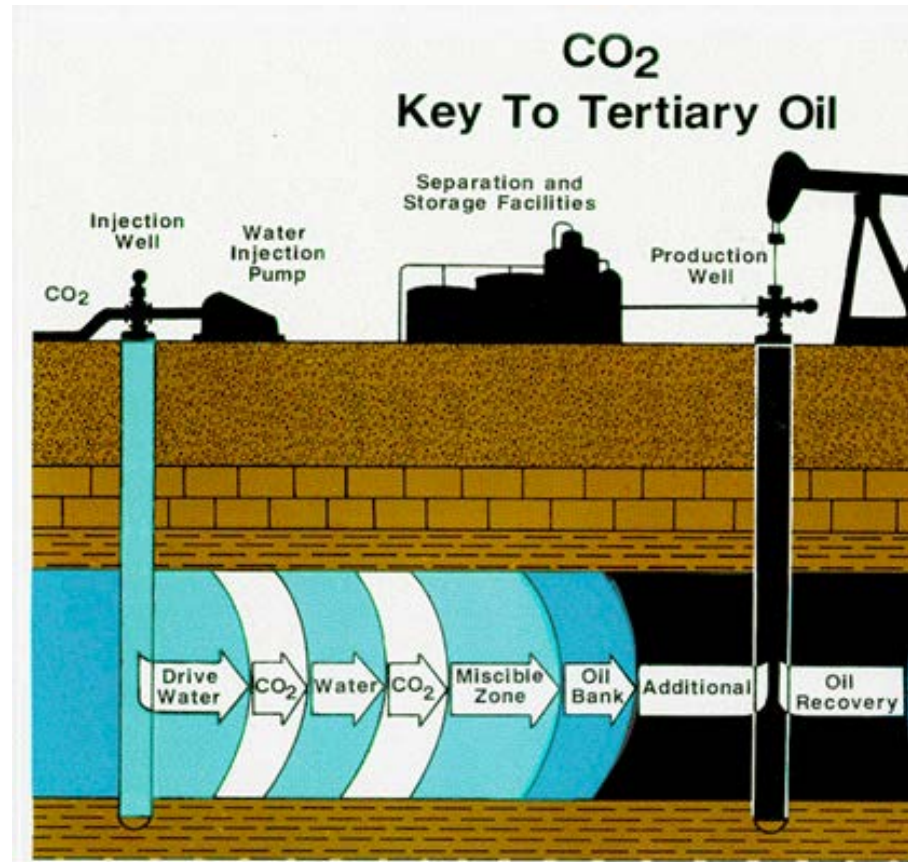
# Applicability

- Methodology applies to CCS projects involving
  - CO<sub>2</sub> capture from industrial sources or DAC systems
  - transport via pipeline, and
  - storage during enhanced oil recovery (EOR) in oil and gas reservoirs



# Applicability (contd.)

## Enhanced Oil Recovery Process



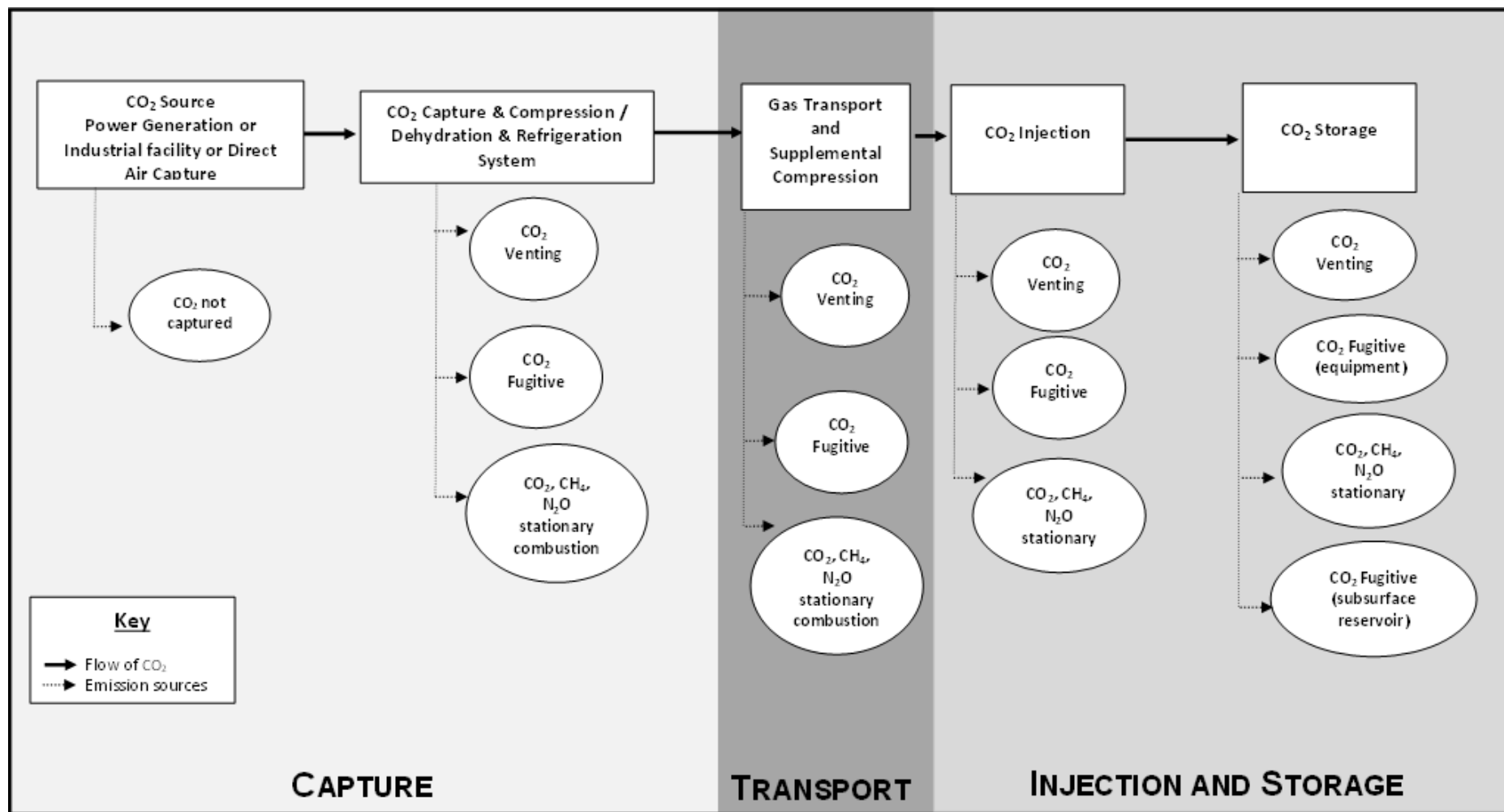
# Applicability (contd.)

- Example Sources include:
  - Power Plants (pre-combustion, post combustion, or oxy-fired technologies)
  - Industrial facilities (e.g., petroleum refineries, gas plants, ethanol production, cement plants)
  - Polygeneration facilities (produce electricity and one or more commercial grade by-products)
  - DAC facilities
- Transport of CO<sub>2</sub> via pipeline

# Applicability (contd.)

- Injection in oil and gas recovery projects
  - to enhance production from hydrocarbon producing reservoirs that have previously produced or are currently producing through the use of primary and secondary recovery processes or
  - to produce from reservoirs that have not produced hydrocarbons through the use of primary or secondary recovery processes but have a potential for hydrocarbon recovery through CO<sub>2</sub> injection in the reservoir
- Methodology does not apply to CO<sub>2</sub> injection in saline aquifers

# CCS Project Boundary





# Temporal Boundary

## Start Date

- Start Date is January 1, 2000 or date when project's captured CO<sub>2</sub> is first injected and stored in the subsurface—whichever is later
- For CCS projects with ongoing EOR operations the start date is the date when custody of the project's captured CO<sub>2</sub> is first transferred to the EOR operator

# Temporal Boundary (contd.)

## Crediting Period

- Crediting Period is 10 years
- Project Proponent can reapply to renew crediting period at the end of each ten-year period

## Project term

- Minimum period for project continuance, monitoring, and verification
  - Entire period of injection
  - 5 years post injection
  - Extend monitoring in 2-yr increments until permanence can be assured based on monitoring and modeling results

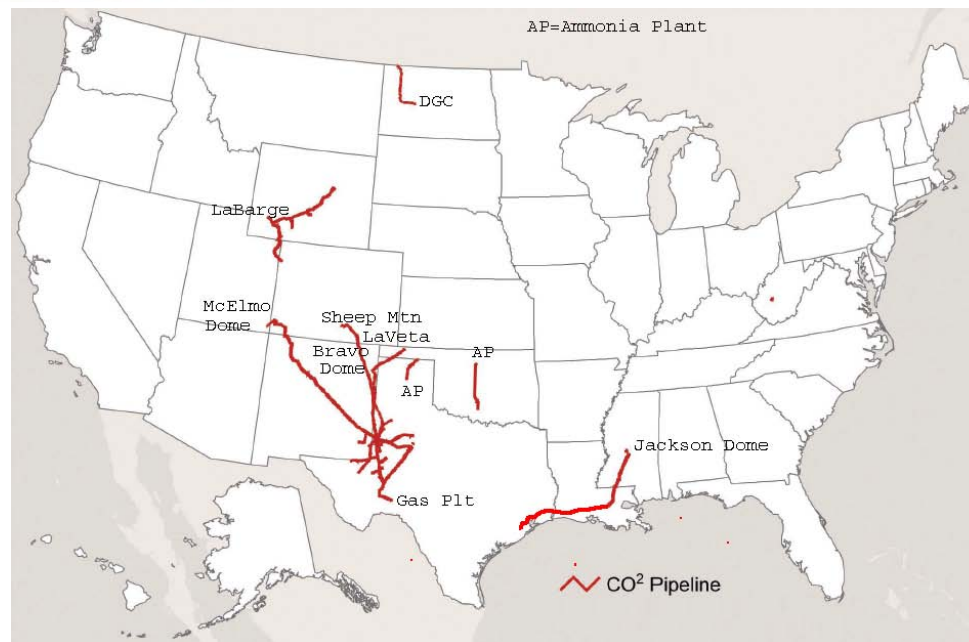
# Baseline Determination

- Projection-based baseline: Baseline corresponds to CO<sub>2</sub> emissions that would have been discharged to the atmosphere absent the capture project- usually applies to retrofit projects
- Standards-based baseline: Usually an intensity metric (tCO<sub>2</sub>e/unit of output) –usually applies when regulations mandate meeting an emissions standard

# Additionality Assessment

- Projects are additional if
  - It passes a regulatory surplus test
    - Project not mandated by existing laws, regulations, statutes, etc. that affect its GHG emission reductions
    - Project proponent must demonstrate that there is no existing regulation that mandates the project
  - Exceeds a performance threshold
    - Practice-based-additional if project activity is not common practice
    - Technology Standard- additional if installed technology is uncommon
    - Emissions Rate or benchmark-additional if project's emissions are lower than an industry sector benchmark

# Additionality Assessment (contd.)



- Only 10 out of an estimated 3,600 industrial plants have CO<sub>2</sub> capture systems installed
- Only 20 percent of CO<sub>2</sub> used for EOR is derived from anthropogenic sources with the remaining 80 percent from natural sources
- Current anthropogenic CO<sub>2</sub> usage rate is <0.5 percent of the estimated total CO<sub>2</sub> emitted to the atmosphere from the industrial plants

# Additionality Assessment (contd.)

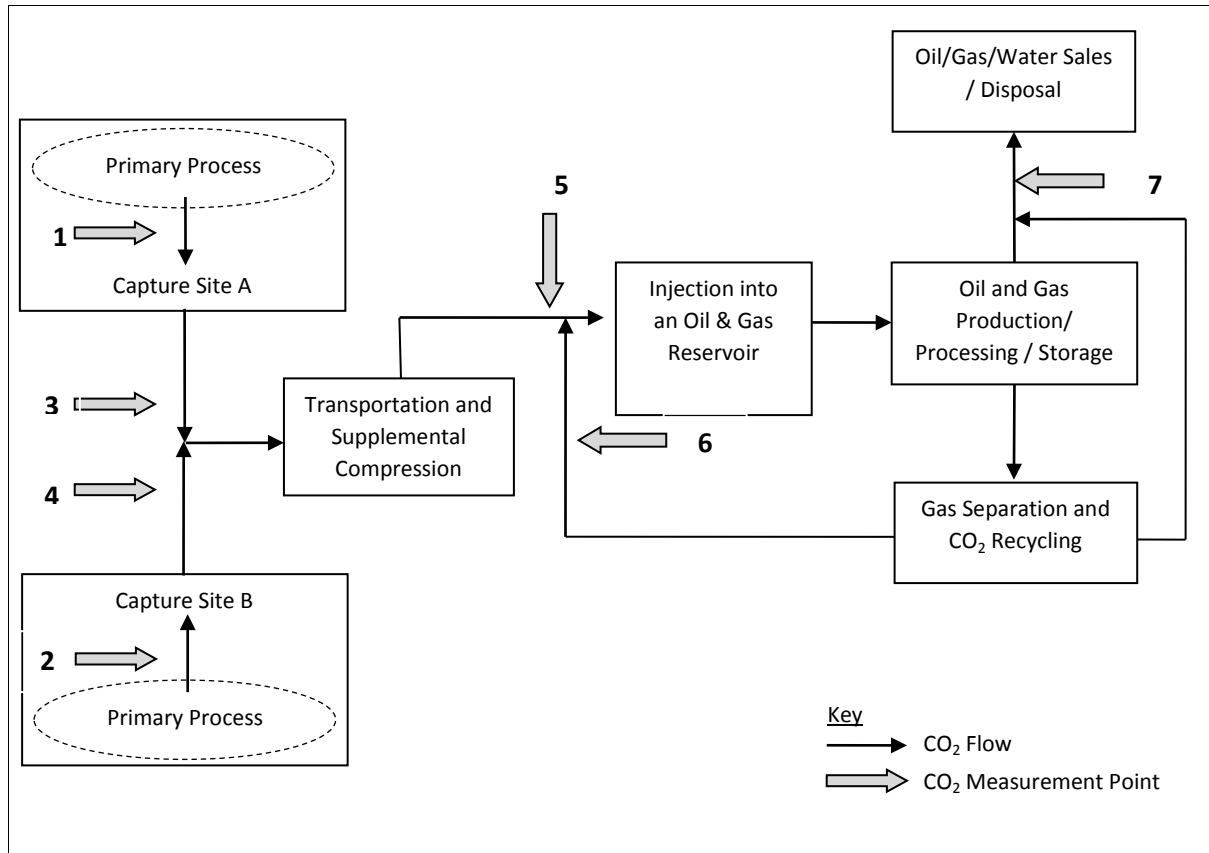
- Adoption rates for Capture technologies are extremely small across various industrial sectors
- Injection of anthropogenic CO<sub>2</sub> in hydrocarbon reservoirs during EOR is not common practice
- Therefore CCS projects with EOR meet a practice-based performance standard

# Quantification Methodology

- Consistent with the accounting framework developed by the *Center for Climate and Energy Solutions* (formerly the Pew Center on Global Climate Change)
- Calculation procedures
  - Baseline emissions (projection-based or intensity-based)
  - Project emissions (capture, transport, and storage segments)
  - Project emission sources include stationary combustion, vented and fugitive, electricity and steam usage
  - GHG gases include CO<sub>2</sub>, CH<sub>4</sub>, and N<sub>2</sub>O
  - Consistent with industry practices and EPA reporting requirements



# Data Collection, Monitoring, and Reporting



# Data Collection, Monitoring, and Reporting

- Monitored Parameters include:
  - CO<sub>2</sub> flow rate and concentration
  - Fuel mass/volume and composition
  - Electricity and/or steam usage
  - Equipment blowdown events (volume, duration, GHG composition)
  - Major equipment counts (headers, separators, etc.)
  - Additional parameters per subsurface monitoring, reporting and verification (MRV) plan
- QA/QC
  - Calibrations of flow meters and analyzers consistent with USEPA requirements and industry best practices
  - Data collection procedures to include periodic data review checks for accuracy, completeness, and consistency

# Monitoring, Reporting, and Verification Plan

- Projects to include a MRV plan to assure permanence of injected CO<sub>2</sub> in oil and gas reservoir
- MRV plan is site-specific
- Typical EOR MRV plan includes
  - Site characterization
  - Baseline Monitoring
  - Operational Monitoring
  - Post-injection Monitoring

# Emissions Ownership and Quality

- Only direct emissions reductions allowed
- Ownership of emission reductions
  - Title must be clearly defined through contract
  - Chain of custody of CO<sub>2</sub> among parties involved in the capture, transport, and storage segments must be documented
- Permanence
  - MRV plan with site-specific monitoring and modeling
  - Post-injection phase monitoring and model predictions
  - Remediation plan should leakage occur

# Emissions Ownership and Quality (contd.)

- Liability

- Evaluate risks of leakage (migration through well bores, fractures, or faults)
- Implementation of safety plan per permit requirements
- CO<sub>2</sub> plume well-characterized through modeling and measurement during injection period
- Small releases during injection period reconciled through accounting
- Private insurance to cover reversals in GHG emission reductions

- Pore space ownership

- Being addressed by State laws which are still evolving
- For EOR projects the right to inject and use the oil and gas reservoir is contained in the oil and gas lease
- Surface rights during post-injection period will be required to conduct monitoring

# Emissions Ownership and Quality (contd.)

- Community and Environmental Impacts
  - Evaluate impacts and develop a mitigation plan for any foreseen negative impacts
  - If environmental assessment are required (e.g., EA or EIS) provide those documents to the registry
  - Disclose in annual attestations any negative impacts or claims of negative impacts by local community

# CCS Methodology

- Questions?
- Further Information

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# Thank You!