

# Update on Developing a Class VI Geotechnical Training Course

Presentation on behalf of committee:

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# Training program goals

- Provide training and information for permit writers and regulators needed to “fill gaps” in knowledge between other well class applications and Class VI applications.
- Work in concert with training provided by EPA
  - Provide context and background
  - Link to other sources of information
  - Review case studies
  - Work with problems “hands on”
- Hear from you what you need and want!

# This year's progress

- Outline of curriculum approved and published
- Working group formed to design training implementation
- Survey of prospective users - we want both in person and on-line options
- Development of slide deck started
- Development of GWPC project Class VI-CCUS Library which will fill need of Module 2
- Waiting for funding from EPA to add detailed content
- Roll out

# Modules in development

1. Programs Overview

2. The Annotated "Bookshelf"

3. Properties and Characteristics of CO<sub>2</sub>

4. Storage Site Characterization

5. Fluid Flow Modelling

6. Site Specific Risk Analysis

7. Monitoring Plans

8. Well Construction and Pre-injection Testing

9. Evaluating monitoring and Testing During Injection

10. Leakage and Corrective Action/ Remediation Plans

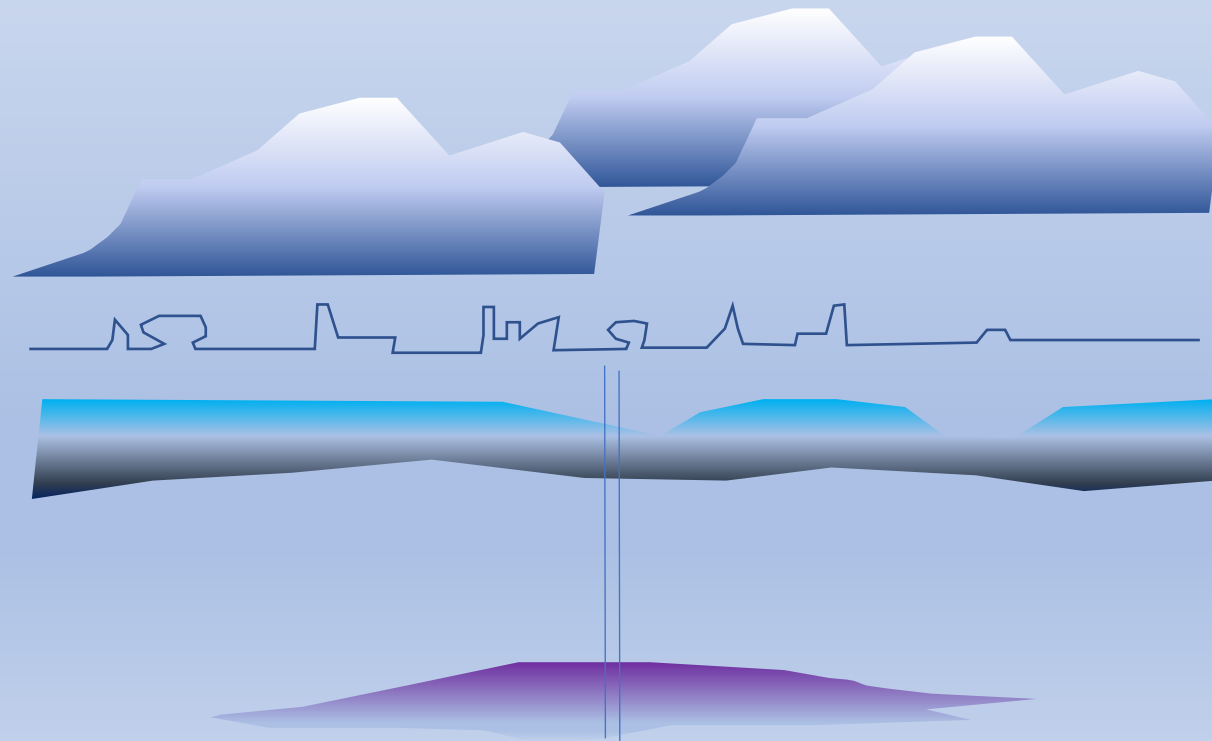
11. Closure and Post Injection Site Care (PISC)

12. Class II EOR vs. Class VI Storage of CO<sub>2</sub>

13. Financial Assurance

# Module 1: GreenHouse gas (GHG) and Underground injection control (UIC) programs

- **Module 1 is a high-level overview of the intersection between the EPA's GreenHouse Gas (GHG) and the Underground Injection Control (UIC) programs. It includes discussions about:**
- **GHG Program goals**
- **UIC Program goals**
- **Influencing drivers**
- **Stakeholder interaction**



# Module 2: The annotated “Bookshelf”

Module 2 covers a “Bookshelf” of reference materials from, introductory to advanced, students can use during permit review such as:

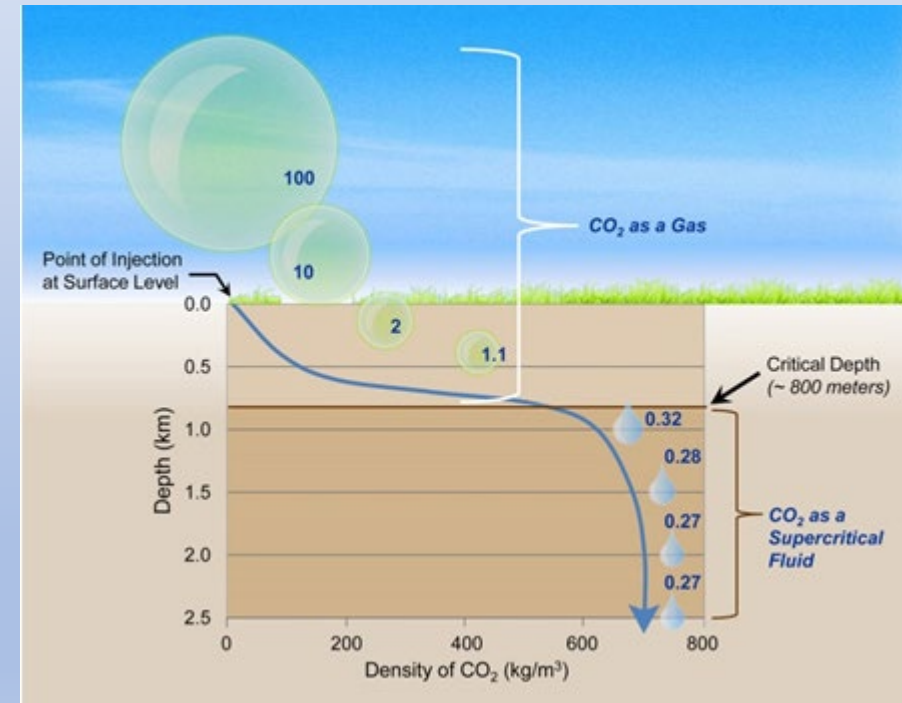
- National Petroleum Council Dual Challenges 2019 Report
- International Energy Agency GHG Program Report
- Department of Energy Reports
- EPA Class VI Rules and Guidance's
- Rules of current Class VI Primacy States
- Books, studies and reports from numerous sources



# Module 3. Properties and characteristics of CO<sub>2</sub>

Module 3 covers specific properties and characteristics of CO<sub>2</sub> as they relate to permitting and includes discussions of:

- The carbon cycle
- CO<sub>2</sub> phase behaviors
- CO<sub>2</sub> HS&E Issues
- CO<sub>2</sub> Dissolution in water
- CO<sub>2</sub> Reactivity with rock
- CO<sub>2</sub> Reactivity with well materials
- Isotopes of CO<sub>2</sub>
- Complex CO<sub>2</sub>-fluid interactions



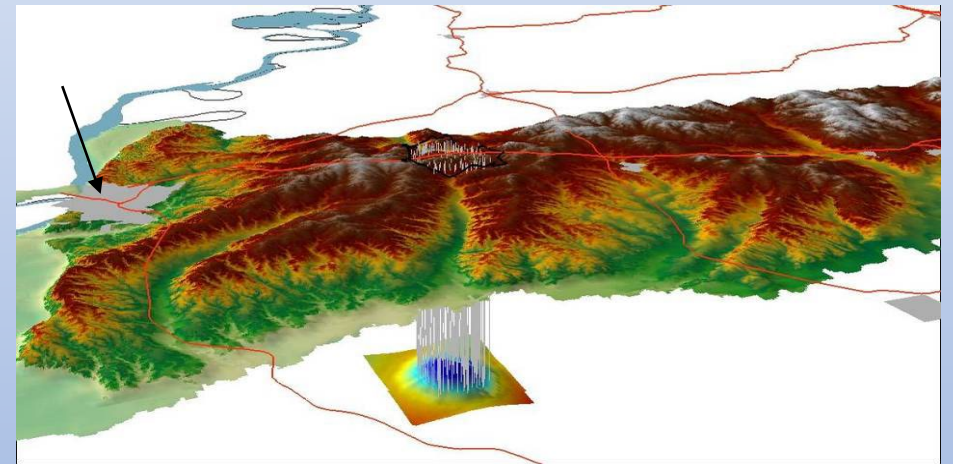
<https://netl.doe.gov/carbon-management/carbon-storage/faqs/carbon-storage-faqs>



# Module 4. Storage site characterization

Module 4 covers the characterization of sites and includes:

- How the geologic system interacts with injected CO<sub>2</sub>
- The parts of a static model
- The data sources used in a static model
- Leakage risks
- Boundary conditions
- Induced seismicity
- Overburden, groundwater, surface characterization
- Questions to ask an operator



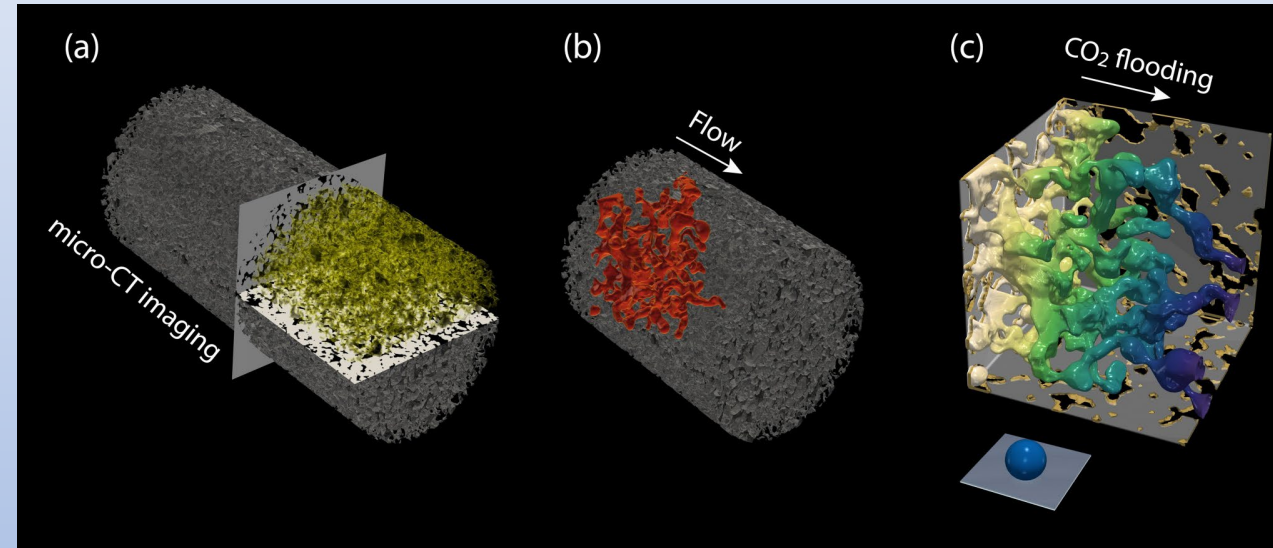
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# Module 5. Fluid flow modelling

Module 5 covers the principals of fluid flow modelling from the standpoint of permit review and contractor oversight including:

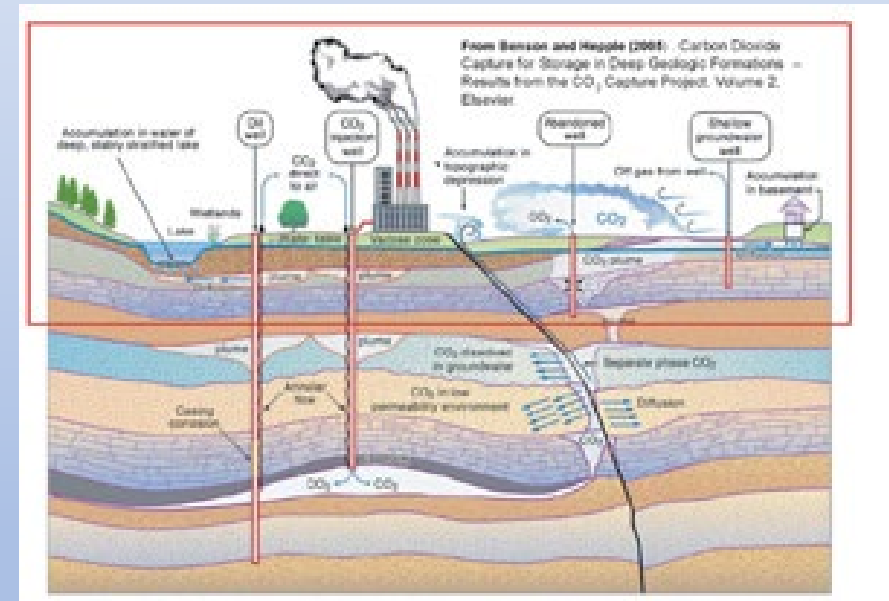
- The basics of fluid flow modelling
- Evaluating model components
- Evaluating storage capacity
- Extracting plumes and AoR's
- Projecting future CO<sub>2</sub> migration
- Updating static and fluid flow models
- Evaluating model cost vs. value
- Model calibration sufficiency
- Evaluating the model contractor
- Updating models



# Module 6. Site specific risk analysis

Module 6 provides a framework for assessing risk at a specific site including:

- Components and goals of risk assessment
- The use of consequence and probability
- Potential leakage mechanisms
- Geomechanical risks
- Using models in risk analysis
- Using risk analysis to drive monitoring plans
- Questions to ask an operator
- Using risk management to set permit conditions

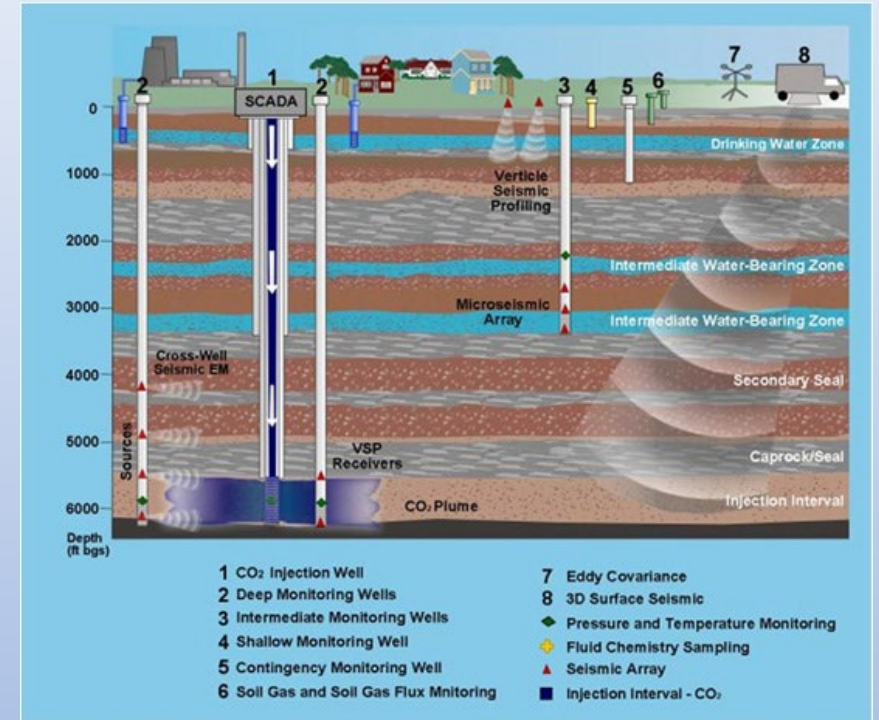


<https://archive.epa.gov/ada/web/html/gsc.html>

# Module 7. Monitoring plans

Module 7 covers the design of monitoring plans including:

- Monitoring goal setting
- Importance of using monitoring to validate models
- Lining up monitoring tools with risks
- Methods for evaluating operator plans
- Tool density, frequency, installation & calibration
- Monitoring tools at depth
- Well based monitoring methods
- Quality control in monitoring
- Monitoring in overburden
- Monitoring in groundwater, surface water, atmosphere & ecosystem

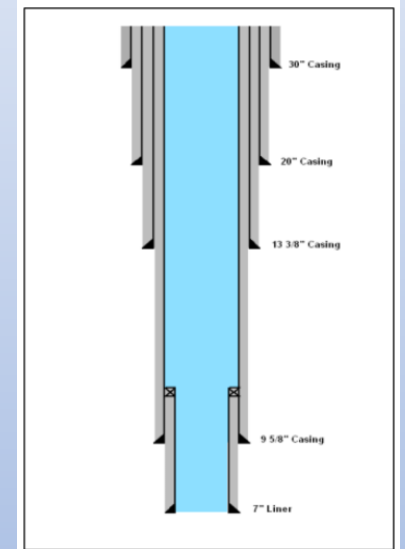


<https://www.e-education.psu.edu/meteo469/node/223>

# Module 8. Well construction and pre-injection testing

**Module 8 covers well construction and pre-injection testing including:**

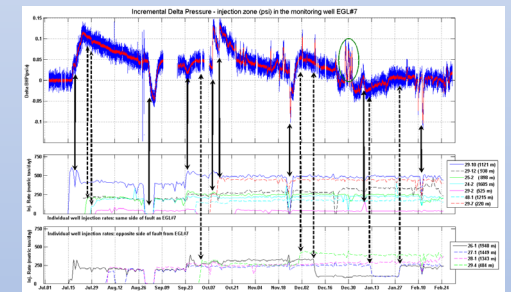
- **Construction requirements for Class VI wells**
- **Monitoring wells**
- **Deviations from original construction design**
- **Using completion reports to evaluate construction**
- **Updating and reevaluating characterization plans**
- **Bringing as-built construction in line with permitted construction**
- **Authorizations to inject**



# Module 9. Evaluating monitoring and testing during injection

Module 9 covers what to do with monitoring and testing results including:

- Detailing the requirements of Class VI well and Part RR monitoring
- Review updates to monitoring plans
- Evaluate the need for mid-course corrections
- Using monitoring to update modelling
- Responses to observed above-zone or surface changes
- Updating designs proposed in the planning stages



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# Module 10. Leakage and Corrective action/ remediation plans

Module 10 is a discussion of how a successful project will prevent CO<sub>2</sub> leakage outside of the injection zone and avoid triggering remediation and induced seismicity including:

- The consequences of CO<sub>2</sub>/ brine leaks
- Insipient and future loss indicators and seismic probabilities
- Evaluating how bad a leak can get
- Determining the consequences of a leak from the operation
- Determining when remediation is needed
- What goes into a remediation plan
- How to conduct a review and remediation plan
- How to define the metrics of remediation plan success



<https://fotospot.com/attractions/utah/crystal-geyser>



# Module 11. Site Closure and post injection site care (PISC)

Module 11 covers the closure and post injection site care (PISC) period. This involves the long-term retention of CO<sub>2</sub> and includes:

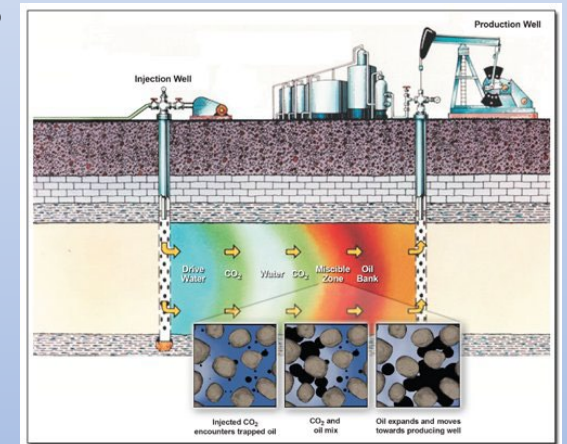
- Approaches to assessment at the end of injection and work needed to reach the end of the project
- Indicators of risk
- PISC monitoring approaches
- Flags that demonstrate failure to reach goals
- Long-term monitoring of wells and potential remediation
- Additional needs for well evaluation at the end of injection
- Well monitoring options during the PISC period
- Requirements for ending the PISC period





# Module 12. Class II EOR vs. Class VI storage of CO<sub>2</sub>

- Module 12 compares CO<sub>2</sub> storage in an Enhanced Oil Recovery (EOR) and a saline aquifer project including:
- Differences between storage in both types of projects
- The basics of EOR
- Modelling approaches in EOR
- Monitoring options in EOR
- EOR accounting
- Requirements for transitioning from Class II to Class VI

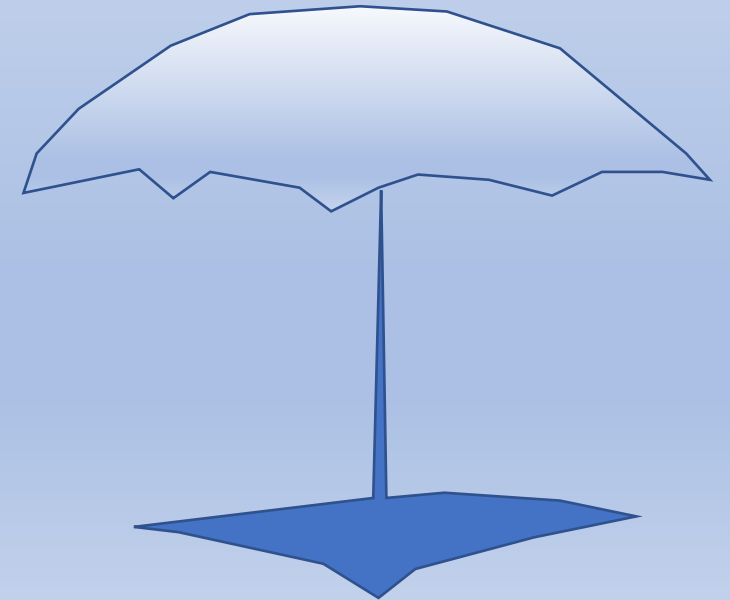


<https://www.energy.gov/fecm/enhanced-oil-recovery>

# Module 13. Financial Assurance

**Module 13 covers financial assurance elements of Class VI projects including:**

- **How to conduct costing estimates for a Class VI project**
- **Risk assessment as it relates to financial assurance**
- **Various financial instruments available**
- **Requirements for releasing financial assurance**
- **Elements of long-term stewardship.**



# We welcome your advice and input!

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