RCSP Regional Carbon Sequestration Partnerships

Water Working Group

RCSP Water Working Group (WWG): The Nexus of Water and Carbon Capture and Storage

Carbon Management Technology Conference
October 23, 2013

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Energy & Environmental Research Center (EERC)

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Regional Carbon Sequestration Partnerships (RCSPs)

- Engage regional, state, and local governments
- Determine regional storage benefits
- Baseline region for sources and sinks
- Establish monitoring and verification protocols
- Address regulatory, environmental, and outreach issues
- Validate storage technology and infrastructure

Developing the Infrastructure for Wide-Scale Deployment

WWG Managed by PCOR Partnership

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- Plains CO_2 Reduction (PCOR) Partnership
- Public and private sector stakeholders
- PCOR Partnership managed by the Energy & Environmental Research Center (EERC) at the University of North Dakota in Grand Forks, North Dakota

RCSP Water Working Group

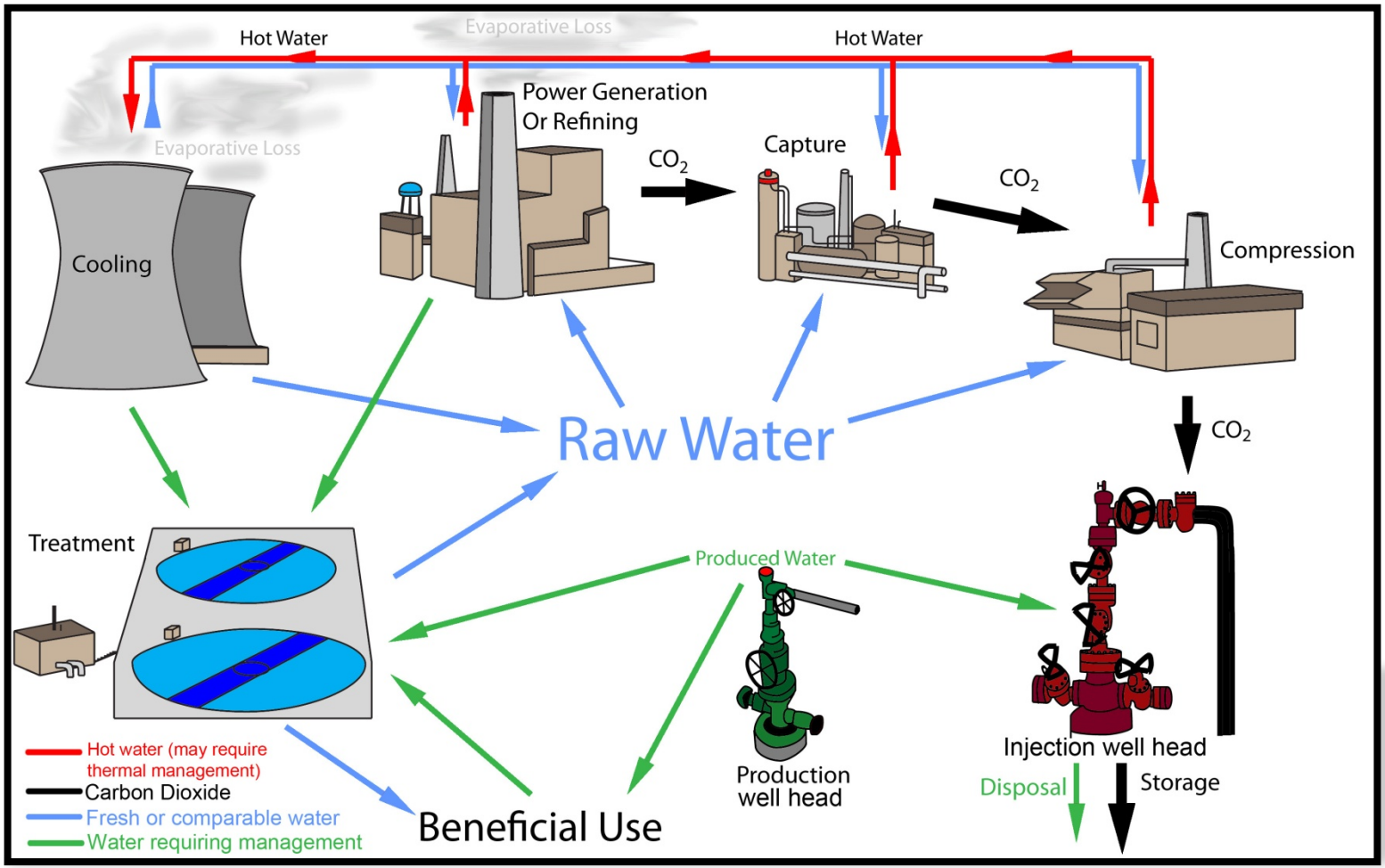
Regional Carbon Sequestration Partnerships

- RCSP WWG
  - Composed of experts from government, academia, and industry.

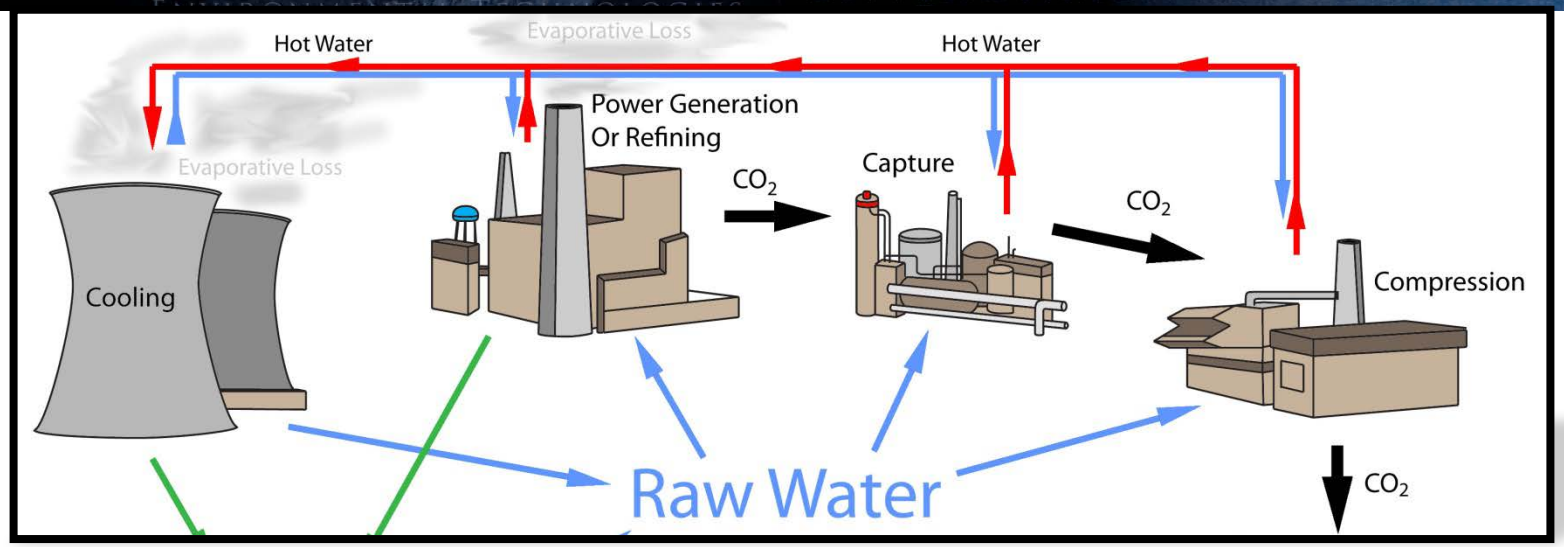
- Mission statement
  - Address stakeholder concerns regarding emerging carbon capture and storage (CCS) technology and potential interactions with local and regional water resources.

Carbon Capture and Storage

The Water and CCS Nexus



Water and Carbon Capture



- Capture
- Compression
- Transportation

- Additional resources
  - Water: cooling, process water
  - Power
    - Replace power diverted to capture and compression

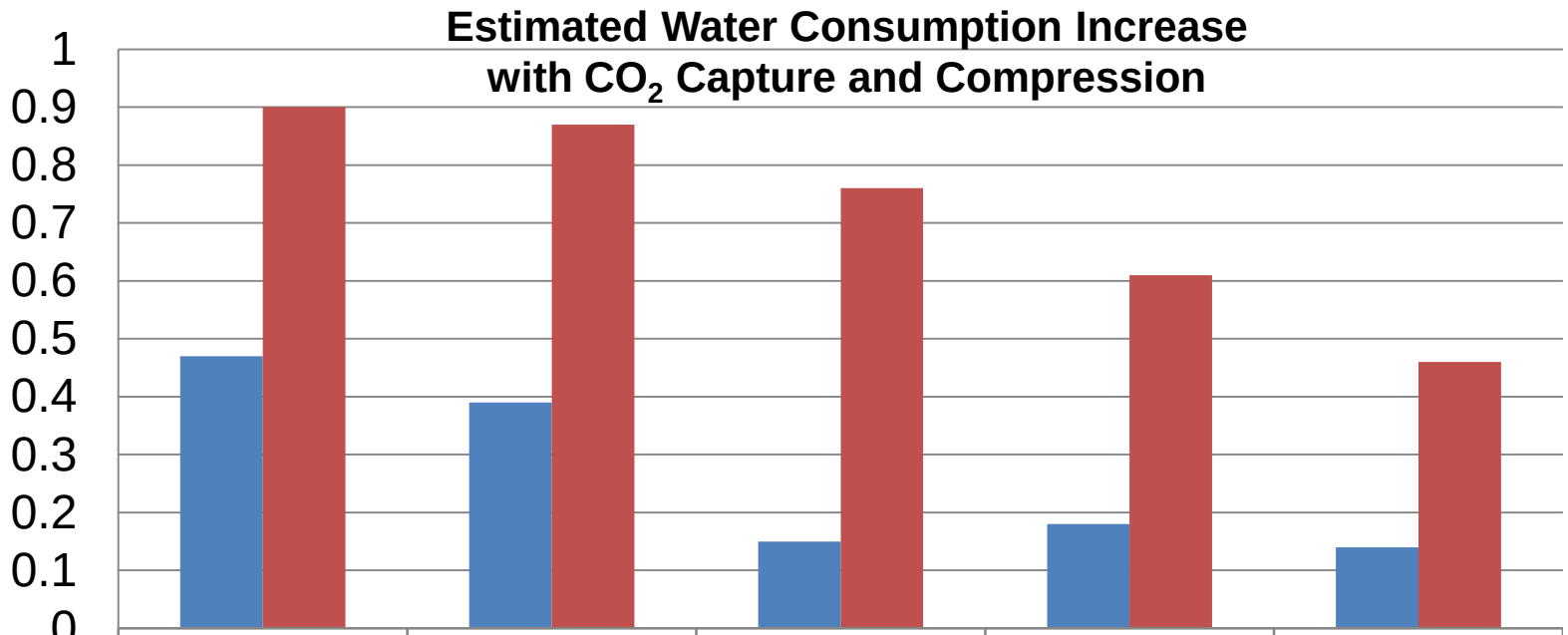
Water and Carbon Capture

Amine Scrubber
Chemical

- Chemical or physical absorption
  - 15%–30% water increase
    - Additional cooling
    - Solvent/sorbent regeneration
    - Process specific subprocesses

Selexol™ Scrubber
Physical

Water and Carbon Capture



	Subcritical pc	Supercritical pc	NGCC	IGCC - dry feed	IGCC - slurry feed
gal/kWh	0.47	0.39	0.15	0.18	0.14
Fraction of total	0.90	0.87	0.76	0.61	0.46

Source: Gerdes, K.; Nichols, C. *Water Requirements for Existing and Emerging Thermoelectric Plant Technologies*; DOE/NETL Report 402/080108; U.S. Department of Energy National Energy Technology Laboratory: Morgantown, WV, 2009.

Water and Compression and Transportation

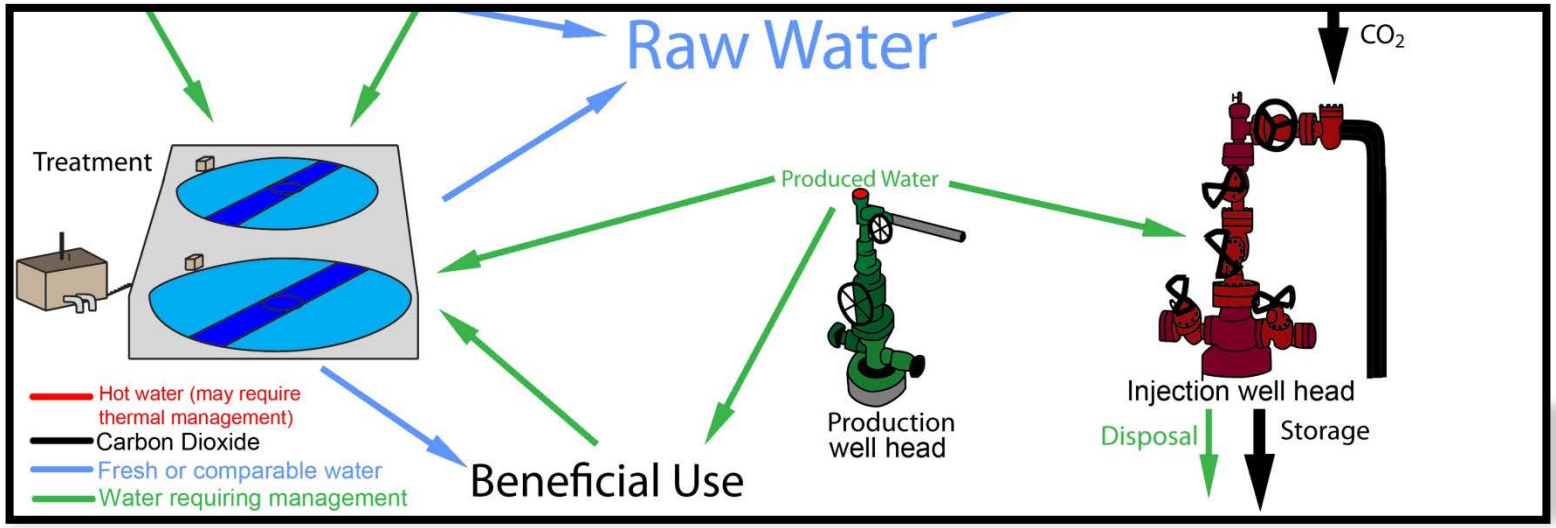
- Compressors represent a considerable additional energy load to a facility (generally 8%–10%).
- Additional cooling for lost power makeup and to cool compressed CO_2 between compressor stages.
  - Adds about 0.01 gal/kWh of energy produced by the power plant to the total water consumption*

*Bennett, B.; Ramezan, M.; Plasynski, S. Impact of Carbon Capture and Sequestration on Water Demand for Existing & Future Power Plants. Presented at the Sixth Annual Conference on Carbon Capture & Sequestration, Pittsburgh, PA, May 2007.

Optimizing Carbon Capture and Transportation Water Use

- Efficient process design
  - Update existing facilities
  - New technologies (e.g., compression)
- Alternative cooling technologies
- Alternative (degraded) water sources

Water and Carbon Storage



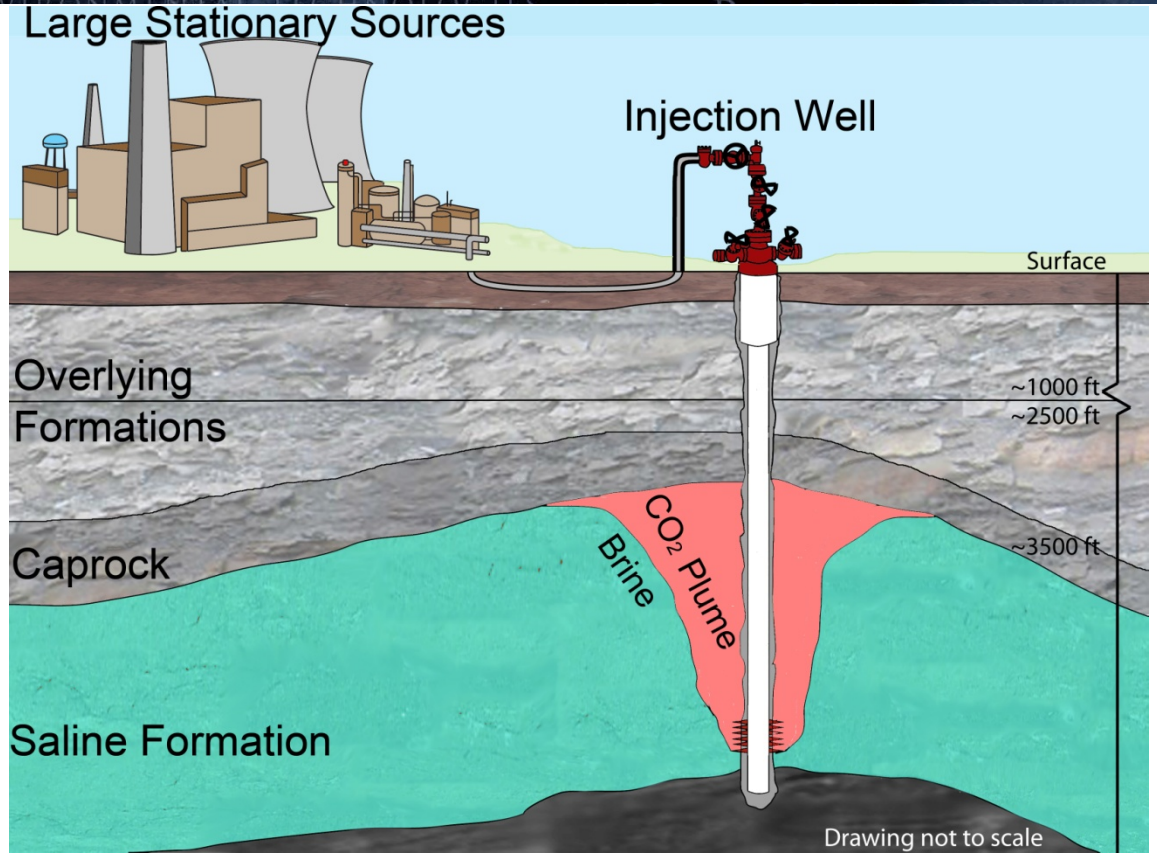
- Storage formations almost certainly contain water.
  - Not suitable for drinking water (total dissolved solids [TDS] >10,000 ppm)
  - Potential for additional water resource (produced water associated with carbon storage)

Water and Carbon Storage

- Water resources.
  - Protect drinking water sources
  - Minimize brine mobilization

- Proper site characterization and selection along with monitoring, verification, and accounting (MVA) and appropriate regulatory compliance will ensure these goals are met.

Water and Carbon Storage



- Storage targets and water
  - Oil/gas reservoirs, coal seams, saline aquifers
- Each represents unique storage environments

Extracted Water

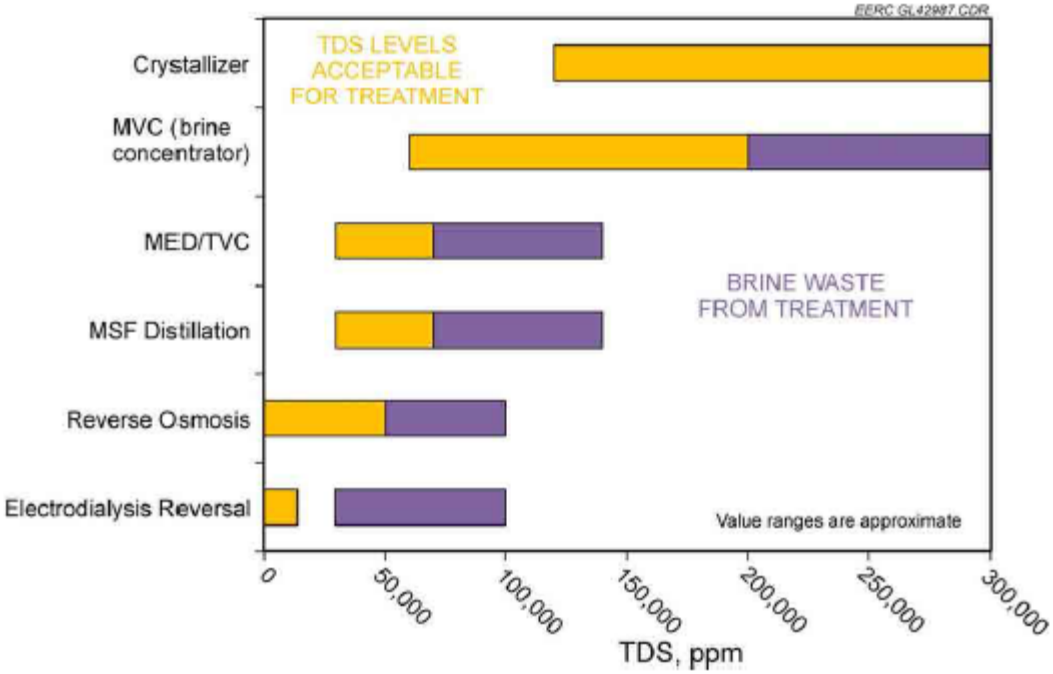
- Typically water extraction is expected to be avoided.
- Reasons water may be extracted from storage activities:
  - Enhanced recovery
  - Increased storage volume
  - Increased plume management control

Extraction Water

- Management strategies
  - Reinjection
  - Minimal treatment for beneficial use
  - Substantial treatment for beneficial use

Options for Extracted-Water Management

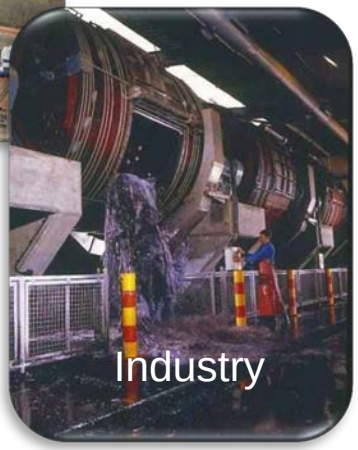
- Water quality potential for extracted water:
  - TDS range = low to very high.
- Water quality needed for beneficial use:
  - Most uses require lower TDS concentrations.
- Water treatment processes:
  - Desalination methods would be used to match extracted water quality to water quality needs.



Extracted-Water Treatment Technologies

- Managing salinity
  - Reverse osmosis
  - Forward osmosis
  - Membrane filtration
    - ♦ Micro-, ultra-, and nanofiltration
  - Electrodialysis, electrodialysis reversal
  - Thermal treatment
    - ♦ Crystallizer, mechanical vapor compression/recompression, multieffect distillation, industrial evaporation, solar evaporation, freeze–thaw evaporation
  - Ion exchange and other deionization (e.g., Higgins Loop™)

CCS Produced Water – Beneficial Use Potential



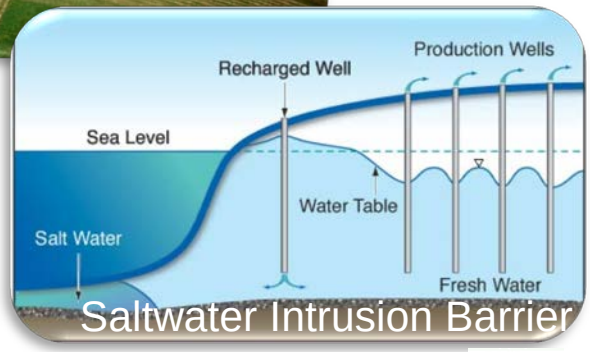
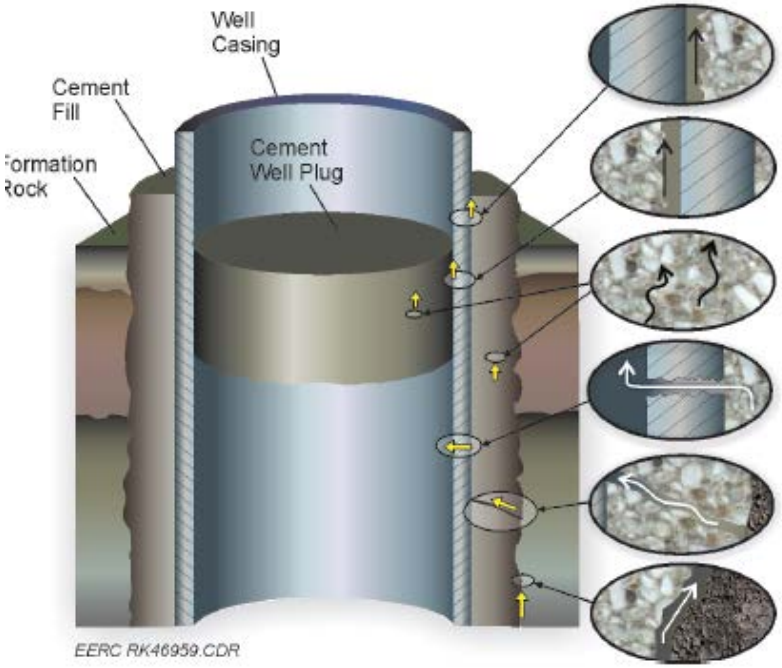
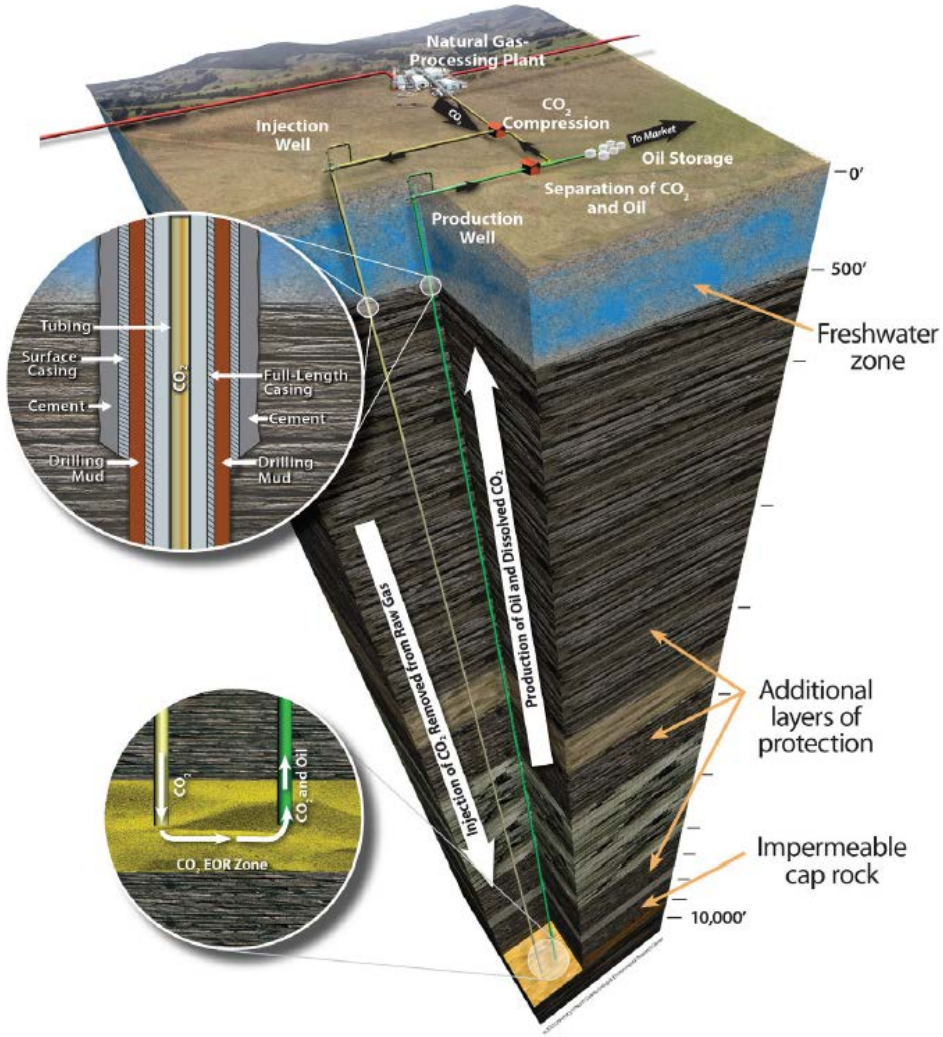


Diagram courtesy of Solinst

Water Resource Protection





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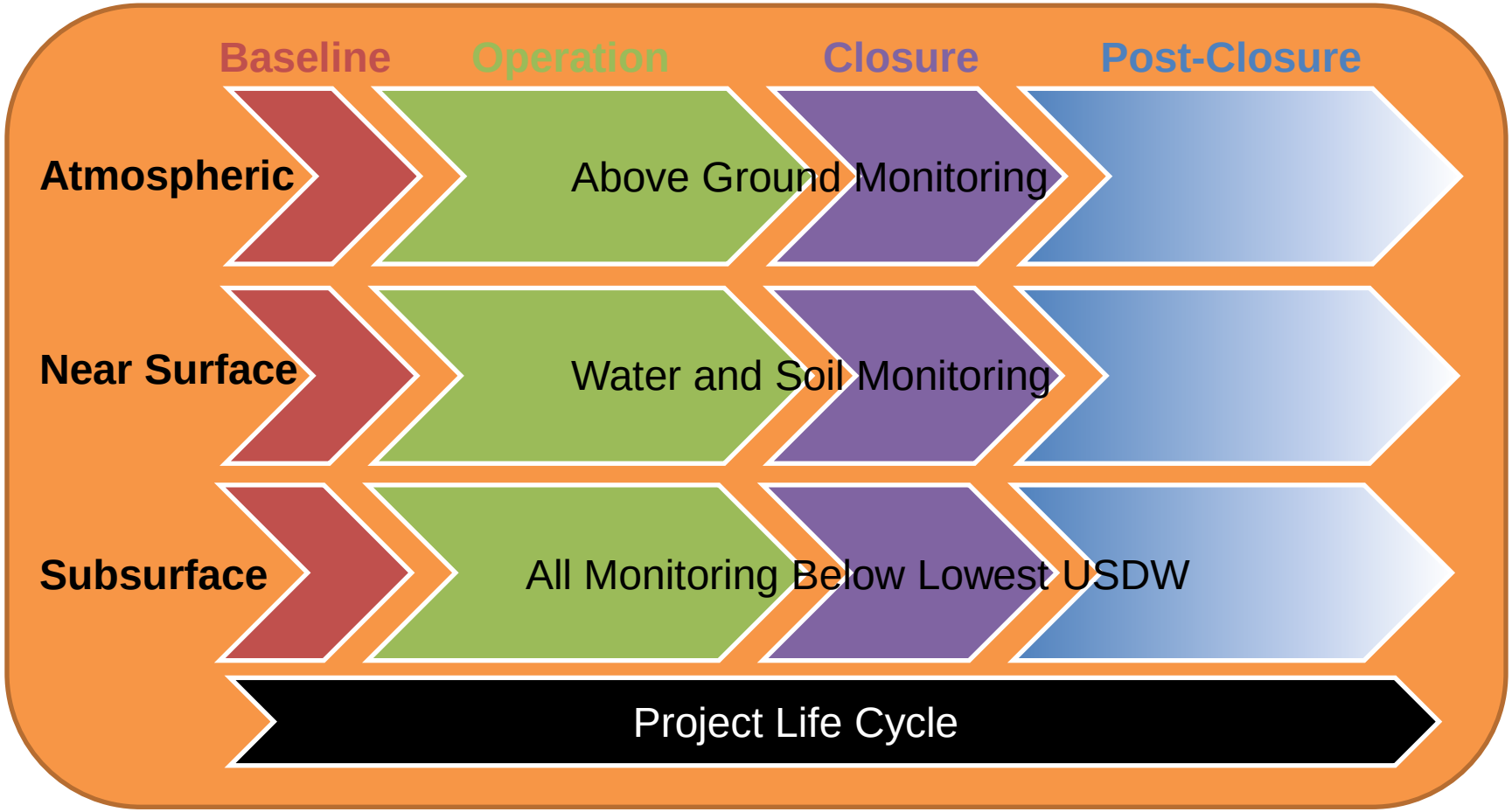
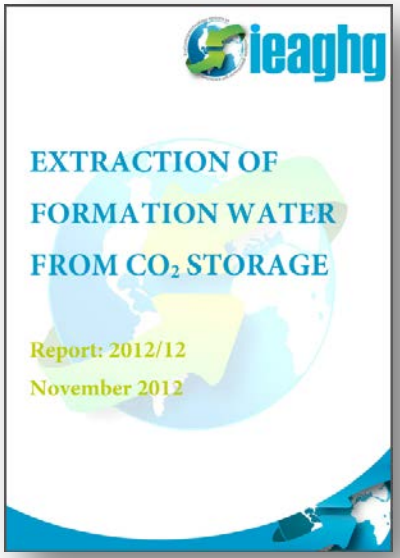


Water Monitoring

- Imperative to any CCS operation.
- Establish baseline conditions for naturally occurring CO_2 levels present in surface water and shallow groundwater aquifers in the vicinity of the carbon storage formation.
- Provide a source of data to show that surface environments remain unaffected by fluid or gas migration and to identify the source and quantify the impact of an out-of-zone migration event should it occur.

Additional Information

Fact Sheets



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