

WEST COAST REGIONAL CARBON SEQUESTRATION PARTNERSHIP
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WESTCARB Phase II Kickoff

Geologic Storage Pilots

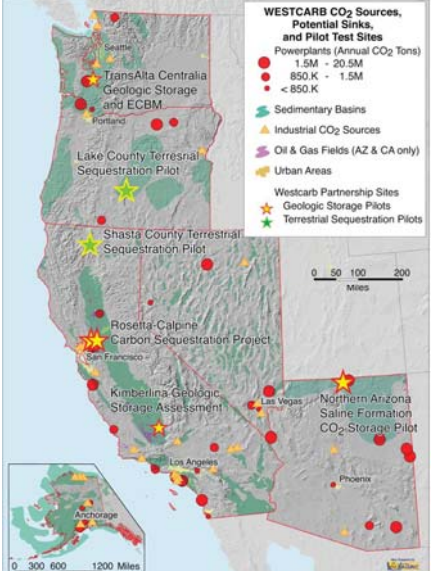
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WESTCARB Geologic Storage Pilots

- Rosetta-Calpine Carbon Sequestration Project
- Northern Arizona Saline Formation CO₂ Storage Pilot
- Kimberlina Geologic Storage Assessment
- TransAlta Centralia Geologic Storage and ECBM Assessment



WESTCARB CO₂ Sources, Potential Sinks, and Pilot Test Sites

Powerplants (Annual CO₂ Tons)

- 1.5M - 20.5M
- 850.K - 1.5M
- < 850.K

Sedimentary Basins

Industrial CO₂ Sources

Oil & Gas Fields (AZ & CA only)

Urban Areas



Westcarb Partnership Sites

- Geologic Storage Pilots
- Terrestrial Sequestration Pilots

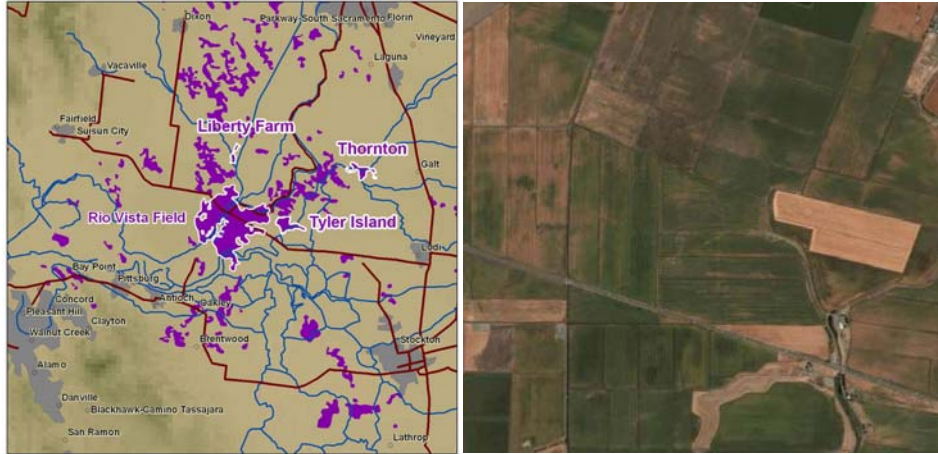
0 50 100 200 Miles

0 300 600 1200 Miles

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Rosetta-Calpine Carbon Sequestration Project



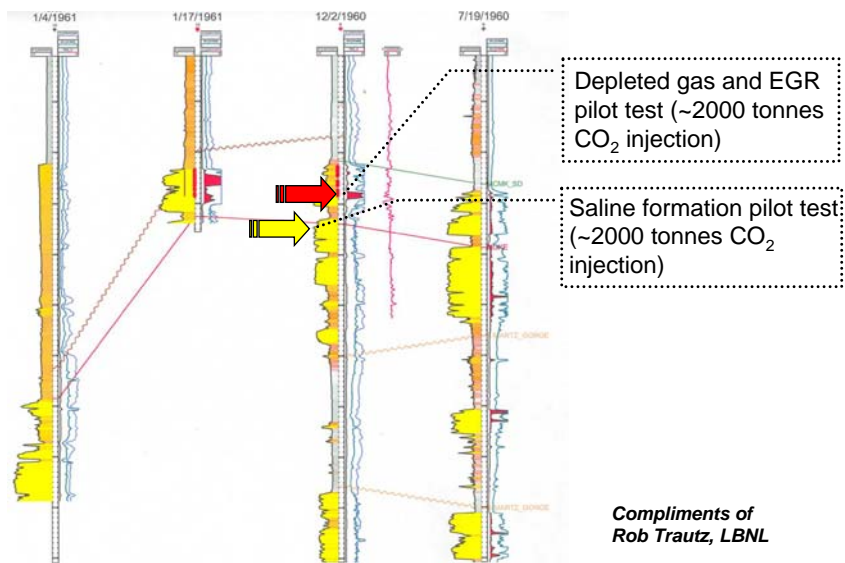
- Preliminary estimate of 1.8 GtCO₂ storage capacity in depleted gas fields in Sacramento Valley (128 fields)
- Preliminary estimate of 140-840 GtCO₂ storage capacity in saline formations in California, based on ten largest basins



WEST COAST REGIONAL CARBON SEQUESTRATION PARTNERSHIP 3



Rosetta-Calpine: Geological Cross-Section



Compliments of
Rob Trautz, LBNL

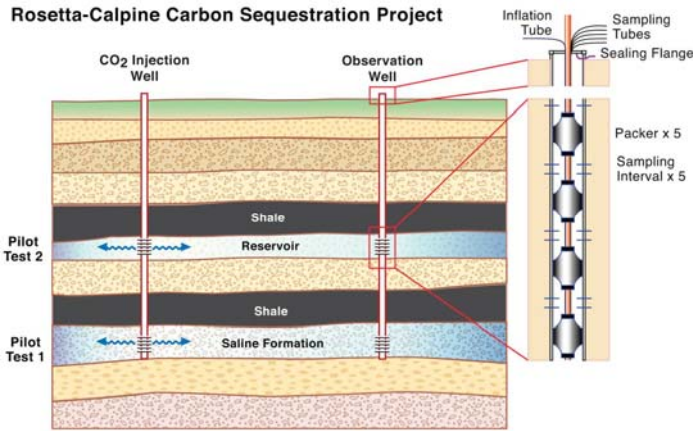


WEST COAST REGIONAL CARBON SEQUESTRATION PARTNERSHIP 4

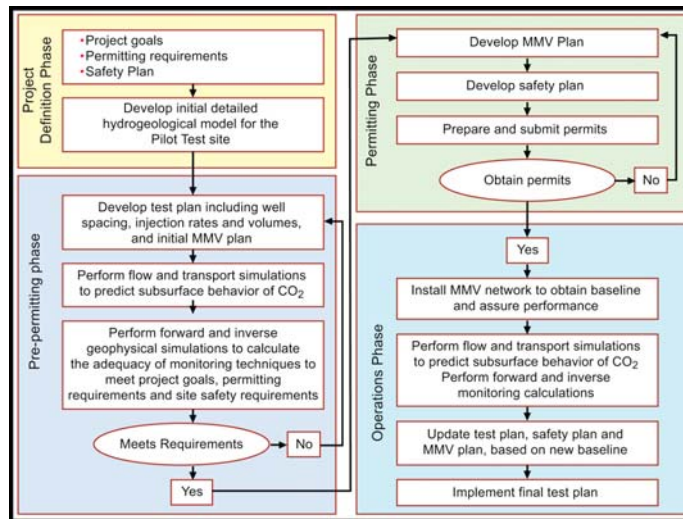


Rosetta-Calpine: Two-Well Pilots

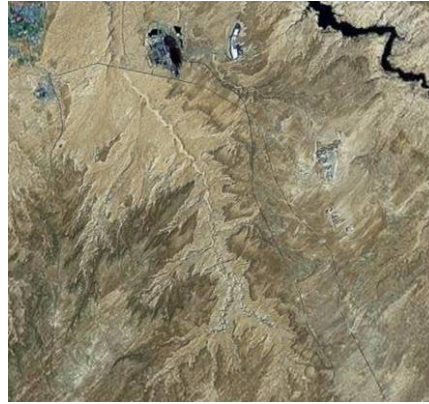
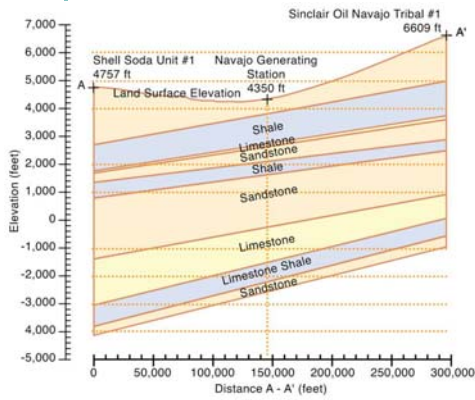
- Fluid and gas sampling
- Cross-well seismic
- VSP
- Reservoir pressure and temperature
- Well logs, including possible RST



Rosetta-Calpine: Project Plan



Northern Arizona Saline Formation CO₂ Storage Pilot



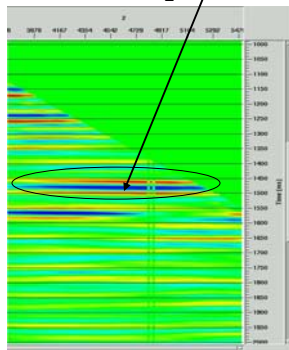
Northeastern Arizona

Large but uncharacterized storage capacity in the Colorado Plateau and basins of northern Arizona



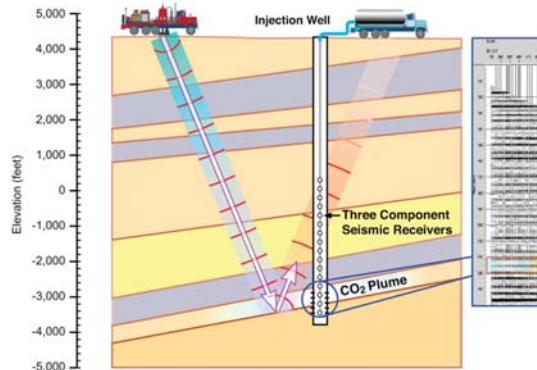
Northern Arizona Saline Formation CO₂ Storage Pilot

Reflection from 1600 tonne CO₂ plume



VSP Results from Frio Formation

Single-Well Test Plan



2000 tonne CO₂ injection



TransAlta Centralia Geologic Storage and ECBM Assessment



Centralia Generating Station



Assess ECBM and storage potential

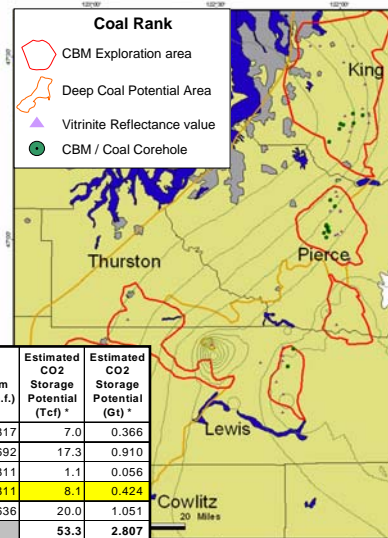


Coal bed



Puget, WA Deep Coals Could be Sink for Centralia Plant

- Favorable coal rank: subbituminous in the W to anthracite in E
- El Paso Production pilot tested 5 md permeability in coals



Sub-Basin	Area (sq mi)	Avg Coal Thickness (ft)	Ash + Moisture (%)	Net Coal Tonnage (million tonnes)	Avg Depth (ft)	CO ₂ Isotherm (scf/t d.a.f.)	Estimated CO ₂ Storage Potential (Tcf) *	Estimated CO ₂ Storage Potential (Gt) *
Carbonado	125	130	57%	8,513	1,691	817	7.0	0.366
Black Diamond	466	110	60%	24,979	1,550	692	17.3	0.910
Storm King	57	65	71%	1,309	1,860	811	1.1	0.056
Centralia	209	100	61%	9,930	1,860	811	8.1	0.424
Rest of Puget Region	1,777	50	71%	31,391	1,500	636	20.0	1.051
Totals	2,634			76,122			53.3	2.807

* Represents TOTAL available potential for each region; actual Stored volume would be significantly less (1-15-50%)

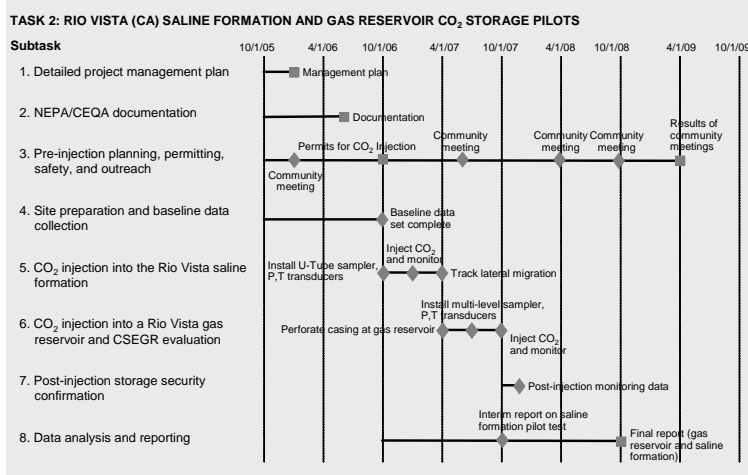


DOE Roadmap Goals for Geological Storage of CO₂ and WESTCARB Contributions

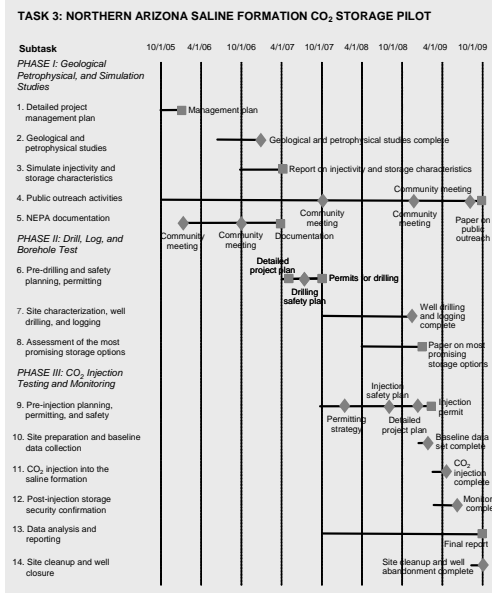
Storage Security and Permanence	Storage Capacity and Optimization	Measurement Mitigation and Verification
<ul style="list-style-type: none"> ■ Demonstrate safe and secure storage in a depleting gas reservoir ■ Demonstrate safe and secure injection into 2 saline formations ■ Improve understanding and modeling of multi-phase flow and residual gas trapping in a saline formation ■ Improve understanding and modeling of solubility trapping ■ Predict mineral trapping rates and quantities in two different geologic settings 	<ul style="list-style-type: none"> ■ Perform the first ever test of CO₂-EGR in a natural gas reservoir ■ Improve understanding and modeling of CO₂ storage capacity in heterogeneous high permeability sandstones ■ Improve understanding and modeling of storage capacity in lower permeability, highly consolidated sandstones ■ Develop methods for predicting storage capacity in depleting gas reservoirs ■ Improve capacity estimation methodology by history matching the injection pilots 	<ul style="list-style-type: none"> ■ Develop methods for monitoring CO₂ storage in gas reservoirs ■ Test methods for monitoring permeability changes due to CO₂ injection ■ Enhance and demonstrate the utility of VSP for monitoring CO₂ mitigation from single-well pilot tests ■ Demonstrate and refine the use of cross-well seismic monitoring to achieve high resolution images of CO₂ migration ■ Demonstrate and expand the utility of down-hole pressure measurements for monitoring CO₂ injection operations



Phase II, Task 2



Phase II, Task 3



Phase II, Task 4

