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Parametric Analysis of Technology and Systems Tradeoffs for CO_2 Storage in Saline Formations

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U.S. DEPARTMENT OF ENERGY

NNSA Nuclear National Security Administration

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Working Results, 32nd USAEE/IAEE North American Conference, July 28-31, 2013.

Water, Energy and CO_2 Sequestration (WECS) Model:

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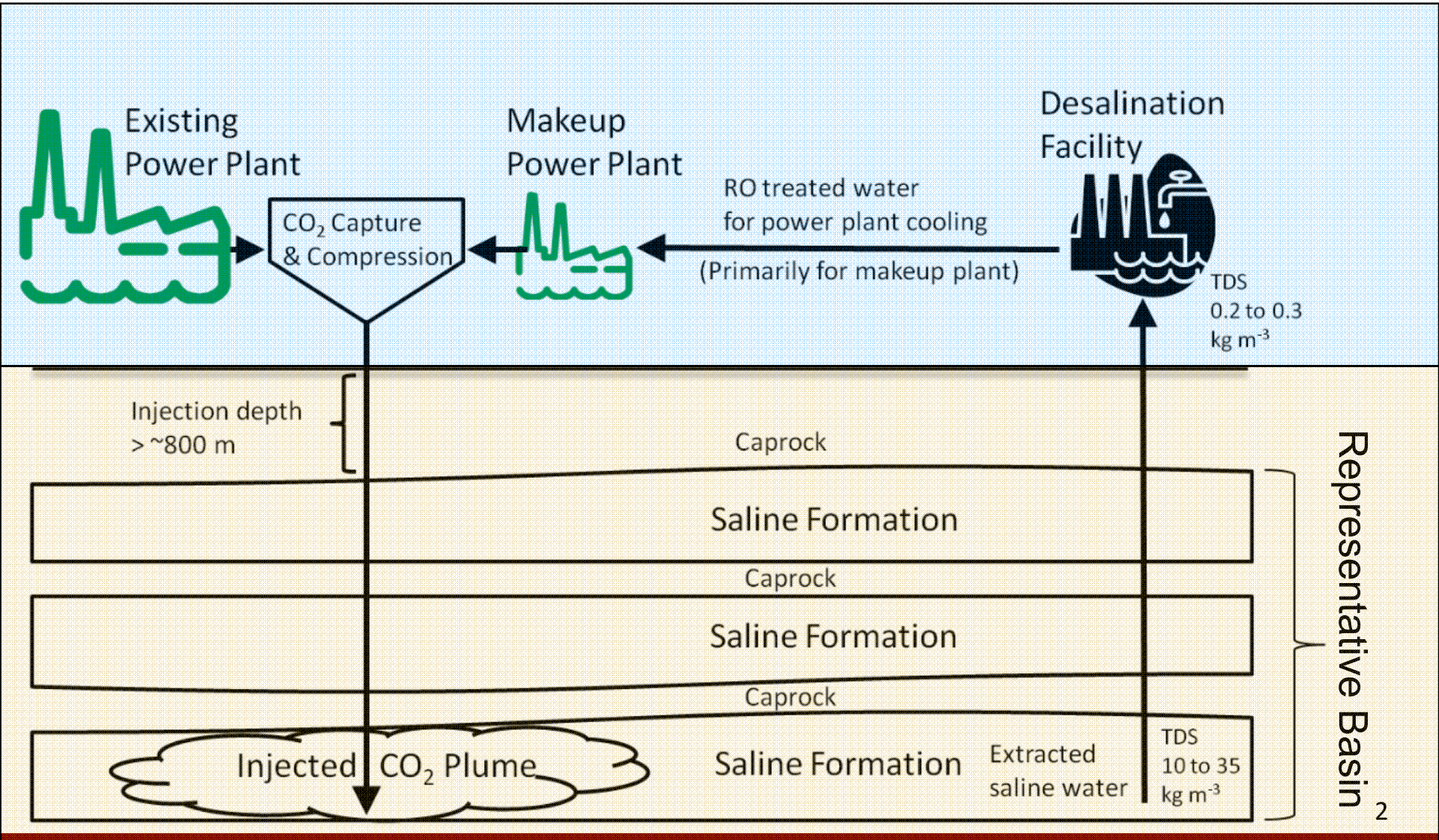

Adapted from Klise et al., 2013

U.S. CO_2 Saline Formation Sinks

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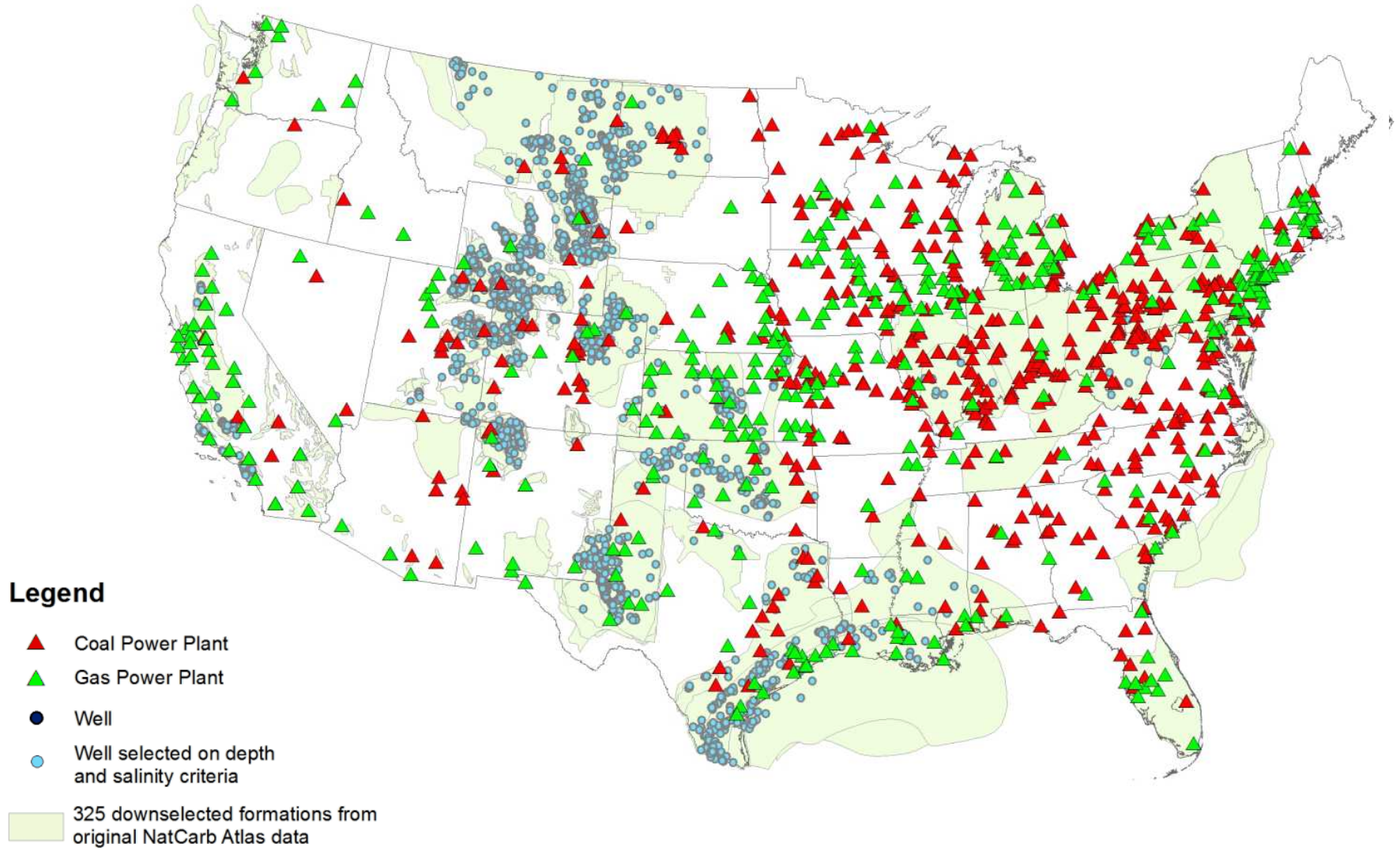
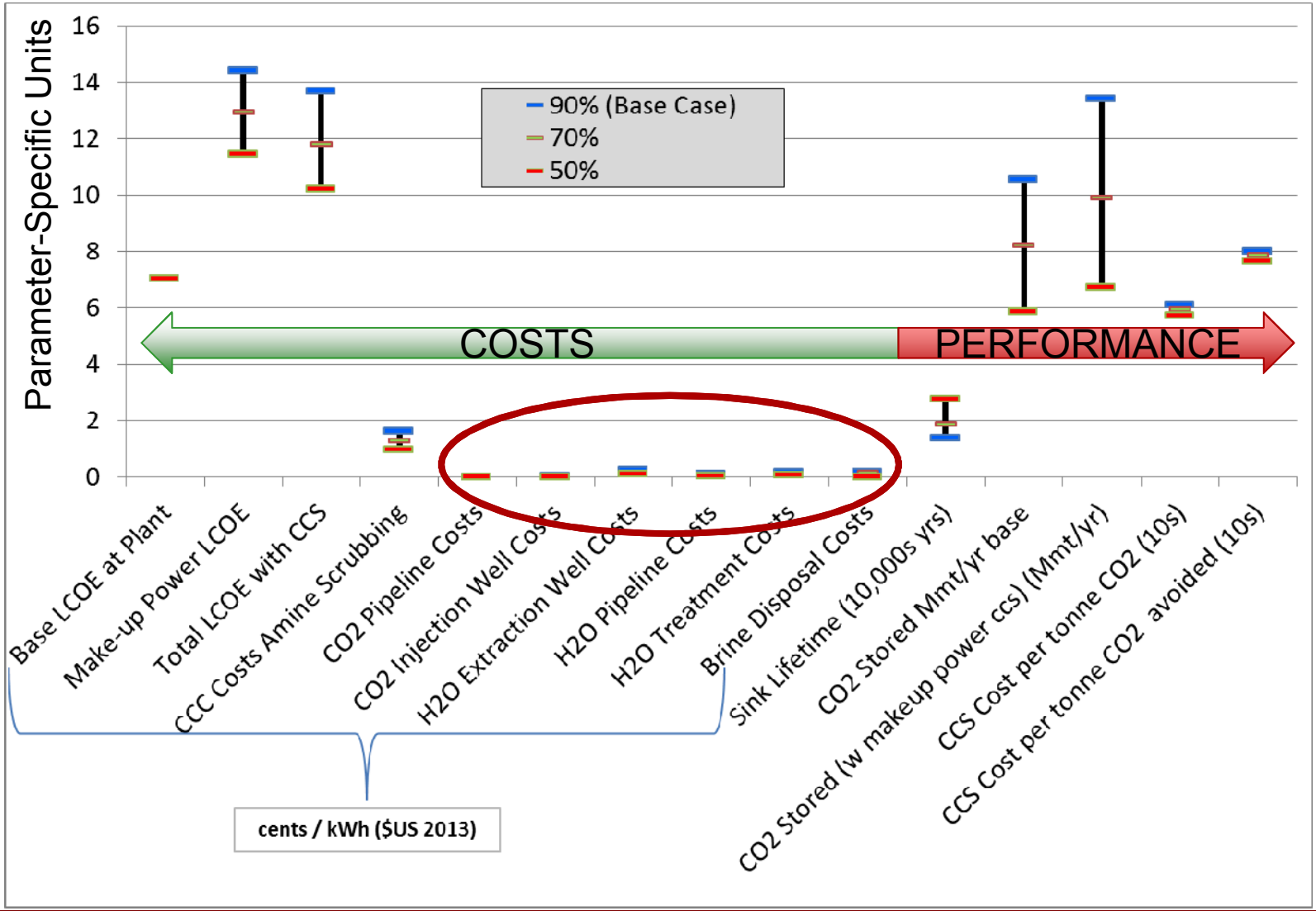
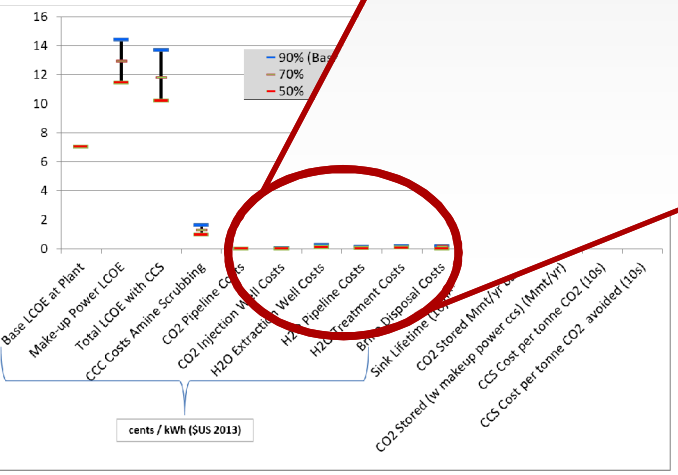
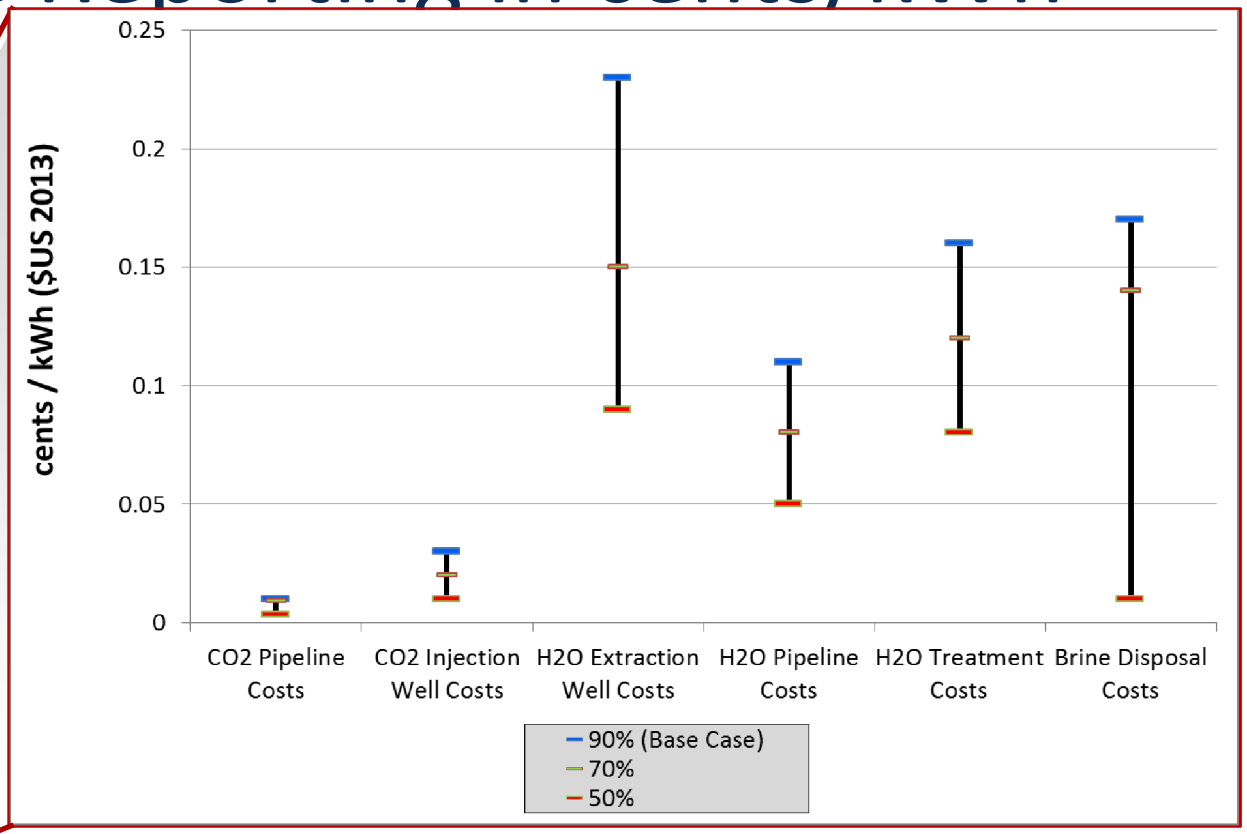


Percent CO_2 Captured at San Juan Generating Station: *90% (base case), 70%, 50%.*

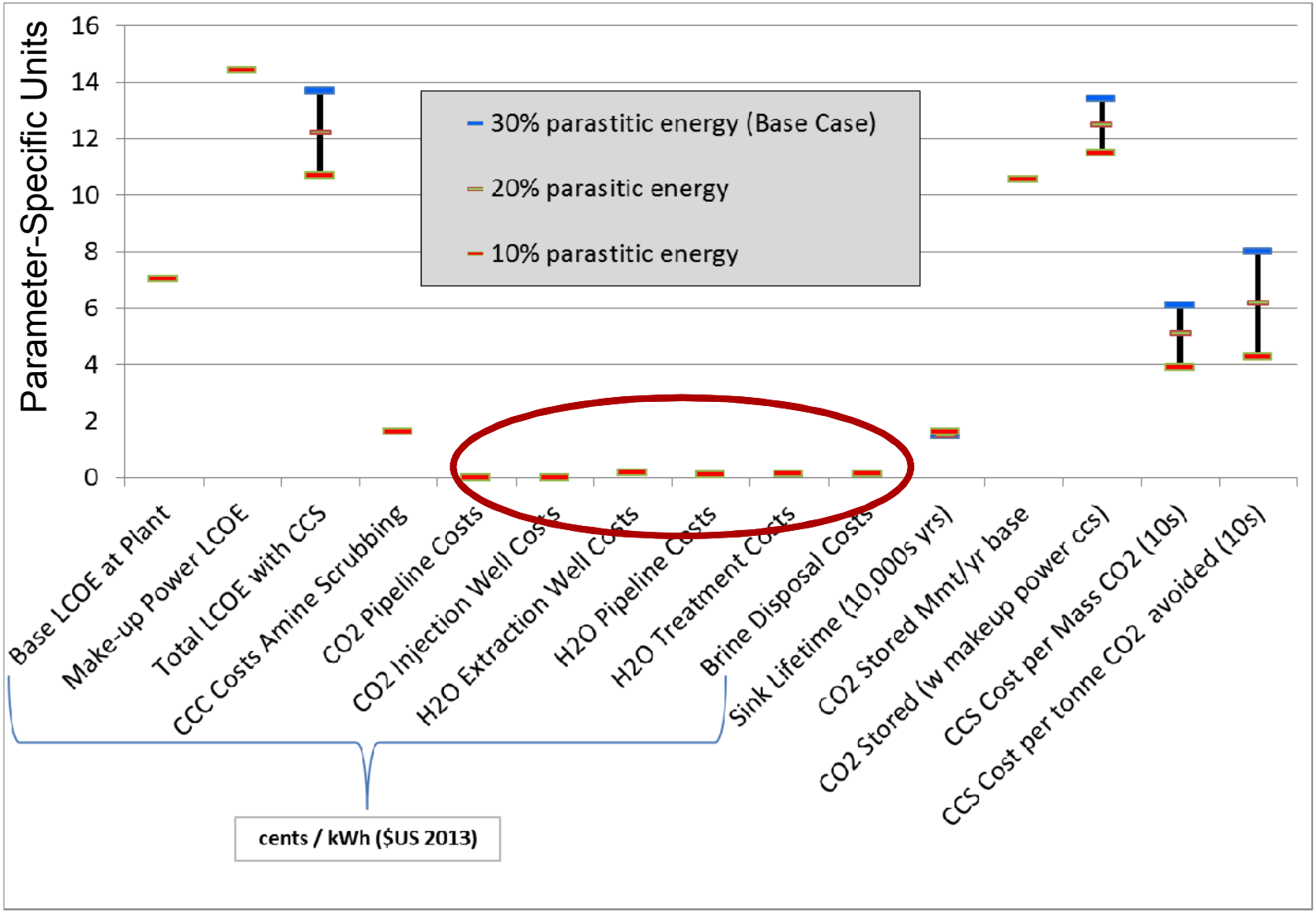


Expanding Select Results from Previous Figure Reporting in cents/kWh

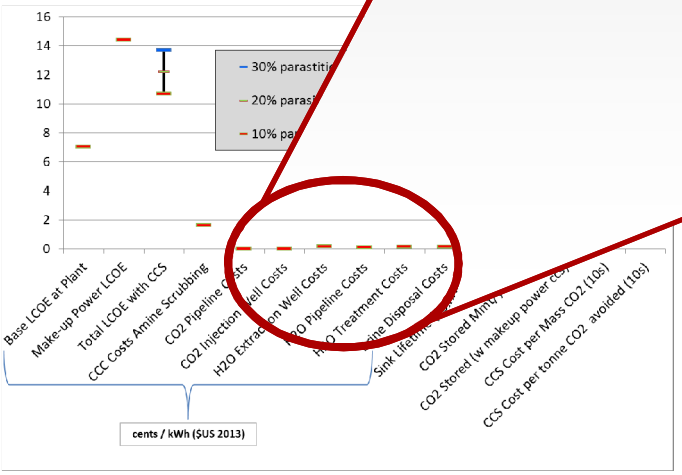


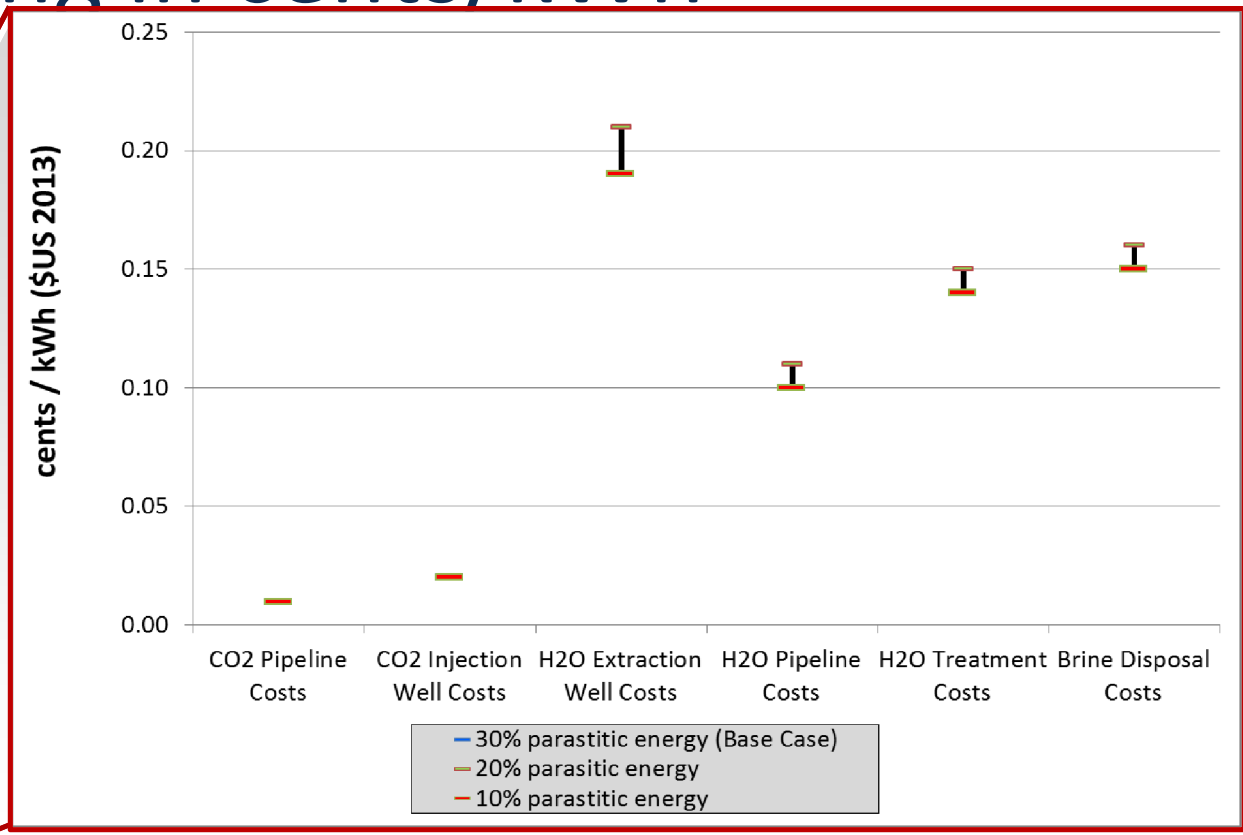


Parasitic Energy for CCS: 30%, 20%, 10%

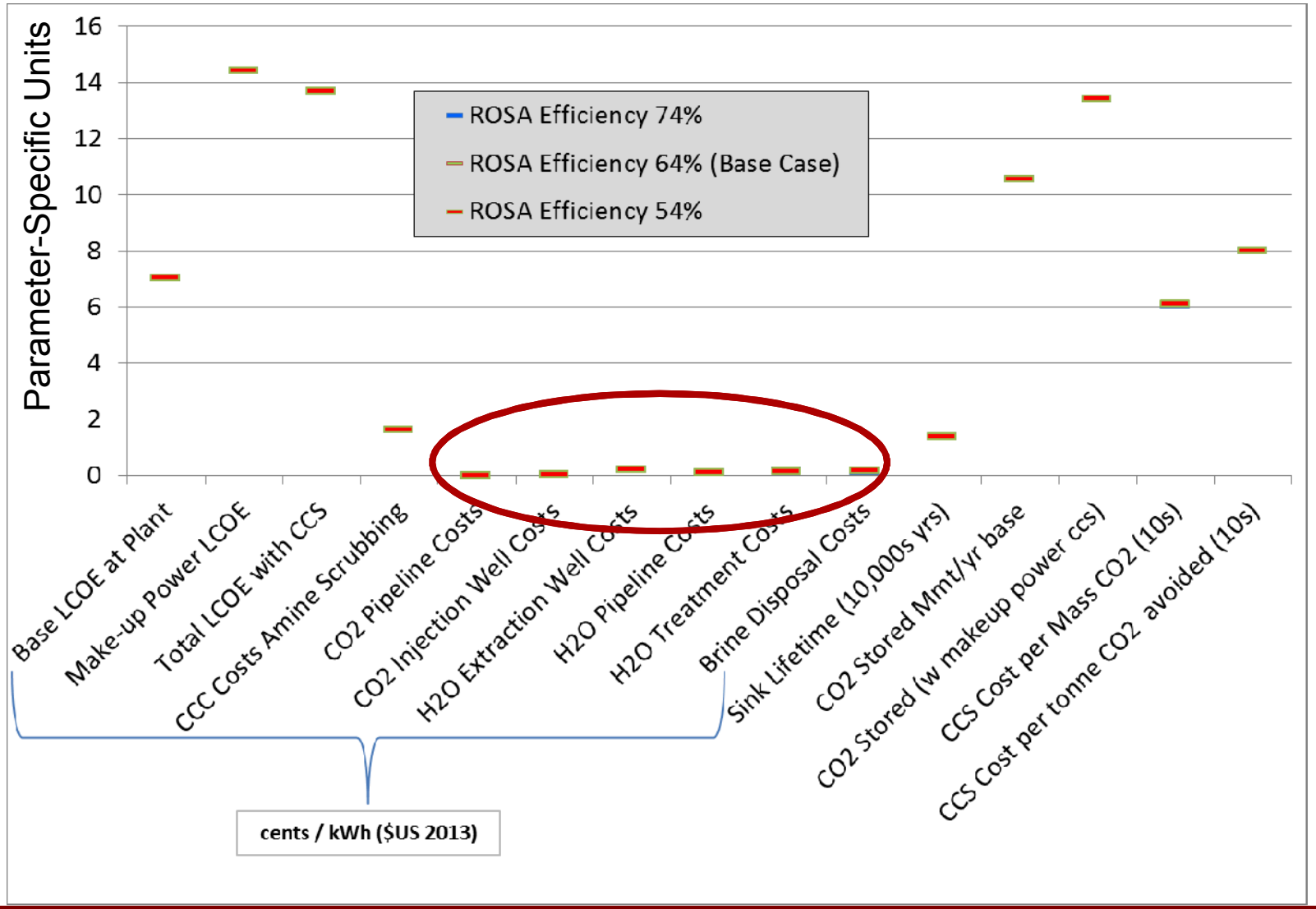


Expanding Select Parasitic CCS Results Reporting in cents/kWh

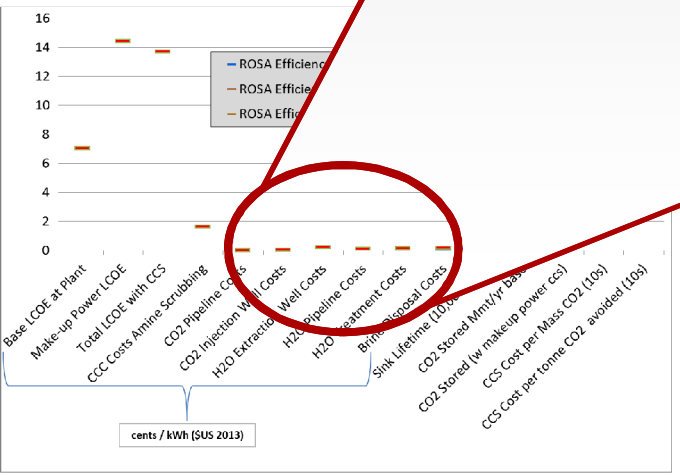


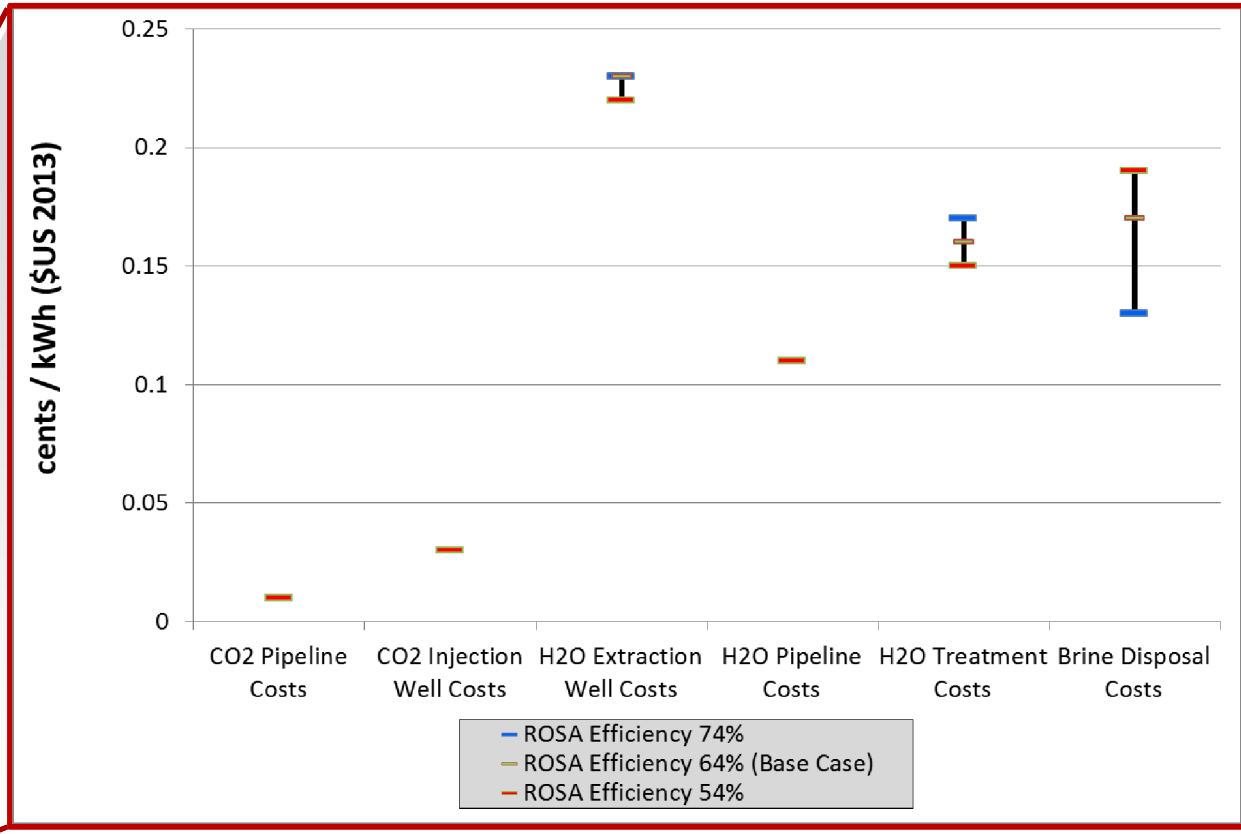


Efficiency of the Reverse Osmosis System Analysis (ROSA): 74, 64, 54%

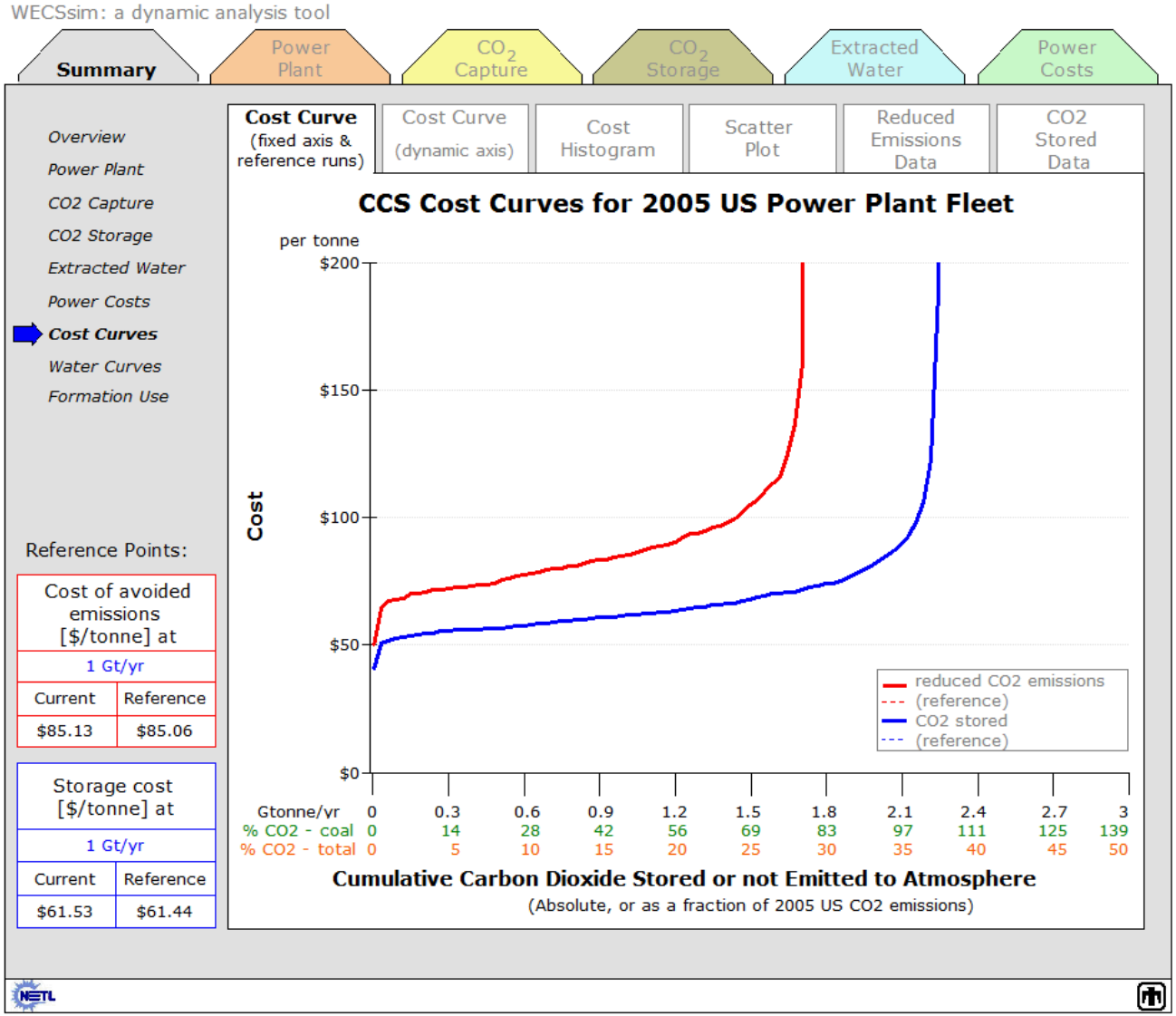


Expanding Select ROSA Reporting in cents/kWh





The National Cost Curve for CO_2 Capture and Storage (CCS)



National-scale Water Demands due to CO_2 Capture and Storage

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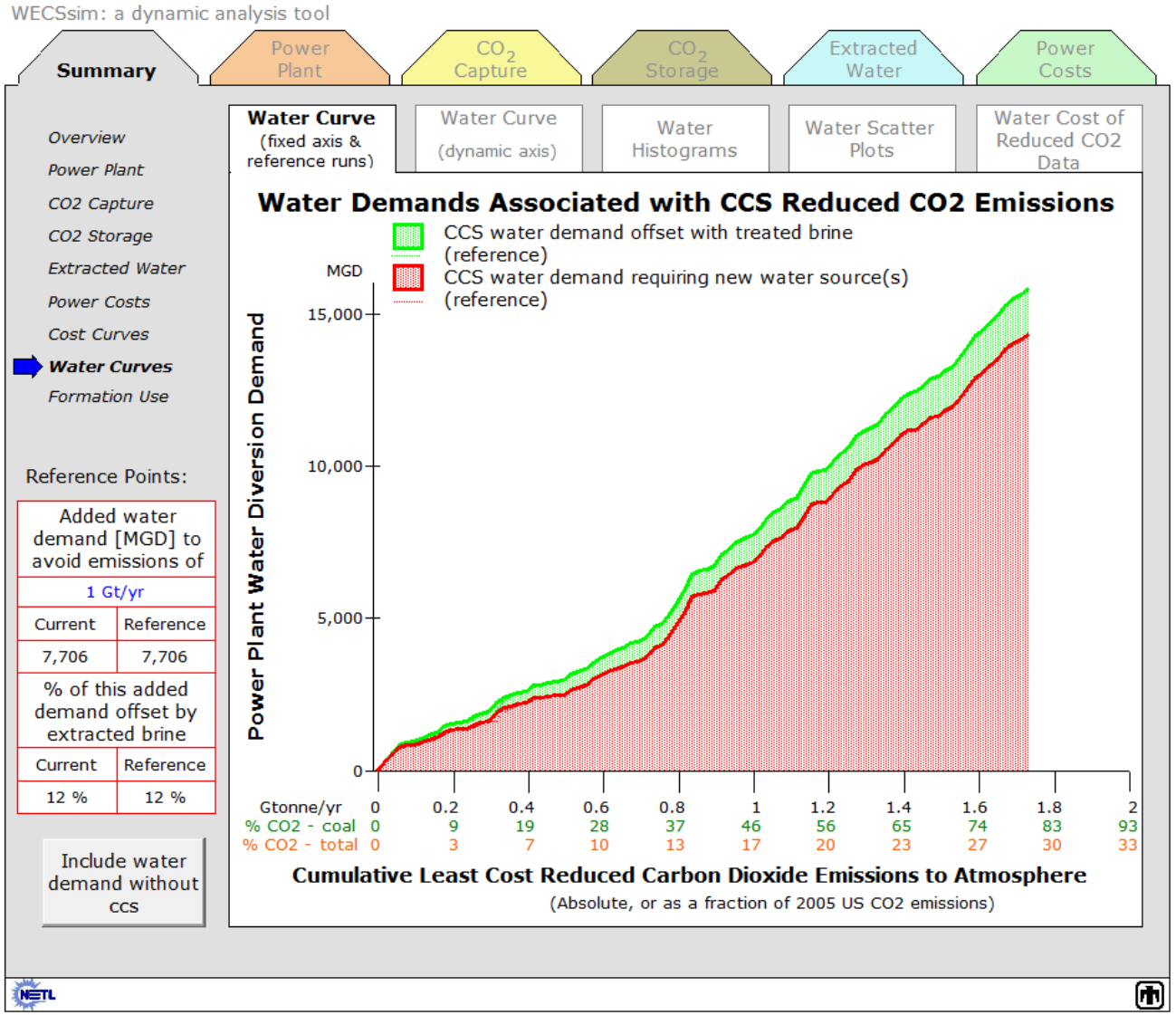
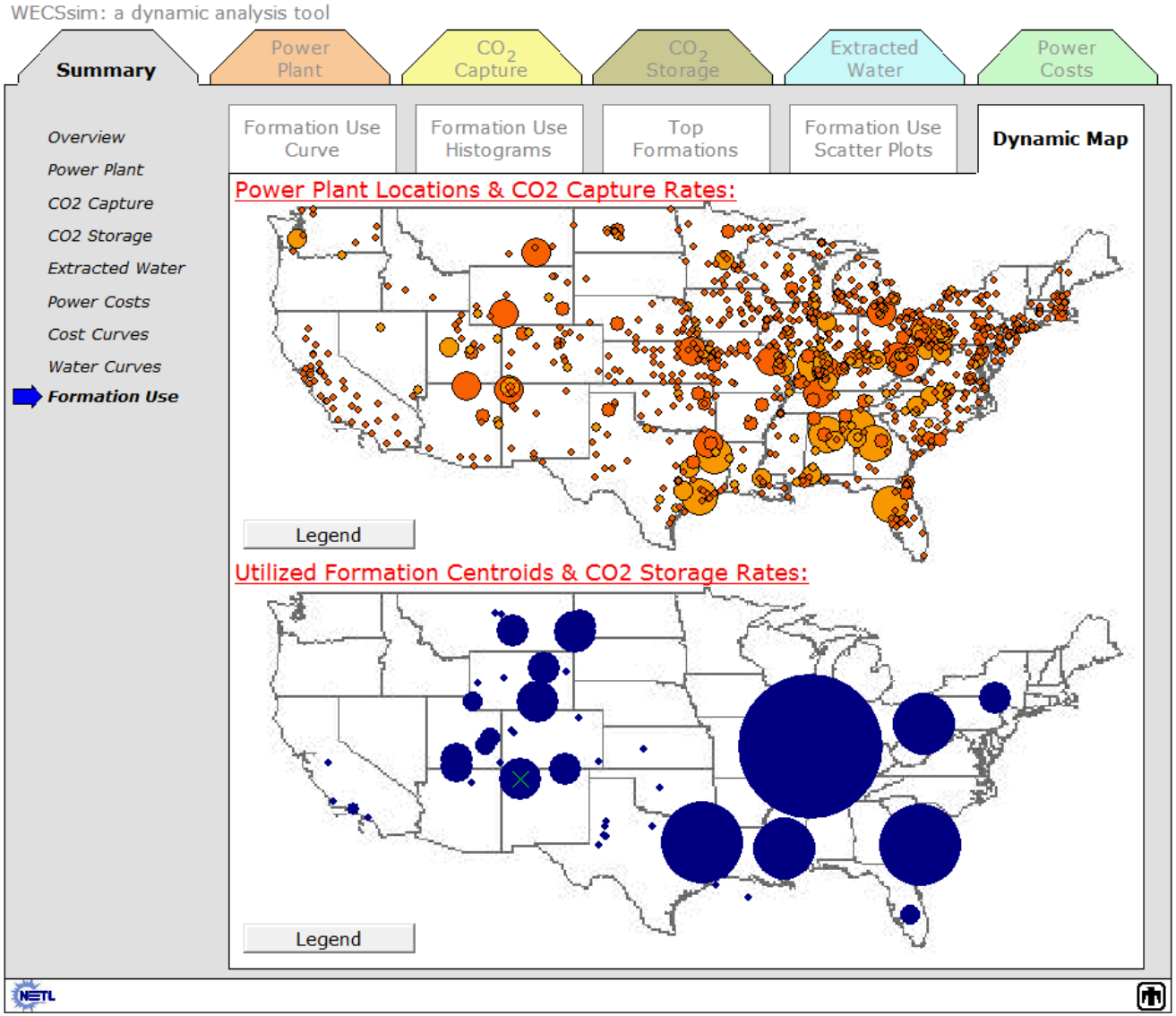
Base Case:

- 90% capture of the CO_2 from the base plant,
- Plus the parasitic energy plant



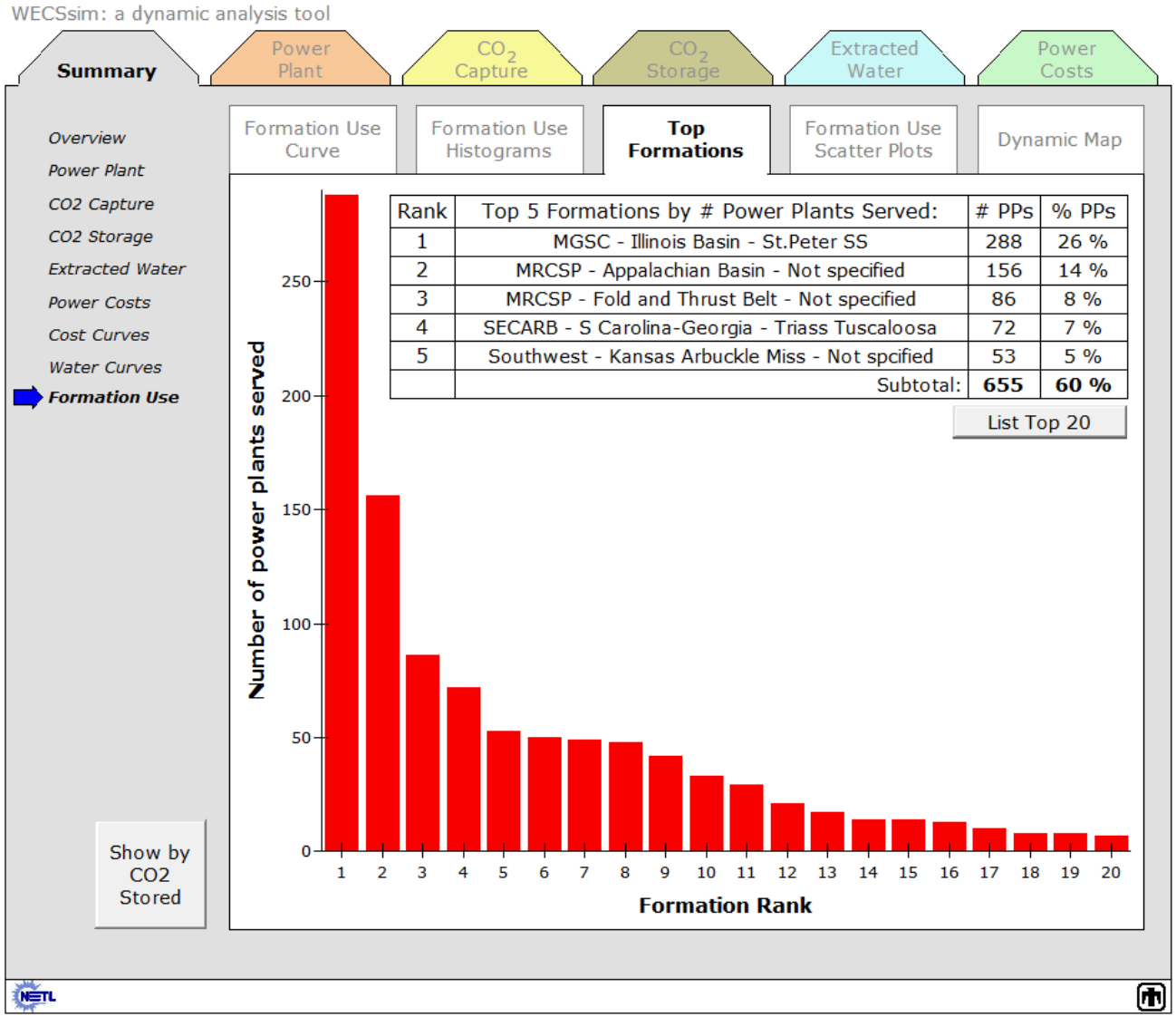
Power Plant Capture & Formation Storage Rates: *Key Geographic Results*

- Assuming competition between power plants for preferred saline formation storage locations
- Upper map, 0 – 20+ CO_2 capture rate (Mmt/yr)
- Lower map, 0 – 800+ CO_2 storage rates (Mmt/yr)



The Top 5 Saline Formations in the Lower U.S.: *storage potential*

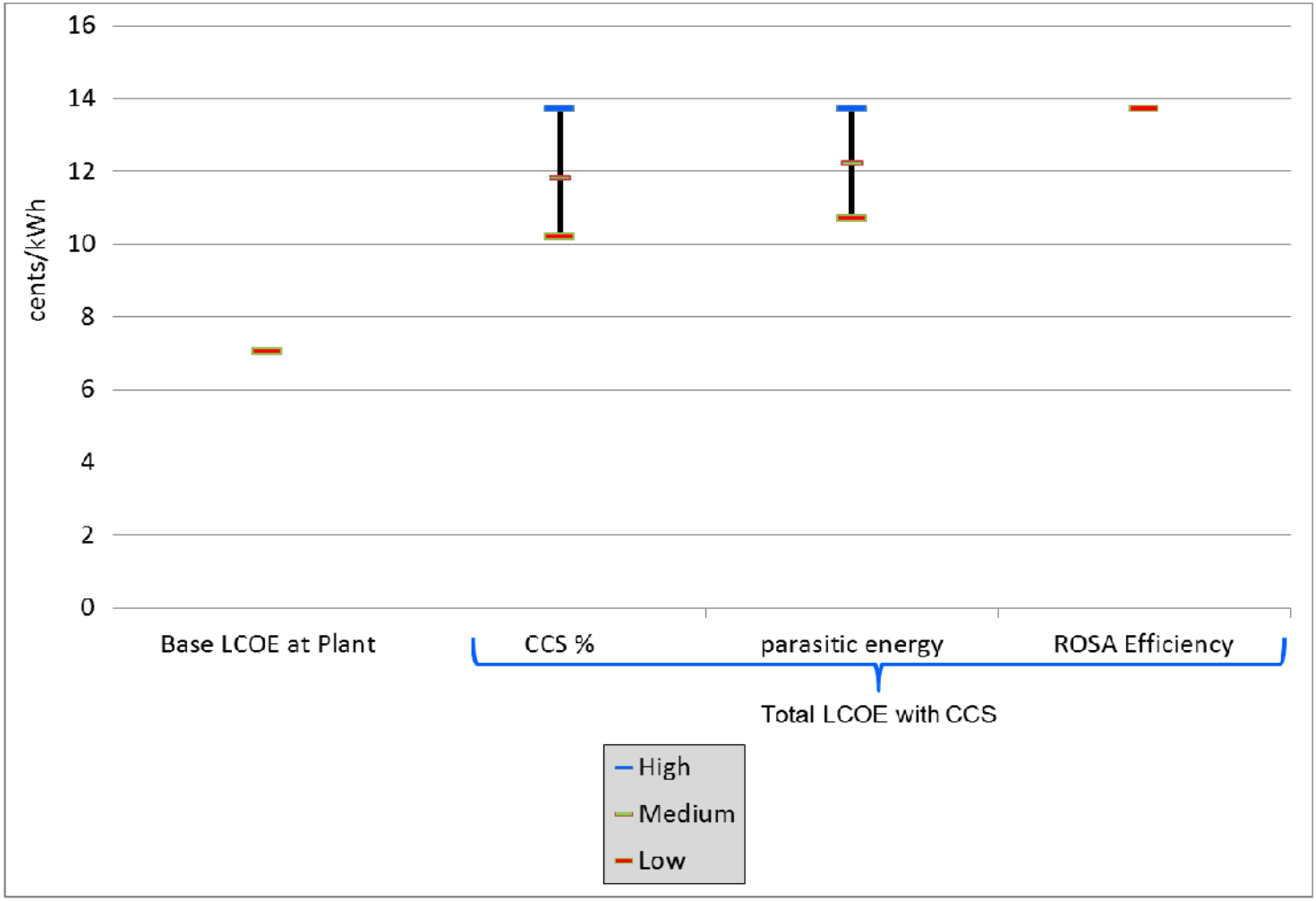
- Top 5 formations may hold 60% of CO_2 emissions
- Over 25% storage in St. Peter Sandstone
- Large(r) and more favorable storage formations may face competition for the best 'supply' of storage space



Cost and Performance Drivers:

% CO_2 captured, Parasitic Energy, Water Treatment Efficiency

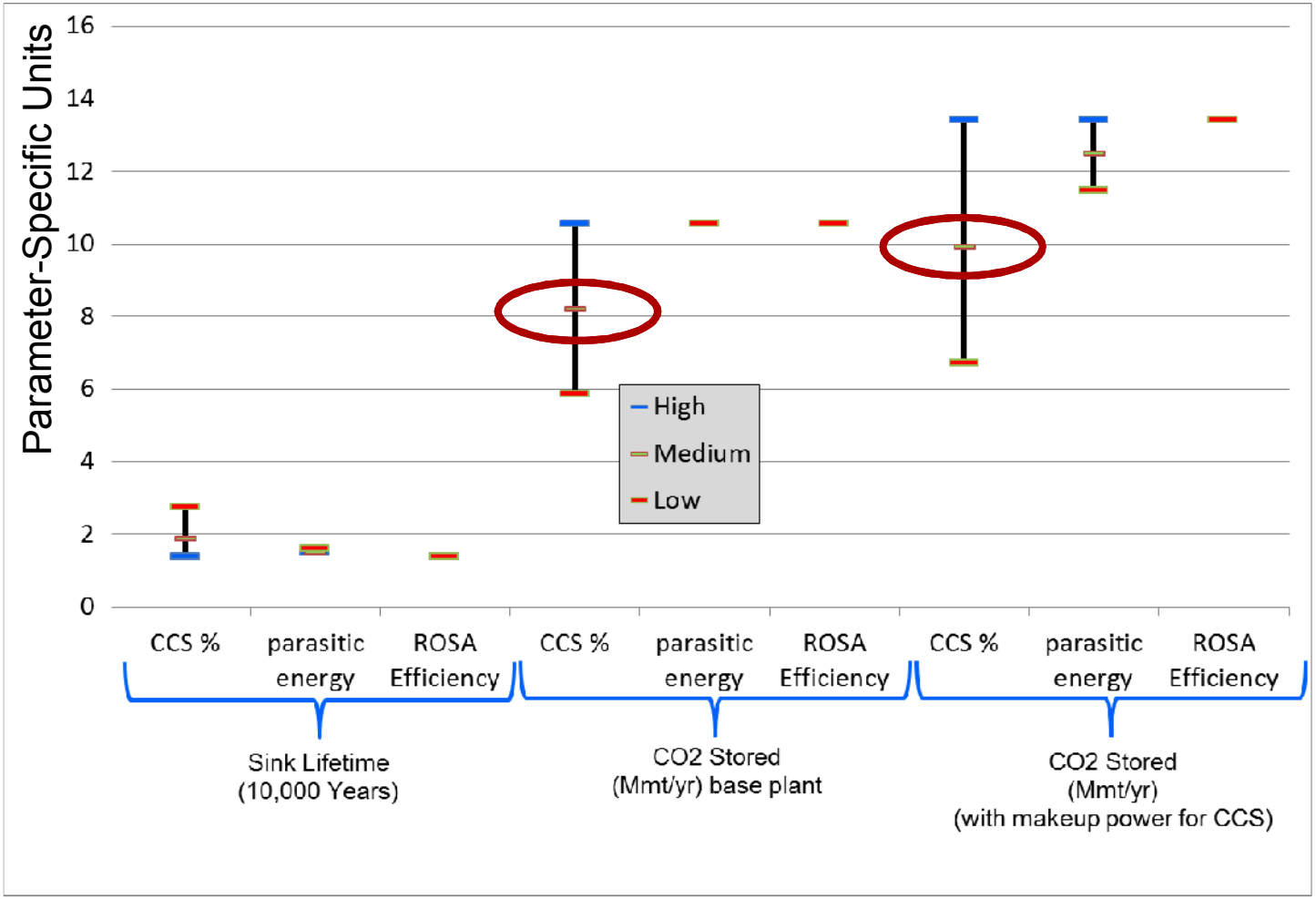
- Percent Capture & parasitic energy greatly affect the LCOE
- Water Treatment Efficiency changes to LCOE are small
- Highlights importance to:
  - Decide on % CO_2 capture
  - Reduce parasitic energy load & costs



Cost and Performance Drivers:

% CO_2 captured, Parasitic Energy, Water Treatment Efficiency

- Percent Capture greatly affects sink lifetime and CO_2 stored
- Parasitic energy requirements affect the amount of CO_2 stored
- Supports notion to focus on avoided CO_2 rather than absolute CO_2 stored

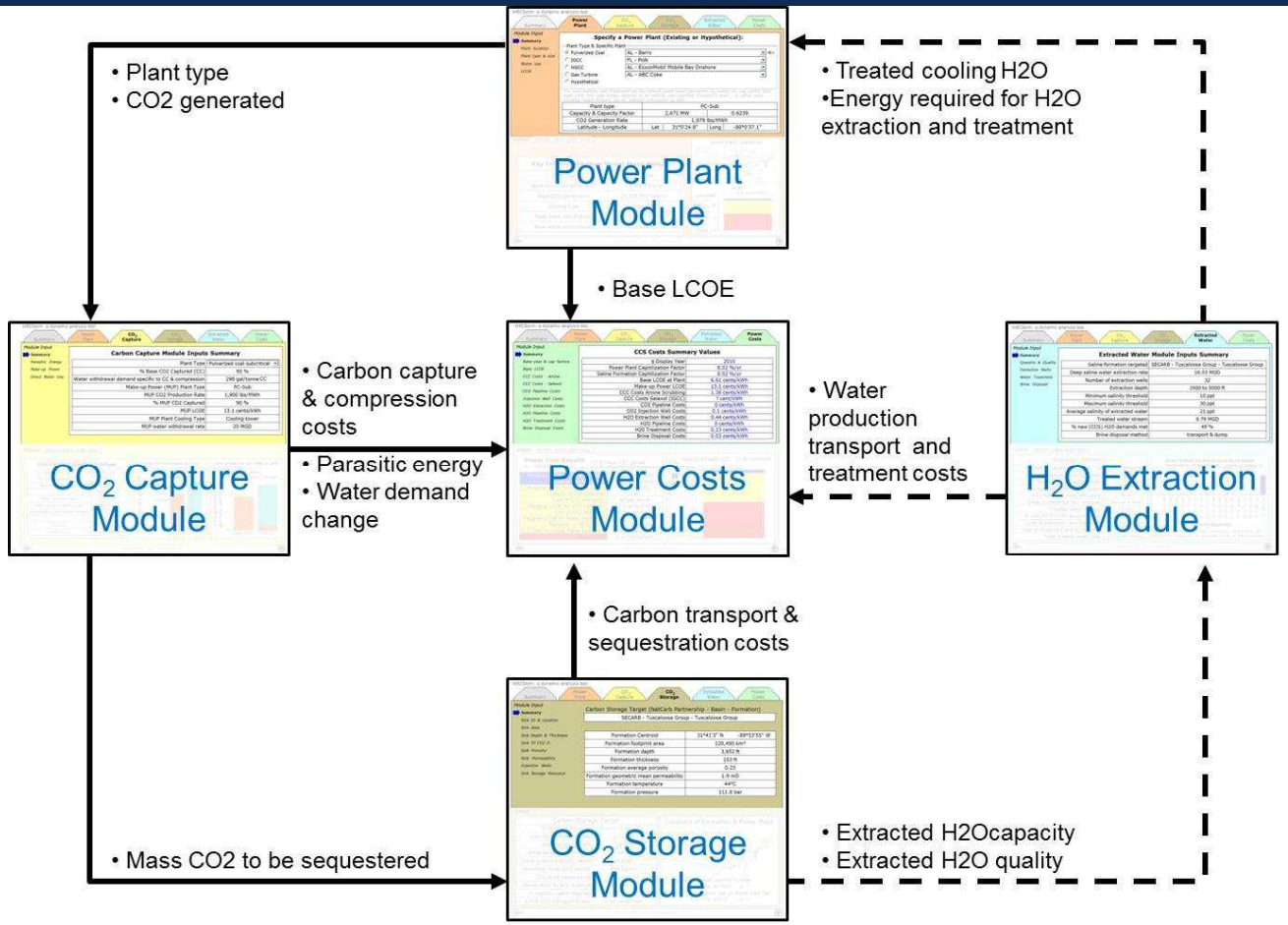


Future Analysis Considerations

- Parametric Analysis using distributions
- Focus on engineered systems' components that reduce total costs the most
- Focus on reducing parasitic energy loads
- Continue to utilize WECSsim©
- Model resources available at: http://carbonmanagement.sandia.gov/

Thank You.

Questions?



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