SAND2015-1797PE

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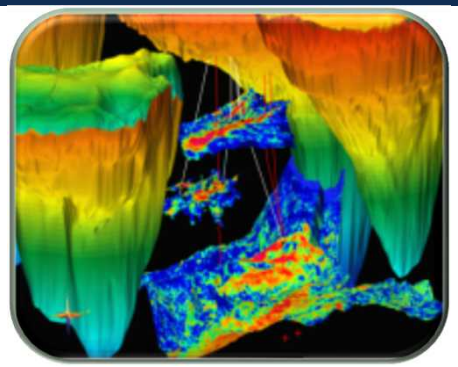

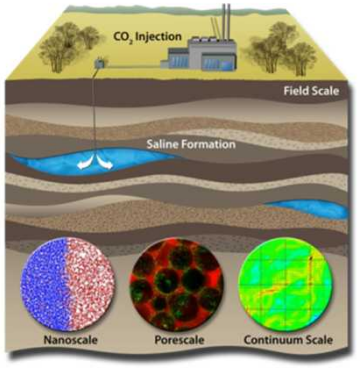

System-Level Cost Characteristics of National-Scale CO_2 Storage and Water Production using WECSsim

Jason E. Heath, Erik K. Webb, Peter H. Kobos

Sandia National Laboratories

U.S. DEPARTMENT OF ENERGY

NNSA National Nuclear Security Administration

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SNL's CO_2 and H_2O Research

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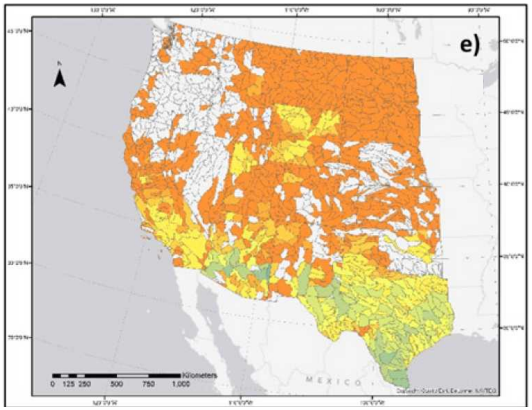
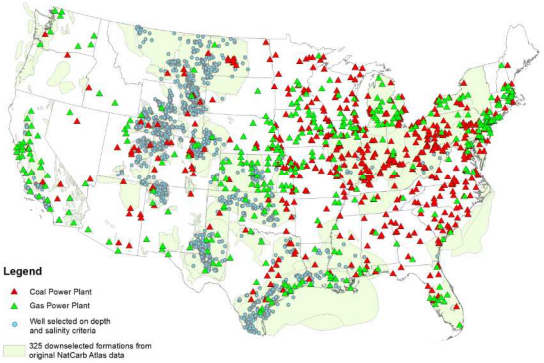
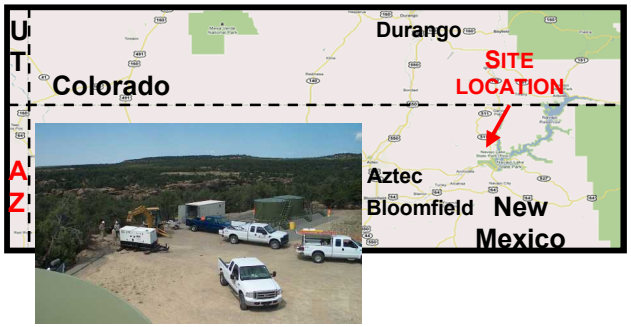
Water Atlas of WECC (ongoing Eastern U.S.)



WECSsim

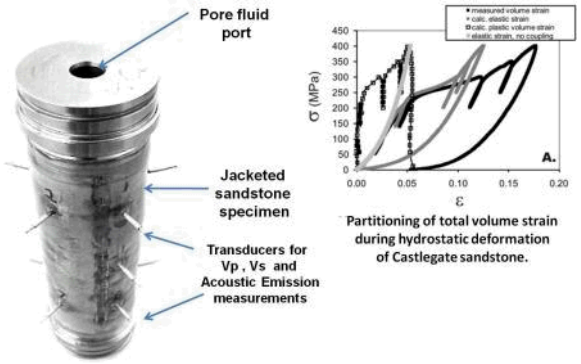


Nanofiltration Treatment of Produced Water

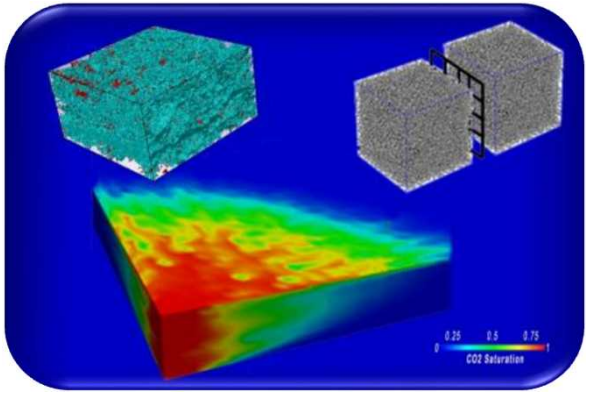


Southwest CO_2 Partnership EOR / CO_2 storage project

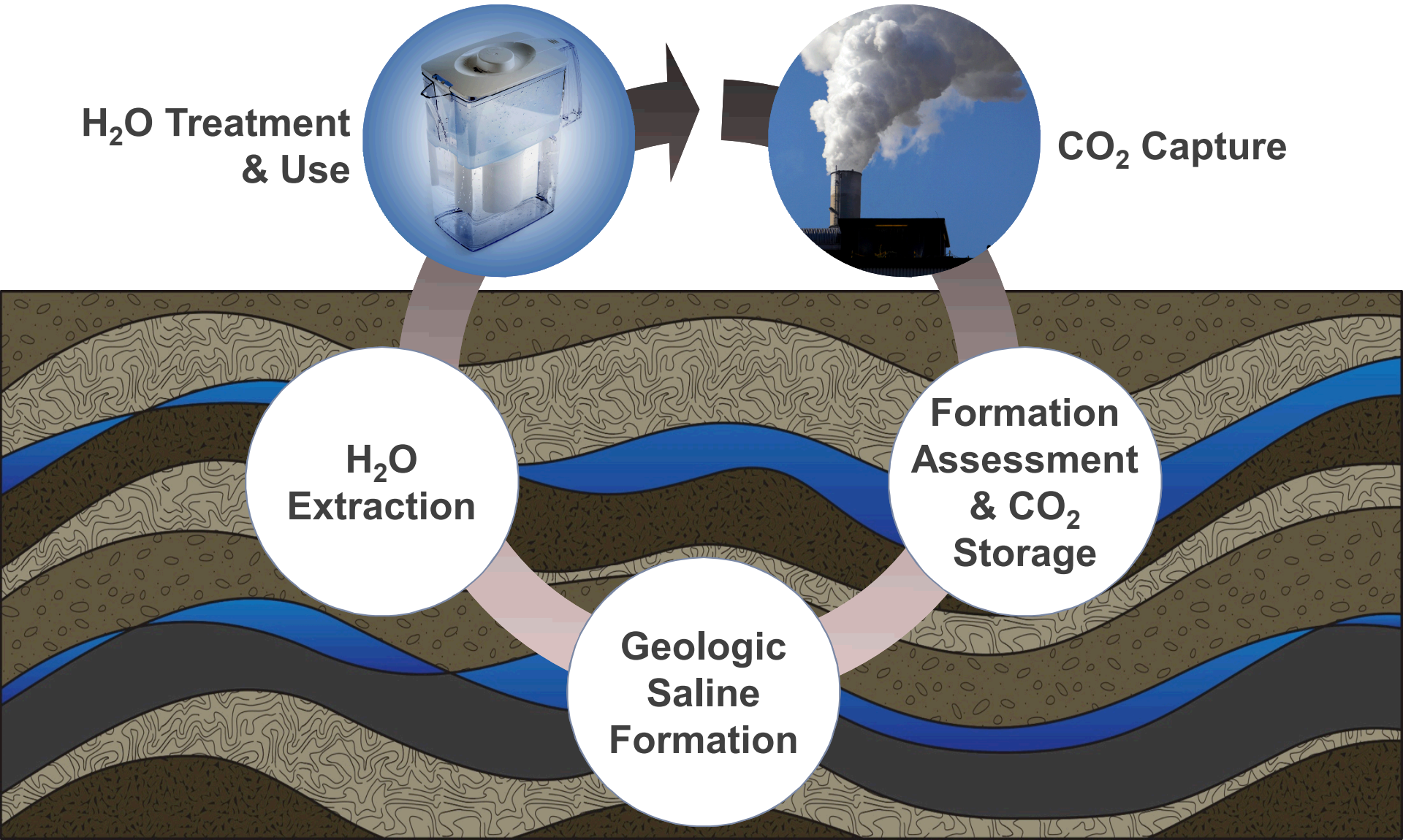
Elasto-plasticity for Geomaterials



Center for Frontiers of Subsurface Energy Security (EFRC)



Water, Energy and CO_2 Sequestration Simulation Model (WECSsim) Model:



DOE-sponsored Efforts on FE and Water for WECSsim

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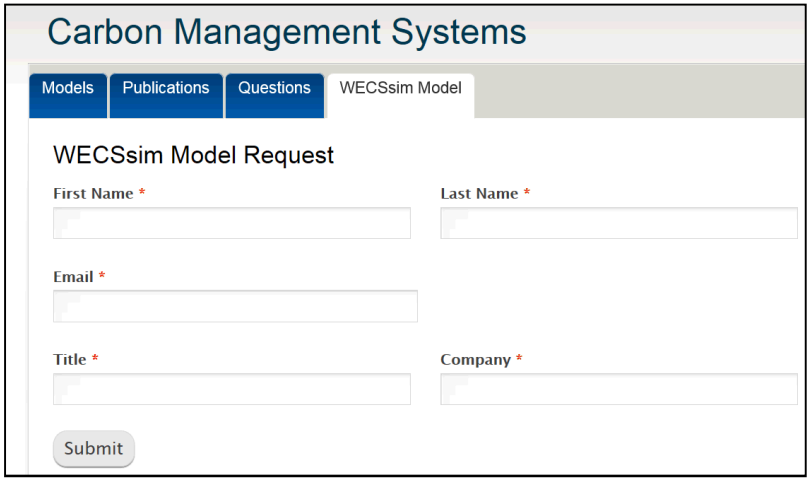
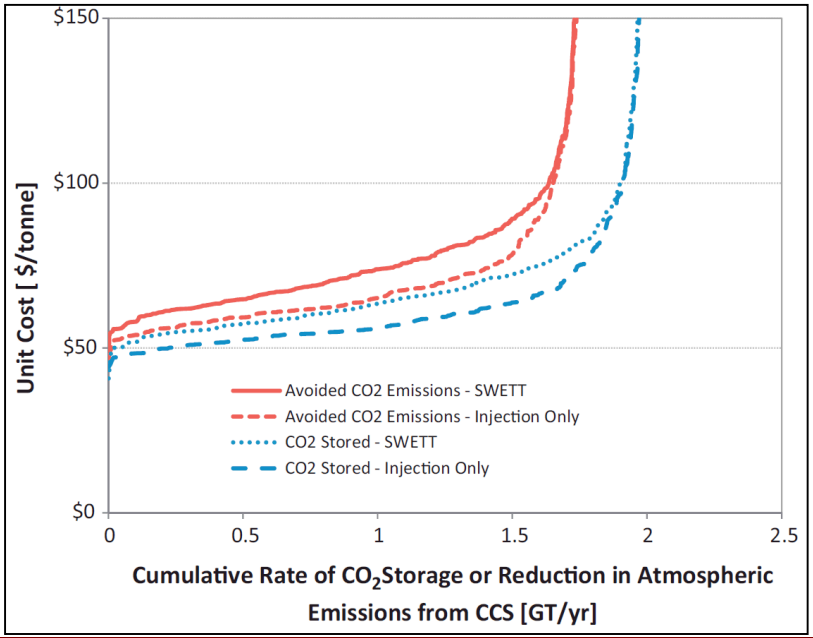
http://energy.sandia.gov/



Rapid ability to capitalize on previous work to address:

- Can we extract and treat water economically?
- What geologic parameters are necessary to store CO_2?
- How much CO_2 can we store?
- How much water can we extract and treat?

- 7+ years of investment
- Regional to National Assessment
- Refined and available software product



All Coal & Natural Gas Plants with Geological CO_2 Storage Database(s)

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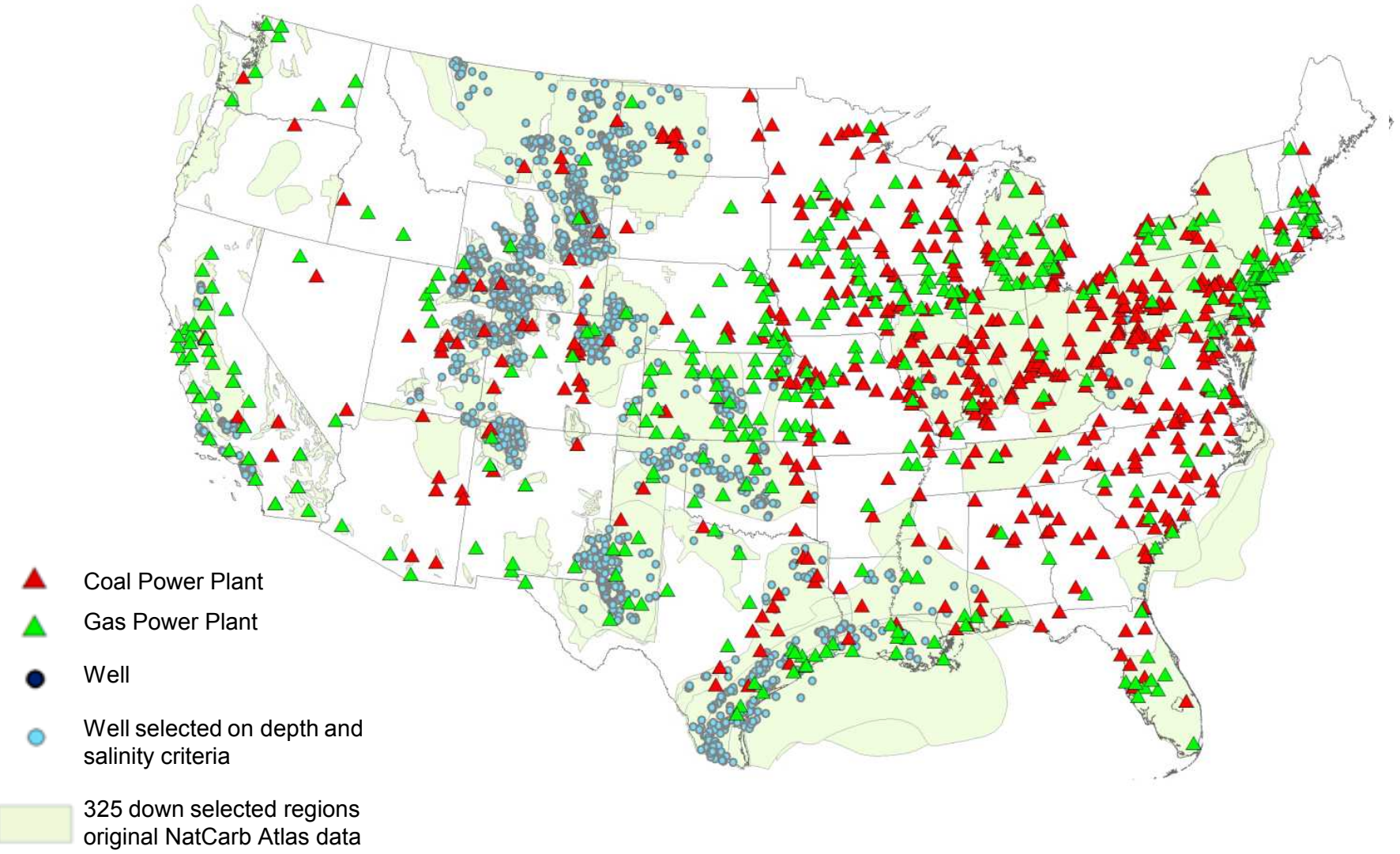

WECSsim Modular Structure

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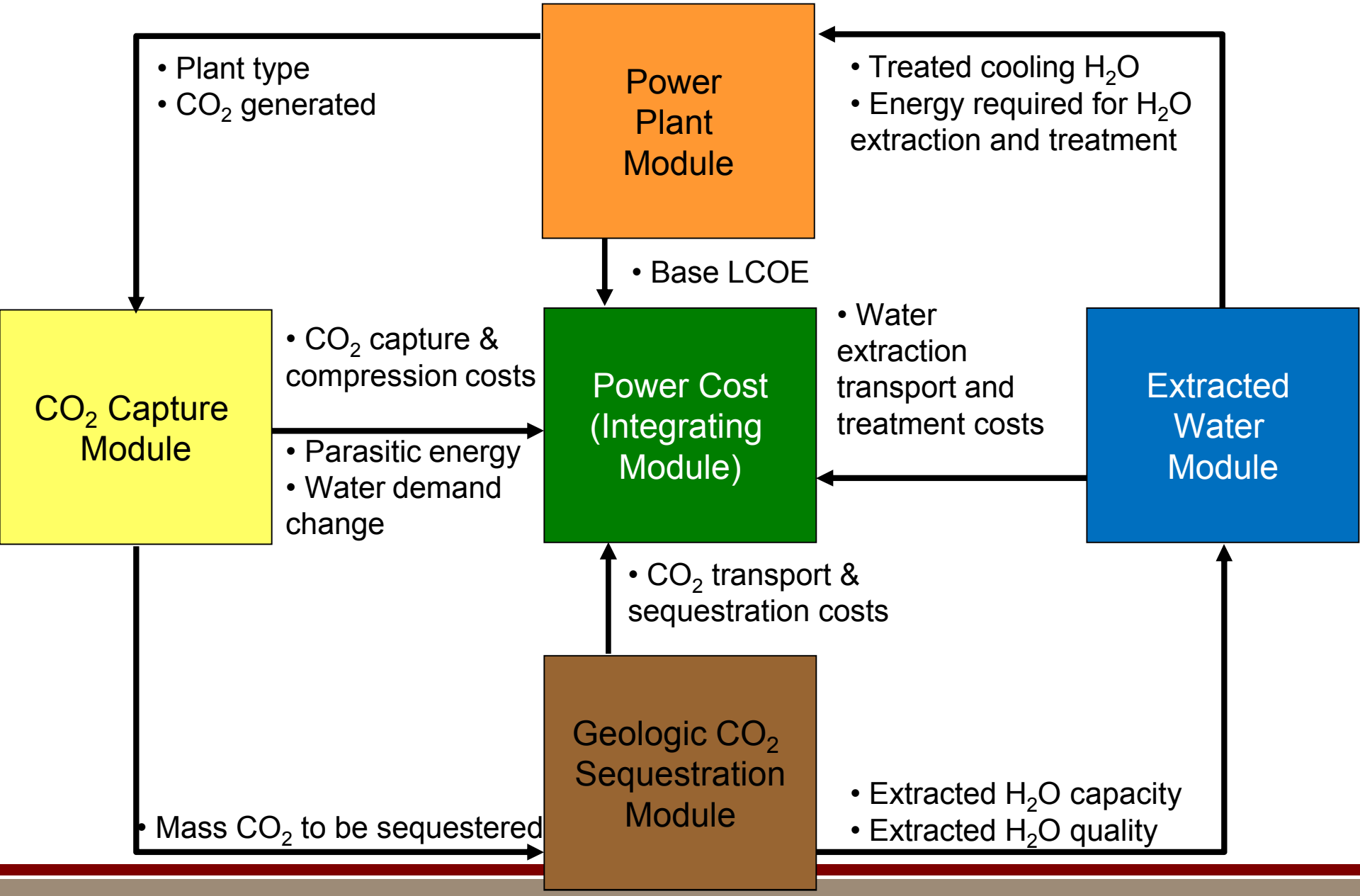

Expanding the 'Geology Controlled' (Permeability) factor to Cost Relationship

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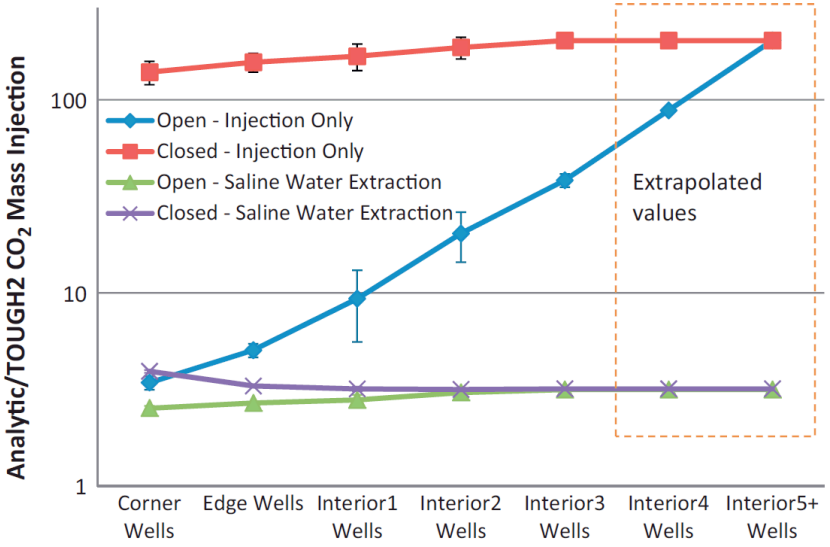
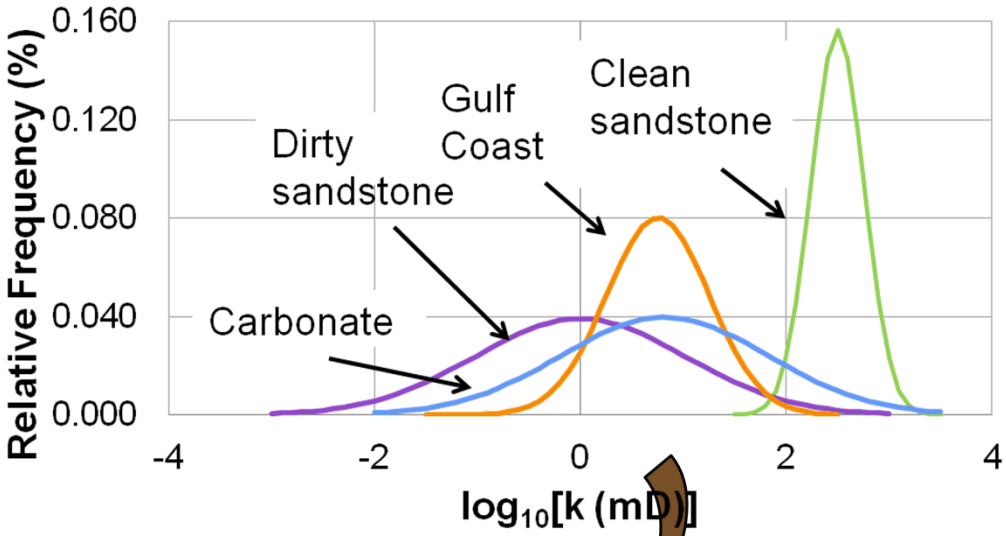
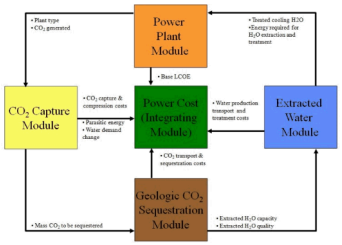
Well Placement and Boundary Condition Scenarios



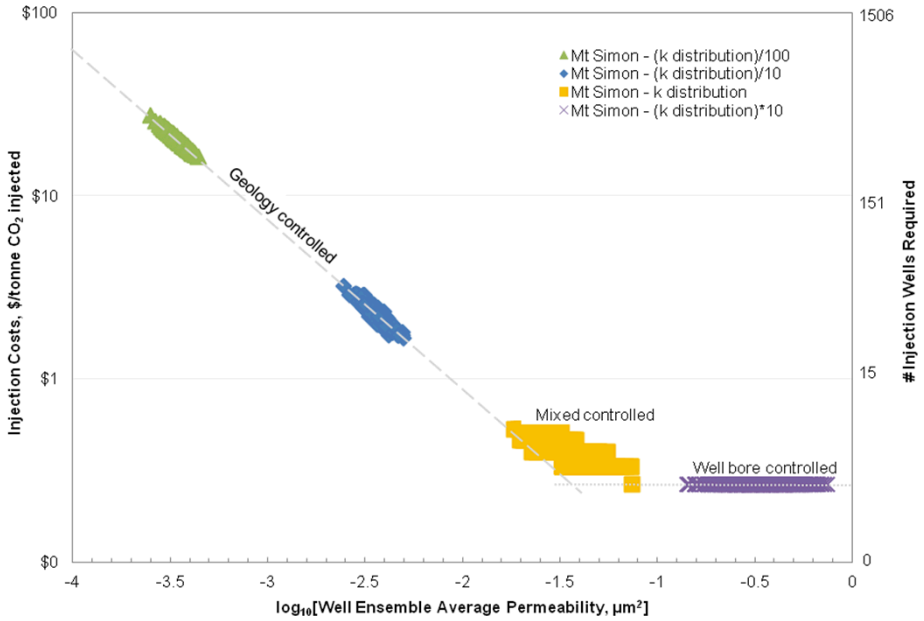
Injectivity equation: permeability sampled from 4 Rock Types





Cost Drivers & Supply Curve:

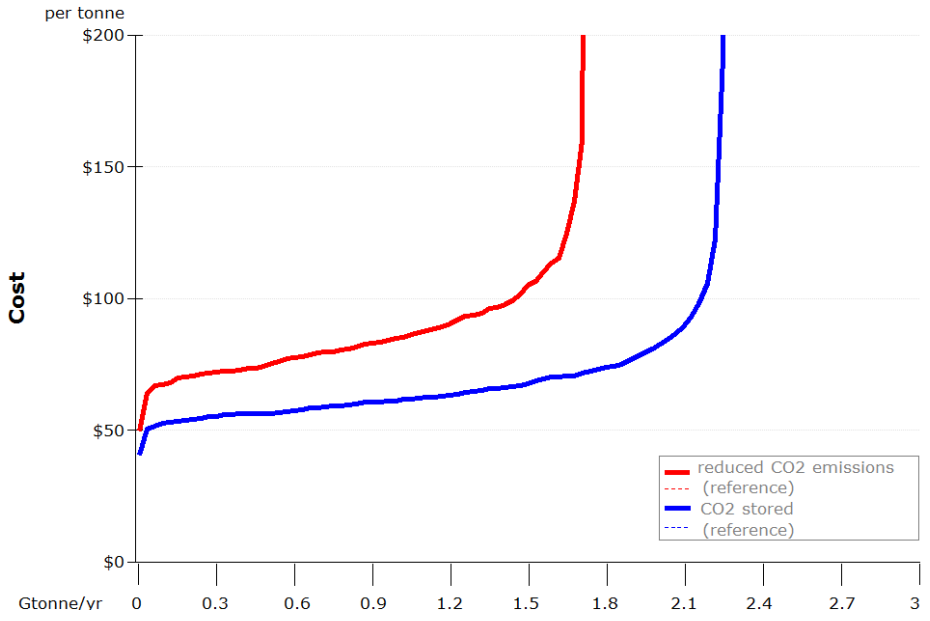
Permeability ↑ = Well Costs ↓



Site-Specific Geology

Informs

Developing a National, CO_2 Storage Supply Curve



National Level CO_2 and H_2O Volumes and Costs

Base Case (90% Capture) and 50% CO_2 capture: Fleet-wide Cost Curves

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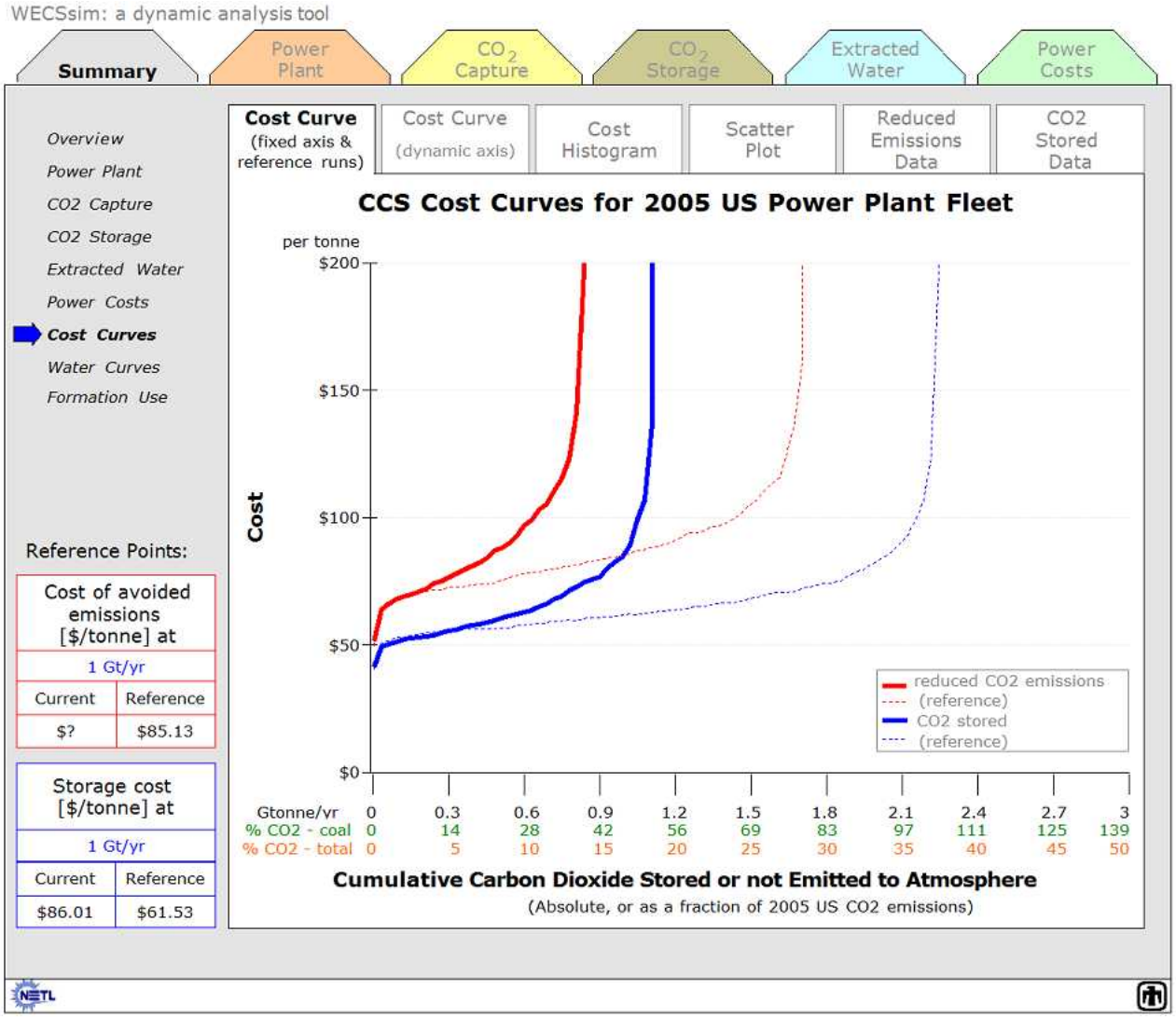
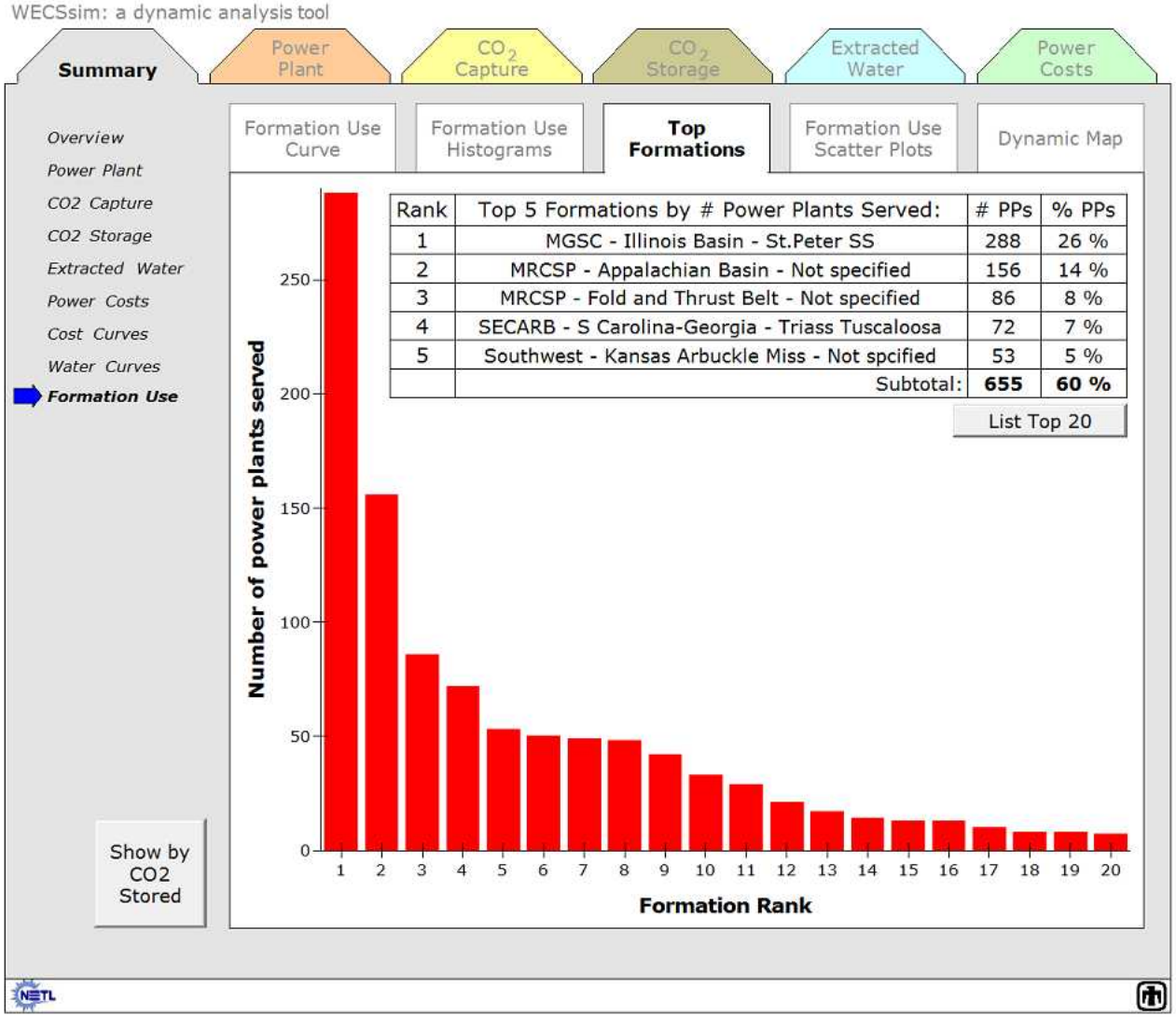


Top Formations (CCS Sinks) Illustrative Scenario



Key Messages

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- Systems-Level Capabilities
  - Geosciences
  - Systems Modeling for Performance and Cost Assessment
- Existing, Ready-to-Use WECSsim
  - Ability to incorporate new water treatment technology parameters
  - Ability to analyze multi-scale analysis from the single prototype plant to national scale
  - Integrated Geoscience-to-Costs capability
- Capitalize on Existing Capabilities
  - Ability to run new and custom CO_2 sequestration, Extracted Water Production and treatment scenarios

Exceptional service in the national interest

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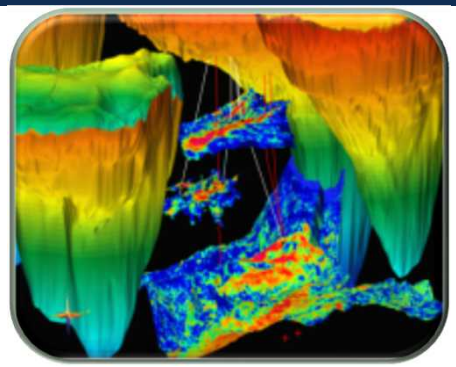

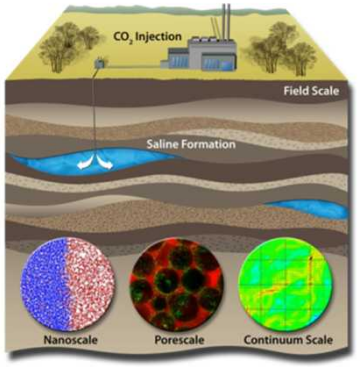

Thank You

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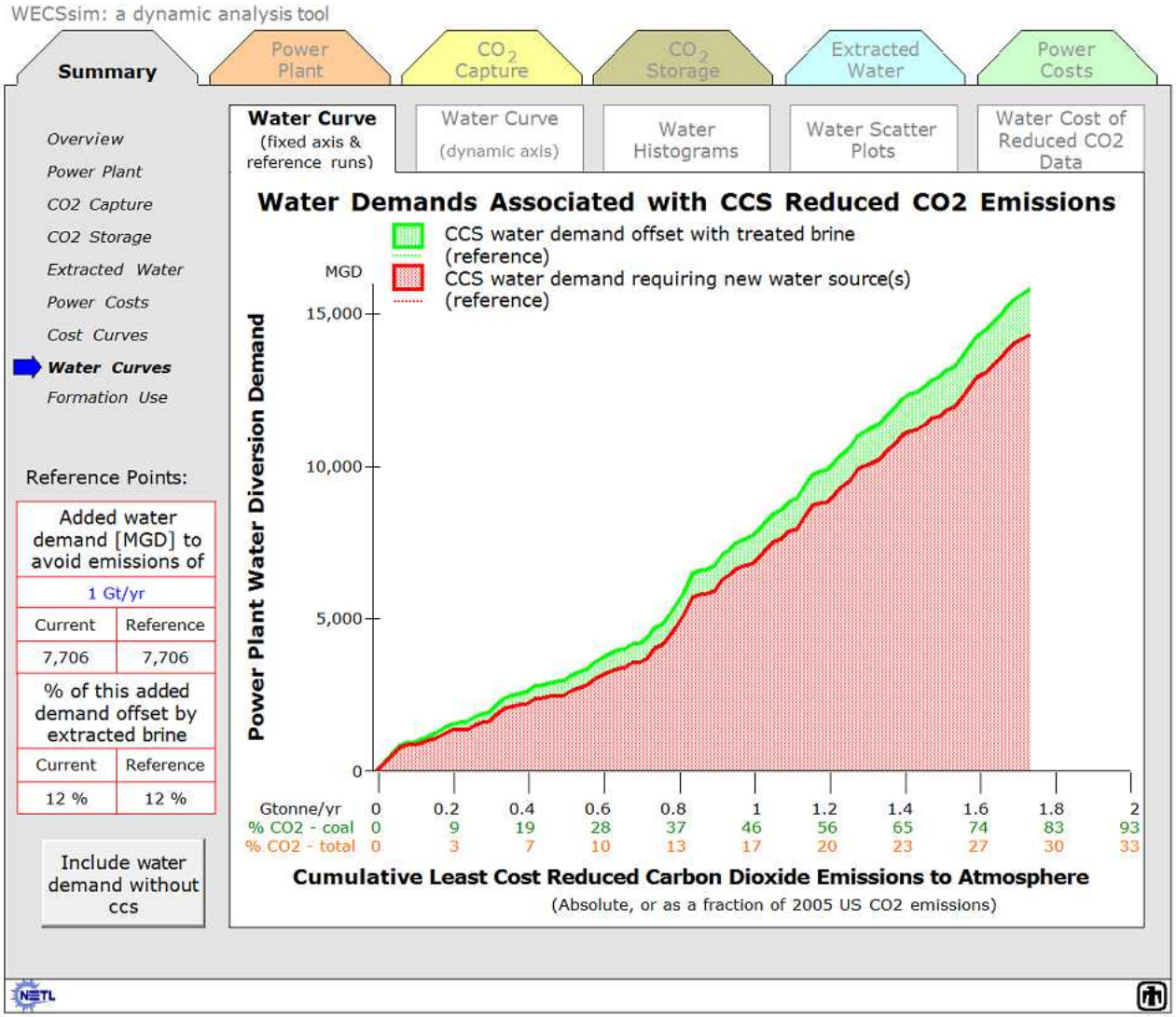
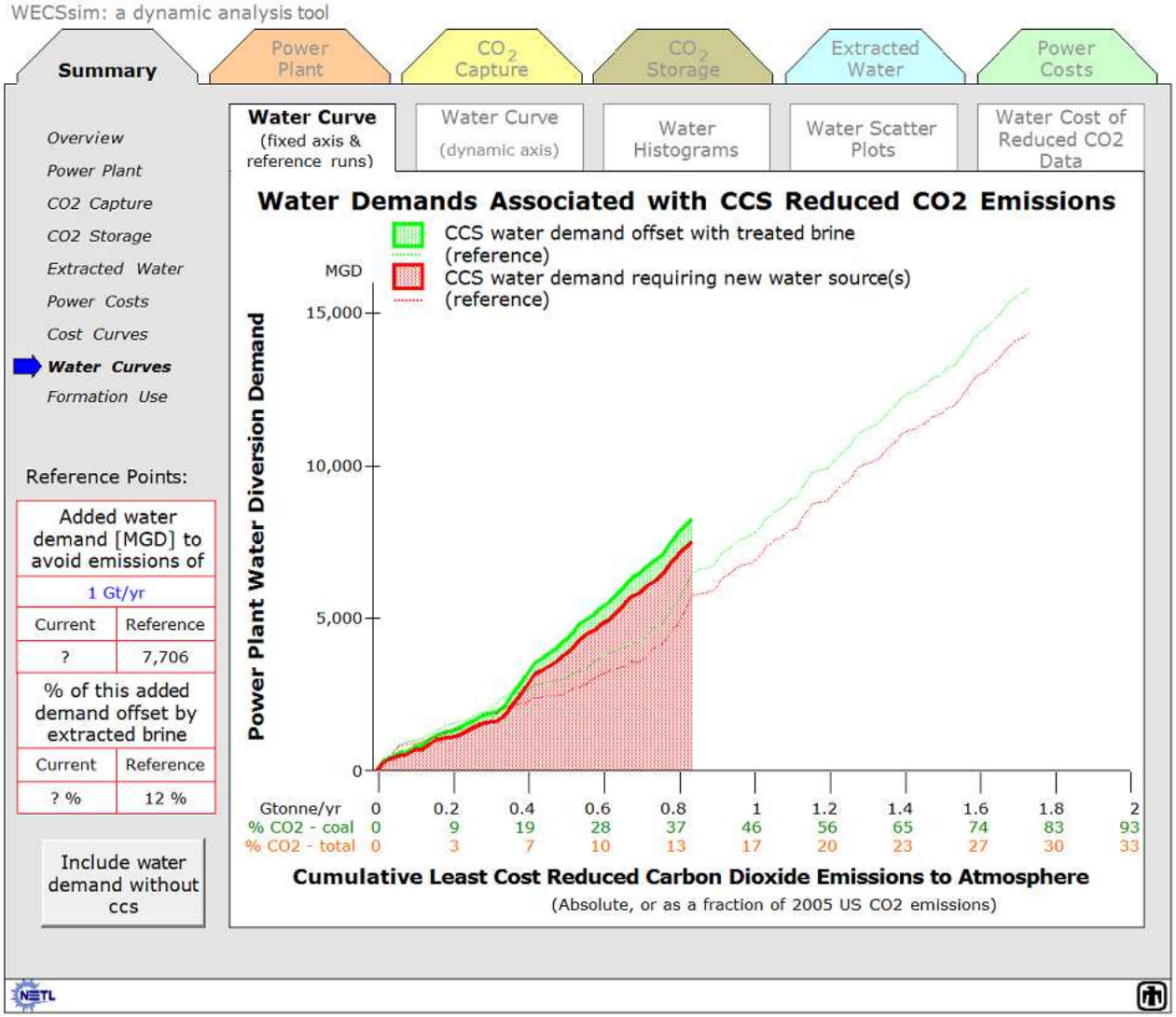
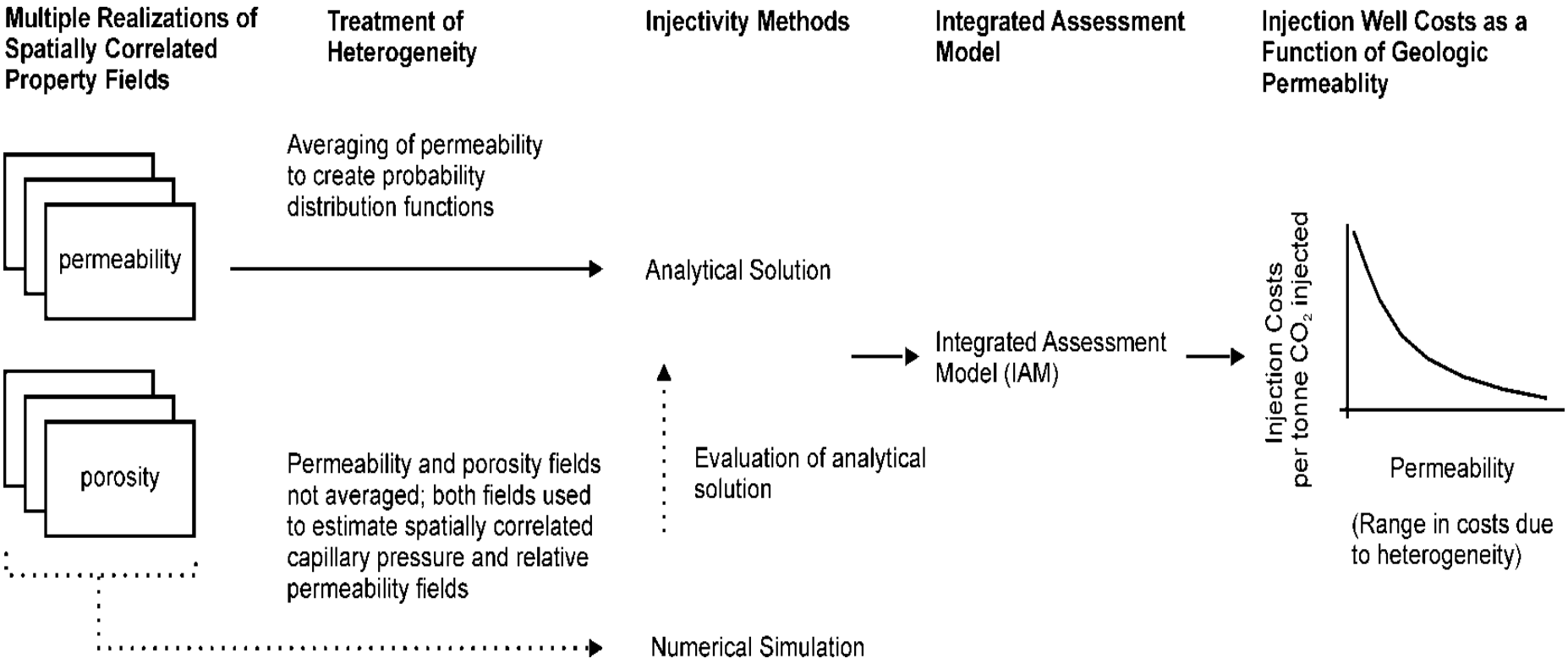
National Fleet Water Curves



Base Case (90% Capture) and 50% CO_2 capture: Water Demands

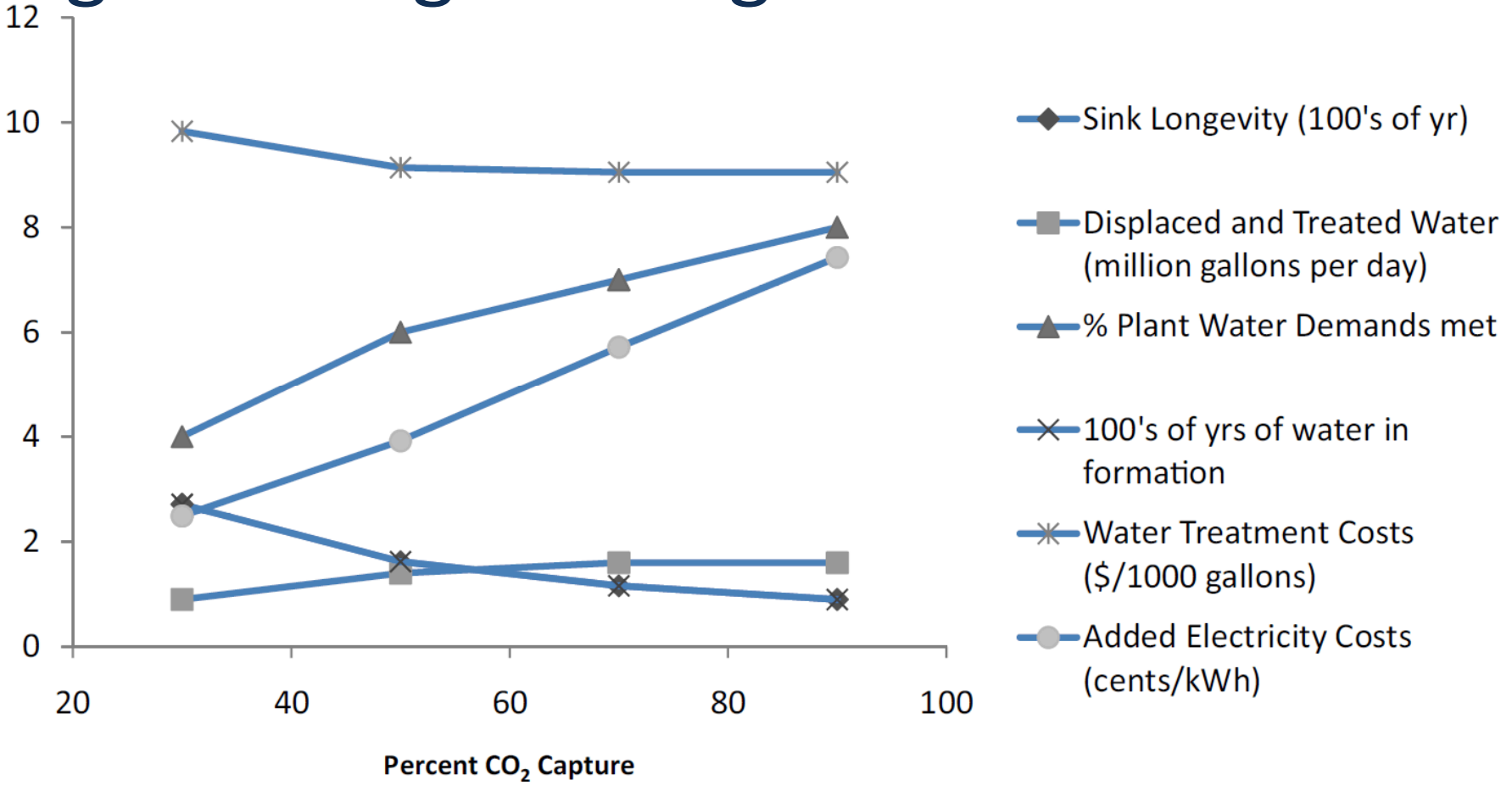


Methods behind the Permeability-to-Cost Analysis



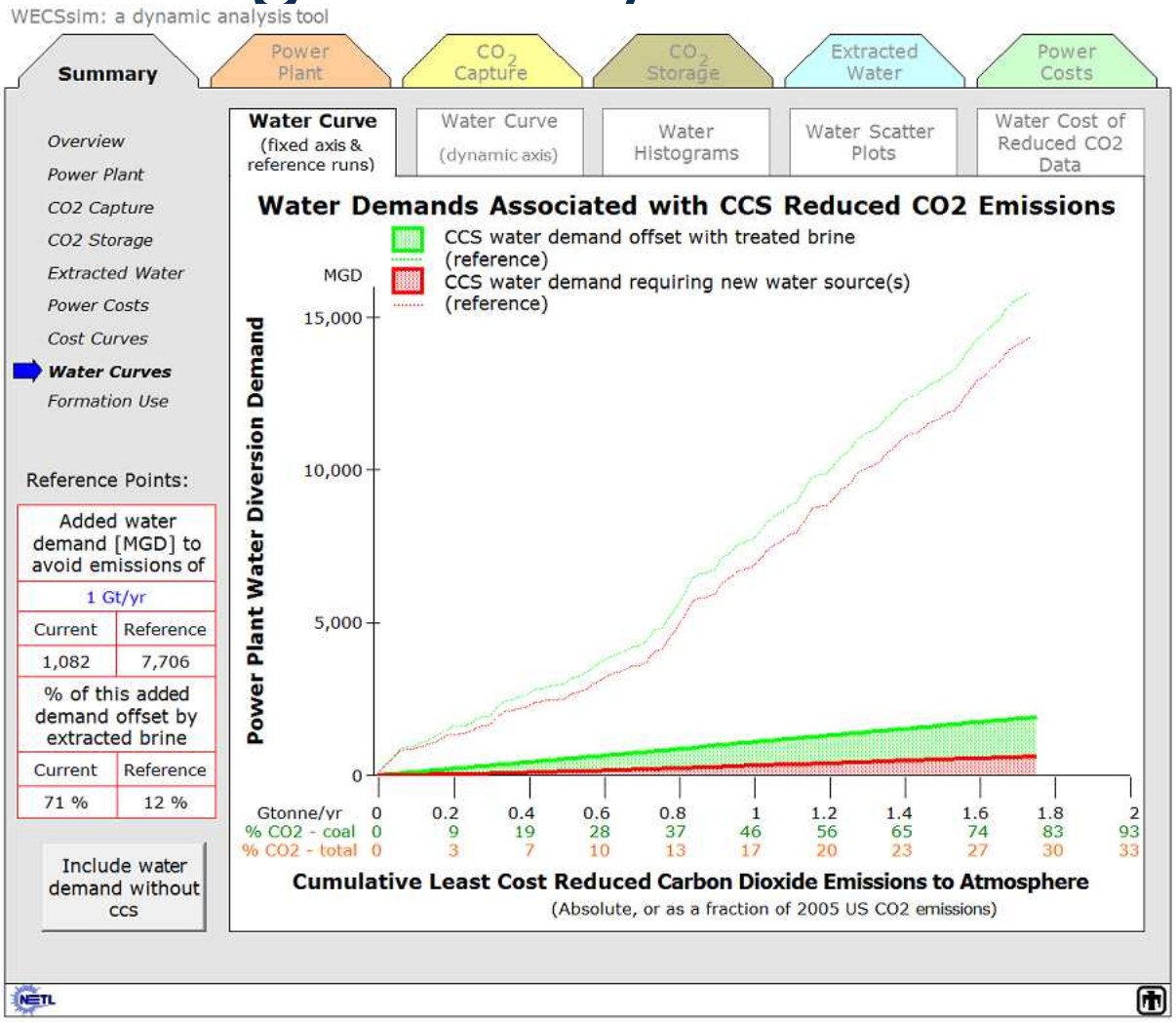
Source: Heath, J.E., Kobos, P.H., Roach, J.D., Dewers, T.A. and S.A. McKenna, 2012, "Geologic Heterogeneity and Economic Uncertainty of Subsurface Carbon Dioxide Storage,"
SPE Economics & Management Journal, January 32-41.

Single Power Plant to Single Geologic Storage Site

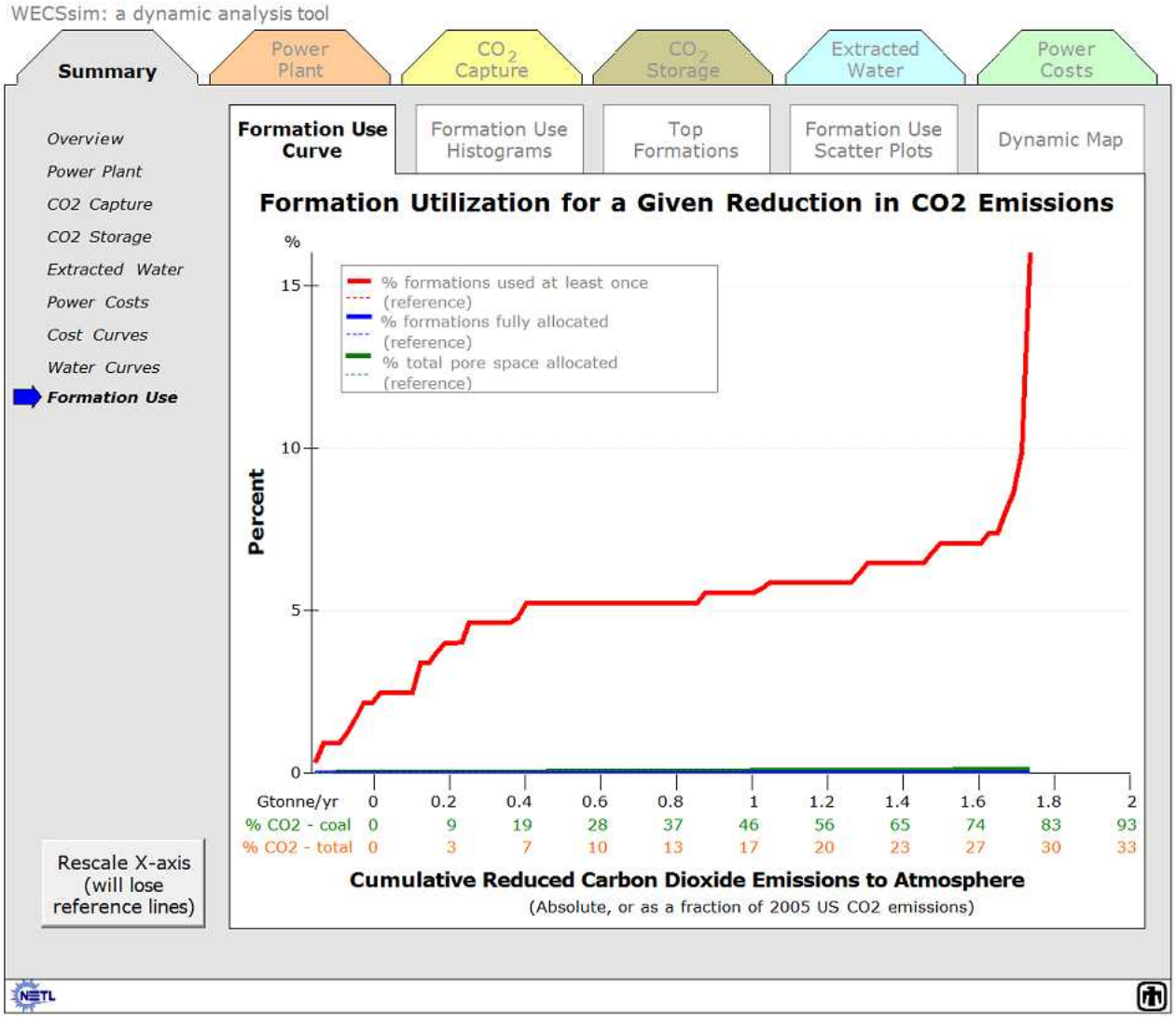


Source: Kobos et al., 2011, Combining power plant water needs and carbon dioxide storage using saline formations: Implications for carbon dioxide and water management policies, *International Journal of Greenhouse Gas Control*, 5, 899-910.

Water Efficient Makeup Power (NGCC, cooling towers)



National Formation Utilization Illustrative Scenario



Base Case (90% Capture) and 50% CO_2 capture: Geologic Formation Utilization

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