SAND2012-3473P

The Water, Energy and Carbon Sequestration Simulation Model (WECSsim©):
Using System Dynamics for CO_2 Management & Planning

Peter H. Kobos & **Jesse D. Roach**

Economist, Ph.D. *Hydrologist, Ph.D.*

Additional Team members include

Geoffrey T. Klise, Jason E. Heath, Thomas Dewers, Sean A. McKenna,

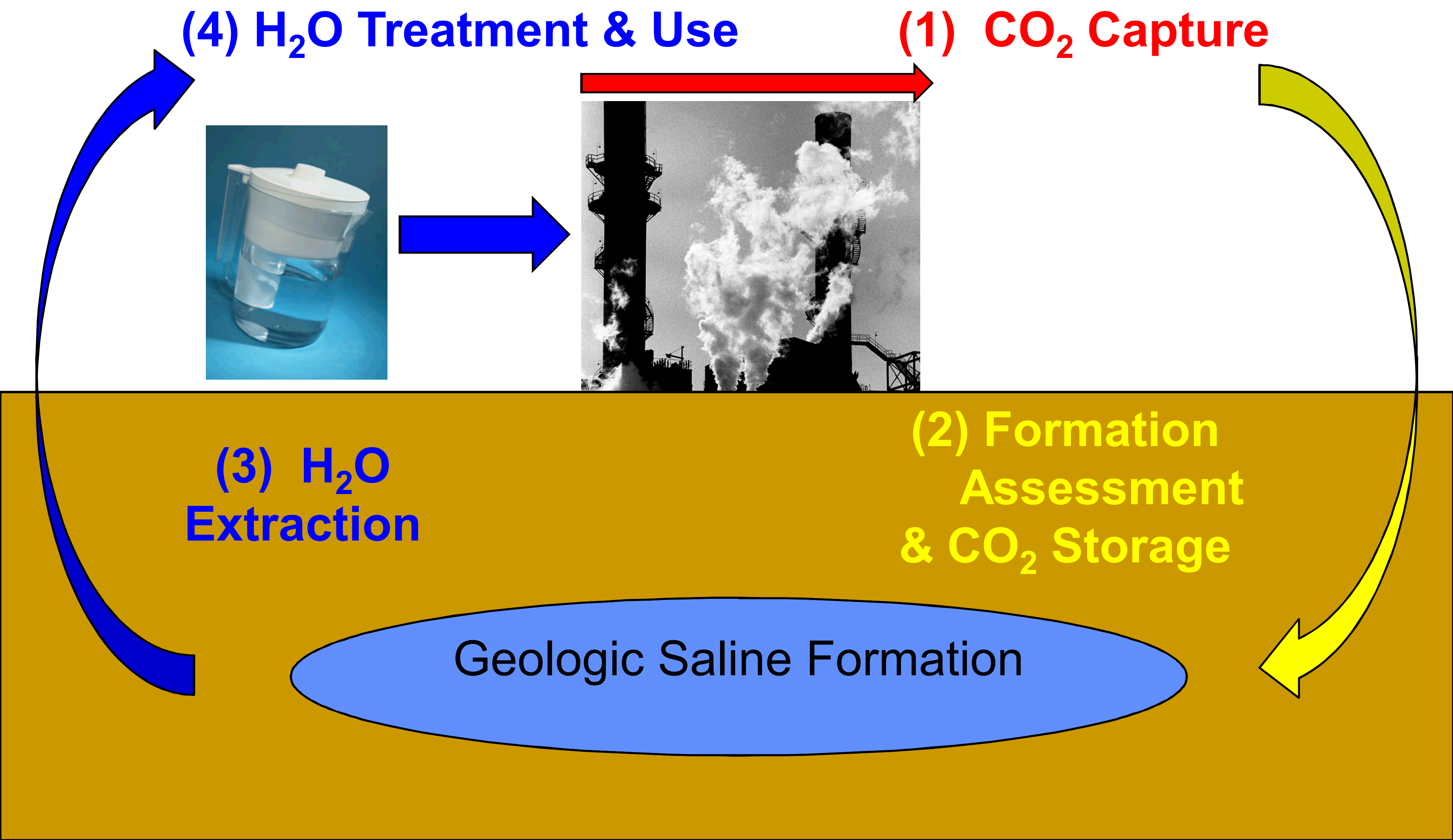
Karen Gutierrez, David J. Borns, Andrea McNemar, *and many others*

2012 Carbon Sequestration Partnership Water Working Group (WWG)

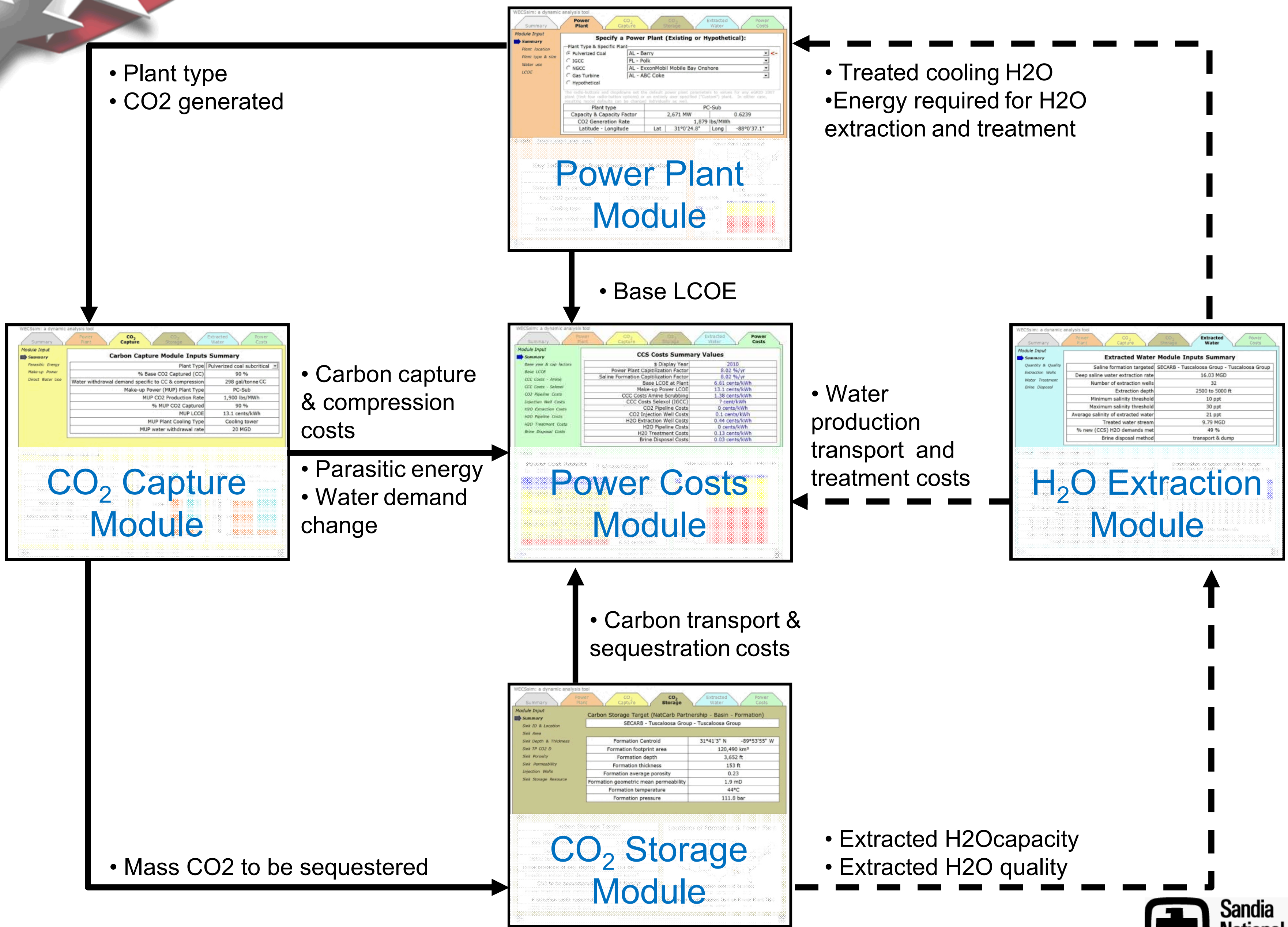
WECSsim project supported by the National Energy Technology Laboratory

Sandia National Laboratories is a multi-program laboratory managed and operated by Sandia Corporation, a wholly owned subsidiary of Lockheed Martin Corporation, for the U.S. Department of Energy's National Nuclear Security Administration under contract DE-AC04-94AL85000. Working Results.

Water, Energy and CO_2 Sequestration (WECS) Model:

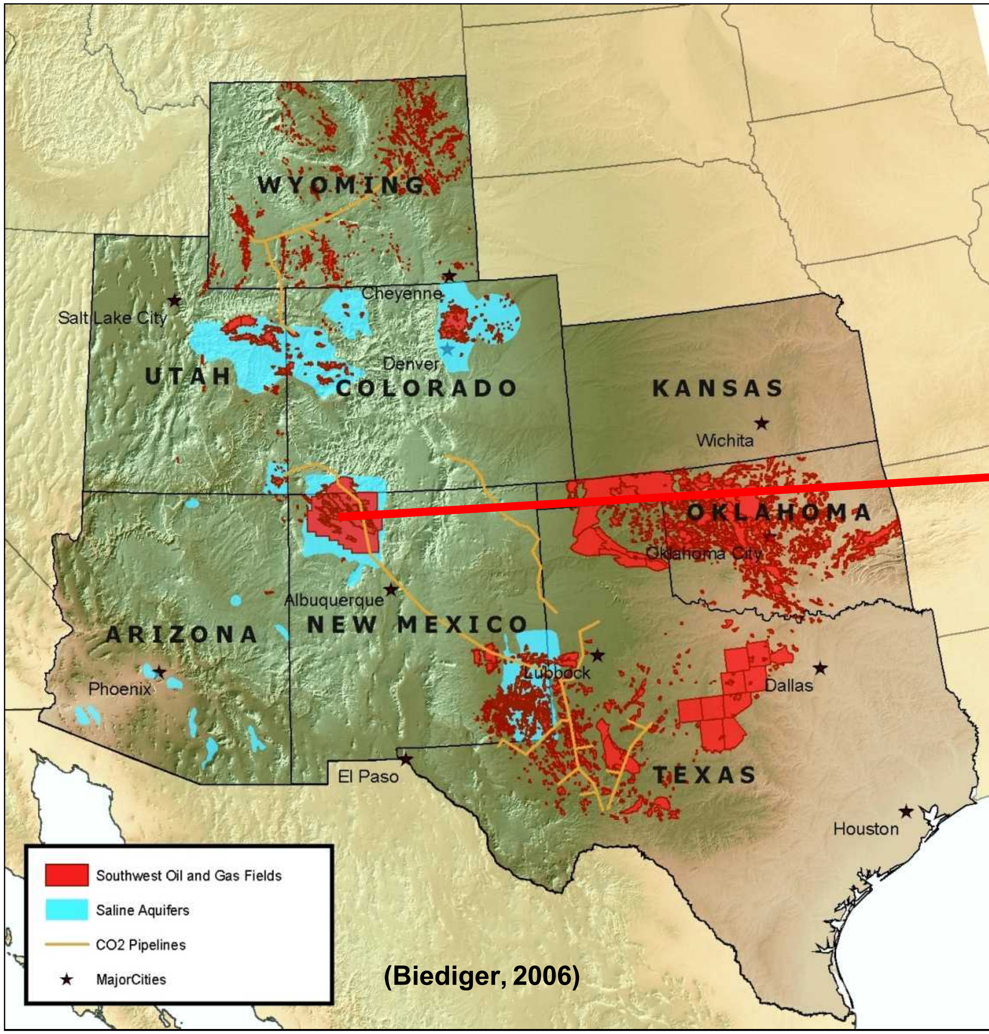


WECSsim Modular Structure



Sandia National Laboratories

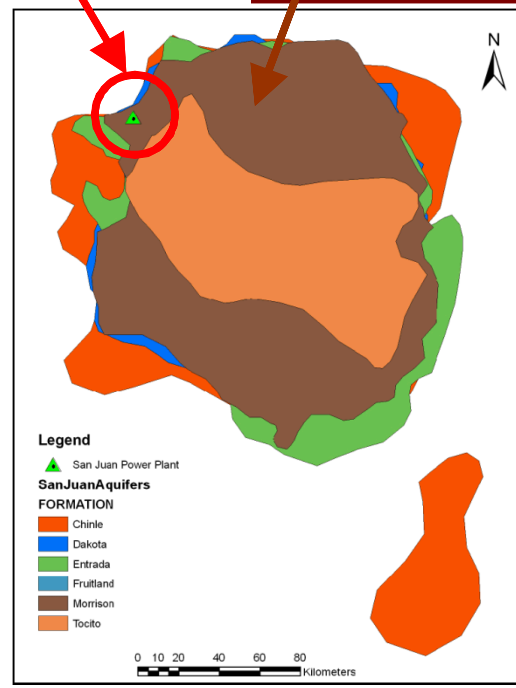
The San Juan Power Plant and Morrison Formation



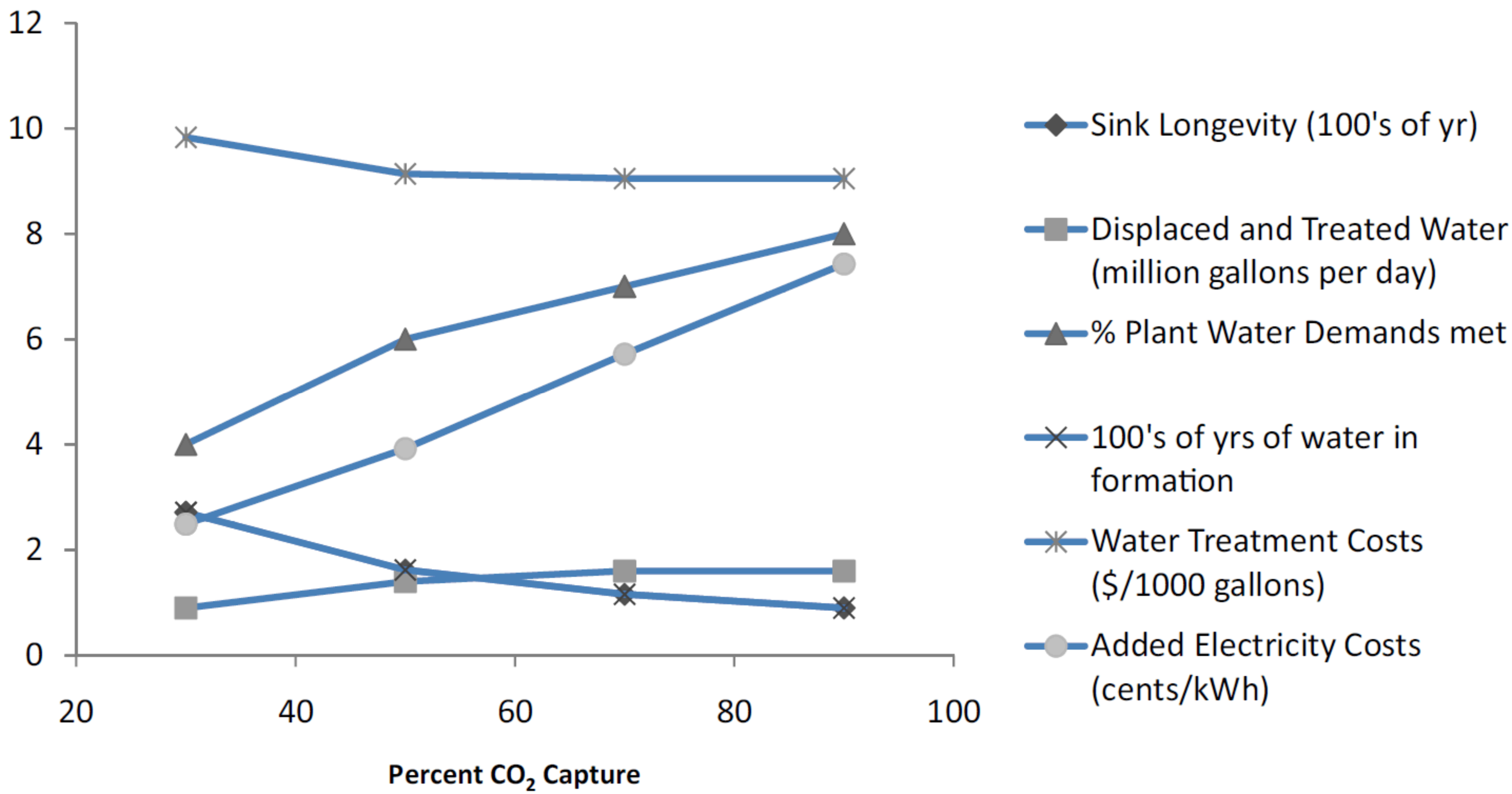
(Biediger, 2006)

San Juan Power Plant

Morrison Formation



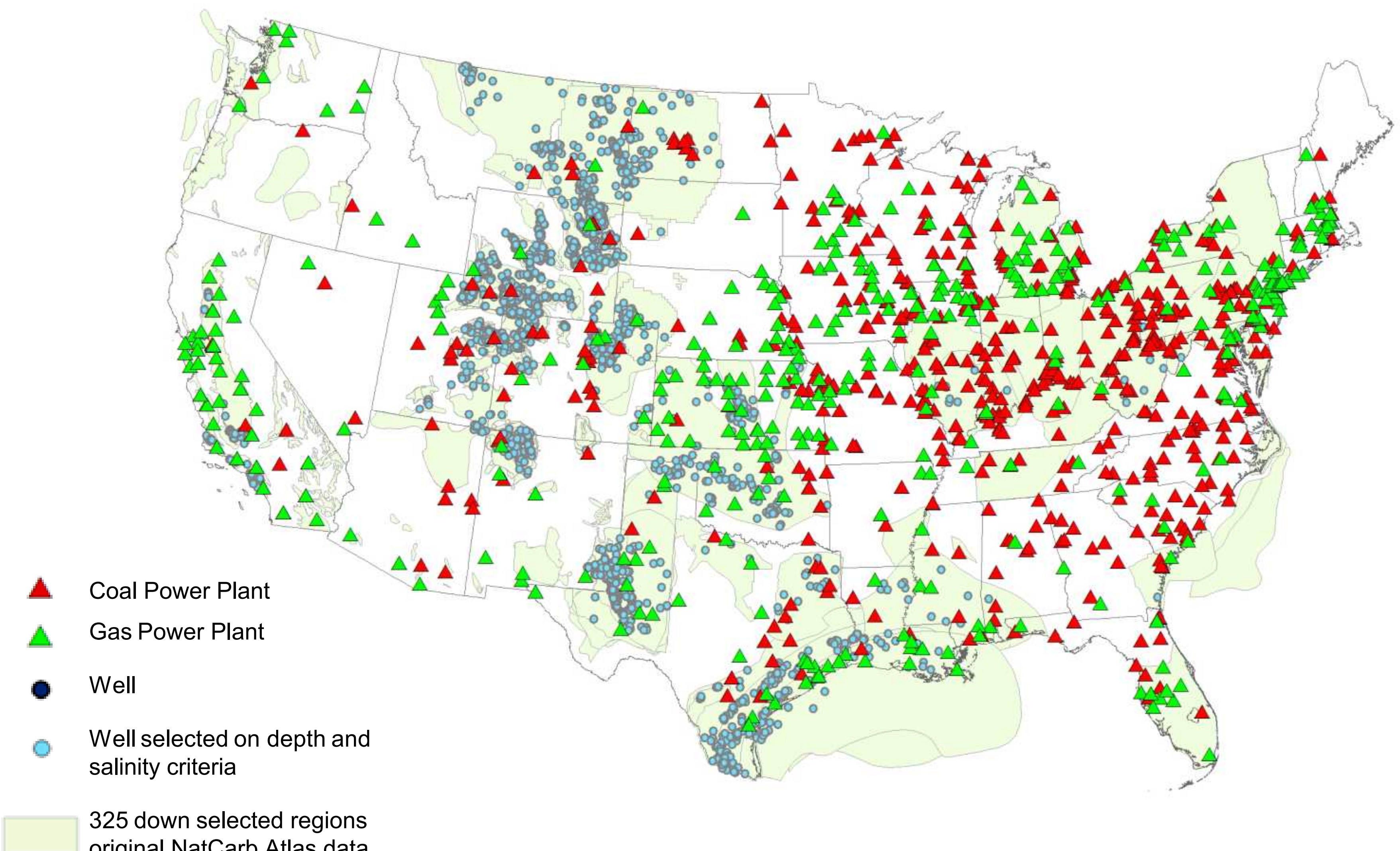
Single Power Plant to Single Geologic Storage Site



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.

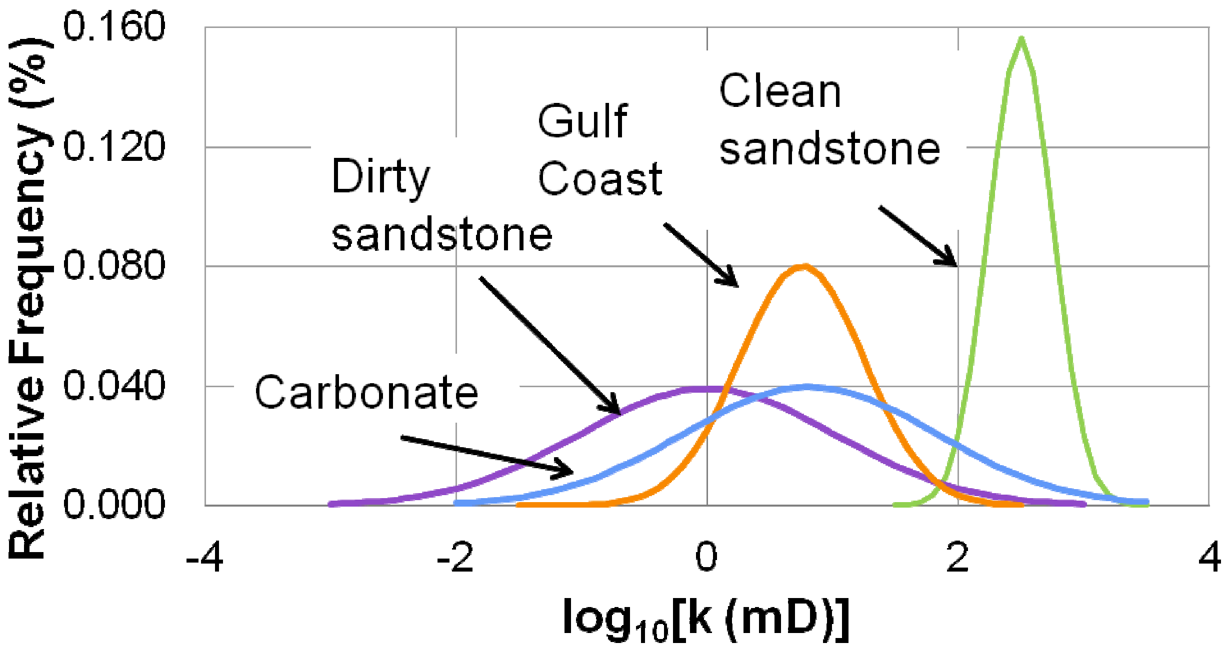
Sandia National Laboratories

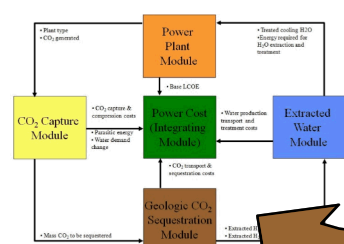
Geological CO_2 Storage Database Challenges



Expanding the ‘Geology Controlled’ (Permeability) factor to Cost Relationship across all Sinks

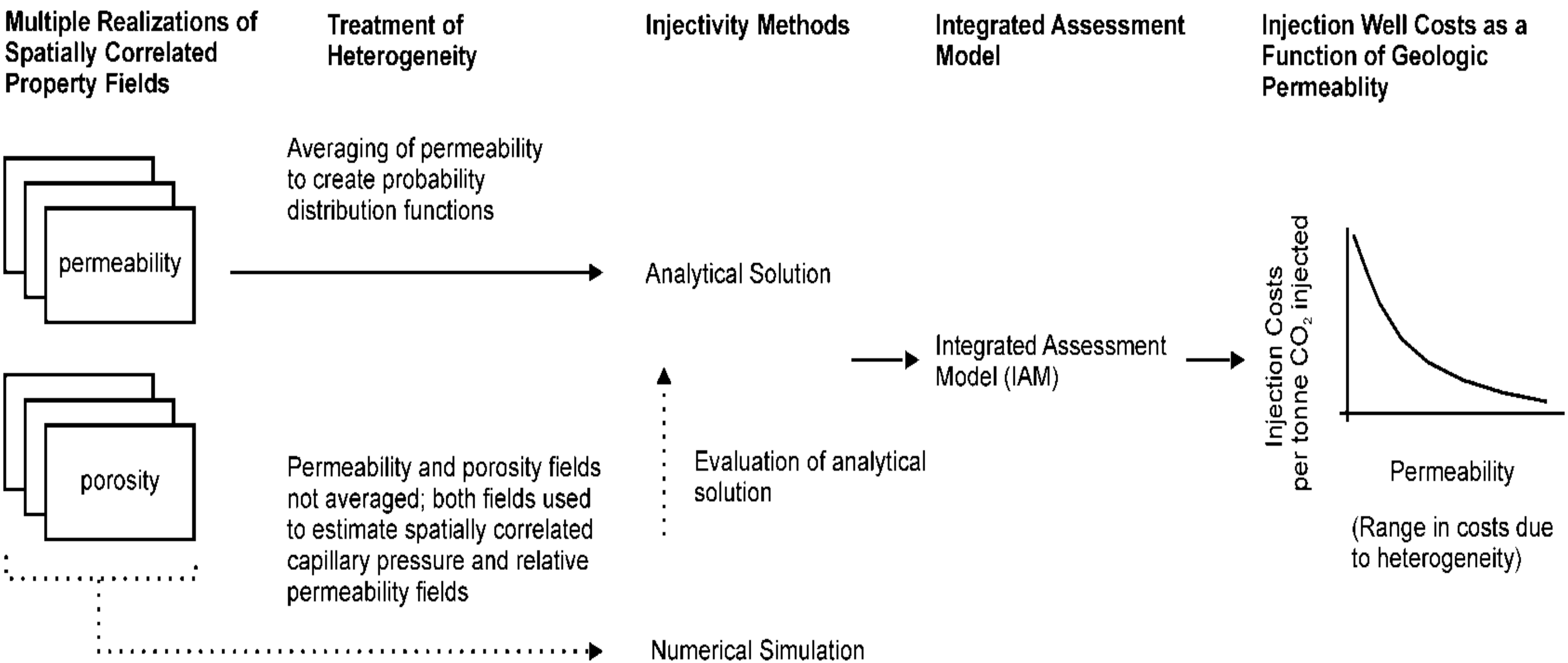
Injectivity equation: permeability sampled from 4 Rock Types





Sandia National Laboratories

Methods behind the Permeability-to-Cost Analysis

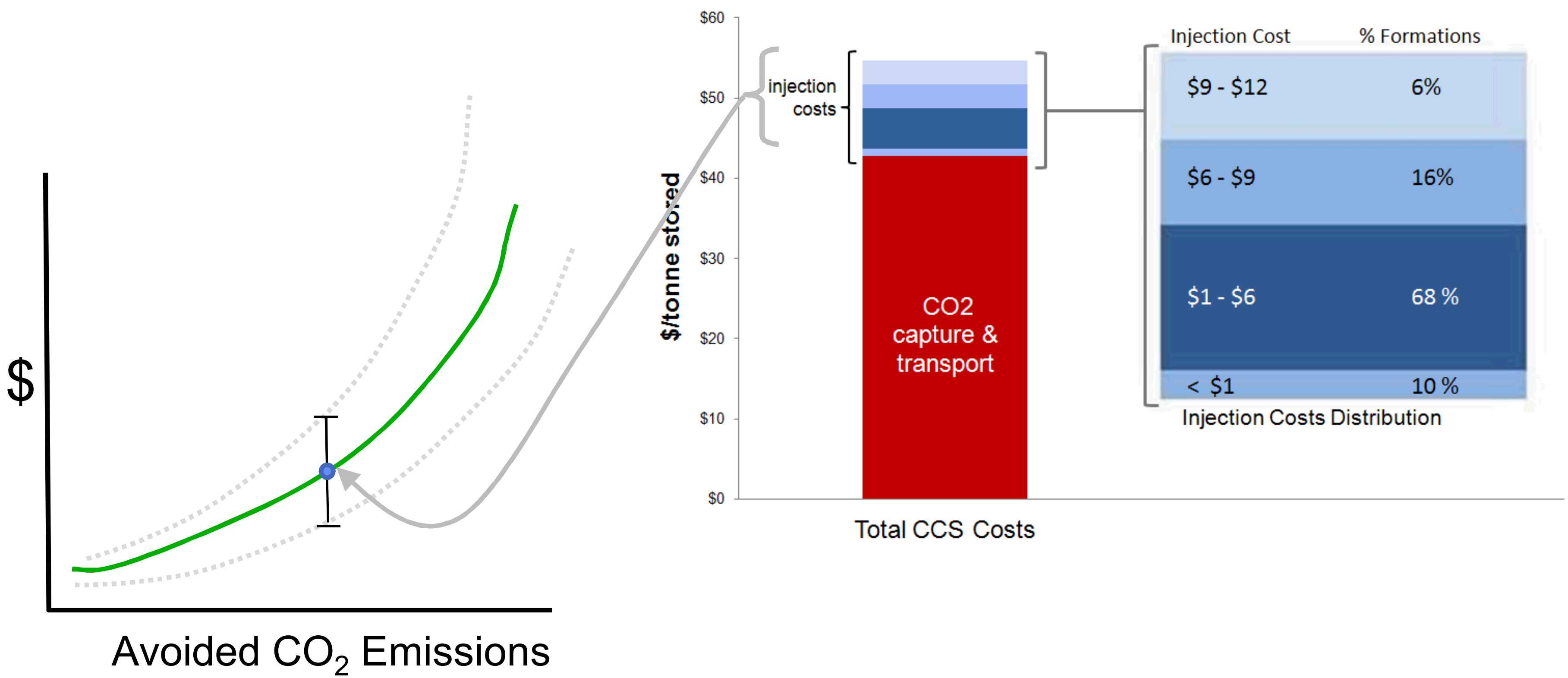


Source: Heath, J.E., Kobos, P.H., Roach, J.D., Dewers, T.A. and S.A. McKenna, 2012, "Geologic Heterogeneity and Economic Uncertainty of Subsurface Carbon Dioxide Storage," *SPE Economics & Management Journal*, January 32-41.

Sandia National Laboratories

WECSsim Results:

Similar Full Economic Analysis Underway

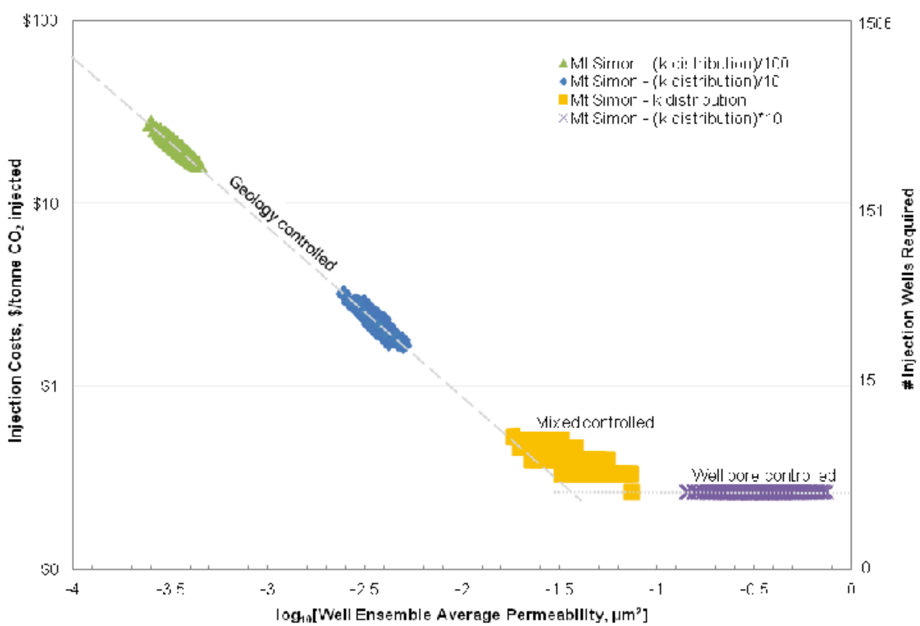


Note: Illustrative Example at this time

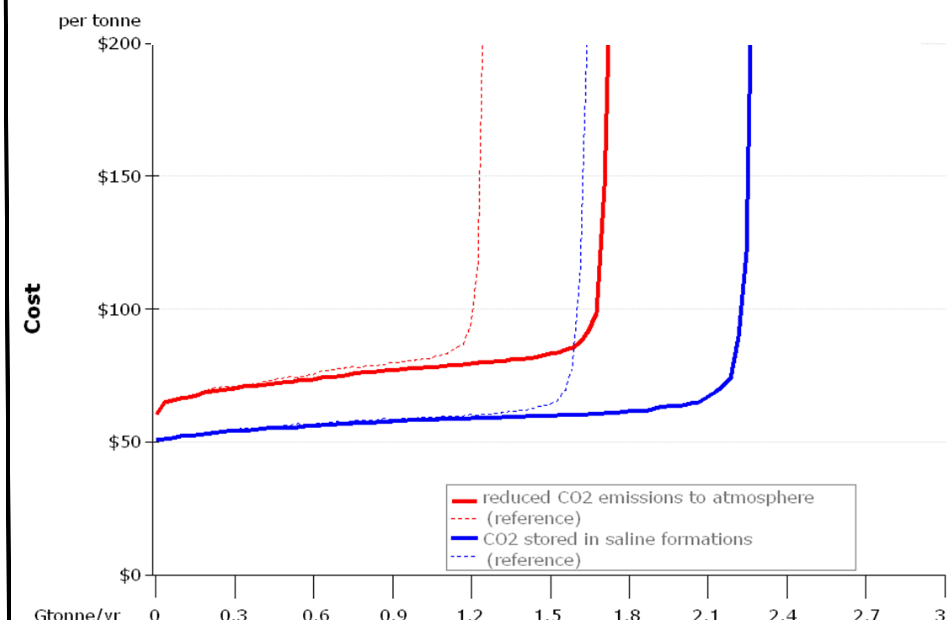
Sandia National Laboratories

Cost Drivers & Supply Curve:
Interactive CO_2 Storage Analysis

Permeability↑ = Well Costs ↓



Developing a National, CO_2 Storage Supply Curve



Sandia National Laboratories

Key Messages

Framework for National Level Assessment

- Cost of CCS from any U.S. fossil fuel power plant to any deep saline formation
- Site-specific nature of geologic data challenge

Impact of Geologic Uncertainty on Costs

- Low injectivity requires more injection wells and therefore higher costs
- High permeability reservoirs with low injection costs (< $1/tonne) represent < ~10% of the 325 formations
- Scale-up challenge
- EOR adds value to CO_2 storage through utilization

Sandia National Laboratories

The Water, Energy and Carbon Sequestration Simulation Model (WECSsim)

Thank you.

WECSsim: a dynamic analysis tool

Summary | Power Plant | CO_2 Capture | Carbon Sequestration | Extracted Water | Power Costs

Sandia National Laboratories

NETL

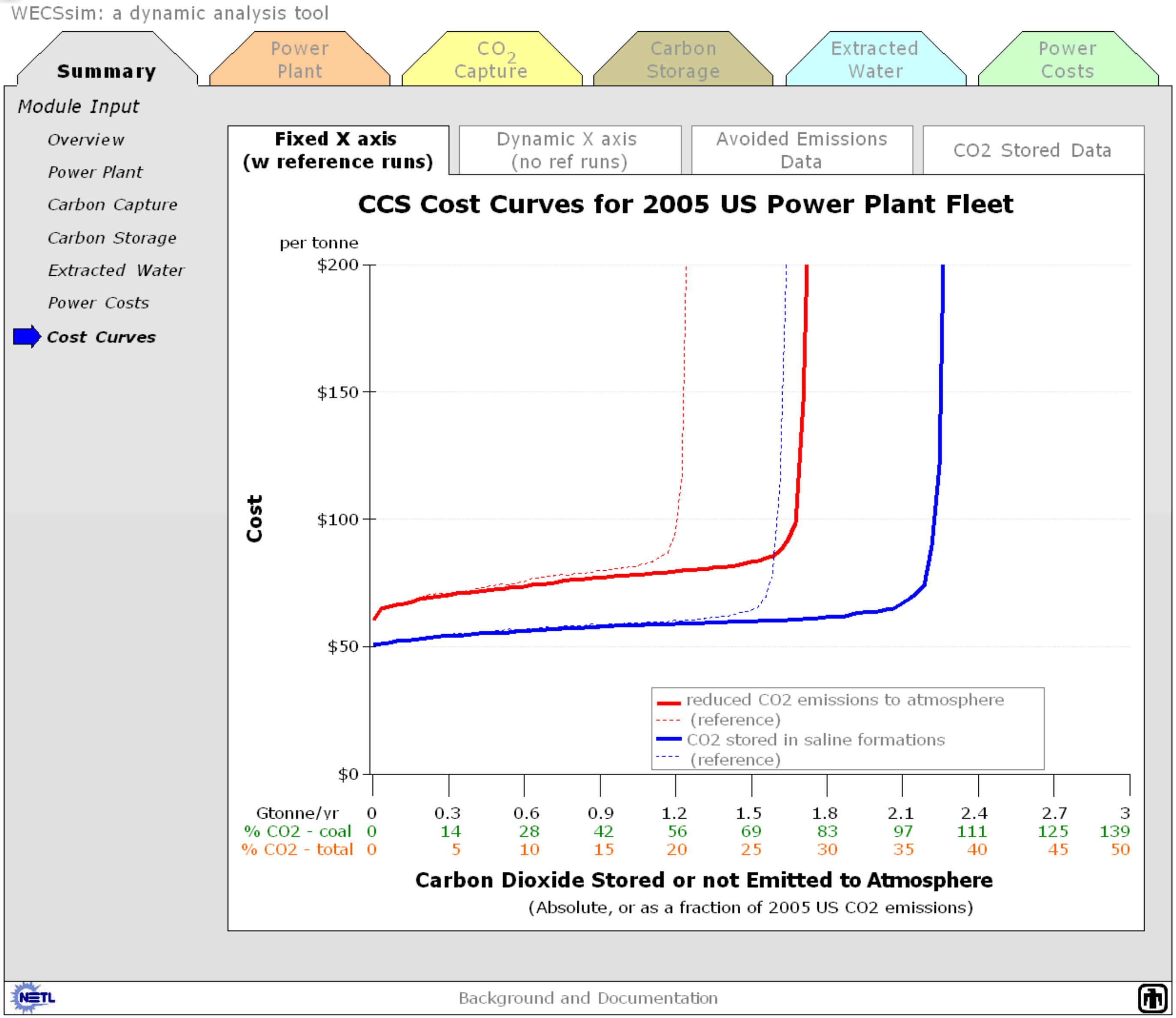
The National Water, Energy and Carbon Sequestration Simulation (WECSsim) Model

Model Development Authors:
P.H. Kobos, J.D. Roach, G.T. Klise
J. Heath, T. Dewers, K. Gutierrez, S. McKenna, D.J. Borns

Evaluate a single powerplant

Evaluate 2005 U.S. powerplant fleet

Version 1.0, September 2011; Working Version, as of 2/2012.



Illustrative, working results, 2/2012.