



***Optimized Solvent for Energy-Efficient, Environmentally-Friendly
Capture of CO₂ at Coal-Fired Power Plants (DE-FE0007716)***

**2012 NETL CO₂ Capture Technology Meeting
Pittsburgh, PA
July 10, 2012**



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The Babcock & Wilcox Company

Power Generation Systems Segment

Fossil and Renewables

- Coal-fired power generation
- Service, operation and maintenance
- Construction and EPC
- Environmental systems (FDG, SCR, mercury, carbon)
- Renewables (Biomass, solar, waste-to-energy)

Nuclear Energy

- Field services
- Plant modifications
- Component manufacturing and installation
- Fuel design, enrichment and fabrication
- B&W mPower



Government Operations Segment

Nuclear Operations

- Virginia-Class submarine program
- Ford-Class carrier program
- Refueling
- Fuel processing and fabrication

Management & Operations

- Nuclear material handling, storage and security
- Nuclear laboratories
- Weapons complex
- Decontamination and decommissioning
- Strategic Petroleum Reserve



Leading technology innovator in power generation and a specialty manufacturer of nuclear components with legacy spanning 140 years

Project Overview

Funding:

US DOE	2,835,680
B&W	<u>708,920</u>
Total	3,544,600

Period of Performance:

Oct 1, 2011 to May 31, 2015

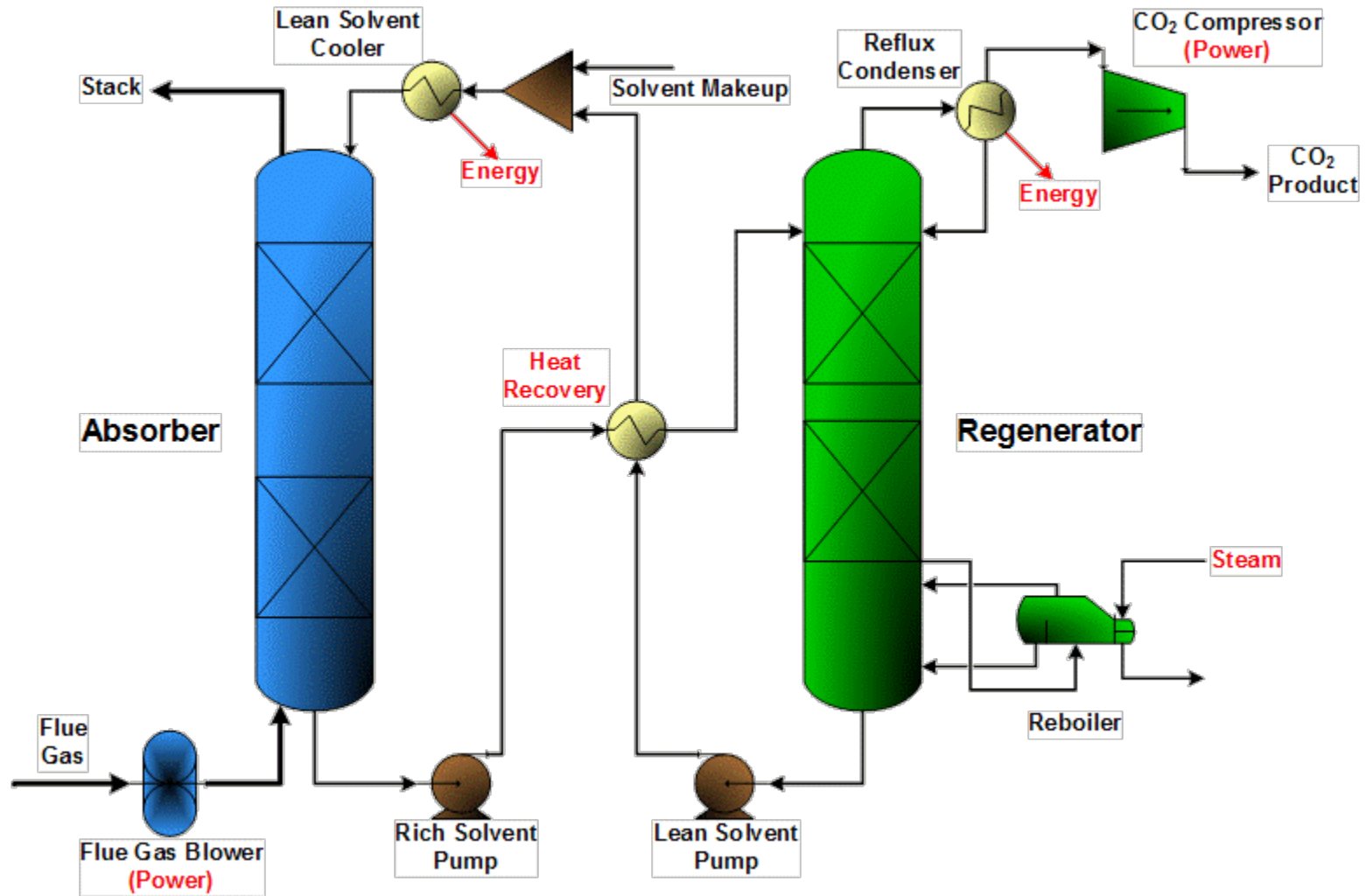
Participants:

B&W Power Generation Group
University of Cincinnati
First Energy

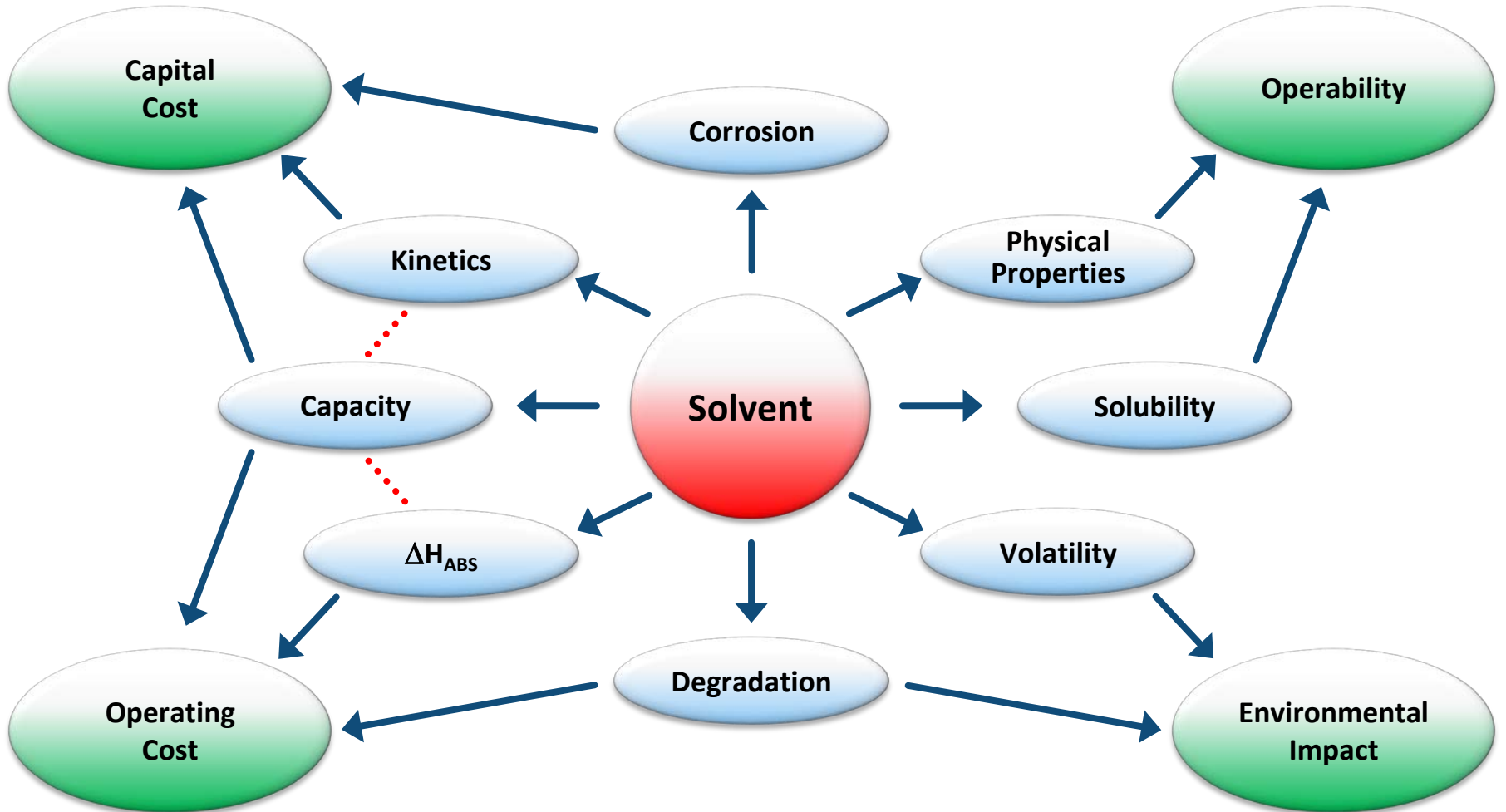
Objective:

To optimize and fully characterize a novel solvent formulation as a critical enabler for cost-effective, energy-efficient CO₂ capture while minimizing environmental impact and maximizing reliability

CO₂ Scrubbing Process



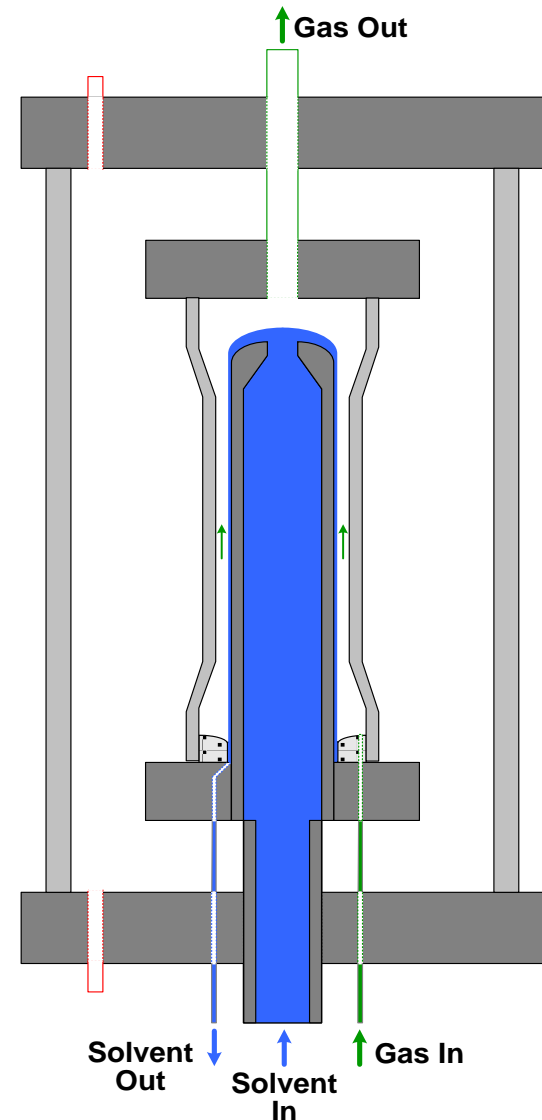
Impacts of Solvent



Wetted-Wall Column

Key Features:

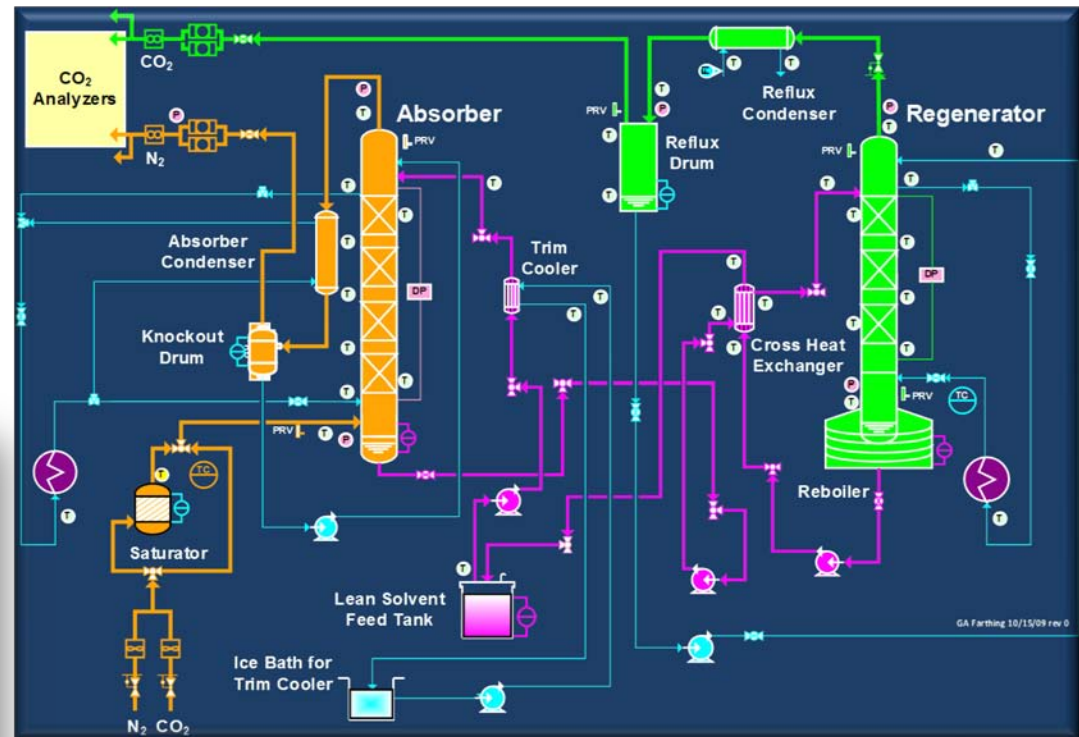
- ▶ Gas/liquid contactor
- ▶ Differential reactor
 - “Slice” of absorber or regenerator
- ▶ Known process conditions
 - Contact area
 - T, p, compositions, flow rates



Bench-Scale Simulator

Key Features:

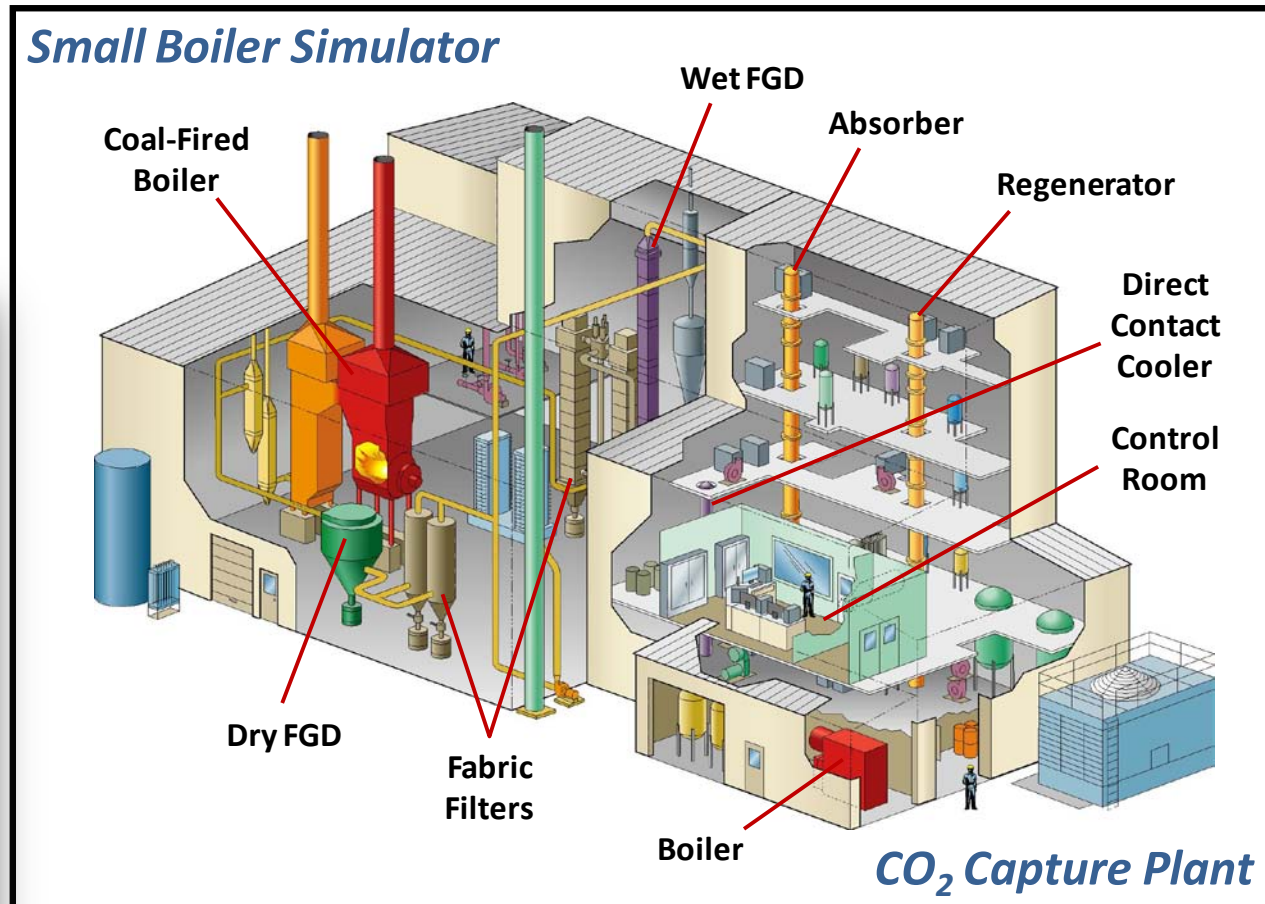
- ▶ 1 kg/hr CO₂ capture
- ▶ Fully-integrated process
- ▶ Flexible, modular design
- ▶ Multiple modes of operation



7 Ton/Day Pilot Plant

Key Features:

- ▶ High quality, representative data
- ▶ Coal flue gas



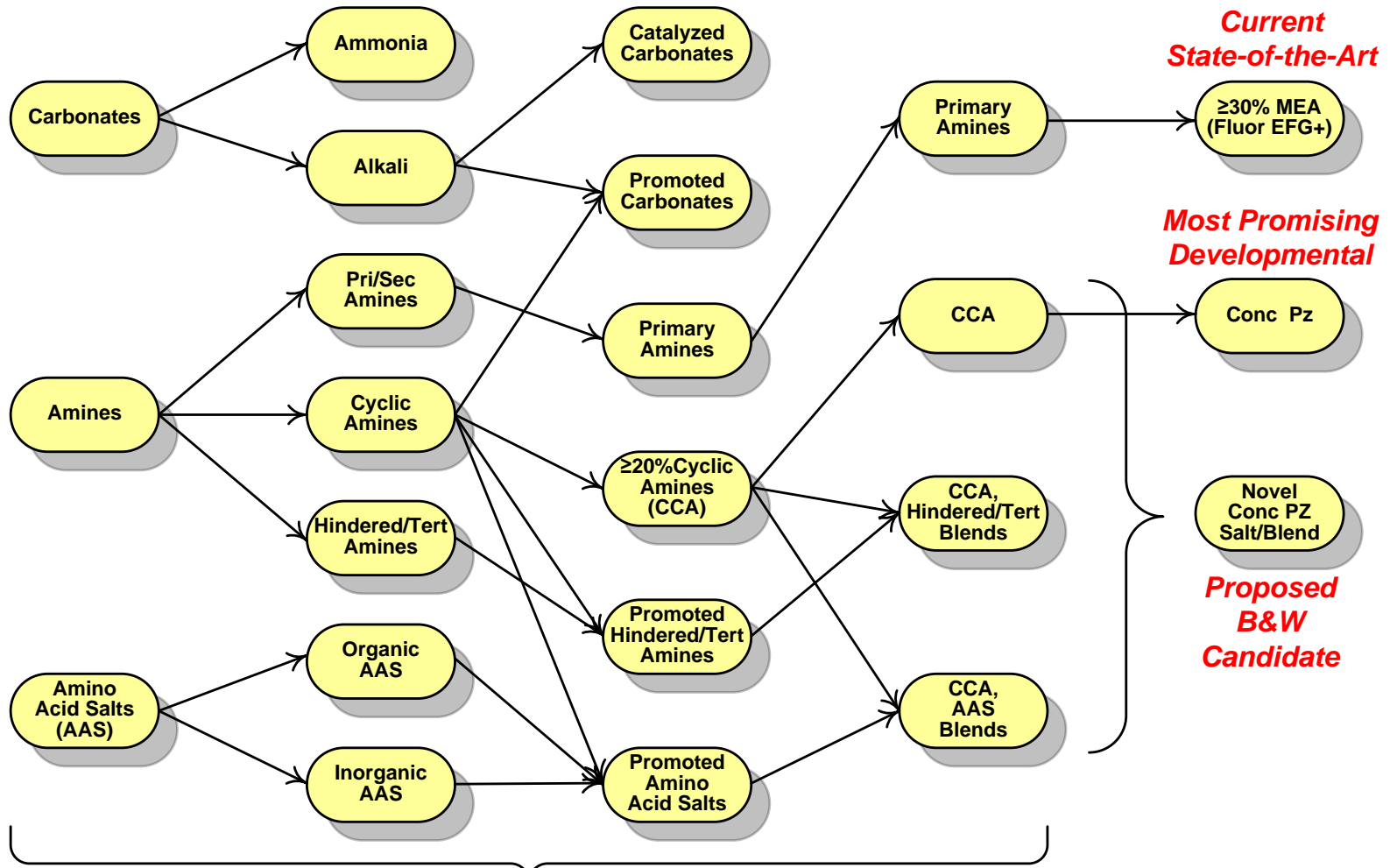
Simulation Modeling

- ▶ Complicated process
 - Multiple components, multiple phases
 - Thermodynamics, chemical reactions, mass & heat transfer
 - Non-ideal solution (aqueous electrolytes)
- ▶ Evaluation of process concepts
- ▶ Performance prediction
- ▶ Support pilot/demo testing
- ▶ Facilitate full-scale plant design



Candidate Formulations

Better Solvents (B&W's Downselect Process)



B&W's 5-Year Solvent Development Effort

B&W's Approach

**Current
State-of-the-Art**

>30% MEA
(Fluor EFG+)



Fluor/B&W strategic alliance

**Most Promising
Developmental**

Conc Pz



OptiCap™ test at NCCC

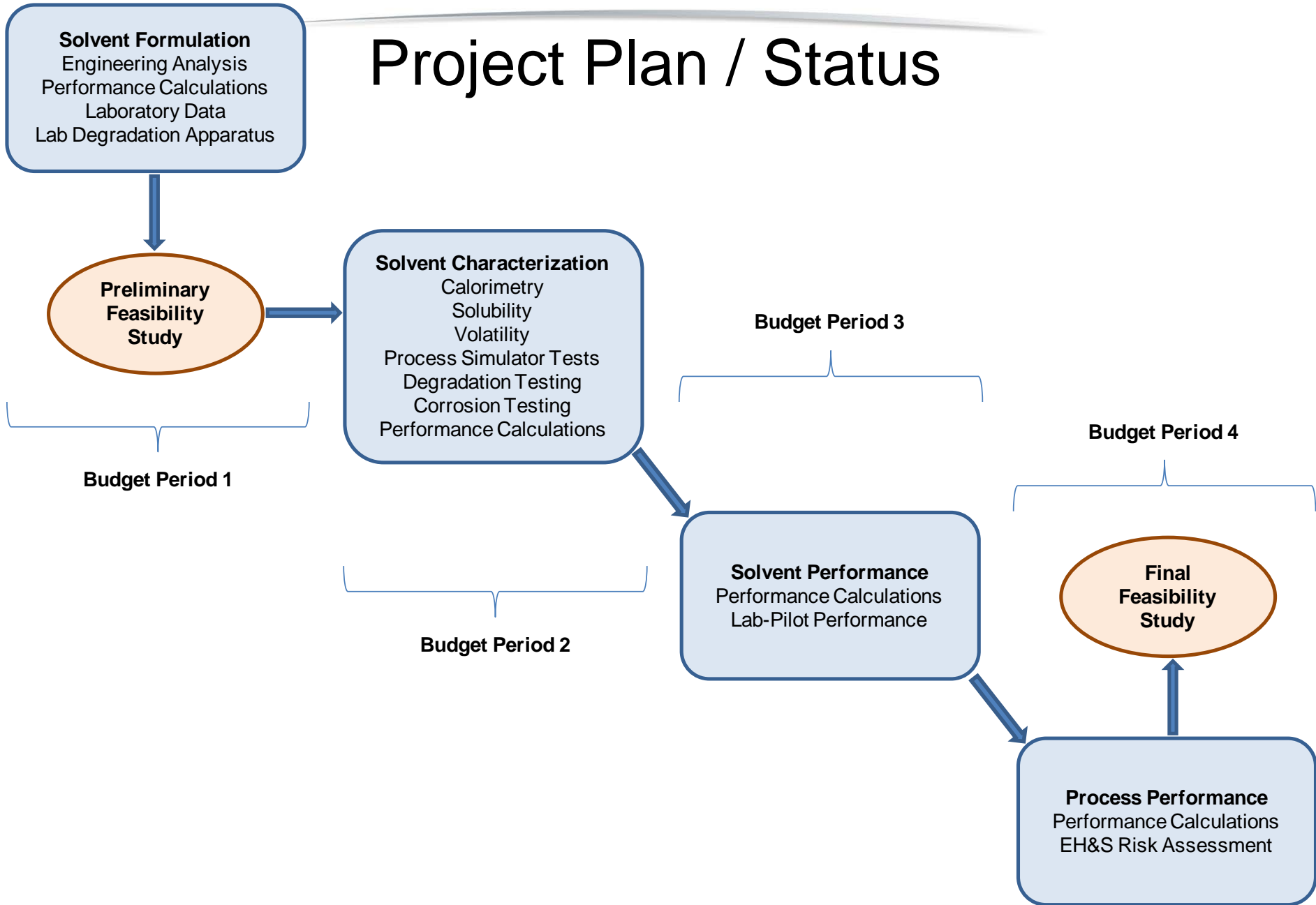
Novel
Conc PZ
Salt/Blend



Current Project

**Proposed
B&W
Candidate**

Project Plan / Status



Program Goals

- ▶ Approaching aggressive US DOE goals will require
 - Advanced solvent (this project)
 - Innovative design (equipment size, materials of construction, etc.)
 - Innovative process heat integration
 - Optimal integration with power plant
- ▶ Advanced solvent expected to provide
 - Low reboiler heat duty
 - Smaller absorber / high removal efficiency
 - Lower compression costs
 - Reduced material cost
 - Reduced emissions / waste

Acknowledgements

▶ US DOE-NETL

- Project Manager: Bruce Lani
- Funding support

▶ Project Partners

- B&W project team: Purusha Bonnin-Nartker, Lei Ji, Mike Klidas, Lisa Rimpf, Victoria Wilson, Ruyu Zhang
- University of Cincinnati (Prof. Stephen W. Thiel, et.al.)
- First Energy (Elizabeth Shaw, Director, FE Technologies & Corporate METT)