

# CO<sub>2</sub> Capture with ECO

*ECO Commercial  
Demonstration  
Open House  
R.E. Burger Plant*

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## **Powerspan CRADA with DOE**

- **Joint research and development program on CO<sub>2</sub> capture with ammonia (NH<sub>3</sub>)**
- **Lab tests show NH<sub>3</sub> has several advantages over commercially available amine (MEA) process:**
  - **higher CO<sub>2</sub> loading capacity**
  - **lower energy consumption for regeneration**
  - **lower cost reagent**
- **By comparison, MEA process suffers from:**
  - **higher equipment corrosion rate**
  - **amine degradation by flue gas requiring higher makeup**

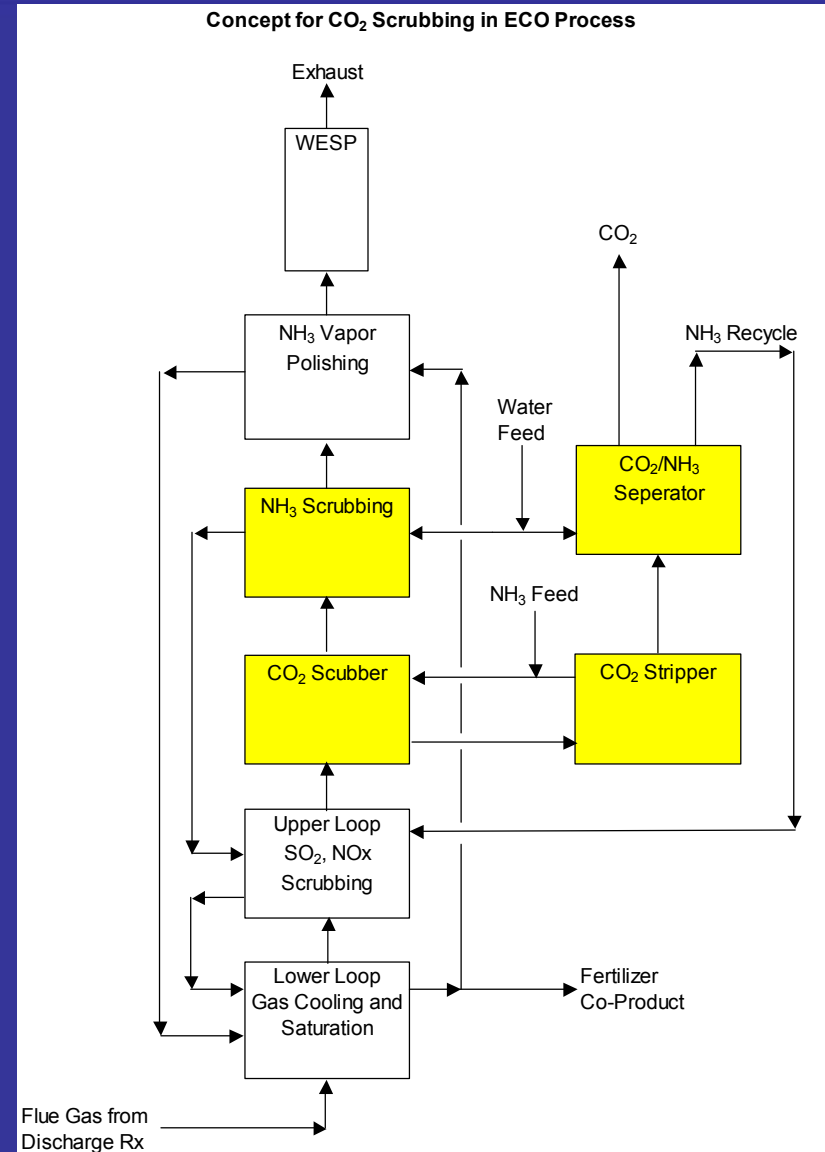
## Lab Results for CO<sub>2</sub> Removal

- 88% CO<sub>2</sub> removal achieved with 10% ammonium carbonate solution
  - Gas and liquid at 130°F
  - 7 second residence time
  - Liquid to gas ratio of 65 gpm/kacfm
  - Simulated flue gas with
    - CO<sub>2</sub> (12%)
    - O<sub>2</sub> (6%)
    - N<sub>2</sub> (Balance)

## CO<sub>2</sub> Capture with ECO

- CO<sub>2</sub> capture incorporated into ECO process
- Approach – Design CO<sub>2</sub> removal as an ECO add-on feature that could be deployed later
- Benefits –
  - Use of ammonia in ECO process makes incorporating CO<sub>2</sub> removal feasible
  - Ability to absorb ammonia vapor and use dilute ammonia stream is key to process efficiency
  - Climate change concerns could result in CO<sub>2</sub> emission caps – requiring capture/sequestration

# Conceptual Process Flow Diagram



## Estimated CO<sub>2</sub> Capture Costs with ECO

DOE analysis indicates:

- Plant capital cost approximately \$295/kW
- Energy use approximately 10% of plant capacity
- Total energy costs (to release CO<sub>2</sub> from solution and compress) is ~\$3.50/ton
- Incremental power costs of <\$0.01/kWh
- Cost per ton of CO<sub>2</sub> emissions avoided \$14.00 - includes \$3.00/ton charge for transportation and underground sequestration

## Estimated CO<sub>2</sub> Capture Costs with MEA

EPRI-Parsons Study on CO<sub>2</sub> removal from a 500MW plant using MEA concludes:

- Plant capital cost approximately \$838/kW
- Energy use approximately 27% of plant capacity
- Thermal efficiency decreases from 40.5% to 28.9%
- Incremental power costs of \$0.04/kWh
- Cost per ton of CO<sub>2</sub> emission avoided - \$47

## Estimated ECO Cost Compared to IGCC

### EPRI-DOE Study on IGCC with CO<sub>2</sub> Capture:

- IGCC plant capital costs increase \$350-550/kW
- Cost of electricity (COE) increases 25-36%
- IGCC COE with CO<sub>2</sub> capture is ~\$0.054/kWh

### DOE Study on CO<sub>2</sub> Capture with Ammonia on Super Critical PC Plants estimates:

- SCPC COE of ~\$0.054/kWh, which includes \$3/ton of CO<sub>2</sub> for sequestration

Key Points: ECO<sub>2</sub> could be applied to current PC plants and be economically preferable over IGCC for new plants with CO<sub>2</sub> capture

## **“ECO<sub>2</sub>” Development Plans**

- **Perform parametric tests in lab to characterize process limits and optimize efficiency - 2005**
- **Compare Powerspan test results with DOE/NETL**
- **Conduct pilot scale tests of CO<sub>2</sub> removal integrated with ECO process at FirstEnergy’s Burger Plant beginning in 2006 – teaming with Fluor (~20 ton/day CO<sub>2</sub> / ~ 1 MW equivalent)**
- **Conduct commercial scale test of ECO<sub>2</sub> beginning in 2008 with CO<sub>2</sub> sold for enhanced oil recovery (500 ton/day CO<sub>2</sub> / ~25 MW equivalent)**