Water-Energy Management Research and Development

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Power Plant Water Program
2001-2013

Innovations for
Existing Plants

Strategic Center
for Coal

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Non-Traditional Sources of Water
Alternative Sources of Water

• Treated Municipal Wastewater

• Mine Pool Water

• Produced Water – oil and gas & brine from carbon sequestration

McGrath Saltwater Disposal Facility

Panda Brandywine Power Plant

Pittsburgh Coal Seam
Water Reuse and Recovery

- Water Recovery from Power Plant Flue Gas
- Use of Restored Wetlands to Enhance Power Plant Cooling
- Transport Membrane Condenser for Water Recovery from Flue Gas
- Coal Drying with Power Plant Waste Heat
- Recovery of Water from Flue Gas Using Condensing Heat Exchangers
- Recovery of Water from Boiler Flue Gas
- Desalination Using Power Plant Waste Heat
- Reduction of Water Use in Wet FGD Systems
Use of Waste Heat

- **Coal Drying**

- **Ammonia Bottoming Cycle**
  - Kotzebue, Alaska

- **Humidification/Dehumidification for water desalination**

Bench-scale unit
Flue Gas Cooler

- Waste Heat Integration with Solvent Process for CO$_2$ Removal (Southern Company-Plant Barry)
- Mitsubishi--several installations in Japan
- Captures waste heat at APH outlet (300 F to 200 F)
- Reheat scrubbed flue gas to eliminate visible plumes
- Carbon steel construction, corrosion mitigated by ash/SO$_3$
- 30% less scrubber makeup water
- Gaseous SO$_3$ 13 ppm to <1 ppm
- PM 0.03 lb/MMBtu to 0.005 lb/MMBtu
- 10% flue gas volume reduction, ID fan 2” additional pressure drop
- No visible plume.
Recovery of Water from Flue Gas

Condensing Heat Exchangers

Ceramic Membranes

Absorption with a Desiccant
SPX ClearSky Plume Abatement
Area of Interest 1
Subtopic 1-A “Utilization of Low Grade Heat within Existing Power Generation System”

Projects started October, 2014
Forward Osmosis (FO) Process Utilizing Low Grade Heat: Applications in Power Plants

Carnegie Mellon University

Establish rigorous models of the temperature and heat duty of the draw solute recovery system integrated with power plant waste heat to determine FO feasibility.
The COHO (CO₂---H₂O) – Utilizing Low-Grade Heat and CO₂ at Power Plants for Water Treatment - Porifera

Osmotic pressure drives water across membrane

Draw solution removes CO₂ from flue gas (miscible)

SPS=switchable polarity solvent water miscibility (60 wt%) to immiscibility (>2000 ppm)

CO₂ released with heat (immiscible)

Waste heat used to treat degraded water and capture CO₂ from flue gas.
Simultaneous Waste Heat and Water Recovery from Power Plant Flue Gases

Institute of Gas Technology

Transport Membrane Condenser (TMC)

Media & Process Technology ceramic nanoporous membrane to remove waste heat and water from flue gas.
Development of a Field Demonstration for Cost-Effective Low-Grade Heat Recovery and Use Technology Designed to Improve Efficiency and Reduce Water Usage Rates for a Coal-Fired Power Plant

Southern Company Services, Inc., Electric Power Research Institute, URS Group

Develop system-level concept that integrates and utilizes waste heat and improves heat transfer.

Addresses the viability of deploying innovative conversion concepts to large-scale power generation systems.

Addresses innovative concepts for utilization of low-grade heat, including facilitation of water treatment, bottoming cycles, and low-cost refrigeration.

Reduces water intake relative to current power practices.

Develops a cost-benefit analysis for large-scale power generation.

A technology recommendation will be made and costs will be developed for a field test of a combined heat-recovery / use process at a Southern Company facility.