



Water-Energy Management Research and Development

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U.S. DEPARTMENT OF
ENERGY

National Energy
Technology Laboratory



NATIONAL ENERGY TECHNOLOGY LABORATORY

Power Plant Water Program 2001-2013

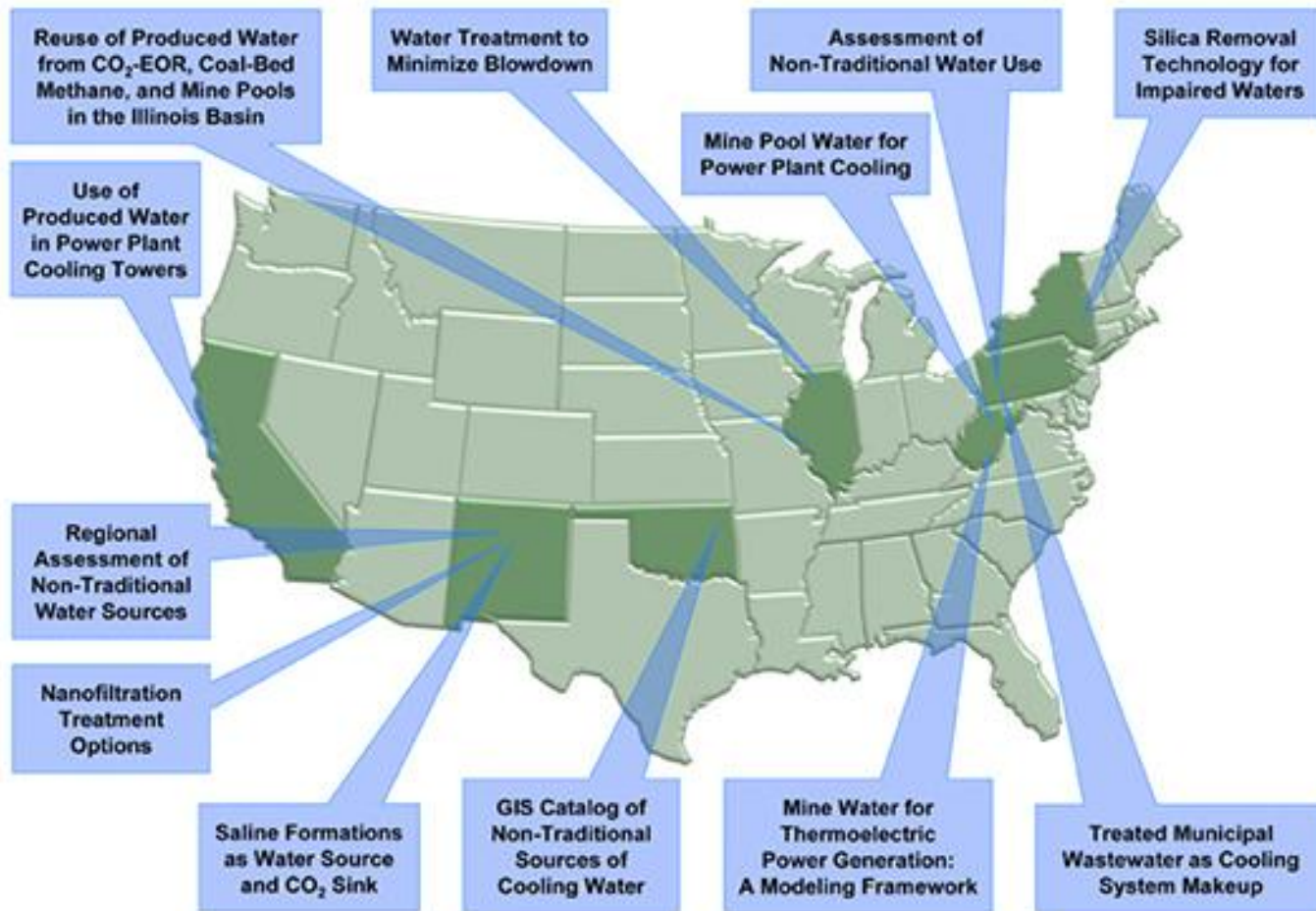
*Innovations for
Existing Plants*

*Strategic Center
for Coal*



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Non-Traditional Sources of Water



Alternative Sources of Water

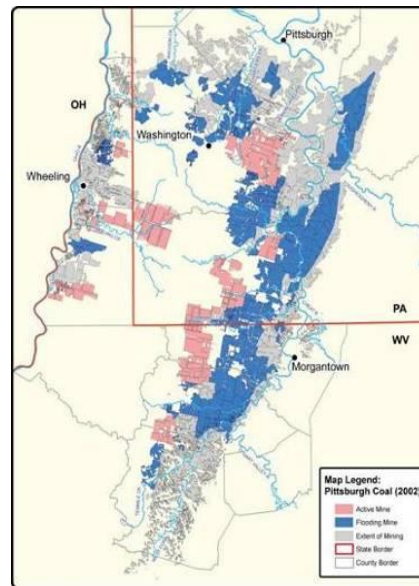
- Treated Municipal Wastewater
- Mine Pool Water
- Produced Water – oil and gas & brine from carbon sequestration



Panda Brandywine
Power Plant

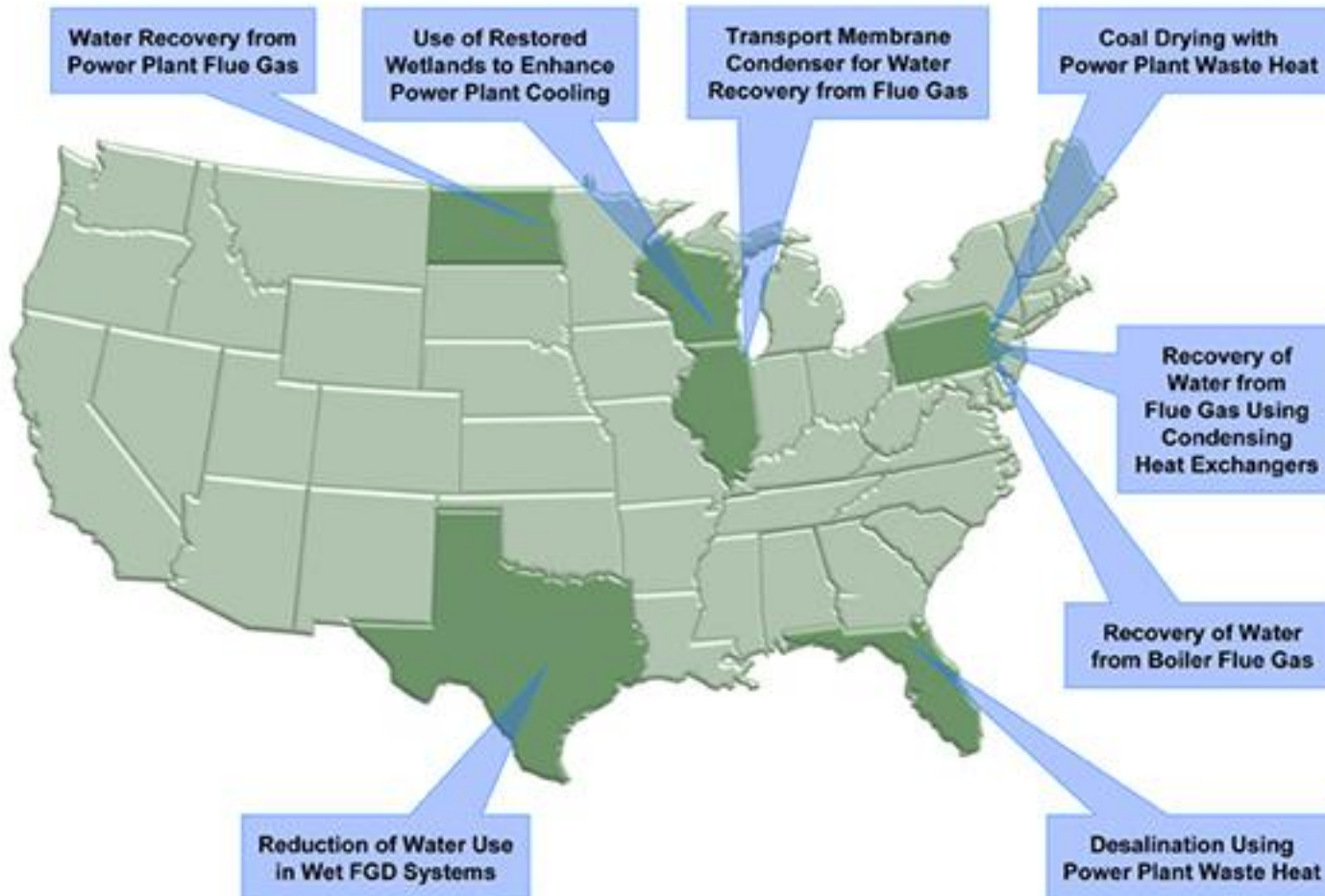


McGrath Saltwater Disposal Facility



Pittsburgh Coal
Seam

Water Reuse and Recovery



Use of Waste Heat

- *Coal Drying*
- *Ammonia Bottoming Cycle*
– *Kotzebue, Alaska*
- *Humidification/Dehumidification for water desalination*



Great River Energy
Coal Creek Station

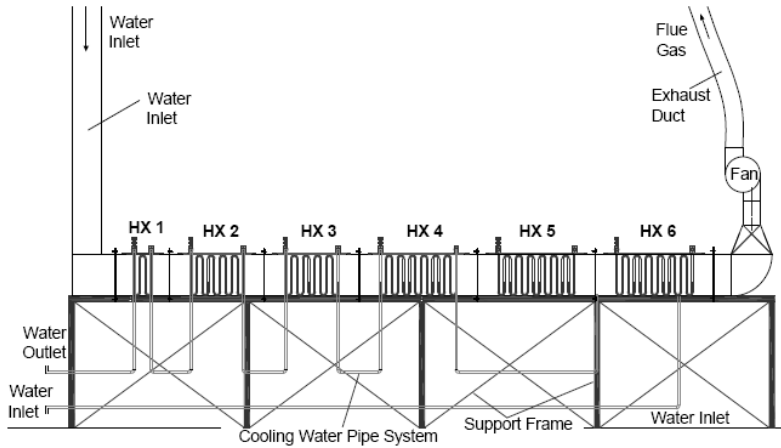
Bench-scale unit



Flue Gas Cooler

- **Waste Heat Integration with Solvent Process for CO₂ 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/SO₃**
- **30% less scrubber makeup water**
- **Gaseous SO₃ 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.**

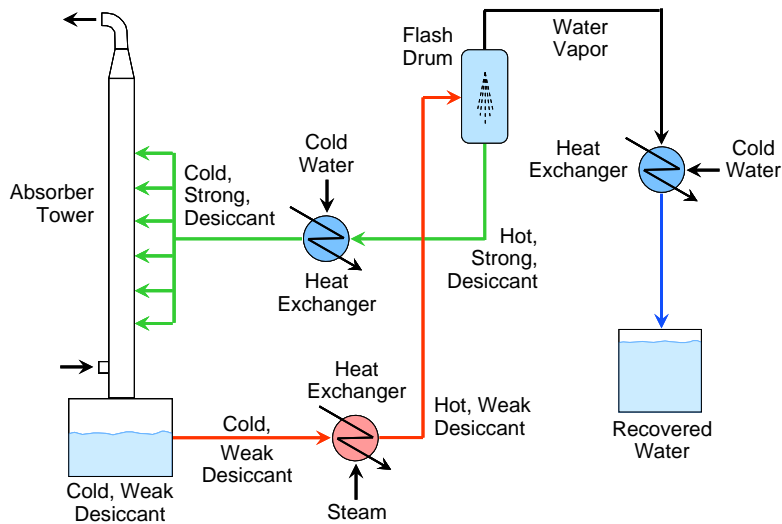
Recovery of Water from Flue Gas



Condensing Heat Exchangers

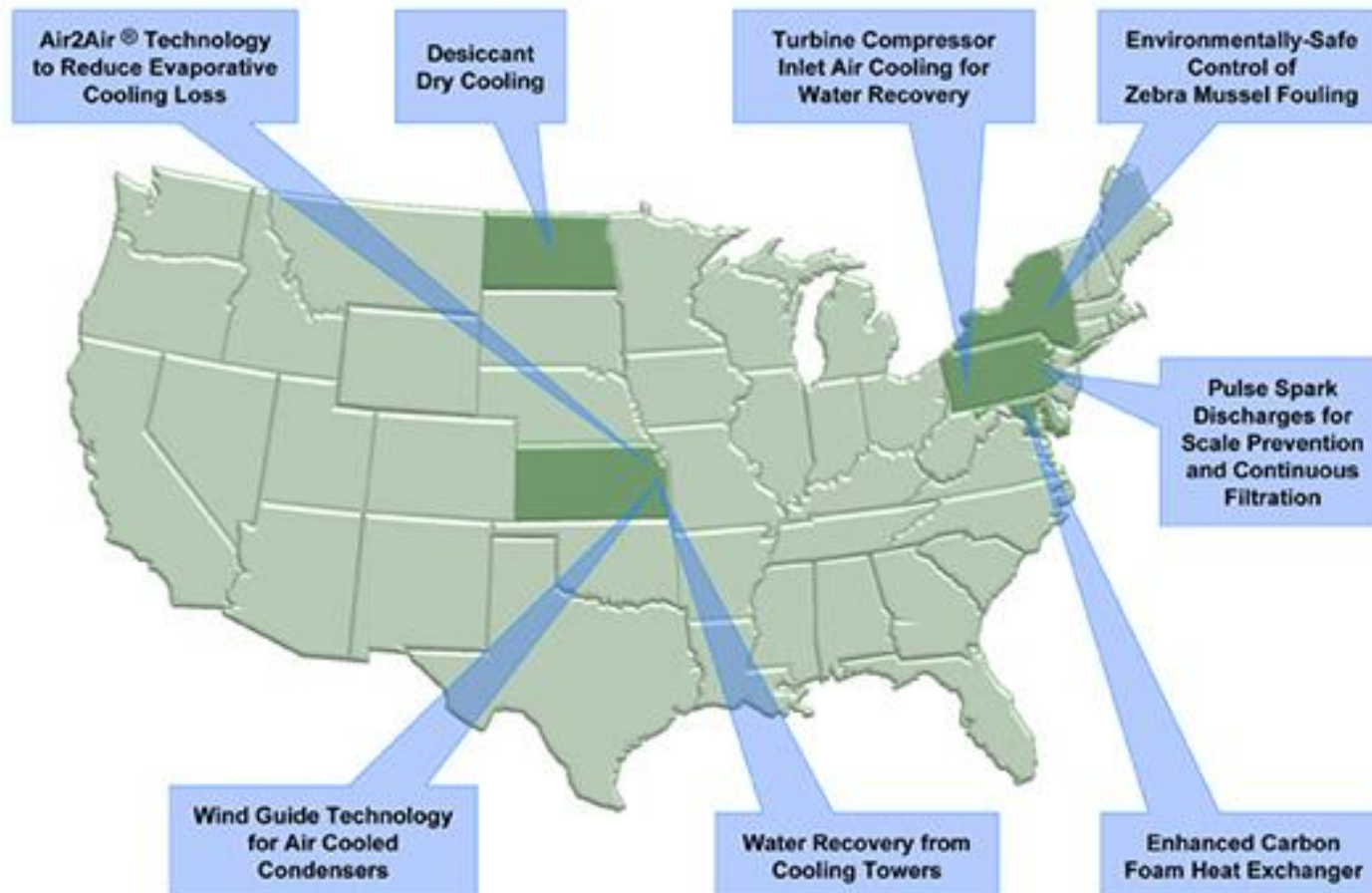


Ceramic Membranes



Absorption with a Desiccant

Advanced Cooling Technology



SPX ClearSky Plume Abatement



Water-Energy Management Research and Development



DE-FOA-00001095

Area of Interest 1

**“Innovative Concepts for Managing Water in
Fossil Fuel Based Energy Systems”**

**Subtopic 1-A “Utilization of Low Grade Heat
within Existing Power Generation System”**

Projects started October, 2014

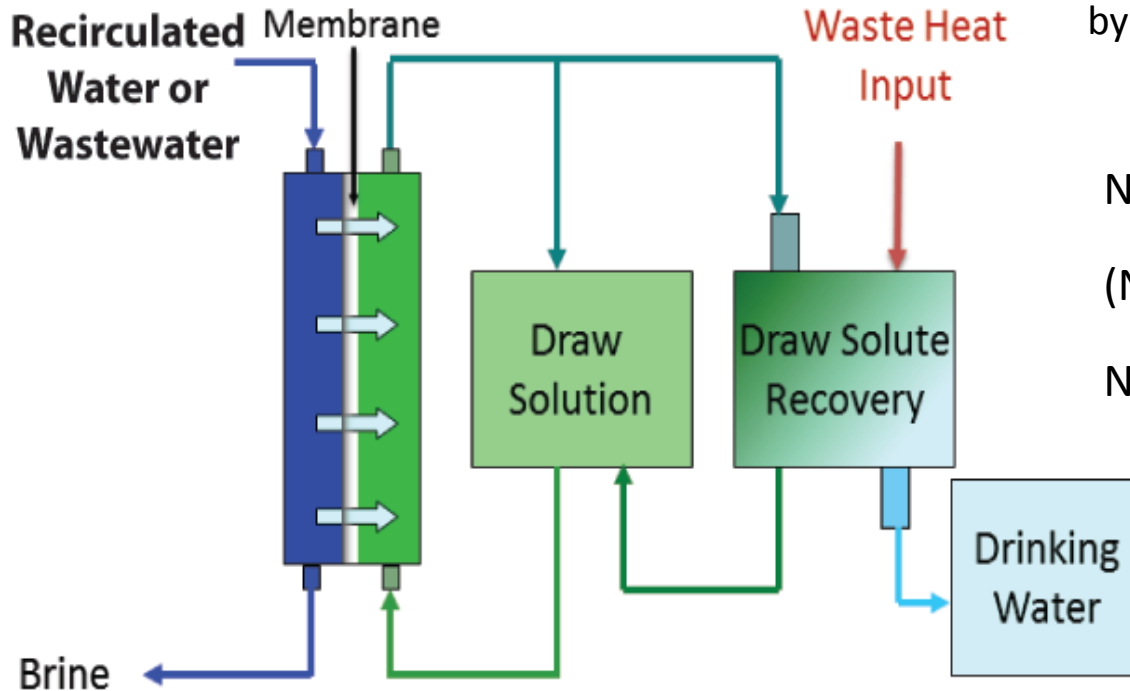


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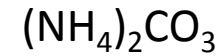
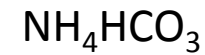
Forward Osmosis (FO) Process Utilizing Low Grade Heat: Applications in Power Plants

Carnegie Mellon University



Generalized FO system design

Draw solute--thermolytic salts created by ammonia and carbon dioxide

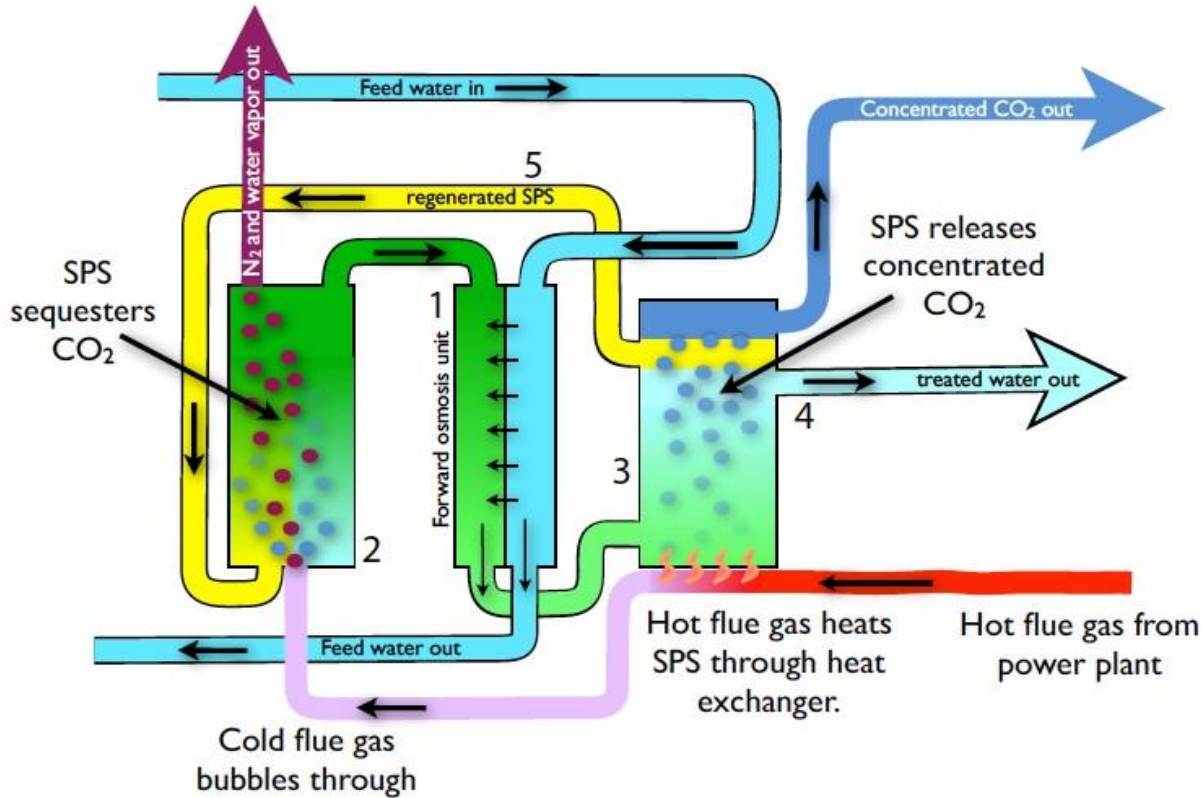


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Establish rigorous models of the temperature and heat duty of the draw solute recovery system integrated with power plant waste heat to determine FO feasibility.

The COHO (CO_2 --- H_2O) – Utilizing Low-Grade Heat and CO_2 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)

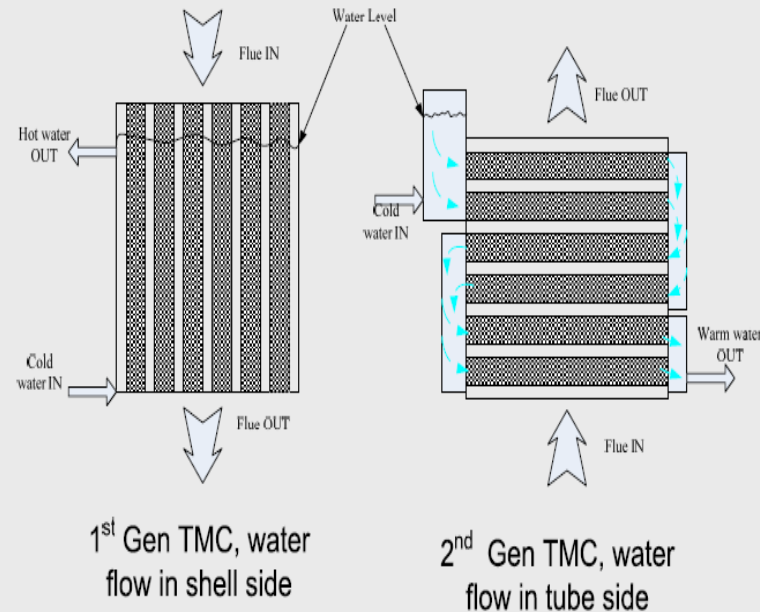
Waste heat used to treat degraded water and capture CO₂ from flue gas.

Simultaneous Waste Heat and Water Recovery from Power Plant Flue Gases

Institute of Gas Technology



TMC design development



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.