Project 1: Waste Heat/Solar Driven Green Adsorption Chillers for Steam Condensation (Collaboration with Allcomp)

Key Potential Benefits

- Dry cooling system
  - Near Zero water use and consumption
- Reduced condensation temperature
  - As low as 35 °C
  - Potential for annual power production increase by up to 5%
- Full power production even on the hottest days compared to air cooled condensers.

Phase 1 Project Update (EPRI Patent Pending)

- Developed several power plant system level approaches to utilize waste heat or solar heat for desorption
- Performed system integration energy and mass flow balance analysis for a 500 MW coal-fired power plant
- Performed technical and economic feasibility study
- Finalizing final report.
**Project 2: Thermosyphon Cooler Technology (Collaboration with Johnson Controls)**

**Project Update**
- Performed a thorough feasibility evaluation of a hybrid, wet/dry heat rejection system comprising recently developed, patent pending, thermosyphon coolers (TSC).
- Made comparisons in multiple climatic locations, to standard cooling tower systems, all dry systems using ACC’s, hybrid systems using parallel ACC’s, and air coolers replacing the thermosyphon coolers.
- Determined the most effective means to configure and apply the thermosyphon coolers.
- Completed final project review on March 5th.

**Key Potential Benefits**
- Potential annual water savings up to 75%
- Compared to ACC, full plant output is available on the hottest days
- Ease of retrofitting
- No increase in surface area exposed to primary steam
- Reduced operating concerns in sub freezing weather
- Broad application for both new and existing cooling systems for fossil and nuclear plants

For further information, please view our [briefing](#) and [published report](#)
Project 3: Advanced M-Cycle Dew Point Cooling Tower Fill (Collaboration with Gas Technology Institute)

**Key Potential Benefits**
- Potential for less cooling water consumption by up to 20%
- Lower cooling tower exit water temperature resulting in increased power production
- Ease of retrofitting
- Broad applications

**Project Scope**
- Develop an advanced fill
- Perform CFD and other types of energy, mass, and momentum balance modeling
- Evaluate performance and annual water savings for several typical climates using simulation models
- Perform prototype testing in lab cooling towers
- Perform technical and economic feasibility evaluation
Project 4: Heat Absorption Nanoparticles in Coolant (Collaboration with Argonne National Laboratory)

Key Potential Benefits
- Up to 20% less evaporative loss potential
- Less drift loss
- Enhanced thermo-physical properties of coolant
- Inexpensive materials
- Ease of retrofitting
- Broad applications (hybrid/new/existing cooling systems)

Project Scope
- Develop multi-functional nanoparticles with ceramic shells and phase change material cores
- Measure nano-fluid thermo-physical properties
- Perform prototype testing in scaled down water cooled condenser and cooling tower systems
- Assess potential environmental impacts due to nanoparticle loss to ambient air and water source.
- Perform technical and economic feasibility evaluation
Potential Project 1: Hybrid dry/wet cooling to enhance air cooled condensers (Collaboration with University of Stellenbosch in S. Africa)

Key Potential Benefits
- Up to 10% more power production on the hottest days than air cooled condensers
- 90% less makeup water use than wet cooling tower systems
- Up to 50% less water use than currently used dry cooling with the aid of adiabatic water spray precooling for incoming air

Project Scope
- Further develop the design concept
- Perform detailed modeling and experimental investigation of various options
- Perform technical and economic feasibility study
Potential Project 2: Reverse Osmosis Membrane Self Cleaning by Adaptive Flow Reversal (Collaboration with UCLA)

Key Potential Benefits
• Prevent fouling and scaling on membranes
  ➢ Prolong membrane lifetime
• Reduce/Eliminate certain chemical pretreatment requirements (20% cost savings)
• Enable cooling tower blow down water recovery by up to 85% (Equivalent of 20% makeup water reduction)

Project Scope
• Further develop the framework for process operation and flow control
• Further develop and demonstrate a real-time/online membrane mineral scale detection monitor (MeMo) and integration with feed flow reversal control
• Perform technical and economic feasibility study

Fouling/scaling mitigation via automated switching of feed flow direction, triggered by online Membrane Monitor (MeMo)
Potential Project 3: Integration of cooling system with membrane distillation aided by degraded water source (Collaboration with A3E and Sandia National Lab)

Project Scope

- Further develop and assess system integration strategy
- Perform technical and economic feasibility study

Key Potential Benefits

- Membrane distillation technology utilizes:
  - Waste heat from condenser hot coolant
  - Cooling system as a water treatment plant
- Reduced fresh water makeup by up to 50% - 100%
- Potential to eliminate cooling tower for dry cooling
Potential Project 4: Carbon Nanotube Immobilized Membrane (CNIM) Distillation (Collaboration with New Jersey Institute of Technology)

Key Potential Benefits
- Compared to top commercial MD technologies
  - Up to 10 times more vapor flux due to CNTs
  - Reduced cost of utilizing alternative water sources
- Enabling technology for A3E concept to eliminate the cooling tower and turn the cooling system into a water treatment plant for other use

Mechanisms of MD in the presence of CNTs

Project Scope
- Develop carbon nanotube (CNT) technology for membrane fabrication
- Further develop and test CNIMs for membrane distillation (MD)
- Develop and optimize MD integration strategies/process for water recovering
- Perform technical and economic feasibility of the process