CHANGING WHAT'S POSSIBLE

Day 1: Exploration of system technology and performance

Breakout session questions

May 23, 2014

Feedback on ARPA-E's proposed system vision

Are the metrics and ARPA-E's vision technically plausible?

	Thermodynamically impossible	Practically infeasible	Really, really hard	Simple Engineering
Overall	0	4	10	0
Air cooled HX	0	3	11	0
Absorption cooling	0	0	8	0
Radiative cooling	0	2	4	7
Fan	0	0	0	8

What are the biggest technical challenges to overcome in realization of ARPA-E's vision?

- Economics. Base case? NGCC vs. coal? Retrofit? Lower ΔT cases?

Feedback on individual components

Are the 3 cooling technologies compatible with each other so that they can be integrated into one system? What are the challenges?

- System design required – tradeoffs between condenser, Heat exchanger, supplementary cooling must all be considered
- Design for annual average, worst season, highest value days?

What are the technology gaps for each of the proposed components (air cooled heat exchangers, adsorption cooling systems, radiative cooling modules, etc.)?

- New heat exchanger designs (perhaps diminishing returns?)
- Manufacturing – any innovation must lower cost. Cannot scale advanced concepts (e.g. cooling for IC's)
- Absorption cooling: materials and integration/assembly
- Radiative: scaling? ~100 W/m2 to MW?

Feedback on individual components

What are some of the materials and design considerations?

- Proposed design advantageous for fouling
- Materials and performance for additive manufacturing
- Absorption cooling materials: seek low heat of absorption (won't need steam to regenerate)

Do polymer heat exchangers have a role for this application, and what metrics are appropriate?

- Yes.
- Thermal conductivity and size of heat exchanger? Dump into ground? (Possible approach on peak days?)

Alternative system designs

What alternative system designs/strategies could achieve the same objectives?* (System diagrams are encouraged)

- "Parallel" configuration – Air Cooled Condenser with indirect + supplementary
- Cooling tower with water recovery
- Others (less than fresh water, heat pipes, phase change)

- What are the biggest technical challenges with these alternative systems?
  - Parallel configuration: control (self regulating?)
  - Cooling tower: must reduce heat of absorption, cost effective recovery
  - Heat pipes: cost; PCMs: lifetime

- What would the major cost drivers likely be for these systems?
  - Parallel configuration: sized for maximum capacity. value (power rating on hot/high value day?), note lower fan loads and no pumping loads for ACC, but reduced rating on hottest days
  - Implications for CC? Value of carbon vs. water

Other components

What advanced fan technologies can be used to maintain high efficiency over a wide range of fan speed and flow rate?

- Unclear impact of fan efficiency – consensus that fan design point makes for manageable losses

Could other components be utilized to mitigate some of the technical challenges?

- Use of thermal storage materials and diurnal design