Day 2: Manufacturability, scalability, and economics of conceptual designs

Breakout session questions

May 23, 2014

Additive manufacturing

- Additive Manufacturing:
- Throughput: X in^3/hr. --> Target of 100 m^3 / hr OR area target (100s of M^2 per hour)
- Energy intensity? is this a major concern?
- Need to validate the impact that AM can actually have on heat exchanger performance? Increase surface area while decreasing HX coefficient? Can you achieve high quality material (all material characteristics…including thermal of course).
- Optimal feature size unlikely to push the limits of AM capabilities. (Limitations on cleaning O&M costs…2mm features used today already require annual cleaning. --> Focus on throughput not feature size reduction.
- Perhaps emphasize simpler features for higher throughput?
- Heat exchanger design and AM are closely coupled….must be done together within each project. Lots of programs already contributing to AM development. Focus specifically on heat exchanger design with AM (not general development of AM tech).

Continued..

- General consensus is that AM could be combined productively with more conventional manufacturing techniques.
- Perhaps AM could be used to produce more sophisticated tooling or dies for conventional manufacturing technologies? This could be a substantial short term opportunity?

Manufacturing considerations for different technologies

Adsorption Cooling:

- Lots of material science to be done. Are there materials approaches with limited scalability ("Scalable nanomanufacturing"?)

Radiative:

- Need innovations in material science while constraining manufacturing costs.
- Photonic crystals are complex structures and we need to find low cost, large area manufacturing techniques.
- Need both spectrally selective element for radiative cooling
- ALSO need broadband mirror over large area to reflect sun's radiation. Need to leverage manufacturing techniques from microelectronics fabrication? (Can low enough cost be achieved for this application?

Heat Exchangers:

- Today: up to 70% of the cost of heat exchangers is manufacturing. So, that can lead you to allocate the cost of new heat exchangers between manufacturing and design. Perhaps this balance will shift
- Alternative cooling fluids should be considered. Though, keep in mind that not all cooling fluids are compatible with all heat exchanger ideas.

Other Markets and supply chain considerations

Other markets:

- Automotive
- Oil & Chemical Processing
- Commercial / Buildings (HVAC)
- Food storage
- Each of these markets have their own, unique constraints (materials compatibility (food), boiler regulations (chemicals), pressure constraints (aerospace) etc.)
- Would automotive have more or less stringent requirements on cost? (Debate) (size, reliability, etc.)
- IP is a major consideration as you look at these other markets.

Supply Chains:

- Very little discussion.
- James' list of possible manufacturing contributions is good and should be included in FOA.
- EPRI/NSF: Several projects exploring new coating technologies for inside of tubes. Scalable manufacturing techniques for coatings inside of tubes are not well developed? Opportunity?