- **Breakout 1 b highlights**
- What are current technology roadblocks? What can ARPA-E do to knock them down?
    - Safety is straightforward. Security is more difficult.
    - High surface to volume ratio opens up design space.
- Safety: theoretically easier at small size.
- Must have demonstration site!
- Physical size of safety system allows for full-scale test.
- Looking at first concept: University of Wisconsin-Madison—molten salt reactor
    - Natural circulation cooling even during extreme scenarios, easier at smaller scales
        - Freezing might be issue for blackout to restart
        - Don't have high-pressure
        - Another safety requirement: passive shutdown.
            - Passive shutdown capability linked to load following capability
                - Autonomous load following.
                - With simplicity, less things can go wrong.
            - Need enough storage to recover from blackout (thermal).
        - Sensors needed more for R+D effort than for actual fielded units?
            - No strong existing industrial base for molten salts.
        - Cyber-design issue to sensors and controls
        - Instrumentation: difficulty designing sensors for very high T
        - Salts are transparent in visible and sometimes IR → spectroscopy development
    - Molten salts and material challenges.
        - No oxidation. Rather try to prevent dissolution
        - Bring NRC into process and encourage them to have a regulatory discussion based on a technical discussion
        - Don't just need R+D in reactors, also need it in policy and regulation!

        - Assumption is made that TRISO fuel can be used. How transferable is the knowledge acquired using Helium cooled to a molten salt reactor?
        - Material issues for liquid and solid. Need to look at chemistry! Understand how chemistry evolves over lifetime, reduction agents, how control chemistry to limit corrosion.
    - Power conversion thoughts
        - Molten salt advantage, higher T.
- Another concept idea: HOLOS—Claudio Filippone
    - Considered 600 SMR designs. Tried to find commonalities and ranking them. What would be the ideal reactor that could solve all of these problems?
    - Gas reactor: many decades of experience, TRISO fuel with He
    - Elimination of BOP
    - Can we integrate power conversion system with core?
    - Can we use off-the-shelf technologies? Avoid reinvention.
    - Design is irrespective of core being used.
    - Regulation: size is so small that:
        - Thermohydraulics – can do full-scale tests.
        - Neutronics – relatively mature
    - Closed He system—by avoiding outside air, no concerns with filters, humidity; better control of thermodynamics
    - Power density 50 kW/liter → higher than where TRISO wants to operate
    - Additive manufacturing: opens up design space dramatically
        - Been trained to only think of cylinders/symmetric/1D/2D
- What technology challenge is here that ARPA-E could tackle
    - Turbomachinery has to be designed for He at these conditions.
    - Magnetic bearings (don't want any lubrication)
    - If it works, does it matter?
        - If thinking distributed grid or base load, there is a market. But can you compete economically?
        - Risk: likelihood and consequence. If we go to small scale, is consequence lower so likelihood isn't as important?

        - Triso: concerns for longer-life, remote applications. Need to refule after 1-2 yrs?
        - Need to be clear that we are doing things to help make the lives of the NRC easier.
        - Smaller size is better for some international applications because of the capabilities / needs of their grid.
    - ARPA-E draft metrics similar to DARPA conditions. Potential for dual-development, dual-use.
    - Designs for 10 MW-scale reactor that meet niche applications are different from designs that would scale up nicely to address the larger DG market?