HIGH TEMPERATURE BREAKOUT

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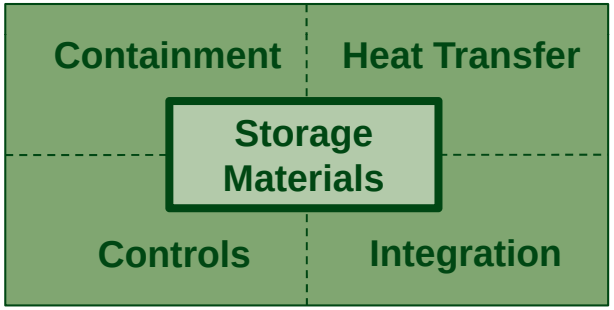
BASIC THERMAL STORAGE CONSIDERATIONS

Key Metrics of Performance	Example Units	Material Property	System Property
Storage Energy Density	MJ /kg, MJ /L	✔	✔
Transfer Power Density	MJ /kg•hr, MJ /L•hr	✔	✔
Operating Temperature	ºC	✔	✔
Cycle Life	# Cycles	✔	✔
Self-Discharge Rate	% /hour		✔
Roundtrip Efficiency	%		✔
Cost	$/MJ	✔	✔

Thermal Storage System



- Several important metrics to consider
- Both materials and system level considerations are important
- Properties may be complex or coupled, for instance:
  - e.g. power capability may change as heat is extracted and reactions proceed
  - e.g. power capability may degrade after several cycles

PRIMARY APPLICATIONS OVERVIEW

Buildings

Impact Objective: Dramatically reduce building energy consumption by storing and redeploying heat or cold to match building loads or optimize time of electricity use

Solar Thermal Power Generation

Impact Objective: Enable widespread deployment of solar thermal power by firming and extending the time window of output power generation

Industrial waste heat capture and storage

Impact Objective: Dramatically reduce industrial energy consumption by storing and redeploying waste heat for processing and manufacturing

Operational Mode(s)	Current Solution(s)	R&D Needs
Buildings: diurnal load shifting	water tanks, ice, embedded building materials, etc.	• Energy density • Power density • Longer storage time and less loss • Thermal cycling stress • Reaction reversibility • Cost
Buildings: seasonal load shifting	soil, sand, water, concrete, etc.	
Buildings: thermal storage coupled to CHP	water, oil, organic phase change materials, etc.	
Solar thermal storage	molten salts, organic phase chance materials	
Industrial waste heat capture and storage	non-water Rankine cycles, thermoelectric materials etc.	

SCALE

Each furnace used to turn scrap metal into steel could be used to recycle about 15 megawatts of electricity.

QUESTIONS

1. What are the highest value uses and impact for high temperature storage?

QUESTIONS

2. What are the biggest technological challenges for high temperature systems?

Can we identify innovative ways to minimize effects of high temperature on long term stability/selectivity?

Are there material constraints that are preventing implementation of thermal storage for high temperature applications?

QUESTIONS

3. How much energy density reduction is acceptable from basic storage material level energy density to system level energy density which includes the heat charging and discharging system?

QUESTIONS

4. What should be the target cost per kWh_t for high temperature systems?

Should the cost be broken into storage cost and delivery cost?

QUESTIONS

5. Can long term (> months) be economically viable given low number of cycles for these systems?

How can energy density be increased from 0.5 MJ/kg to 5 MJ/kg without increasing the cost significantly?

QUESTIONS

6. What will a very high impact research and development program look like for high temperature system?

What will be the composition of an ideal research team?

POLL

What are the highest value uses and impact for high temperature storage?