Stor4Build
U.S. DEPARTMENT OF ENERGY

Stor4Build Supporting Thrust Project Update

Development and Optimization of Phase Change Materials for Thermal Energy Storage

Moderator: Judith Vidal (NREL)

Presenter: Tugba Turnaoglu (ORNL)

Stor4Build Annual Meeting
August 26–27, 2024
Oak Ridge National Laboratory

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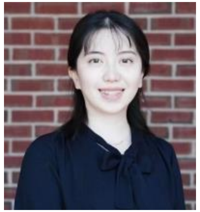

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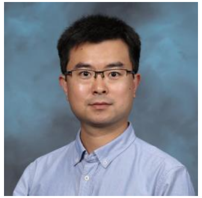

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Overview

- **Material Support:** Materials Support Thrust provides critical material testing and support to the integration team, ensuring they have the necessary materials for their systems
- **TES Material Optimization:** We investigate and optimize TES materials, focusing on phase change materials (PCMs) and thermochemical materials (TCMs), to meet the specific requirements of various TES-integrated heat pump systems under development

Materials Optimization (2-Ma-MatOpt)

- Focus is PCM in two key areas:
  1. Compatibility of PCM materials
  2. Improving material performance

Materials Optimization (2-Ma-MatTCM)

- Focus is TCM:
  - Optimize various TCM materials

Materials Database (2-Ma-MatData)

- Focus is:

Fills the gaps in IEA database

This presentation's goal is to review the progress made in the materials project, focusing on key accomplishments.

- An overview of the technical s accomplishments
- Highlights on the strategic importance of these achievements in aligning with the U.S. Decarbonization Blueprint

Overview – PCM optimization

Our research and development efforts are focused on several key areas:

1. Material Innovation
   Developing or optimizing advanced TES materials that meet the specific requirements of next-generation heat pump systems
2. System Compatibility
   Ensuring that these materials integrate seamlessly with existing technologies, reducing the need for costly system overhauls
3. Long-Term Performance
   Focusing on durability, working on solutions to extend the lifespan and reliability of TES materials in real-world conditions

TES-integrated heat exchanger at ORNL

Strategic Alignment: Our achievements are not just technical milestones; they are strategically aligned with broader national goals. This work directly supports the U.S. Decarbonization Blueprint by contributing to:

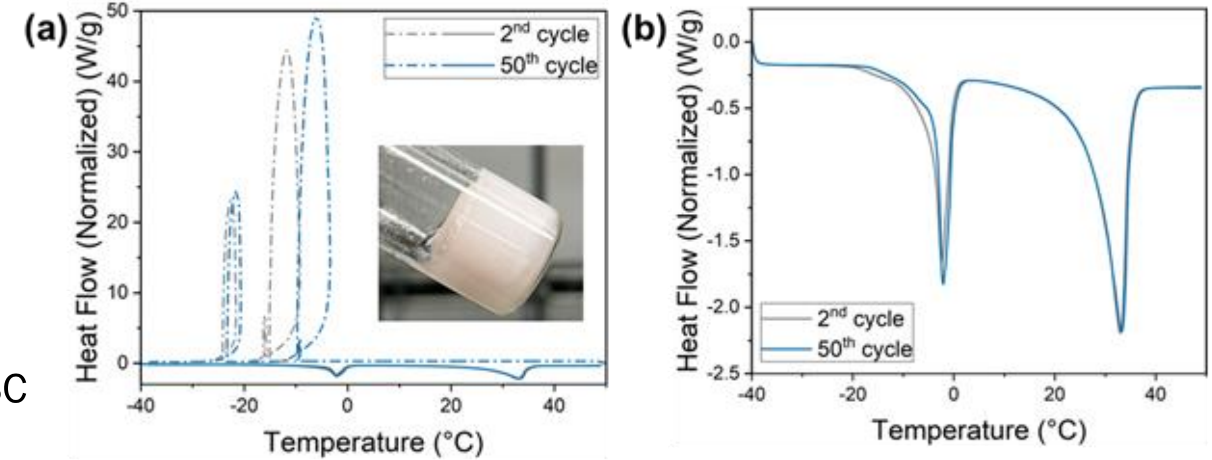
- ✓ **Energy Efficiency**
  Enhancing the performance of TES materials to reduce energy consumption in buildings
- ✓ **Emission Reductions**
  Developing materials that enable more efficient and sustainable heating and cooling solutions, thus reducing on-site greenhouse gas emissions
- ✓ **Resilience and Sustainability**
  Focusing on material durability and compatibility to ensure that the solutions we provide are both long-lasting and environmentally responsible

Technical Accomplishments: PCM Stability and Cost

Polymer-Based Additives for PCM Stability
Successful development of a polymer-based additive that stabilized PCM, reducing costs while maintaining performance over many cycles with minimal supercooling (Milestone Q1)

The team successfully developed a composite in which PCM is **encapsulated with an inexpensive polymer hydrogel:**

- Melting peak at ~33°C
- 203 J/g latent heat
- Cost below $7/kWh
- Stability up to 50 cycles in DSC



DSC plot and real image for the polyacrylic acid polymer capsulated PCM sample

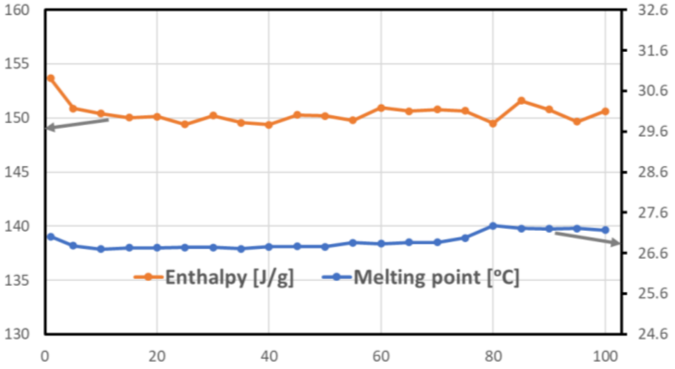
Alignment with Decarb Blueprint : This milestone directly supports the Blueprint's objective to **"Increase building energy efficiency"** by ensuring that PCMs can be used more reliably and cost-effectively in buildings, reducing the overall energy demand.

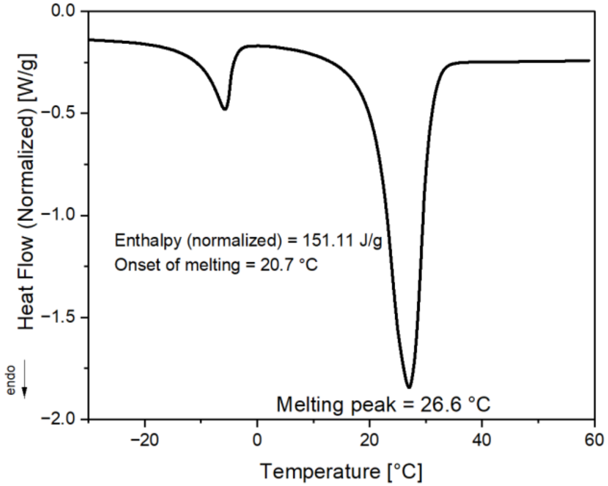
Impact: By optimizing PCM stability, we contribute to reducing the energy consumption required for heating and cooling, aligning with the Blueprint's aim to decrease building energy use by 50% by 2050

Technical Accomplishments: Near-ambient PCM

Development of Near-Ambient PCM with high energy storage density
Successfully developed a novel PCM with a phase change transition near room temperature, which demonstrated stability and high thermal storage capacity.

The team successfully developed a new PCM
- Melting peak at ~26°C
- 151 J/g latent heat
- Cost below $10/kWh
- Stability up to 100 cycles in DSC





Alignment with Decarb Blueprint: This milestone aligns with the Blueprint's goal to **"Accelerate on-site emissions reductions"** by developing materials that reduce the need for traditional heating and cooling systems, thereby lowering GHG emissions in buildings.

Impact: By creating a PCM that operates efficiently at near-ambient temperatures, this innovation directly supports the decarbonization of building operations, contributing to the target of reducing on-site GHG emissions by 75% by 2050

Technical Accomplishments: Compatibility with Existing Systems

PCM Compatibility with Heat Exchanger Components
Outline the selection and testing of PCM materials (both commercial and in-house developed) for compatibility with existing heat exchanger (HX) and heat pump systems.

- PCMs were selected based on the product information from their manufacturer specifications and direct inquiries. Parameters used: phase change transition temperature, energy storage capacity, and cyclic stability


Example of aluminum coupon


Example of copper coupon


Example of stainless steel coupon

Metric	Manufacturer 1		Manufacturer 2				ORNL
Phase change temperature (^oC)	22	29	22	25	29	58	19-32
Energy Storage Capacity (kj/kg)	190	214	175	175	200	280	120-200
Number of cycles tested	2000	2000	5000	5000	5000	500 0	Min 100

Alignment with Decarb Blueprint : This work aligns with the Blueprint's objective to **"Minimize embodied life cycle emissions"** by ensuring that new materials can be integrated into existing systems without the need for extensive modifications, thereby reducing the carbon footprint associated with building renovations
Impact: Ensuring compatibility helps avoid unnecessary upgrades or replacements of existing systems, contributing to the Blueprint's aim of reducing embodied emissions from building materials by 90% by 2050.

Technical Accomplishments: Compatibility and Corrosion Rates

Corrosion Inhibition in PCM Systems

Provide an overview of the corrosion inhibition materials and methods developed, including material additives and surface modifications, Report the compatibility findings of selected commercially available and in-house developed PCMs.

(1) Corrosion Inhibitors

- **Pros:** Can be tailored to specific conditions; cost-effective; lower toxicity options available.
- **Cons:** Potential impact on PCM thermal properties; requires precise concentration; may need replacement over time.

(2) Encapsulation

- **Pros:** Prevents leakage, enhances heat transfer area, and offers corrosion protection; extends PCM lifespan
- **Cons:** Adds weight and cost; may reduce heat transfer efficiency; might require design based on PCM

(3) Surface Coatings

- **Pros:** Provides uniform protection; applicable to various materials; directly protects HVAC components.
- **Cons:** Requires meticulous and time-consuming preparation; potential changes in heat transfer efficiency; coatings can degrade over time and require reapplication.

Alignment with Decarb Blueprint : This milestone supports the Blueprint's goal to **"Increase resilience in building systems"** by developing materials that are more durable and require less frequent replacement, contributing to the longevity and sustainability of building components

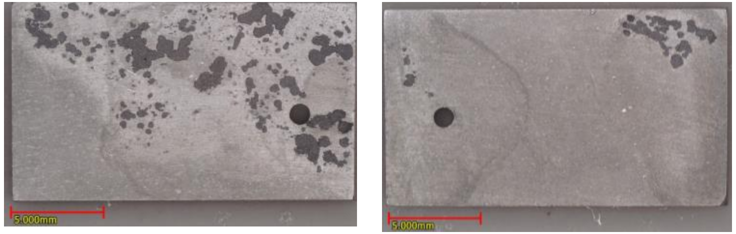
Impact: By reducing corrosion, these advancements help extend the lifespan of PCM systems, aligning with the Blueprint's emphasis on resilience and reducing the environmental impact of maintenance and replacements

Technical Accomplishments: Compatibility and Corrosion Rates

Corrosion Inhibition in PCM Systems

Provide an overview of the corrosion inhibition materials and methods developed, including material additives and surface modifications, Report the compatibility findings of selected commercially available and in-house developed PCMs.

Al1100 before experiment



Al1100 after experiment at 30C, 168 h

mg/cm^{2}yr	mm/yr	mills/yr	Recommendation
>1000	2	78.7	Completely destroyed within days
100–999	0.2–1.99	7.9–78.6	Not recommended for service greater than a month
50–99	0.1–0.19	3.9–7.8	Not recommended for service greater than a year
10–49	0.02–0.09	0.8–3.8	Caution recommended, based on the specific application
0.3–9.9	–	–	Recommended for long-term service
<0.2	–	–	Recommended for long-term service; no corrosion, other than as a result of surface cleaning, was evident

Ren SJ, et al. Materials and Corrosion. 2017;68:1046–1056.

Corrosion Rate = 15 mils per year

It means that each year, 0.015 inches of the material's surface will be corroded away

$$Average\ Corrosion\ Rate = \frac{(k\ x\ m)}{(A\ \ t\ \ \rho\ )}$$

k= a conversion factor
m = mass loss (grams)
A = total surface area of the specimen (cm^2)
t = time of exposure (hours)
ρ= density of the specimen (g/cm^3)

Reference: ASTM G1-03

Alignment with Decarb Blueprint : This milestone supports the Blueprint's goal to **"Increase resilience in building systems"** by developing materials that are more durable and require less frequent replacement, contributing to the longevity and sustainability of building components

Impact: By reducing corrosion, these advancements help extend the lifespan of PCM systems, aligning with the Blueprint's emphasis on resilience and reducing the environmental impact of maintenance and replacements

Conclusion & Future Work

FY23-FY24

- Milestones are successfully completed, demonstrating significant advancements in PCM stability, ambient temperature.

FY25

- Future contributions
  - ✓ We will continue to support the goals of **DOE Decarbonization Blueprint: increasing energy efficiency, reducing emissions, enhancing building resilience** by ensuring that our work remains aligned with the national decarbonization strategy.
  - ✓ Our future work will continue to **drive innovation** in materials science, ensuring that our contributions **remain at the forefront of national efforts to decarbonize** the buildings sector.
- Partnership and Collaboration: Collaboration with stakeholders to ensure that our work is aligned with the latest developments in the decarbonization strategy and to identify new opportunities for impact.

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Thanks

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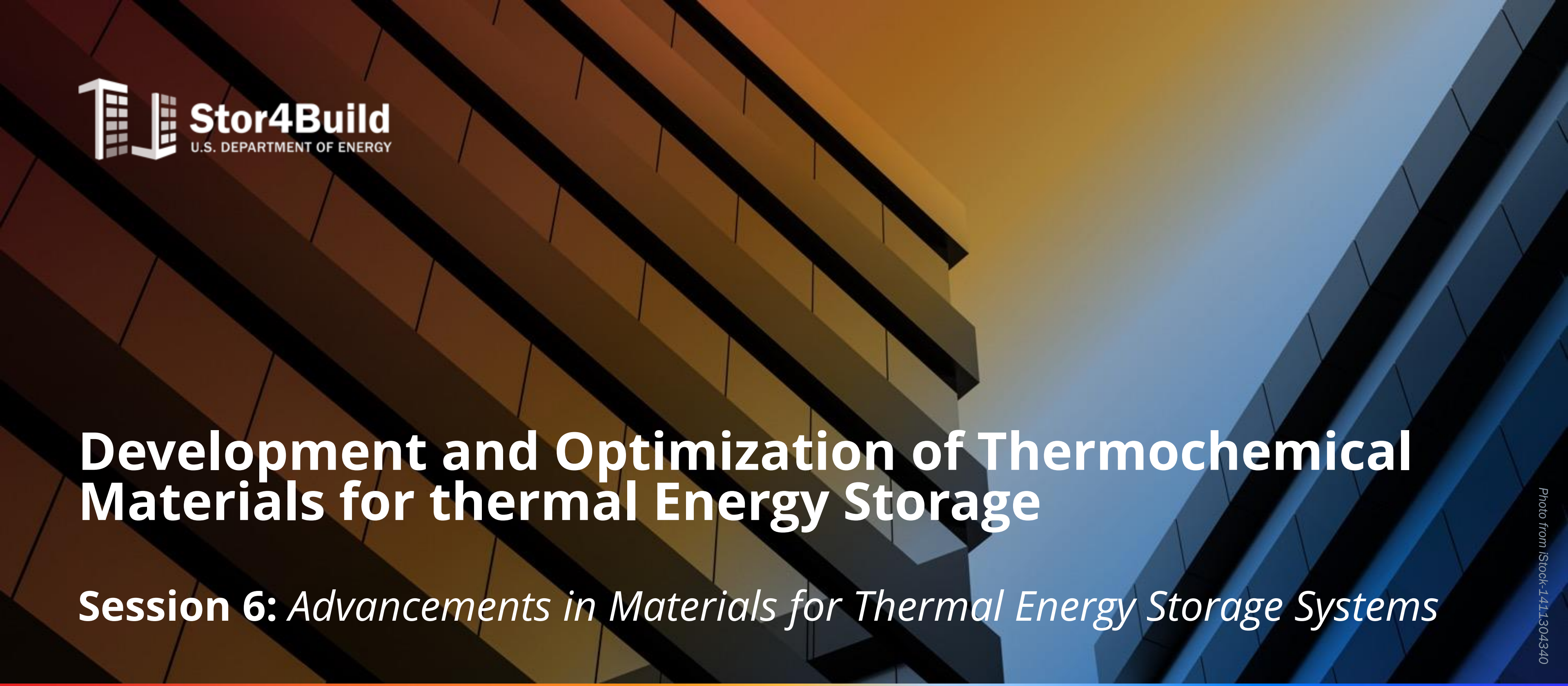

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Development and Optimization of Thermochemical Materials for thermal Energy Storage

Session 6: *Advancements in Materials for Thermal Energy Storage Systems*

Photo from iStock-1411304340

Moderator: Judith Vidal, NREL

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Outline

- **Initial Screening**
  - *Salts Investigated*
    - ❖ $SrBr_2 \cdot 6H_2O$, $Na_3PO_4 \cdot 12H_2O$, $CaCl_2 \cdot 6H_2O$, $MgSO_4 \cdot 7H_2O$ **(Current)**
    - ❖ $SrCl_2 \cdot 6H_2O$ **(Previously tested)**
  - *TGA Based Long term Testing*

- **Composite Level Testing**
  - *Impact of Host Matrix*
  - *Hydration kinetics*
  - *Structural Stability*
  - *Impact of Relative Humidity*
  - *Cyclic Stability*

- **Strategies to improve the Energy Density**
  - *Effect of Composite Thickness*
  - *Millimeter sized Pellets*

Initial Screening

Objective: Investigate salts for low RH conditions and fast kinetics.

Salts Studied:

- $SrBr_2{\cdot}6H_2O$, $Na_3PO_4{\cdot}12H_2O$, $CaCl_2{\cdot}6H_2O$, $MgSO_4{\cdot}7H_2O$, (Current)
- $SrCl_2{\cdot}6H_2O$ (Previously tested)

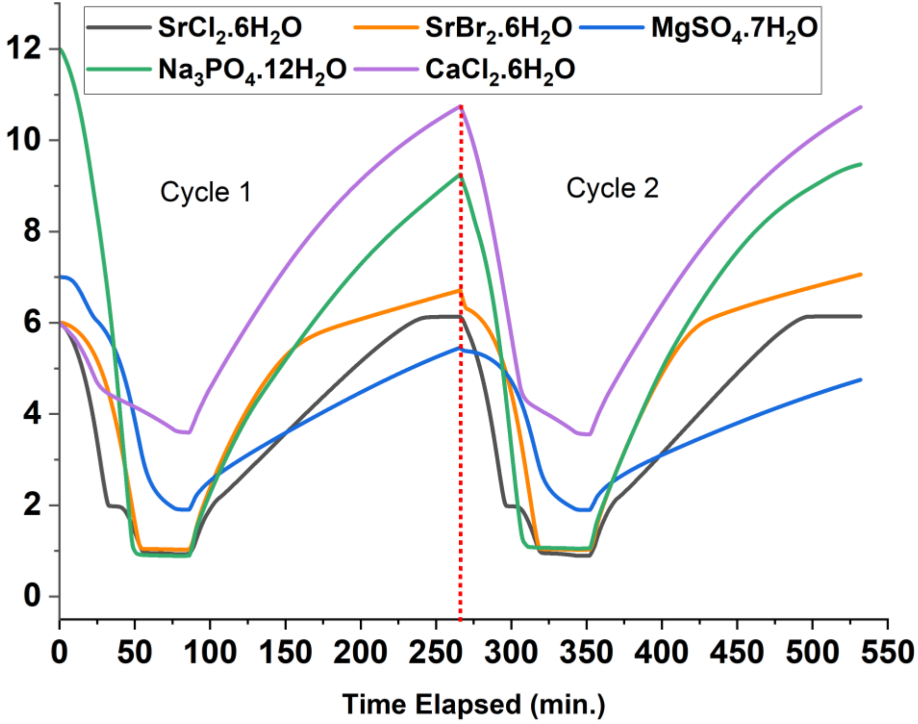
Method: TGA analysis on 10 mg samples.

- Dehydration: 80°C.
- Hydration: 60% RH, 25°C.

Results:

- **$SrBr_2{\cdot}$ $6H_2O$** : Transition between 1 H_2O and 6 H_2O, like $SrCl_2$ but have faster Kinetics.
- **$CaCl_2$** Have already been studied previously.
- **$MgSO_4$** only transitioned between 4.5 H_2O and 2 H_2O therefore not feasible.
- $Na_3PO_4{\cdot}12H_2O$: Lost 11 H_2O, regained 8 H_2O.
- $SrBr_2.6H_2O$ presents faster kinetics.

H_2O loss/Uptake during dehydration/hydration for various salts.



Cyclic Stability of $Na_3PO_4{\cdot}12H_2O$

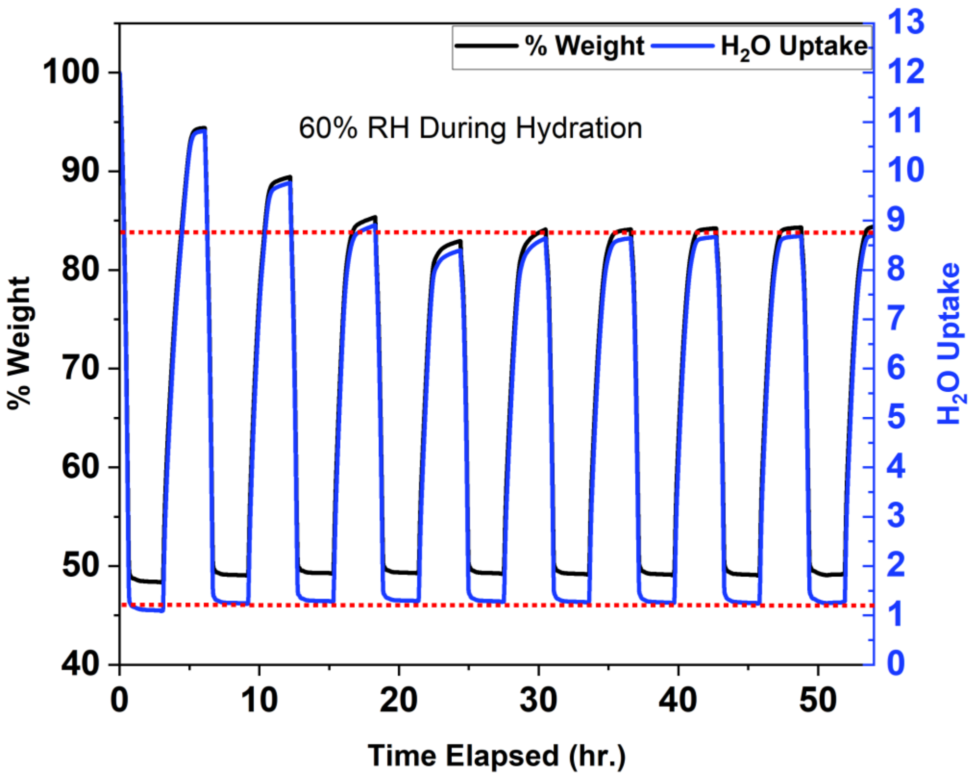
Observation: $Na_3PO_4{\cdot}12H_2O$ didn't fully return to 12 H_2O but has the potential to releases more energy than $SrCl_2$ and $SrBr_2$.

Further Investigation: Tested cyclability between 1 H_2O and 9 H_2O.

Method: Exposed $Na_3PO_4{\cdot}12H_2O$ to 9 cycles.

Result: $Na_3PO_4{\cdot}12H_2O$ is cyclable between 1 H_2O and 9 H_2O.

Cyclic stability of Na_3PO_4 for 9 cycles where the transition between $1H_2O$ and 9 H_2O is shown.



Impact of Host Matrix on Hydration Kinetics

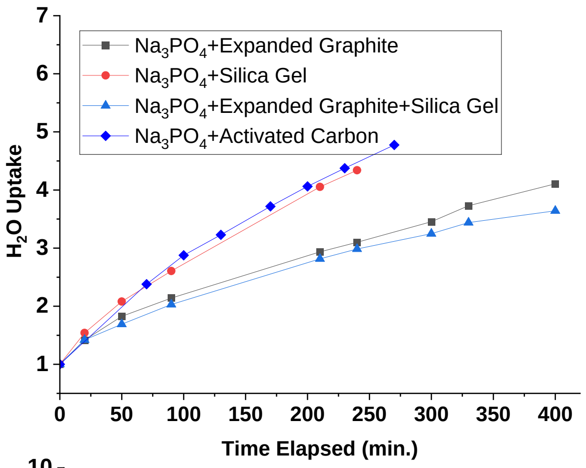
Further Testing: $SrBr_2$ and Na_3PO_4 composites with expanded graphite, silica gel, and activated carbon.

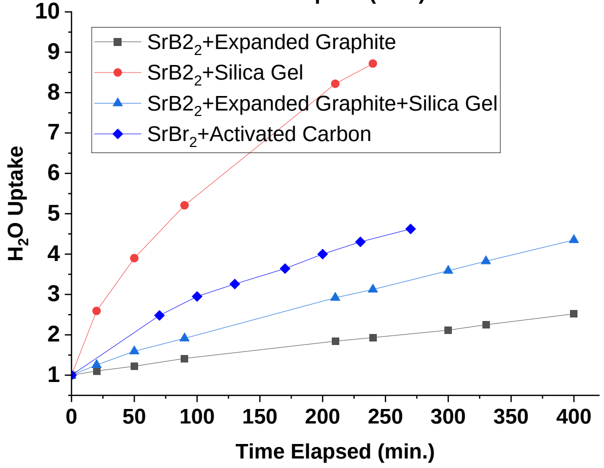
Conditions:

- Dehydration: 80°C ; Hydration: 65% RH

Results:

- **Activated Carbon:** Fastest hydration due to high surface area.
- **Silica Gel:** Faster hydration but caused composite collapse; impractical for use.
- **Structural Integrity:** Activated carbon and graphite composites remained intact.
- **Na_3PO_4:** Did not reach 9 H_2O; further optimization required.



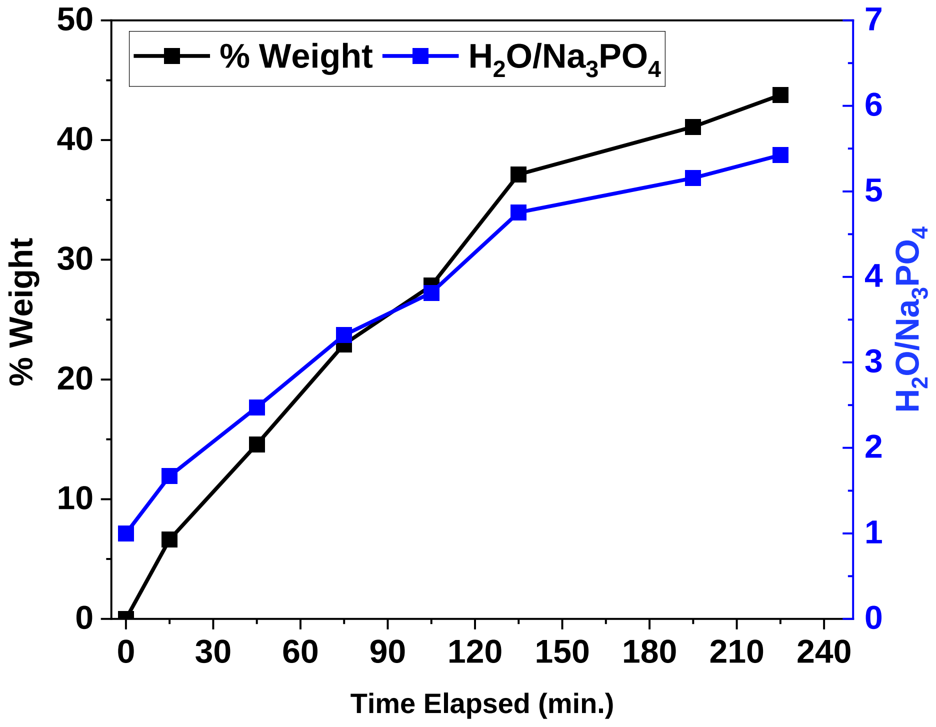


Hydration rate of various composites (2g total) with:

- 70% salt
- 20% host matrix
- 10% polymeric binder

Kinetics of $Na_3PO_4·12H_2O$ Composite

Hydration rate of $Na_3PO_4·12H_2O$ in a composite with 70% $SrBr_2$ +20% host matrix +10 % polymeric binder.



Observation: Na_3PO_4 need more time to get to 9 H_2O .

Further Investigation: Further optimization of the recipe is needed to enhance kinetics and achieve cyclability between 1 H_2O and 9 H_2O.

Cyclic Stability of $SrBr_2$ Composite

Optimization: Improved $SrBr_2$ recipe tested over 30 cycles.

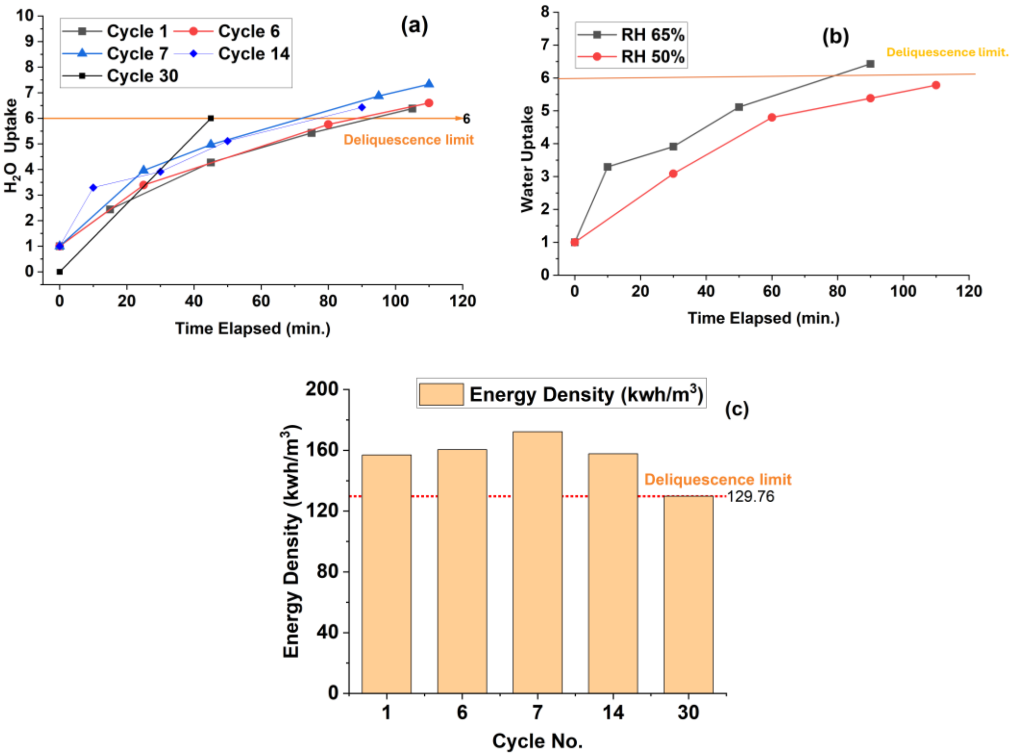
Results:

Hydration Time: Reduced from 2 hours to 45 minutes by the 30th cycle.

Energy Density: Increased beyond 129.76 kWh/m³ by exceeding deliquescence limit.

Low % RH Performance: Comparable hydration time, supporting potential cascade system design.

Hydration rate of SrBr2 in a composite with 70% $SrBr_2$ +20% host matrix +10 % polymeric binder. (a) Cyclic Performance ; (b) Effect RH and (c) Energy Density



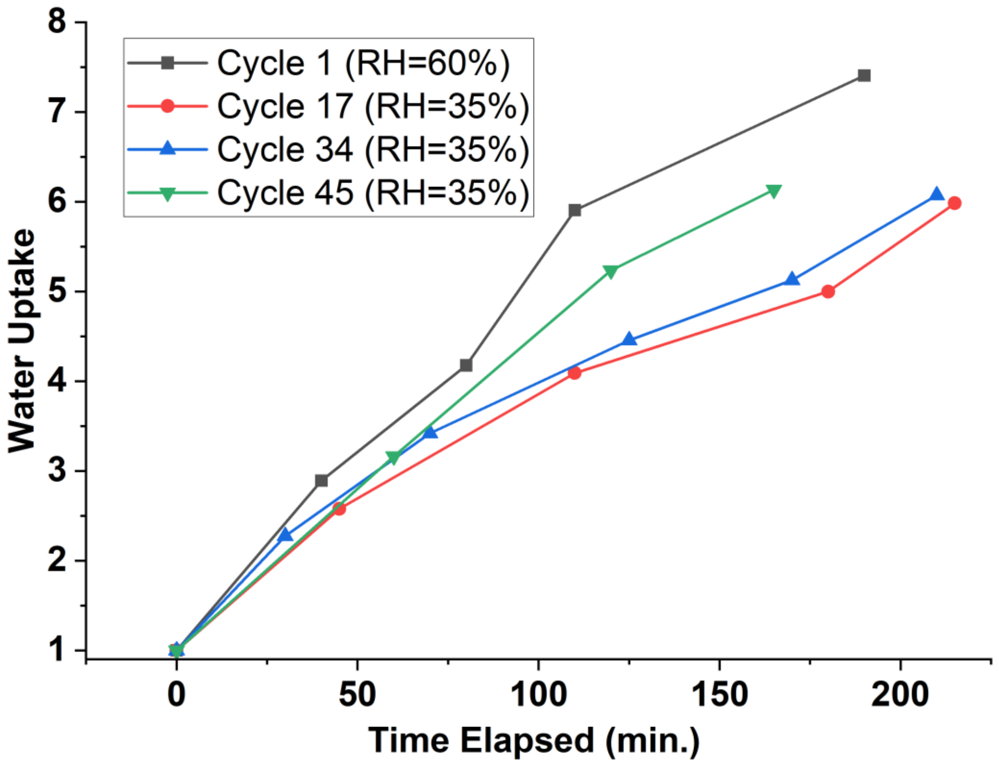
Hydration Kinetics Improvement And Cyclic Stability In $SrBr_2$

Observation: Hydration kinetics keep improving as the cycle process advances.

Low %RH Performance: At low relative humidity, hydration kinetics are notably favorable, and complete hydration can be achieved within 3 hours by the 45th cycle.

Further Investigation: Further optimization of the recipe will be carried out if necessary, and additional cycles will be conducted to ensure the cyclic stability for approximately 100 cycles.

Hydration rate of SrBr2 in a composite (3g Total) with 70% $SrBr_2$ +20% host matrix +10 % polymeric binder.

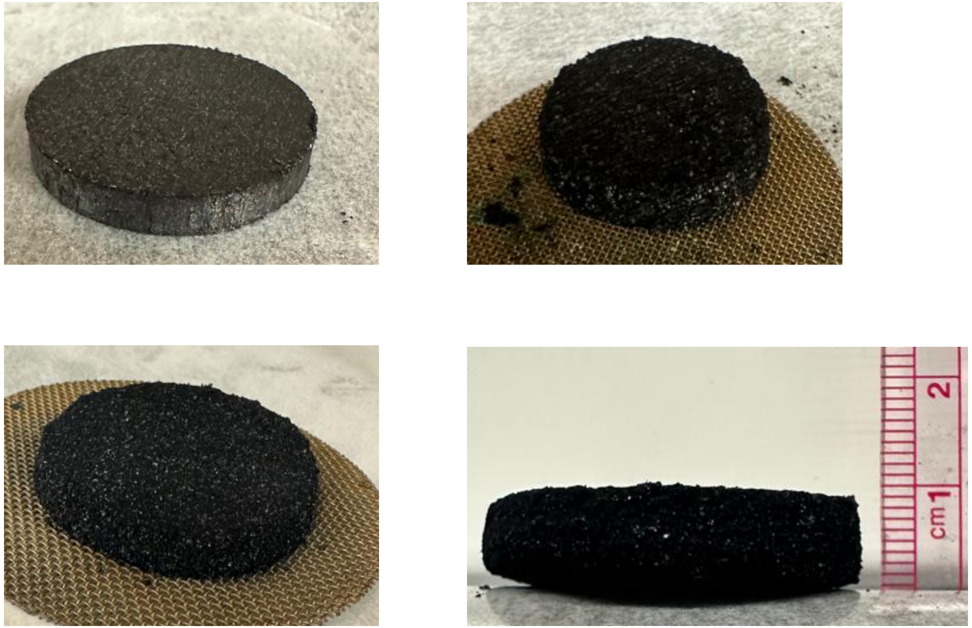


Hydration Kinetics Improvement And Cyclic Stability In $SrBr_2$

Observation: Compared to the fresh sample with a thickness of 5.2 mm, the 45 cycles old sample reached approximately 6mm(left side) to 8mm (right side) mm, resulting in an energy density of around 129-172 kwh/m^3 or 150.5 kwh/m^3 on average.

Structural Integrity : The composite remained intact after 45 cycles, indicating the structural integrity of $SrBr_2$.

Shape of the $SrBr_2$ composite with 70% $SrBr_2$ +20% host matrix +10 % polymeric binder at various stages.



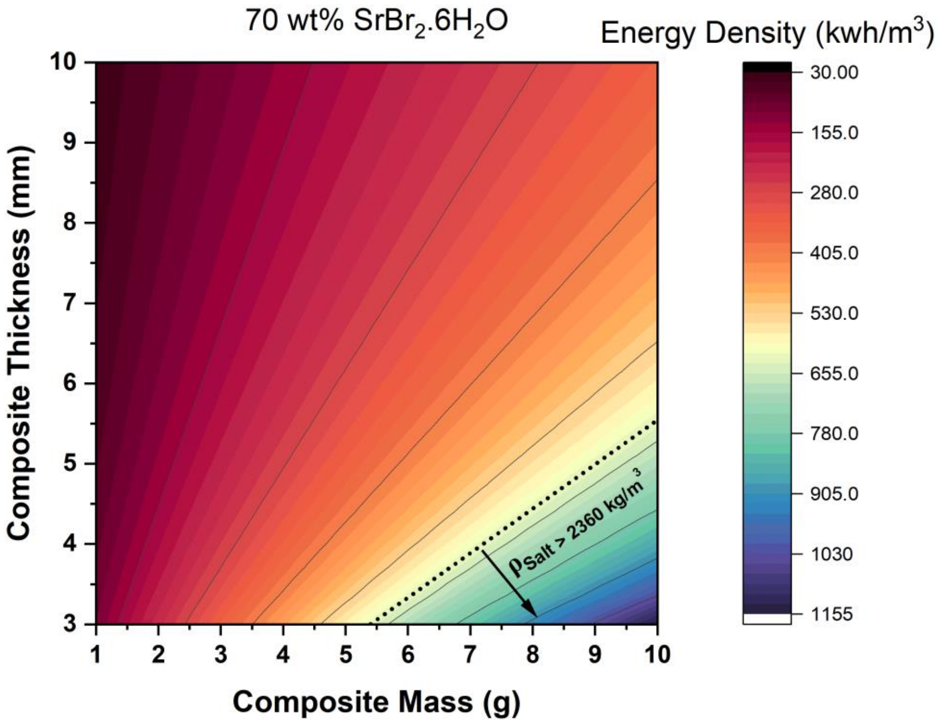
Future Work

- Based on this figure, the theoretical energy density can be enhanced by:
- ❖ Increasing the composite mass.
- ❖ Decreasing the thickness.

- However, there are some constraints regarding the maximum salt density in the composite.

- Therefore, optimizing the recipe to achieve maximum energy density is the goal.

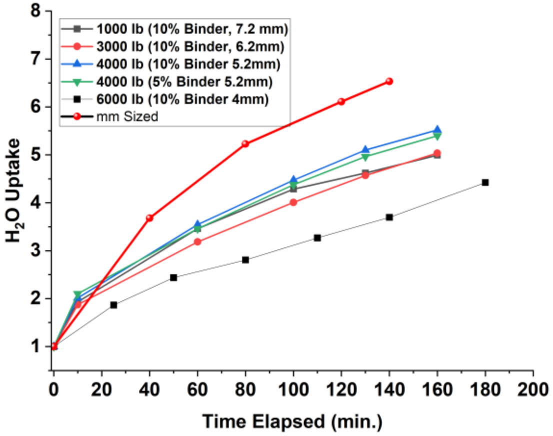
Theoretical Energy Density $SrBr_2$ composite with 70% $SrBr_2$ +20% host matrix +10 % polymeric binder.



Preliminary Results

- Initially tested the effect of different thicknesses at a 3g constant mass.
- Preliminary results showed that thinner samples had better hydration kinetics.
- Further optimization will focus on stability and energy density.
- Millimeter-sized particles of the same recipe were synthesized, showing better kinetics and stability over 70 cycles.

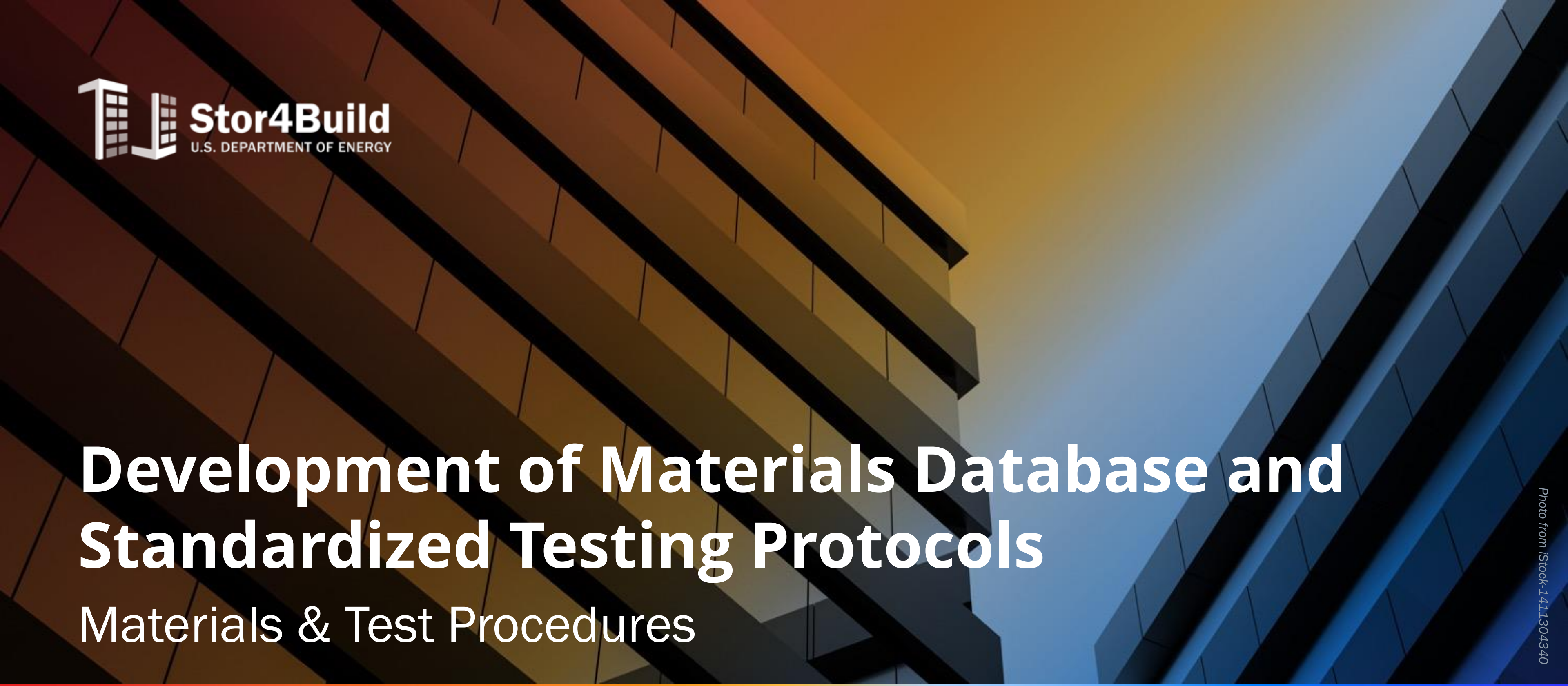
Theoretical Energy Density $SrBr_2$ composite with 70% $SrBr_2$ +20% host matrix +10 % polymeric binder.



Fresh

mm-sized Particles

Post 70-Cycles



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Development of Materials Database and Standardized Testing Protocols

Materials & Test Procedures

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Moderator: Judith Vidal, NREL

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Outline

- Material Database
  - Internal efforts
  - External collaboration
- Test Procedures activities
  - Internal efforts
  - External collaboration
- ROVI (Rapid Operational Validation Initiative)

Material Database

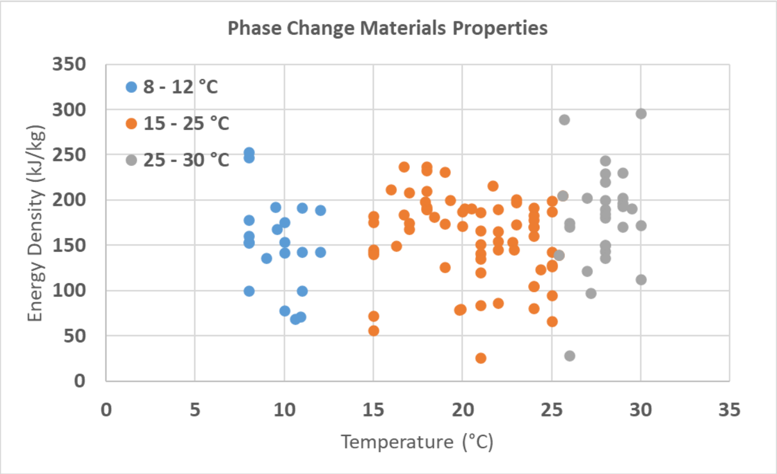
Collection of PCMs in temperature ranges relevant for S4B projects

- 8 – 12 °C
- 15 – 25 °C
- 25 – 30 °C

Built from former/ongoing TES projects, review papers, literature

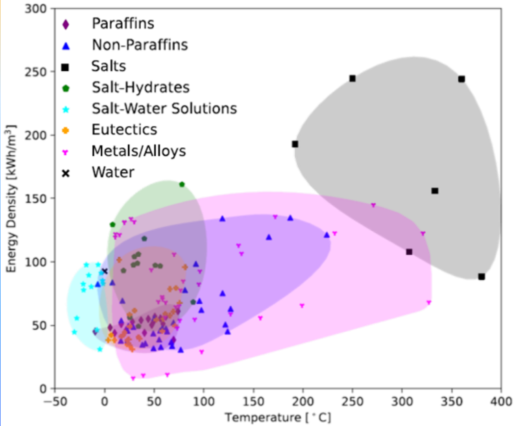
Targeted Applications

- HVAC
- Ambient/envelope
- Water heating



Materials Identified

- Paraffins
- Salt hydrates
- Fatty acids
- Fatty esters
- Fatty alcohols
- Glycols
- Metal alloys
- Eutectics
  - Org & Inorg



By categorizing materials and identifying gaps in thermal properties, this project assists on R&D of new materials that can meet the specific needs of energy-efficient building systems. This aligns with the Blueprint's emphasis on **accelerating technology innovation** to achieve energy efficiency and emissions reduction targets..

Material Database

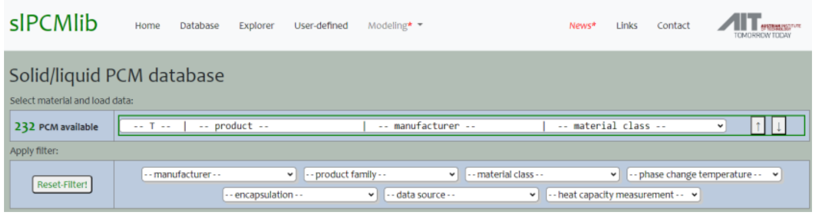
Supporting existing database efforts

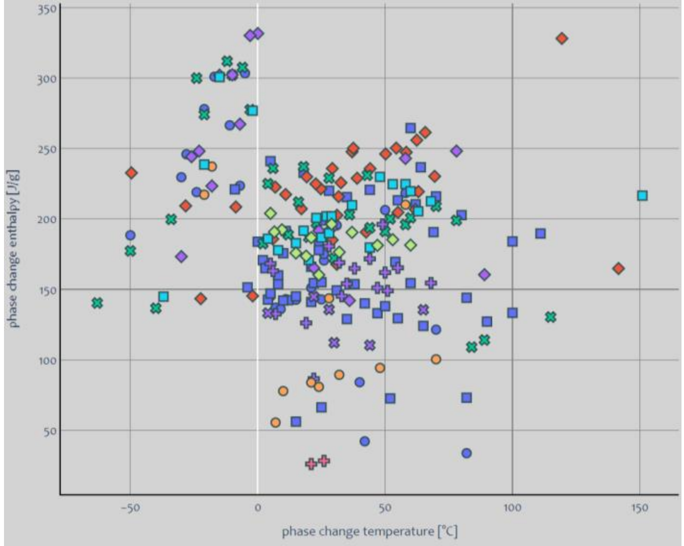
- Contains 232 commercial PCMs
- Exports properties in python, matlab, modelica, fluent
- Interpolated properties

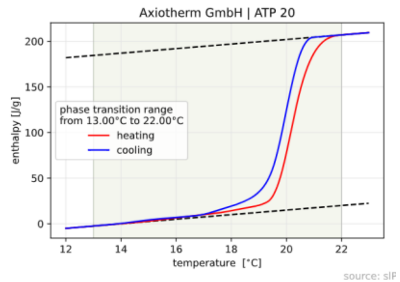
Company	# of PCMs	Lower T (°C)	Upper T (°C)	Types
Axiotherm	32	-63	115	organic, salt hydrate
Climator Sweden AB	11	-21	70	salt hydrate
Croda	13	5	60	paraffin
Knauf Gips KG	2	21	26	paraffin-composite
Pluss Adv. Tech.	39	-30	68	salt hydrate, eutectic mixtures
PureTemp	23	-37	151	organic
Rubitherm	78	-50	111	organic, salt hydrate
Sigma Aldrich	34	-50	142	Paraffin, organics, salt hydrate

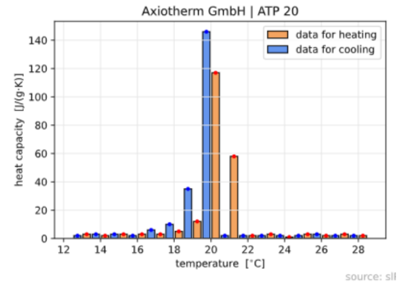
We have been contacting additional companies to receive in depth PCM property data

- e.g., Encapsys, Phase change solutions, Insolcorp, Microcaps, Microtek, etc.









Integration of PCM databases and identifying gaps in materials support the Blueprint's goal to **foster cross-sector collaboration**. This project provides a critical resource for researchers and professionals from academia, national labs, and industry and help accelerate development of innovative materials that are essential for decarbonization efforts.

Test Procedures

IEA Task 67/40

A. Materials Characterization
B. CTES Material improvement
C. State of Charge
D. Stability of PCM and TCM
E. Effective Component performance with innovative materials

We participated in Subtask A

A1. Standardized measurement procedures and round robin tests
- A1.1. Thermal conductivity
- A1.2. Specific Heat capacity
- A1.3. ~~Sorption Enthalpy~~
- A1.4. ~~Thermal Expansion~~, density, viscosity

A2. Materials Database Development

15 countries / 39 organizations

1	Austria	AIT Austrian Institute of Technology GmbH
2	Austria	TU Wien
3	Canada	CanmetENERGY / CanmetÉNERGIE
4	Canada	Dalhousie University
5	Canada	University of Ottawa
6	France	INSA Lyon
7	France	Université de Nantes - CNRS -LTeN
8	France	CEA LITEN
9	France	Université d'Artois
10	France	Université de Pau et des Pays de l'Adour
11	Germany	Bavarian Center for Applied Energy Research e.V.
12	Germany	Bavarian Center for Applied Energy Research e.V.
13	Germany	DLR
14	Germany	Fraunhofer Institut für Solare Energiesysteme ISE
15	Germany	TU Munich
16	Germany	Dr. Harald Mehling
17	Italy	CNR
18	Netherlands	TNO
19	Netherlands	TU Eindhoven
20	Slovenia	National Institute of Chemistry
21	Spain	University of Barcelona
22	Spain	CIC energiGUNE
23	Spain	University of Zaragoza
24	Switzerland	HSLU
25	United Kingdom	University Birmingham
26	United Kingdom	Warwick School of Engineering
27	Norway	SINTEF Energy & Industry
28	USA	U.S. DOE
29	USA	U.S. DOE Lawrence Berkeley National Laboratory
30	USA	U.S. DOE Oak Ridge National Laboratory
31	USA	U.S. DOE National Renewable Energy Laboratory
32	Spain	CIEMAT
33	Greece	University of Ioannina
34	Germany	Fraunhofer-Institute for Chemical Technology
35	United Kingdom	Northumbria University Newcastle
36	Spain	University of Basque Country
37	United Kingdom	Swansea
38	Portugal	University of Porto
39	Denmark	DTU

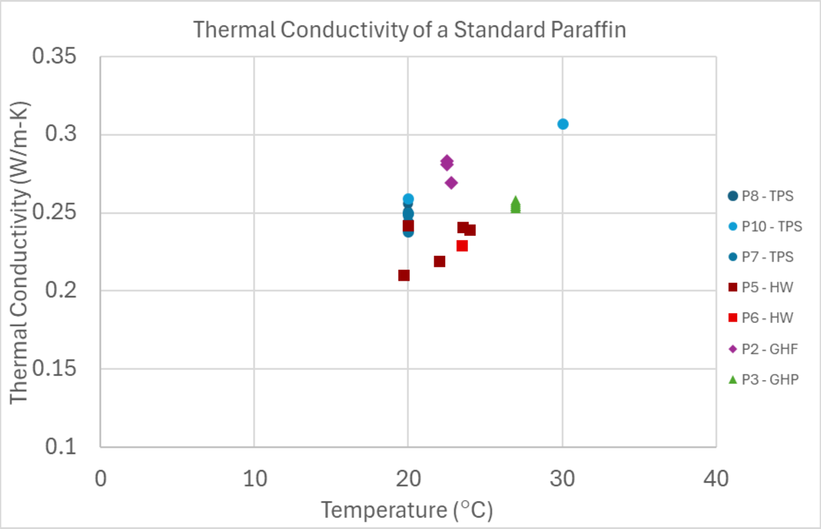
Development of standard testing protocols for PCMs/TCMs ensures that these materials perform reliably and consistently, which is critical for their widespread adoption in energy-efficient systems. This aligns with the Blueprint's goal to **Ensure building resilience and performance**, by providing reliable materials that can enhance the energy efficiency of buildings.

The testing protocols developed under this project will help accelerate the market introduction of advanced thermal energy storage technologies, which is essential for achieving the **Decarbonization of the buildings sector** as outlined in the Blueprint.

Test Procedures

Thermal Conductivity: Standard Paraffin

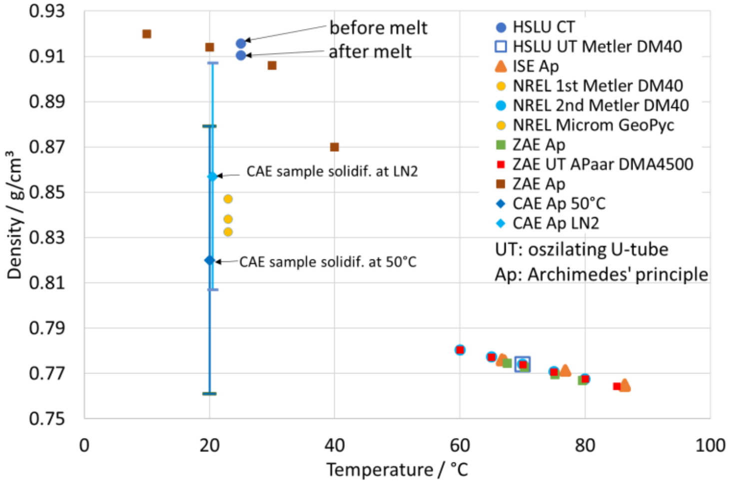
- Multiple methods compared
- Hot Wire (HW), Transient Plane Source (TPS), Guarded hot plate (GHP), Guarded heat flow meter (GHF), Laser Flash (LFA)



Heat Flow Meter

Densities (sol/liq): Standard Paraffin

- Liquid density has no issues – easy!
- Solid density – more nuanced
  - Methods: Archimedes principle, computed tomography, solid-media pycnometer
  - Depends heavily on cooling rate
    - Fast cool – more free volume
    - Slow cool – denser material



Solid/Powder Density Meter

Liquid Density Meter

Test Procedures

Viscosity of a Standard Paraffin

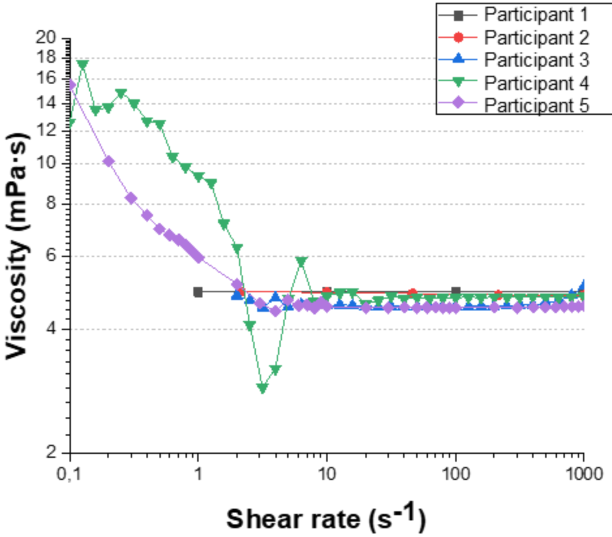
- Controlled stress rheometer
- Controlled strain rheometer
- Viscometer

Convergence 4.71 ± 0.16 mPa-s (70 °C)

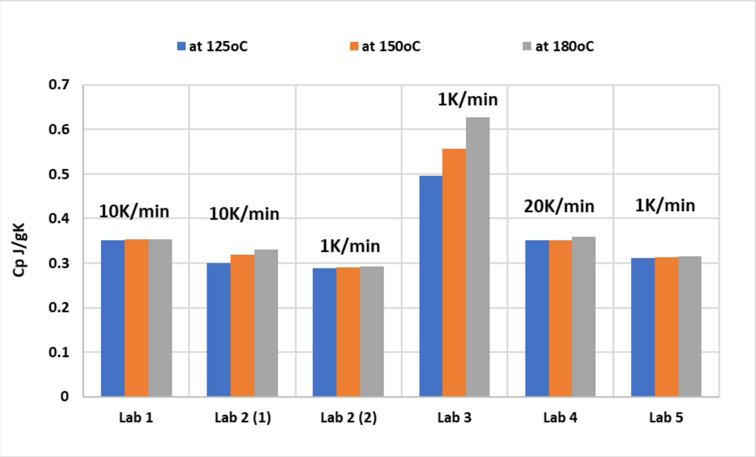
- Higher shear rates (> 10 s^{-1}) required

Heat Capacity of $SrBr_2$

- Differential scanning calorimetry
- Good agreement (except for Lab 3)
- Varying ramp rate: minimal effects
- 125 °C: 0.340 ± 0.031 J/g-K
- 150 °C: 0.344 ± 0.028 J/g-K
- 180 °C: 0.348 ± 0.027J/g-K



Rheometer



Differential Scanning Calorimetry

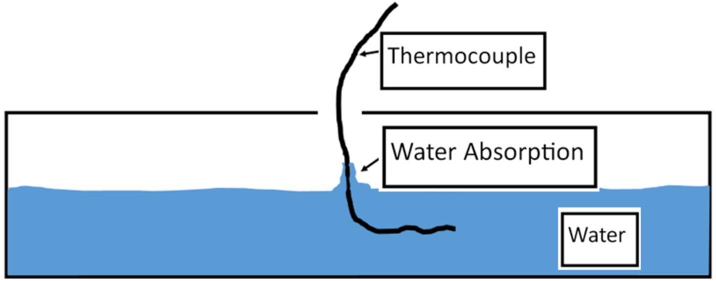
Test Procedures

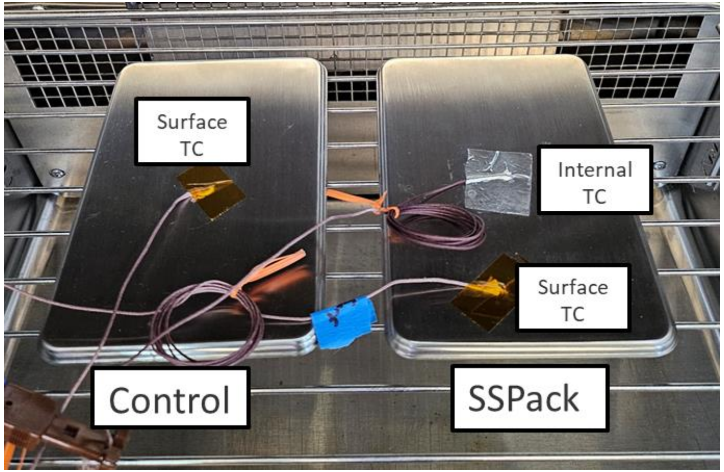
Support for an integration task.

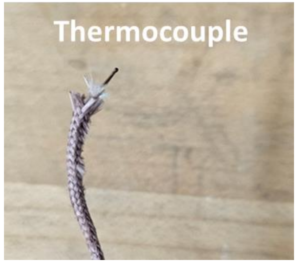
T-History measure on metal ice packs

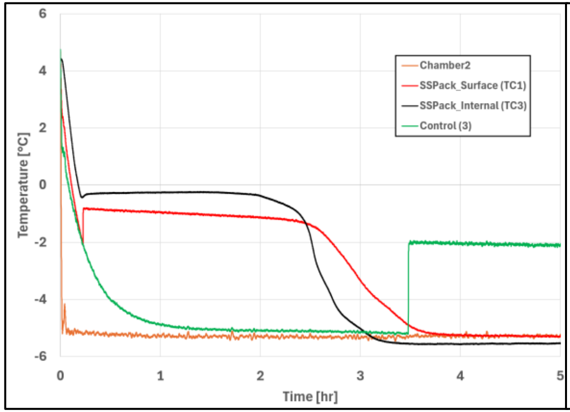
<u>**Measurement of Water Supercooling**</u>

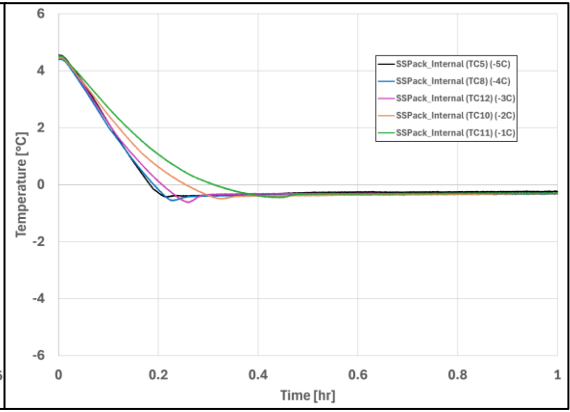
- Metal ice packs
- SC eliminated by inserting thermocouple
- Fabric sheathing contributed to ice nucleation











Test Procedures

<u>New IEA task</u>

- Incorporation of low and high temp PCMs (<-20 °C & >500 °C)
- Additional round robin testing
- Scaled up material production
  - Lower cost, greater sustainability
- State of Charge

<u>ASHRAE SPC 233</u>

- Ongoing review of PCM-related standards
- Development of relevant properties to test

Task 67/40 follow-up
Timeline

Task Idea presented to ExCo's	June 2024
1st Task Definition Meeting (online)	October 2024
First Workplan to ExCo's	November 2024
2nd Task Definition Meeting (in person)	Spring 2025
Final Workplan to ExCo's	April/May 2025
Approval by ExCo	May/June 2025
Start of Task	July 2025
End of Task	June 2028

SPC 233P – Proposed Standard authorized November 2021.
Testing, Evaluating, and Reporting of Phase Change Materials Performance

PURPOSE: To provide a test method to evaluate the performance of Phase Change Materials (PCMs). This standard also provides a method of reporting the performance of different phase change materials in a standardized way based on laboratory testing.

2. SCOPE:
1. This standard covers the testing and evaluation of Phase Change Materials (PCM) thermal and life-cycle performance.
2. This standard includes:
   - Uniform method of testing
   - Identification of testing equipment for performing such testing.
   - Identification of data required and calculations to be used.
   - Identification of reporting method to be used.
   - Criteria for determining the life cycle performance.
   - Definitions and Terminology
3. This standard does not cover thermal energy storage system-level evaluation.

ROVI

Rapid Operational Validation Initiative

Problem Statement:

- Evolving grid has increasingly complex demands that require a step-change in amount of accurate ES performance information needed for efficient & robust designs
- ES characterization today is too slow & expensive to meet urgent information needs

Solution:

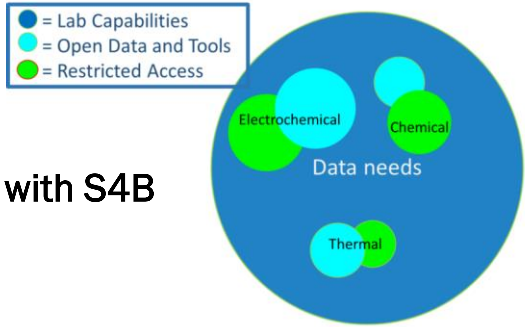
- AI/ML for rapid, accurate & cost-effective performance characterization, with quantitatively reliable certainty

Goal: Can we comprehensively compile existing energy storage system data to predict 15-year performance with 1 year of data.

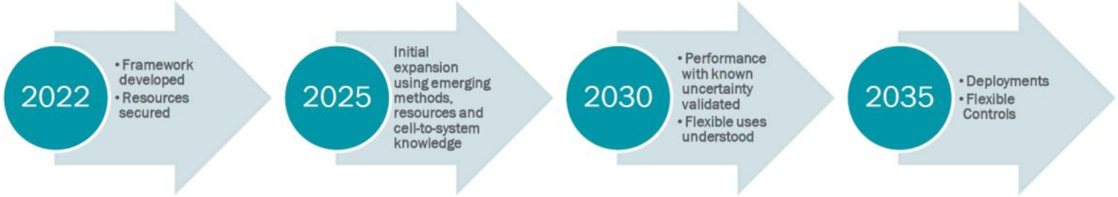
- Focus on flow batteries and Li-ion
- Initial discussion of including TES, but not selected ☹

Challenges with TES (and other ES technologies)

- Direct comparison of TES systems across broad temp ranges
- Fragmented data availability
- Proprietary barriers



Little collaboration opportunity with S4B



Future Work for Materials Database and Test Procedures

FY24

- Completed milestones and furthered international collaborations with other TES researchers

FY25

- Ongoing outreach to PCM companies for integration of their materials data into existing model integrated PCM database and increased involvement as potential stakeholders
- Development and involvement in a new IEA task to continue international TES collaborations and advanced testing on PCMs
- Support ASHRAE SPC233 for PCM testing and standard development to continue broader alignment of the TES and buildings community and support the DOE blueprint
- In-depth testing on PCM/TCMs utilized in other S4B projects for comprehensive view of behavior and resiliency of the material

Thank You

Moderator: Judith Vidal, NREL

Kyle Foster (NREL) Tugba Turnaoglu (ORNL) Sumanjeet Kaur (LBNL)

Stor4Build Annual Meeting
August 26–27, 2024
Oak Ridge National Laboratory