**Introduction: (1 slide)**

The study explores the potential of inorganic phase change materials (PCMs), focusing on salt hydrates, to enhance energy efficiency in urban development. It advocates for integrating thermal energy storage methods into the evolving energy grid to manage fluctuations and optimize renewable energy utilization. Foundational models like Pitzer's ion interaction model aid in understanding electrolyte solutions, while thermodynamic models elucidate ternary systems' behavior. Salt hydrates' industrial appeal lies in their high latent heat of phase change, thermal conductivity, stability, and non-toxicity, making them promising for energy storage and environmental applications. Challenges like supercooling are addressed through innovative methods. The research also examines thermal management systems, emphasizing the transition to renewable energy sources and the importance of efficient energy storage solutions. Through comprehensive analyses, the study aims to contribute to sustainable energy solutions across diverse industries.

**Literature Review: (2 slides)**

**Slide 1:**

Our literature review includes works of various researchers like

1. **M. Gaeini (2018)**, who studied thermochemical heat storage in salt hydrates.
2. **Lin Liang (2017),** who studied that a new cold storage phase change material eutectic hydrate salt (K2HPO4·3H2O–NaH2PO4·2H2O–Na2S2O3·5H2O) was prepared, modified, and tested.
3. **Luca Scapino (2017)** studied that sorption heat storage has the potential to store large amounts of thermal energy from renewables and other distributed energy sources.
4. **Dongdong Li (2018)** studied the development of a multi-temperature thermodynamically consistent model for Salt Lake brine systems.
5. **Christoph Rathgeber (2019)** worked on the modified BET equations that are extended to calculate solubility phase diagrams of concentrated salt solutions with relatively high-water activities within the range of undersaturation.

And many more to add on.

**Slide 2:**

Various Thermodynamic models are studied from literature.

1. Debye-Huckel equation
2. Davis Equation
3. Pitzer Equation
4. BET Model
5. Pitzer Simonson Clegg

**Research Gap and Novelty: (1 slide)**

There is wide research gap in the Salt hydrates such as

1. Lack of experimental data at high temperature and pressure and validation,
2. Model accounting for salt hydrates at elevated temperature, pressure, and concentration.
3. Accounting of unstable chemical reactions.
4. Accounting of complex phase equilibria (vapor: liquid: solid).

**Objective: (1 slide)**

The main objectives include:

1. Study of phase change of salt hydrates
2. Study of Charging and Discharging cycles
3. Study of Capacity of batteries
4. Study of thermal management in batteries

**Methodology: (1 slide)**

In this work, Gibbs free energy term is given by long range (Lr) electrostatic contributions b/w ions and short range (Sr) interaction b/w all species.

Using Pitzer`s form of the Debye- Huckle (PDH) function as the electrostatic contribution to the free energy. So,

The expression for the short-range interaction contribution of aqueous salt solution is obtained from Flory- Huggins theory as given below,

On combining both the equations we get,

The derivative of the above w.r.t. moles of water and salt gives us chemical potential of water and salt hydrate respectively.

The osmotic coefficient (φ) of an aqueous electrolyte is related to the chemical potential of water, (µw), as follow:

**Results and discussion: (Max 5 slides)**

In this add, temperature vs volume fraction for all the components and parity plot. No need for any explanation, we will tell that orally.

**Work Plan: (1 slide)**

This part we will ask with mam and then add.