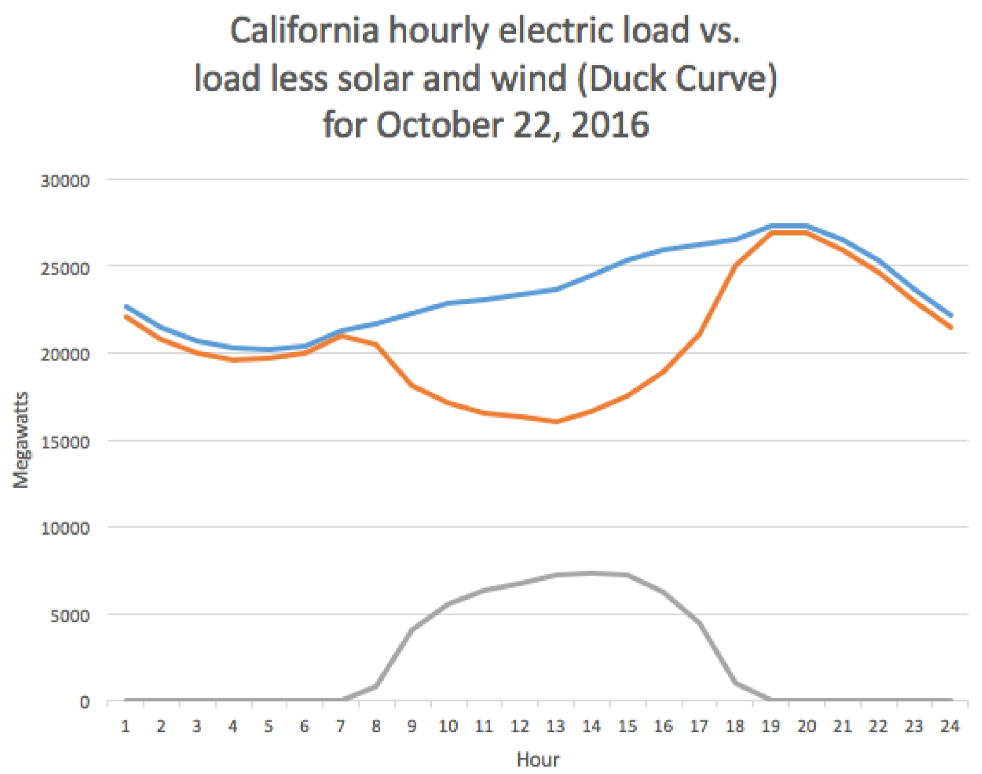
Comparing the External Thermal Properties Between Lithium-Ion and Solid-State Electrolyte Batteries in Photovoltaic Applications

Jacob Greene, Krish Viren Nanavati, Seth Storino, Adam Wong

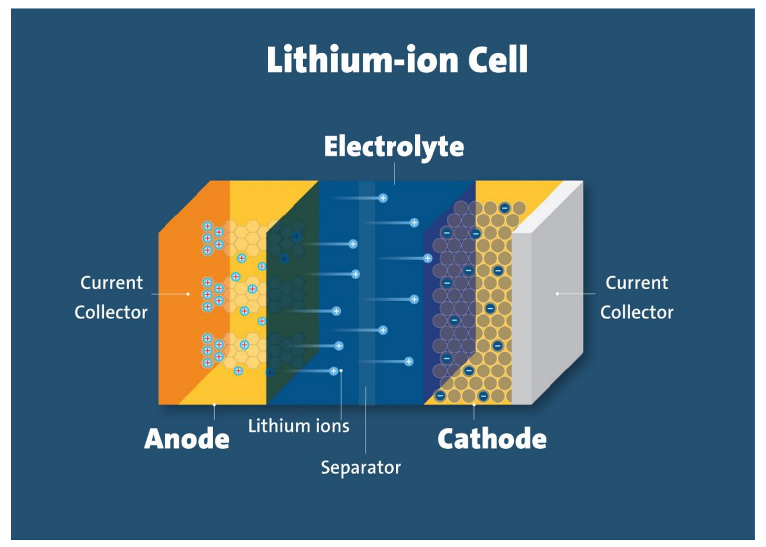
Capstone Mentor: Dr. Nicholas Rolston

Problem Statement

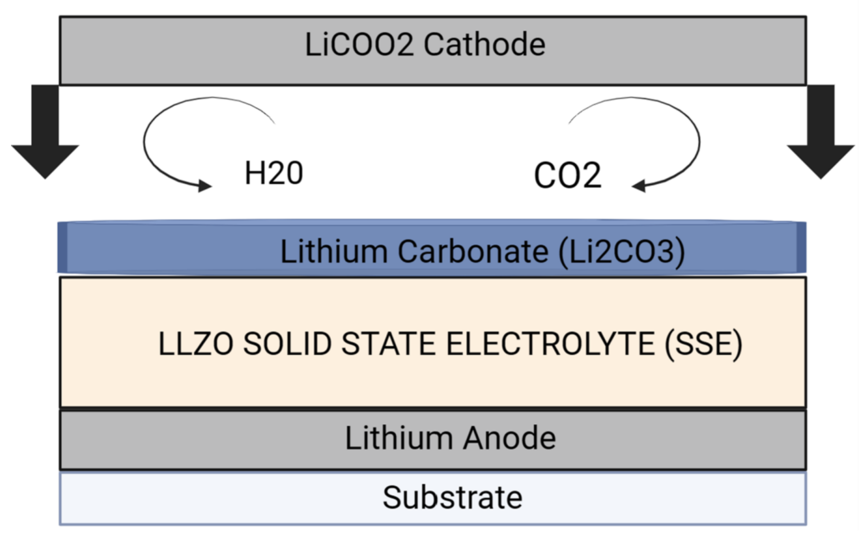
As solar energy continues to rise in popularity, one key challenge remains: the role of batteries in ensuring its feasibility and reliability. Batteries store the energy generated by solar panels during peak sunlight hours and release it when the panels are operating at reduced efficiency, such as in the evening or at night.



A liquid-state electrolyte battery is the standard of what industries use for any battery-operated device. The cons of lithium-ion batteries are their flammability, unstableness, and subpar levels of efficiency at higher temperatures.

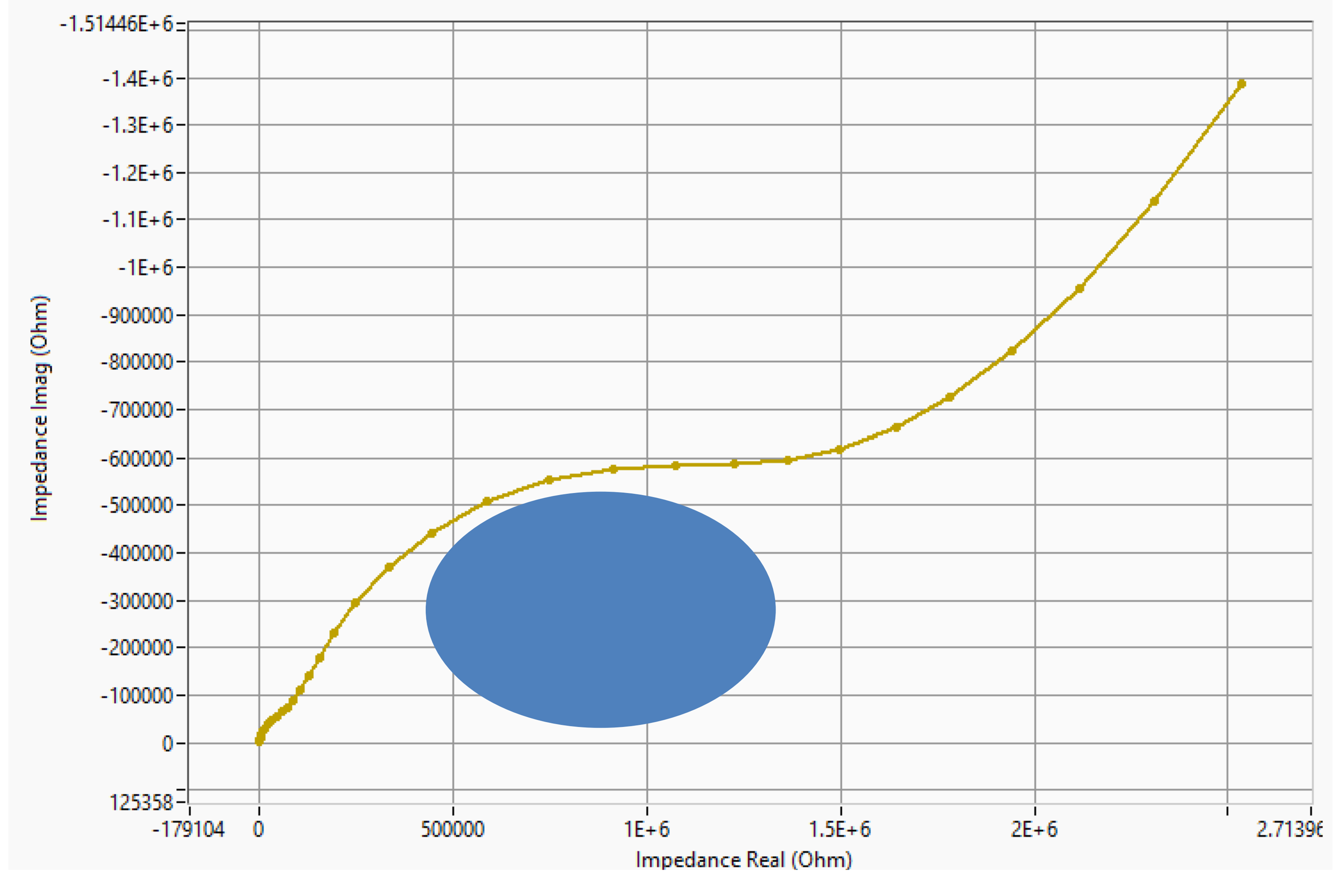


Solid-state electrolyte batteries are a better alternative due to enhanced user safety and higher ionic conductivity. This project aims to demonstrate why solid-state electrolyte batteries can revolutionize the solar industry.



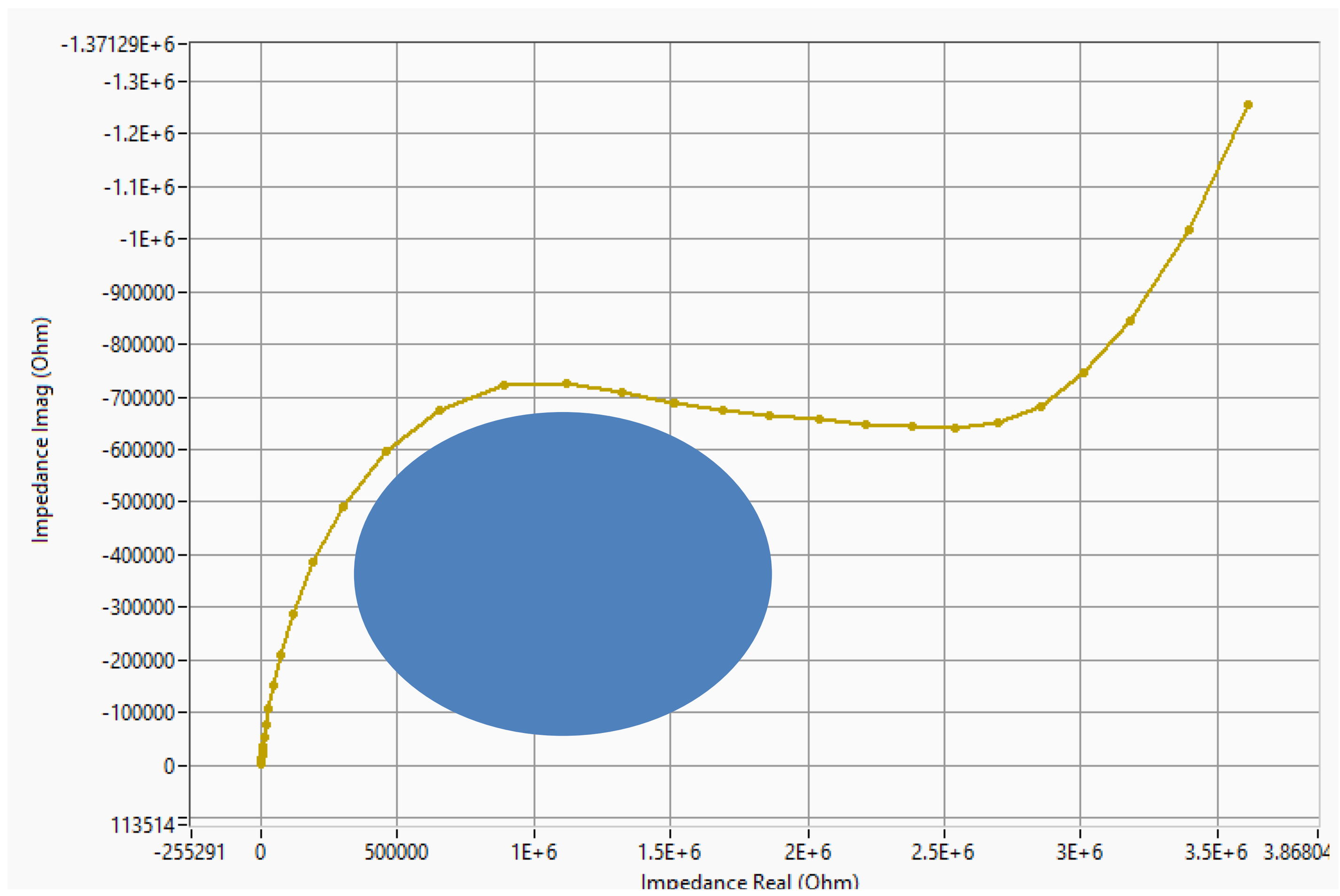
Research & Analysis

LLZO Starting at 298K(25C/77F)



Ionic conductivity is important for batteries because it measures how well ions move through the battery's conductor. The semicircle shape shown above indicates good ionic conductivity.

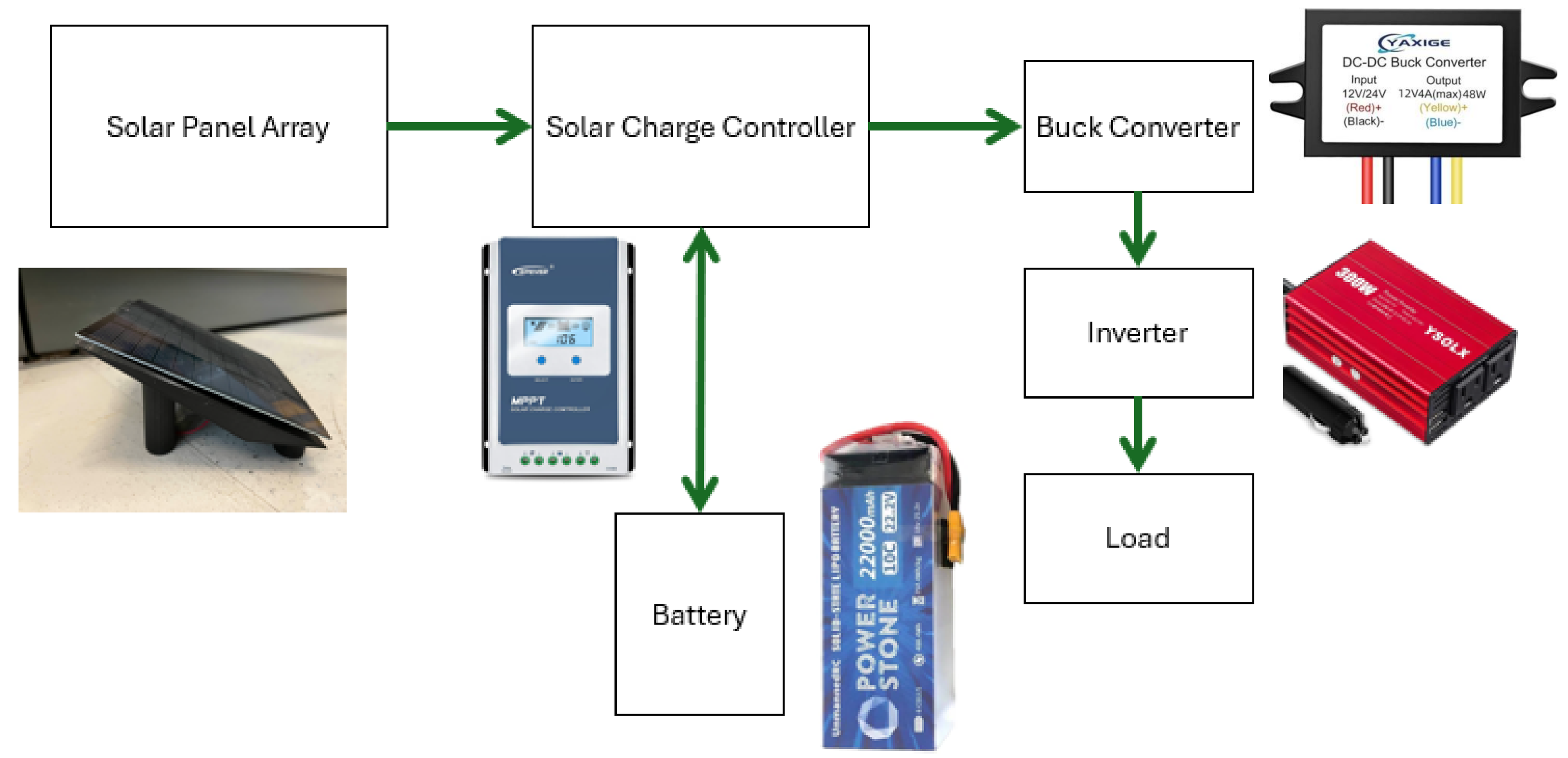
LLZO Ramping Up at 373K (100C/212F)



At higher temperatures, the ionic conductivity increases, as shown by a larger semicircle. This happens because heat encourages more ion movement across the layers. Therefore, solid-state electrolyte samples perform well in high-temperature applications.

Proof of Concept

This project combines tangible components presented through an in-person demonstration with experimental and simulation results showcased via a physical proof of concept and modeling simulation.



Conclusion

The physical proof of concept highlights the practical implementation of the project, demonstrating how solid-state electrolyte batteries could revolutionize the battery industry. This model can be scaled for various applications, including solar farms, data centers, residential buildings, bikes, and more. By adopting this technology, energy generation and distribution can become significantly more efficient and reliable.

Thank You & Acknowledgments

- Dr. Nicholas Rolston
- Harshitha Marikundam
- ECEE
- Nitish Jolly
- Professor James McDonald

ASU Ira A. Fulton Schools of Engineering
Arizona State University
School of Electrical, Computer and Energy Engineering