TSINGHUA UNIVERSITY
IEDE SPRING PROGRAM
2023

Group Name

INNOVATING GREEN ECONOMY

(GREEN ENERGY STORAGE &BATTERY TECHNOLOGIES)

Group Project Presentation

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INNOVATING GREEN ECONOMY

1.Introduction

BACKGROUND

- Green economy is evolving with advancements in battery technologies.
- Battery technologies have seen significant advancements in recent years.
  - Lithium-ion batteries, solid-state batteries, flow batteries and metal-air batteries

MAIN FOCUS

i. Study Battery Technologies initiatives in Advanced Economies
ii. Vs Emerging Economies
iii. Latest advances in battery technologies
iv. Opportunities and challenges in the Battery Technologies

OBJECTIVES OF THE STUDY

i. Study Green Economy initiatives in Advance Economies Vs Emerging Economies
ii. Special focus on latest advances in Battery technologies and Green energy storage
iii. Identify specific opportunities and propose solutions

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2.Study Battery Technologies initiatives in Advanced Economies Vs Emerging Economies

Advanced Economies

- **Research and Development (R&D) Focus**
  - Government funding
  - Private sector investments
  - Academic research
- **Technological Sophistication**
  - advanced manufacturing technologies
  - materials
  - infrastructure for battery production
- **Stringent Regulations**
  - stricter environmental regulations
    - emissions standards
    - waste disposal regulations.

Emerging Economies

- **Market Demand**
  - economic growth
  - Urbanization
- **Cost-Effective Solutions**
  - developing cost-effective battery technologies ;affordable & accessible.
- **Local Manufacturing**
  - create jobs
  - build domestic capacity
  - reduce dependence on imports
- **Sustainability Challenges**
  - environmental impacts
  - resource depletion
  - waste management

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3.1.Special focus on latest advances in Battery technologies

Lithium-ion Batteries

- Exploring new cathode materials.
- Solid-state electrodes replacement for liquid electrodes in lithium-ion batteries.
- Incorporate silicon into anodes of lithium-ion.
- Battery recycling and sustainability
- Safety enhancements;
  - development of smart battery management systems

Solid-state batteries

- Exploring new materials with improved ionic conductivity, stability, and safety.
- Manufacturing Techniques; thin-film deposition, solid-state sintering, and roll-to-roll manufacturing
- Interface engineering approaches
- Battery architectures
- Safety enhancements

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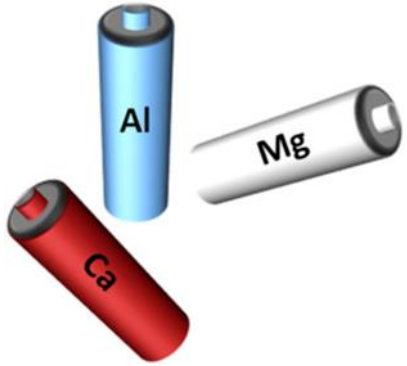
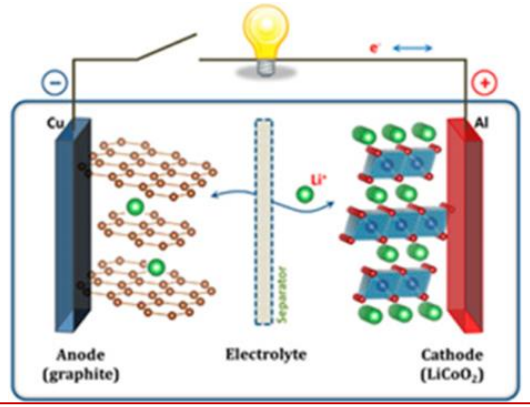
3.1.Special focus on latest advances in Battery technologies

Flow Batteries

- Use New electrolyte chemistry
- Development of new electrode materials.
- Use of ion-selective membranes & advanced Nano-composite membranes.
- System design & integration
- Cost reduction
- Operational strategies
- Applications

Multivalent





- Electrode materials
- Electrolyte chemistry
- Mechanisms and kinetics of multivalent ion insertion and extraction
- Strategies for improving cycling stability
- Scalability and cost-effectiveness
- High-energy and high-power applications

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3.1.Special focus on latest advances in Battery technologies

Solid-State Lithium Metal Batteries

- Solid-state electrolyte materials
- Lithium metal protection strategies
- Advanced electrode materials
- Interfaces and interphases
- Scalability and manufacturability
- Safety and reliability
- High-energy and high-power applications

Recycling and Sustainability

- Circular economy approach
- Improved battery recycling processes
- Sustainable battery materials
- Battery second-life applications
- Policy and regulations
- Education and public awareness
- Innovative recycling technologies

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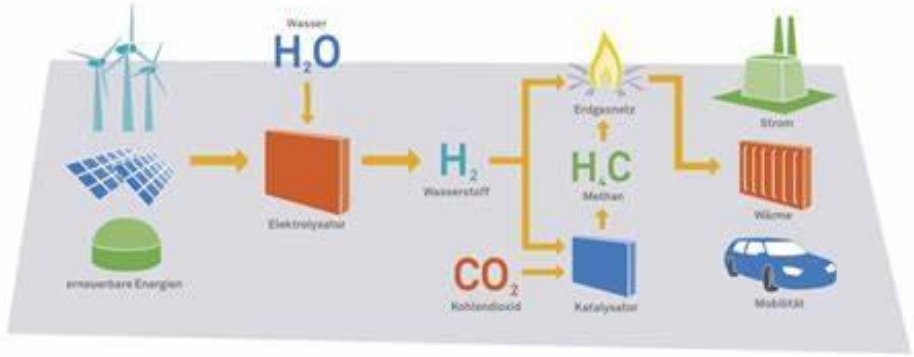
3.2.Special focus on latest advances in Green energy storage.

Thermal Energy Storage

- Development of advanced materials for
  - thermal energy storage;
  - phase change material
  - high temperature heat storage materials

Power-to-Gas

- Improving the efficiency of the conversion process.
- Reducing the costs associated with electrolysis.
- Developing advanced catalysts for improved performance.



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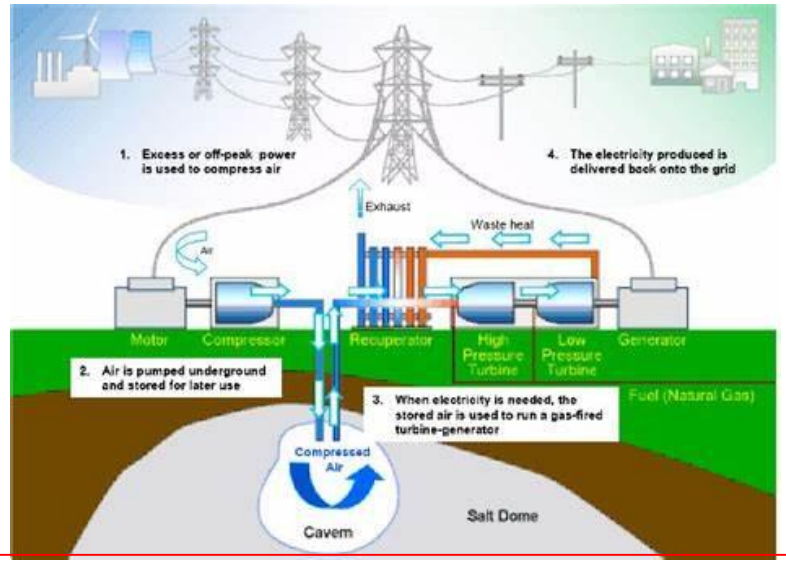
3.2.Special focus on latest advances in Green energy storage.

Lithium Recycling

- Developing efficient and sustainable methods for recovering lithium from spent batteries
- reducing the reliance on newly mined lithium
- minimizing environmental impacts associated with lithium extraction.

Compressed Air Energy Storage



- improving the energy efficiency of the compression and expansion processes
- optimizing the cavern design
- developing advanced control systems for better grid integration.

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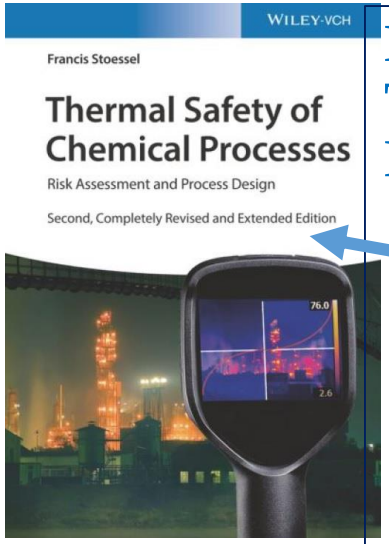
4.Specific Opportunities and Solutions for Battery Technologies

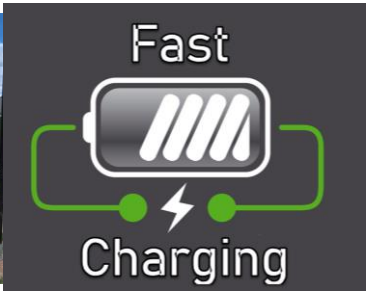


Enhance Safety and Thermal Management

- Improve thermal management systems
- Develop new battery chemistries

Increasing Energy Density:

- Develop new materials & technologies



Longevity and Durability

- Improving battery chemistries, designs& manufacturing process

Fast charging

- Develop fast-charging technologies
- Improve infrastructure for charging EVs.

Recycling and Circular Economy

- Developing effective and scalable battery recycling technologies.

Enable Grid-scale Energy Storage

- Develop large-scale, stationary batteries

Sustainable and Environmentally Friendly Battery Production

- Methods: Recycled materials, reducing toxic materials

Thank you for listening

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