E-PROCEEDINGS

INTERNATIONAL TINKER INNOVATION & ENTREPRENEURSHIP CHALLENGE (i-TIEC 2025)

"Fostering a Culture of Innovation and Entrepreneurial Excellence"

23 January 2025
PTDI, UiTM Cawangan Johor
Kampus Pasir Gudang

ORGANIZED BY:

Electrical Engineering Studies, College of Engineering
Universiti Teknologi MARA (UiTM) Cawangan Johor
Kampus Pasir Gudang
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e ISBN 978-967-0033-34-1

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e ISBN: 978-967-0033-34-1

Published in Malaysia by
Universiti Teknologi MARA (UiTM) Cawangan Johor
Kampus Pasir Gudang, 81750 Masai

A-ST061: SOLARPV-REVB: SUSTAINABLE ENERGY STORAGE TECHNOLOGY FOR RURAL ELECTRIFICATION USING SECOND-LIFE BATTERIES

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ABSTRACT

SolarPV-REVB (Retired Electric Vehicle Battery) is an innovative energy storage technology that utilizes retired electric vehicle batteries (REVBs) to power stand-alone photovoltaic (SAPV) systems. This approach addresses three significant issues, which are SAPV system reliability, cost of energy storage and environmental sustainability. SolarPV-REVB assures optimal system performance by integrating second-life battery in SAPV system design which balances system reliability and cost-effectiveness. The aim of the project is to repurpose electric vehicle batteries as energy storage and to enhance the SAPV system's reliability and cost. This approach positively impacts both the socioeconomic and environmental landscapes by minimizing battery waste, lowering energy costs, and boosting off-grid communities' access to sustainable electricity. SolarPV-REVB encourages the circular economy, renewable energy usage, and technology innovation. Its reliability, cost competitiveness, and environmental benefits offer major commercialization opportunities, making it an appealing solution for remote energy applications. This system solves global energy storage concerns by developing a sustainable approach and significantly provides solutions for renewable energy systems.

Keywords: retired electric vehicle battery, solar photovoltaic system, stand-alone photovoltaic system, second-life battery

1. Product Description

SolarPV-REVB is an innovative energy storage solution that integrates retired electric vehicle batteries (REVBs) with stand-alone photovoltaic (SAPV) systems to provide sustainable, reliable, and cost-effective power. This system addresses critical challenges in energy sustainability and affordability by repurposing second-life EV batteries, offering a practical alternative to conventional energy storage technologies. By giving EV batteries a second life, SolarPV-REVB significantly reduces environmental waste while meeting the energy demands of off-grid and remote communities. SolarPV-REVB aligns with United Nations Sustainable Development Goal 7 (SDG 7) by promoting affordable, reliable,

sustainable, and modern energy for all, fostering a greener and more inclusive future. **Figure 1** illustrates the configuration of the SAPV system, integrating REVB as the energy storage component. **Figure 2** presents the development process for implementing REVB as an energy storage for rural electrification initiatives.

The system's reliability and cost is measure through loss of power supply possibility (LPSP) levelized cost of electricity (LCOE) respectively. The LPSP and LCOE analysis between lead-acid, REVB and lithium-ion battery storage in SAPV application are presented in **Table 1** and **Figure 3**. From the table and figure, REVB demonstrates the lowest LCOE at RM 0.463 per kWh, making it the most economical energy storage solution among the three options. While lead-acid batteries excel in reliability with the lowest LPSP, the high LCOE diminishes the economic feasibility. REVB, on the other hand, offers an excellent balance between reliability and cost. Thus, position it as an ideal choice for sustainable and affordable energy storage in SAPV systems. Overall, REVB has the possibility to emerge as the optimal solution for rural electrification, combining low costs, reasonable reliability, and eco-friendly benefits to support sustainable energy goals.

2. Product Development and Output

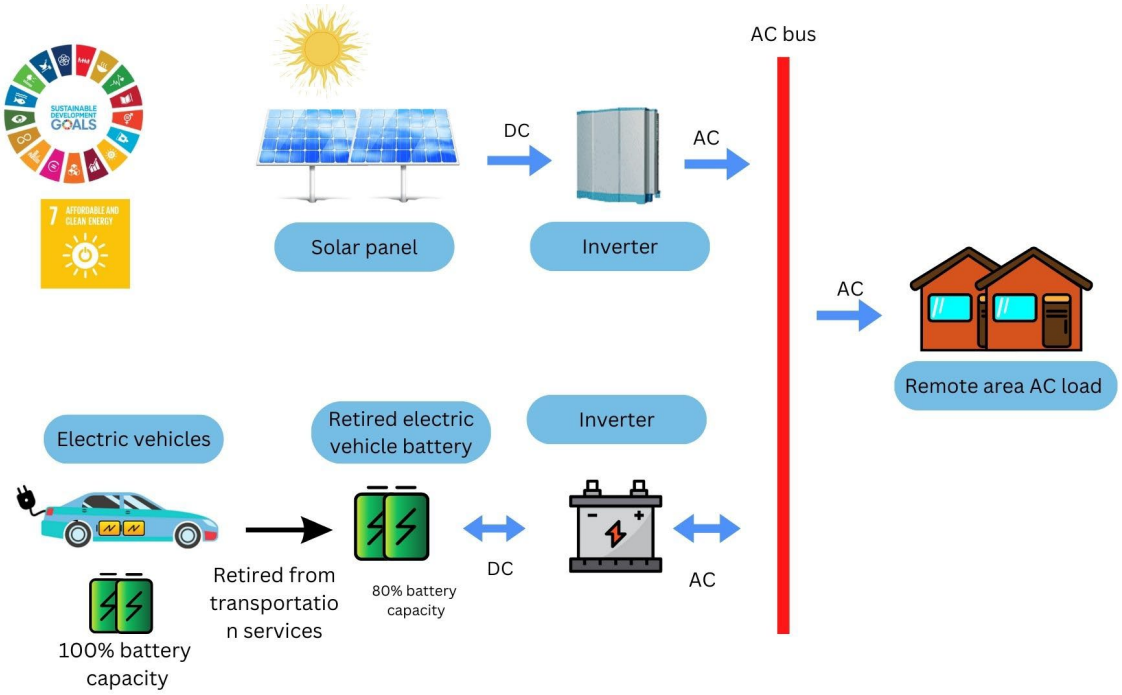

Figure 1. Configuration of SAPV system, integrating REVB as the energy storage component.

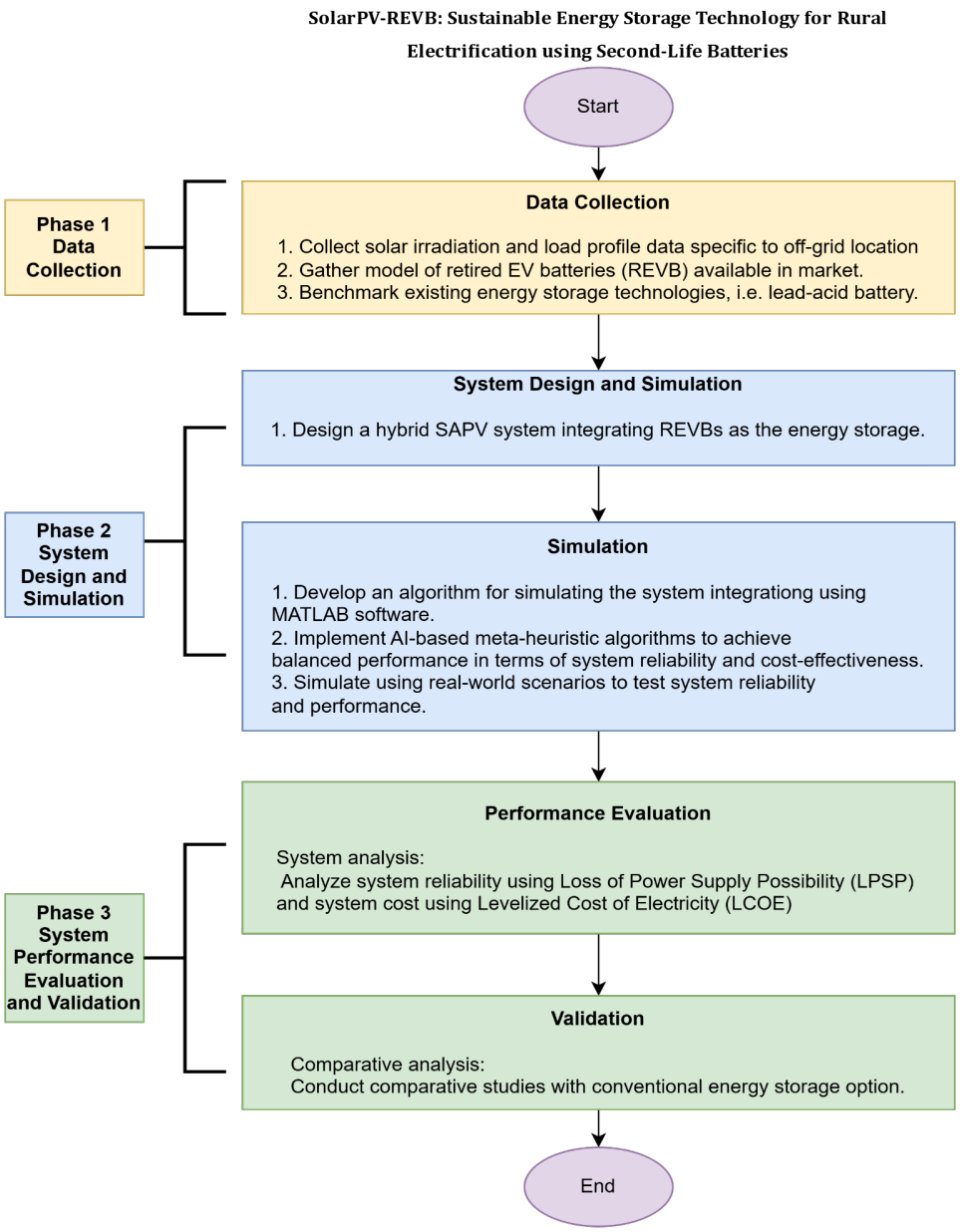

Figure 2. Development process for implementing REVB as an energy storage for rural electrification initiatives.

Table 1. Dataset and findings comparison between lead-acid, REVB and lithium-ion battery storage in SAPV application

Type of battery	*Model*	*Capacity (Ah)*	*Voltage (V)*	*Price (RM)*	*LPSP (%)*	*LCOE (RM/ kWh)*
Lead-acid	OPzV2-1000 Rosen Solar	1500	2	1224.45	0.04	0.53
Lithium-ion	Jingsun	100	48	2700	7.5	0.468
REVB	VW e-golf	108	15	1290.52	6.4	0.463

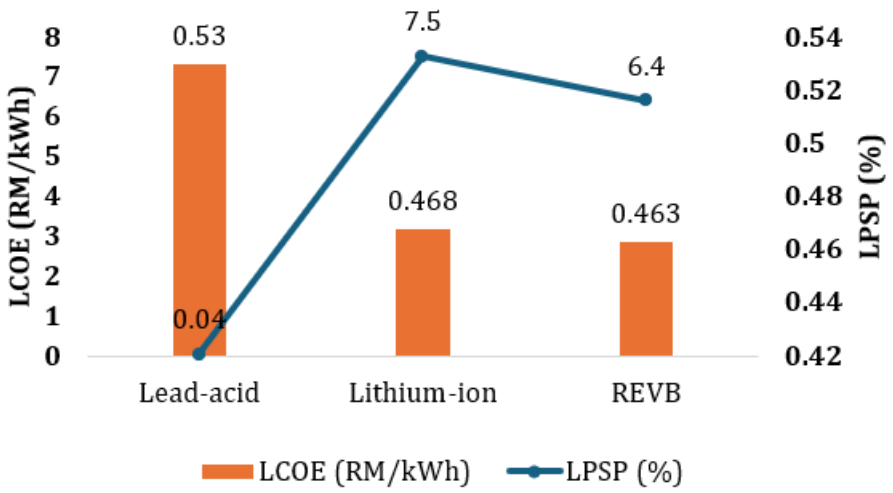

Figure 3. LPSP and LCOE comparison between lead-acid, REVB and lithium-ion battery storage

3. Novelty and uniqueness

The novelty of SolarPV-REVB is on the innovative solution that bridges the gap between energy reliability, affordability of energy storage and environmental sustainability. The project uniquely combines:

Second-Life Battery Utilization: Repurposing REVBs for a second life, significantly reduces waste and costs associated with energy storage.

Hybrid System Design: Integrating REVBs with SAPV systems to maximize renewable energy utilization and minimize dependency on conventional power sources.

4. Benefit to mankind

The integration of REVB into SAPV systems enhances energy access by providing reliable and secure power to underserved communities, fostering socioeconomic development in remote areas. It also offers significant economic benefits by delivering affordable energy storage solutions, reducing upfront and operational costs for users in off-grid areas. Additionally, it has a positive environmental impact by significantly reducing battery waste and promoting a circular economy through the repurposing second-life batteries. This approach also drives technological advancement by encouraging innovation and the adoption of sustainable practices in renewable energy systems.

5. Innovation and Entrepreneurial Impact

This project introduces an approach to energy storage by repurposing REVBs for SAPV systems, which merges environmental sustainability with technological innovation. Proper design of the system enhances the system's efficiency, ensuring a balance between system reliability and cost-effectiveness. The innovation's entrepreneurial significance relies on the potential to transform the energy storage market. Providing a second life to EV batteries, it addresses the pressing issues of battery waste management and the drawbacks of conventional storage solutions. The project fosters new business opportunities in battery refurbishment, renewable energy systems, and rural electrification initiatives. Moreover, it opens opportunities for collaborations across industries, including EV manufacturers, battery recyclers, and renewable energy providers, creating a robust ecosystem for sustainable energy solutions. This innovation aligns with global efforts toward achieving energy equity and environmental conservation, positioning it as a catalyst for change in the renewable energy and energy storage sectors.

6. Potential commercialization

The findings of this project demonstrate significant commercialization potential. It provides valuable recommendations for industries to refurbish and adapt retired EV batteries in the application of renewable energy. Thus, allowing for a more practical and eco-friendly approach to energy storage. The model can be applied to various use cases, including rural electrification projects, backup power systems, and small-scale energy solutions. Additionally, it opens opportunities for collaboration with EV manufacturers, battery recyclers, and renewable energy providers, fostering partnerships that promote sustainability and innovation in the energy sector.

7. Acknowledgment

The head project member acknowledges financial support from the Universiti Teknologi MARA, for providing financial support and facility for this research.

8. Authors' Biography

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