



E-PROCEEDINGS

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

"Fostering a Culture of Innovation and Entrepreneurial Excellence"



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23 January 2025
PTDI, UiTM Cawangan Johor
Kampus Pasir Gudang

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Electrical Engineering Studies, College of Engineering
Universiti Teknologi MARA (UiTM) Cawangan Johor
Kampus Pasir Gudang
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Editors

Aznilinda Zainuddin
Maisarah Noorezam

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

Nur Atharah Kamarzaman¹, Shahril Irwan Sulaiman¹, Hedzlin Zainuddin²,
and Intan Rahayu Ibrahim³

¹School of Electrical Engineering, College of Engineering, Universiti Teknologi MARA,
40450 Shah Alam, Selangor, Malaysia

²Faculty of Applied Sciences, Universiti Teknologi MARA, 40450 Shah Alam, Selangor,
Malaysia

³Centre for Electrical Engineering Studies, College of Engineering, Universiti
Teknologi MARA, Cawangan Pulau Pinang, Pulau Pinang, Malaysia

Corresponding author: Nur Atharah Kamarzaman, atharah8155@uitm.edu.my

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

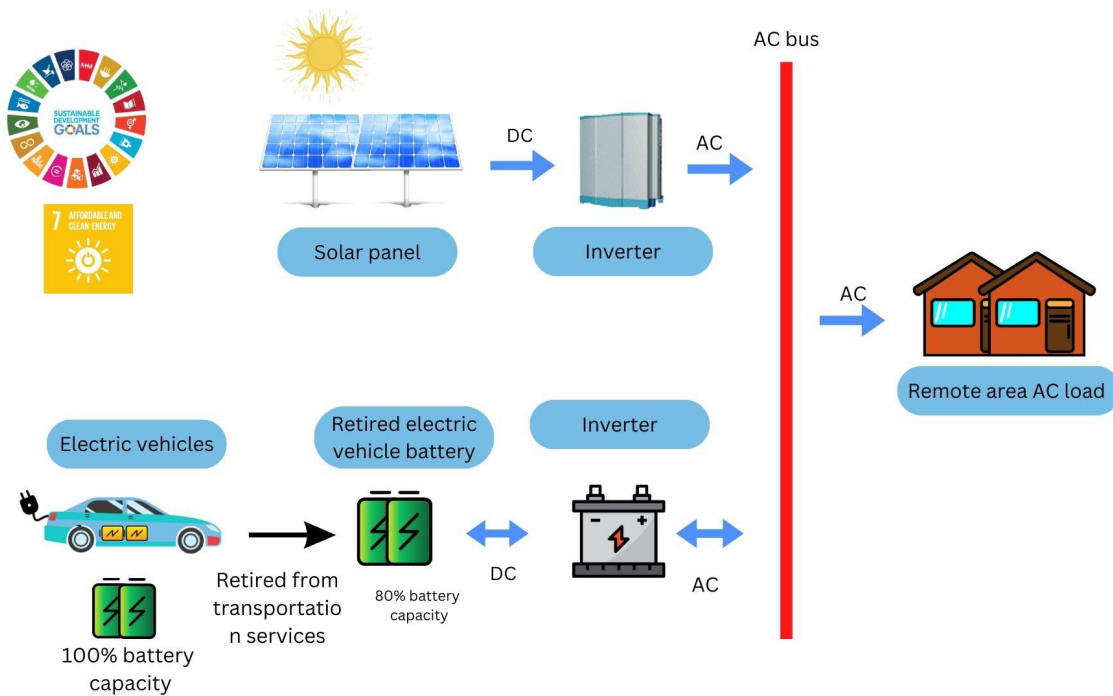


Figure 1. Configuration of SAPV system, integrating REVB as the energy storage component.

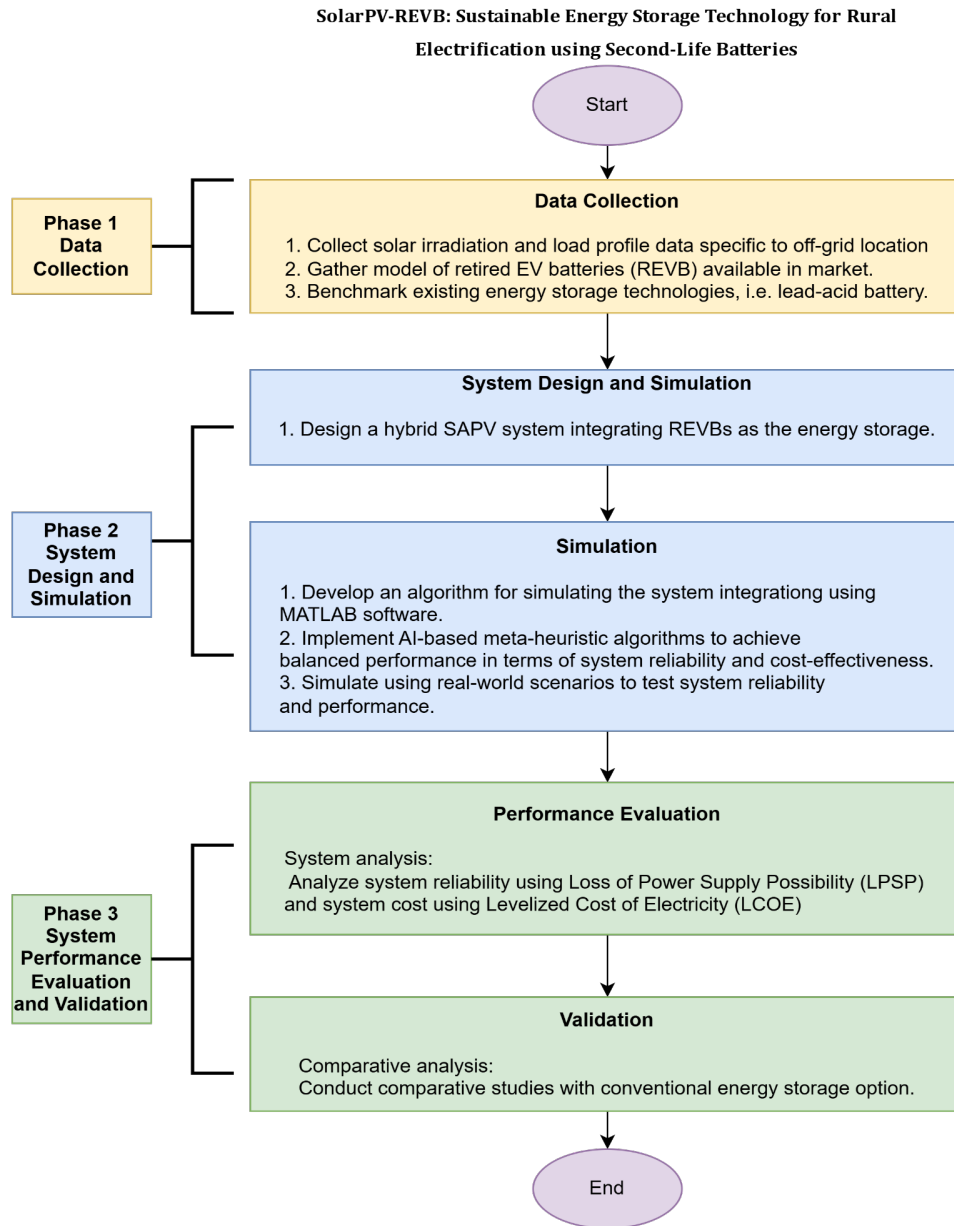
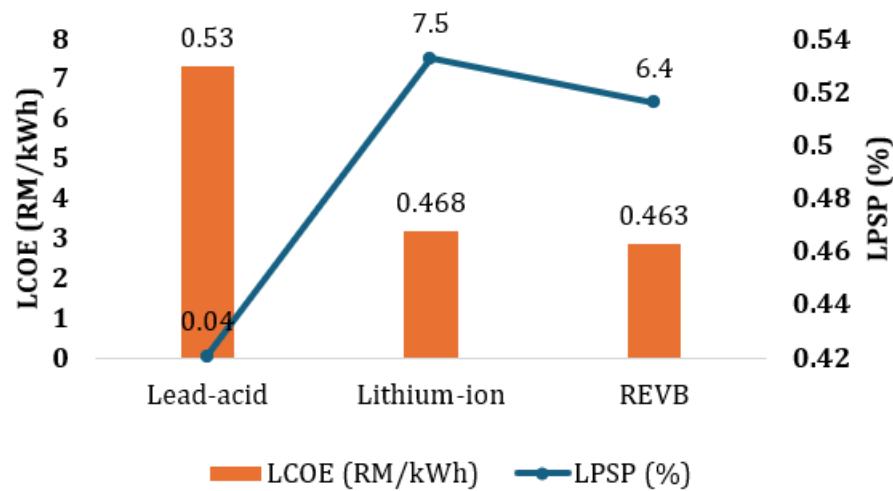


Figure 2. Development process for implementing REVB as an energy storage for rural electrification initiatives.

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

<i>Type of Model battery</i>		<i>Capacity (Ah)</i>	<i>Voltage (V)</i>	<i>Price (RM)</i>	<i>LPSP (%)</i>	<i>LCOE (RM/kWh)</i>
<i>Lead-acid</i>	OPzV2-1000 Rosen Solar	1500	2	1224.45	0.04	0.53
<i>Lithium-ion</i>	Jingsun	100	48	2700	7.5	0.468
<i>REVB</i>	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

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8. Authors' Biography



Nur Atharah Kamarzaman currently pursuing a PhD in photovoltaic system optimization at Universiti Teknologi MARA, Shah Alam in the area of optimization photovoltaic system. Her current are of interest are in renewable energy, system optimization and artificial intelligence.



Shahril Irwan Sulaiman holds a Ph.D. in Electrical Engineering from Universiti Teknologi MARA, Malaysia, an M.EngSc in Photovoltaic Engineering from the University of New South Wales, Australia, and a B.Eng in Electrical & Electronics from Universiti Tenaga Nasional, Malaysia. He hold position as Head of the Green Energy Research Centre at Universiti Teknologi MARA. With over a decade of experience, he specializes in photovoltaic system design, installation, and maintenance. In regards to photovoltaic system, he contributes to Malaysian and IEC standards development Email: shahril_irwan2004@yahoo.com.



Hedzlin Zainuddin earned her B.Sc. in Physics (2000) and M.Sc. in Photovoltaic Energy Systems (2003) from Universiti Kebangsaan Malaysia and completed her Ph.D. in Photovoltaics at Universiti Teknologi MARA in 2014. Her expertise includes solar PV field testing, GCPV and OGPV system design, modeling, and fault detection. She has four competency certificates in PV systems and has worked with companies and government agencies on consultation projects since 2007. Email: hedzl506@uitm.edu.my.



Intan Rahayu Ibrahim earned her B.Eng. (Hons) in Electrical and Electronic Engineering (2000) and M.Eng. (Electrical) by Research (2005) from Universiti Tenaga Nasional (UNITEN), Malaysia, and her Ph.D. in Electrical Engineering (2017) from Universiti Teknologi MARA. She is a senior lecturer at UiTM Pulau Pinang, with expertise in solar photovoltaic systems, microprocessor systems and power electronics. She is a Malaysia's Green Technology Financing Scheme (GTFS) technical expert and a SEDA-certified designer for grid-connected PV systems. Email: intan121@uitm.edu.my.