Evaluation and Standardization of Locally Fabricated Lithium-Ion Power Packs for Affordable Portable Energy Solutions in Nigeria: A Case Study on Enhancing Standards and Reducing Dependence on Imported Alternatives.

Research Background and Justification

Nigeria's increasing need for reliable and portable power has resulted in heavy reliance on expensive, often unsuitable imported lithium-ion power packs, which sometimes fail to meet safety and performance standards in local conditions. This research proposes to design, build, test, and standardize locally made power packs that adhere to global standards, offering affordability and suitability for Nigerian users. The project aims to benchmark these prototypes against imported products, providing a framework for local standardization, commercialization, and technological advancement, aligning with the NASENI mandate for sustainable industrialization through indigenous innovation.

Research Objectives

Main Objective

To design, evaluate, standardize, and enhance the performance of locally fabricated lithium-ion power packs as affordable alternatives to imported products.

Specific Objectives

- To design and fabricate a practical prototype lithium-ion powers packs from locally available materials and imported cells.
- To analyze the performance of locally made power packs against imported alternatives in terms of efficiency, safety, cost and resilience to Nigerian factors (whether).
- Adopt and apply international safety and performance standards.
- To develop a framework for standardization and quality assurance of locally fabricated lithium- ion power packs in Nigeria.
- Evaluation of affordability and accessibility for households and small business owner.
- Confirm the functional design for upgrade for large scale application.

Methodology;

The project will adopt a design–test–standardize–deploy approach:

1. **Design and Fabrication;** Develop CAD based designs select most suitable, fabricate, assemble prototype using lithium-ion cells, battery monitoring system and locally sourced materials for casing
2. **Performance Evaluation;** Test prototypes under laboratory and field conditions. Parameters to be considered include: cycle life, energy efficiency, discharge profile, thermal stability, durability
3. **Standards Application;** Validate prototypes against IEC 62133, UL 1973, and UN38.3 standards and document compliance gaps and corrective measures.

4. **Benchmarking;** Compare cost and performance with imported alternatives. Collect user feedback from small businesses and households.
5. **Framework Development;** Propose a **NASENI-based standardization protocol** for local manufacturers, develop commercialization and scale-up strategies.

Expected Results;

1. Standardized and tested prototypes of lithium-ion portable power packs suitable for Nigerian conditions.
2. Performance benchmarking data against imported packs
3. Verified cost reduction of at least 15–35% compared to imported alternatives.
4. Framework for quality assurance and standardization in local lithium-ion power pack production.
5. Improved energy access and affordability for households and small businesses.
6. Contribution to NASENI's mandate of fostering indigenous innovation.

Deliverables

1. Prototypes of three categories of locally fabricated portable lithium-ion packs.
2. Standards report; evaluation of compliance with IEC/UL/UN standards.
3. Benchmarking Report which is cost and performance analysis versus imported products.
4. NASENI Standardization Framework; draft policy guideline for indigenous manufacturing.
5. Final Report and dissemination Workshop; including commercialization roadmap.

Work Plan;

Table 1: Activity GANTT Chart

Activity	**Literature Review and Design Concept**	**Fabrication of Prototypes**	**Laboratory Testing and Standards applications**	**Field Deployment and User Evaluation**	**Data analysis and Bench marking**	**Final report and dissemination**
Month 1	Design frame work					
Month 2						
Month 3		600W 1000W and 2000W				
Month 4						
Month 5			Test results and Safety Validation			
Month 6						
Month 7						
Month 8				Field data report		
Month 9					Comparative study report	
Month 10						
Month 11						
Month 12						Research Report and Commercialization Plan
Month 13						

Budget and Costing

Table 2:proposed budget

Table : Budget in Proposal format				
S/N	**Description of Item**	**Cost/Item (₦)**	**Qty**	**Expected From NASENI**
1.0	**TOOLS AND CONSUMABLES**			
1.1	Metric Drill Bits set	15,000	2	30,000
1.2	Sealant tape	600	5	3,000
1.3	Silicon seal Gum	8,000,	3	24,000
1.4	Cyanoacrylate adhesive	1,500	10	15,000
1.5	Perplex Cutter Hook Acrylic Cutting tool with spare tungsten blades	8,000	2	16,000
1.6	Spot welding lit-ion printing machine	250,000	1	250,000
1.7	Hole saw set	19,000	1	19,000
1.8	Hack saw blade spare	300	10	3,000
1.9	Power screw bits	900	10	9,000
1.10	Cordless Power drill machine	60,000	1	60,000
1.11	Mini Angle grinder machine	85,000	1	85,000
1.12	Hacksaw	9,000	1	9,000
1.13	Trimmer	4,500	1	4,500
1.14	Hot Gun Glue	150	200	30,000
1.15	Hot Glue Gun	4,000	1	4,000
1.16	Soldering iron	9,000	2	18,000
Sub-Total				**579,500**
2.0	**POWER PACK MAINS**			
2.1	Nickel Straps/Tape	35,000	3	105,000
2.2	18650 cells	3,000	1,500	4,500,000
2.3	Battery monitoring system	60,000	3	180,000
2.4	Cablings	60,000	1	160,000
2.5	Soldering lead	25,000	1	15,0000
2.6	USB module	8,000	3	24,000
2.7	Output display	10,000	1	10,000
2.8	Ac output socket	3,000	3	9,000

2.9	Dc plug and Socket	5,000	1	5,000	
2.10	Cooling system	3,000	10	30,000	
2.11	Boost converter	15,000	4	60,000	
2.12	Silicon Diodes	100	30	3,000	
2.13	led	1,000	1	1,000	
2.14	Battery terminals	5,000	12	60,000	
2.16	AC input terminal	500	3	1,500	
2.17	Power switches and relays	3000	6	18,000	
2.18	DC Breaker twin pole	8,000	3	24,000	
2.19	AC Breaker twin pole	7,000	3	21,000	
2.20	Power Surge Protector	8,000	6	48,000	
2.21	Dc Fuse	12,000	3	36,000	
2.23	AC voltage Regulator	8,000	3	24,000	
2.24	Monocrystalline photovoltaic panel and cabling	2,000,000	-	2,000,000	
2.25	Inverter system	250,000	3	750,000	
Sub-Total				**8,084,500**	
3.0	**FRAME/ SHELLING**				
3.1	4/5mm Plexi glass	135,000	1	135,000	
3.2	Plywood	30,000	1	30,000	
3.3	Fasteners	10,000	-	10,000	
3.4	High density polystyrene sheets	8,000	1	7,000	
3.5	Handles bars	2,000	3	6,000	
3.6	Wall Mount Chrome Brackets	750	12	9,000	
3.9					
Sub-Total				**197,000**	
4.0					
4.1	Volt meter.	10,000	1	10,000	
4.2	Amp meter.	75,000	1	75,000	
4.3	Temperature sensor module with Digital Display	6,000	5	30,000	
4.4	Field trials & user deployment	2,000,000	-	2,000,000	
4.5	Laboratory Testing	1,500,000	-	1,500,000	
4.6	Single cell charger/balancer racks	98,000	-	98,000	
4.7	Laptop Computer	700,000	1	700,000	
4.8	Software	215,000	1	215,000	
Sub-Total				**4,628,000**	

5.0	**PERSONNEL**				
5.1	Principal, Research Assistants and personnel	400,000	12	4,800,000	
5.2	Report writing, dissemination & workshops	2,500,000	-	2,500,000	
5.3	Contingency (10%)			**2,078,900**	
Sub-Total				**7,300,000**	
Total Direct Cost				**22,867,900**	
Indirect Cost (5% NASENI direct cost)				1,143,395	
Grand Total				**24,011,295**	

Sustainability Plan

1. Engage local SMEs and fabricators to scale production after project completion.
2. Establish a NASENI-backed certification framework to ensure safety and standardization.
3. Develop a commercialization roadmap in partnership with local industries and investors.
4. Ensure affordability through bulk production, material sourcing, and government incentives.
5. Build capacity among local engineers and technicians through training and knowledge transfer.

References

1. International Electrotechnical Commission (IEC 62133, 2017).
2. UN38.3 Transport of Dangerous Goods, Lithium Battery Tests.
3. IEA (2022). *Global EV Outlook.*
4. NASENI (2023). *Strategic Plan on Local Content Development in Renewable Energy.*
5. Zhang, S. et al. (2020). "Cost reduction strategies for lithium-ion batteries." *Journal of Energy Storage.*