Proposal for the Production and Commercialization of the Solar Powered Internet Enabled Power Bank to NASENI Research and Commercialization Grant Programme (NRCGP)

Submitted by:

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Karshi, Abuja

Project tile:

Design and Development of a Solar Powered Internet Enabled Power Bank

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1. Introduction

The COVID-19 pandemic, which disrupted normal life across the world, exposed deep gaps in educational systems and research, particularly in terms of access to reliable power and internet connectivity for virtual learning and related activities [1]. Globally, institutions of learning and research including offices among others were forced to adapt to online platforms for their day to day activities known as 'a new normal'. However, many institutions, especially in the developing countries lacked the necessary infrastructure to support this transition.

In Africa, prolonged lockdowns led to the closure of academic institutions that halted academic and research activities [2]. This highlighted the challenges of unstable electricity supply and weak internet networks. Recognizing these constraints, NASENI Solar Energy Limited (NSEL) in collaboration with the African Engineering Deans Council (AEDC) and the African Engineering Education Association (AEEA) initiated a research to develop a portable and internet-enabled solar powered device to sustain e-learning and research.

This device is designed to supply continuous electrical energy for laptops, mobile phones and lighting, while providing wireless internet connectivity for uninterrupted online engagements. The project seeks to provide an indigenous, cost-effective engineering solution to Africa's power and digital divide, fostering collaborative and multicultural innovation.

Based on the commercialization plan as shown in Fig 1, the first five prototypes have been successfully developed, tested and validated in collaboration with five Nigerian Universities with their feedback taken note for improvement. The next phase as shown in Fig 1 is the evaluation of the improved prototype (version 0.2) in ten African universities to experience the operations of the device in different

climatic conditions in the continent followed by mass production for commercialization (version 1.0).

The project gained international recognition when presented at the World Engineering Education Forum/Global Engineering Deans Council (WEEF/GEDC) conference in Madrid in 2021 and was subsequently published by the Institute of Electrical and Electronics Engineers (IEEE). The publication titled *"Affordable and Reliable Power and Communication Device for Continuous Online Learning for African Students."* can be accessed via the following link: https://ieeexplore.ieee.org/abstract/document/9657267

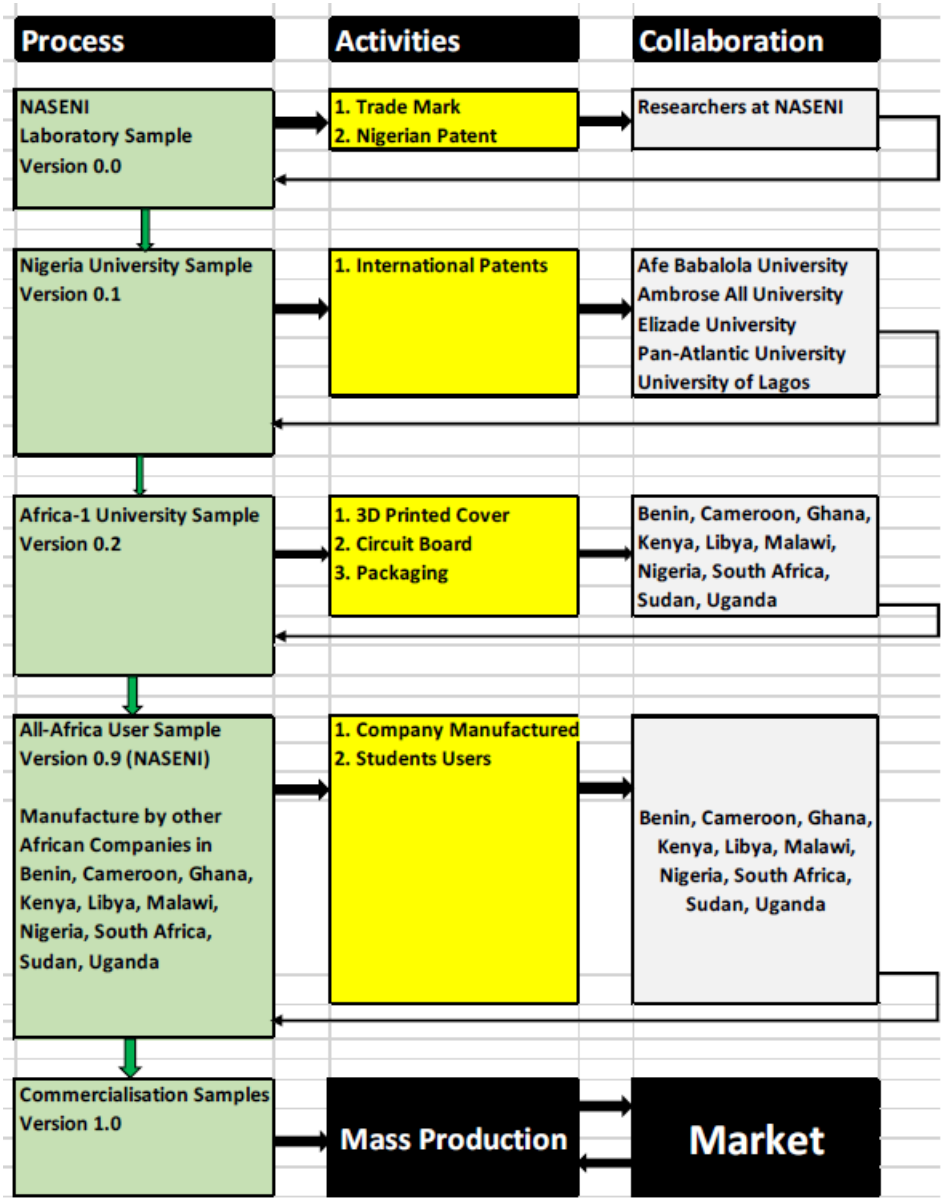

Fig 1: Research commercialization plan

2. Problem Statement

Frequent power outages and unreliable internet connectivity remain critical barriers to learning, research and innovation not just in Nigeria but across Africa. These constraints became evident during the COVID-19 lockdown when students and researchers could not effectively engage in virtual activities. While previous designs of solar-based power banks exist [3, 4, 5, 6], they fall short due to:

i. Insufficient storage capacity
ii. Inefficient solar inclination angles
iii. Lack of built-in internet connectivity.

This work therefore directly addresses these gaps by combining efficient energy storage, effective solar power generation through collapsible solar panel and wireless internet access in one portable and user-friendly device.

3. Aim and Objective

The aim of this project is to commercialize the developed prototype into a mass-producible, affordable product for students, researchers, and mobile professionals with the following objective:

i. To refine the existing prototype for large-scale production and improved efficiency.
ii. To establish a pilot manufacturing line at NASENI Solar Energy Limited.
iii. To standardize the design for regulatory certifications
iv. To promote local job creation, skills transfer and entrepreneurship.
v. To strengthen NASENI's leadership in renewable energy innovation and commercialization.

4. Technical Overview

The major components information is as highlighted below and shown in Fig 2:

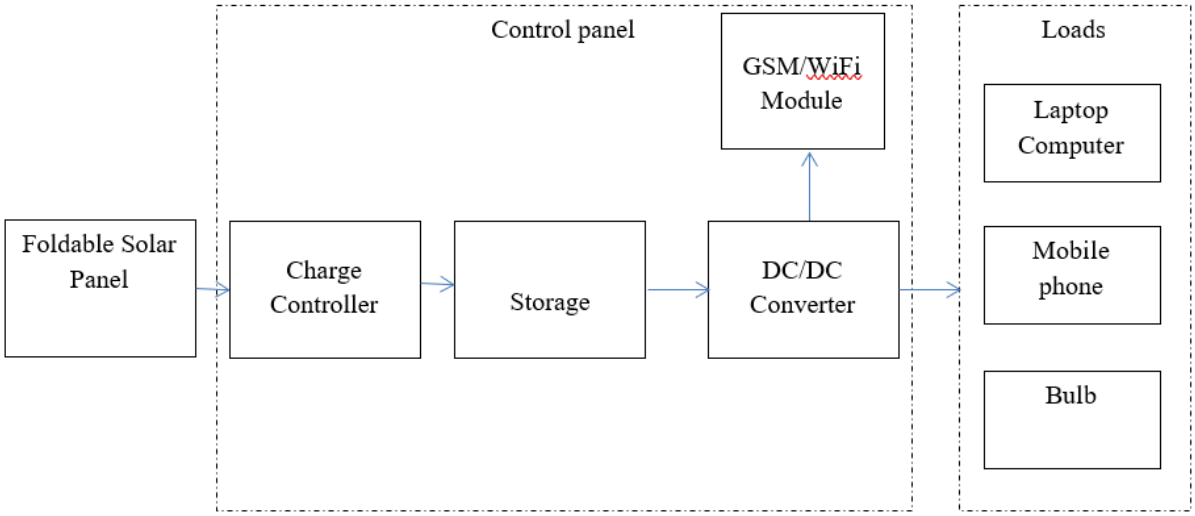

Figure 2: Schematic diagram of a solar powered backpack

i. Collapsible solar PV module
ii. Lithium ion battery bank with micro charge controller
iii. DC/DC converters for powering laptops, mobile phones and an LED bulb
iv. Embedded wireless modem for internet connectivity
v. Connecting cable for solar PV module to power bank
vi. USB charging cords and multi-input ports for laptops
vii. Compact casing
viii. Total weight is <7kg

Preliminary Test and validation

The test was carried out to increase the state of charge of two smart phones and a laptop with the test results shown in Fig 3 and 4.

i. Successfully charged one laptop and two smartphones from 0–100% state of charge (see Fig 3 and 4) at 12% depth of discharge
ii. Field-tested in selected Nigerian Universities

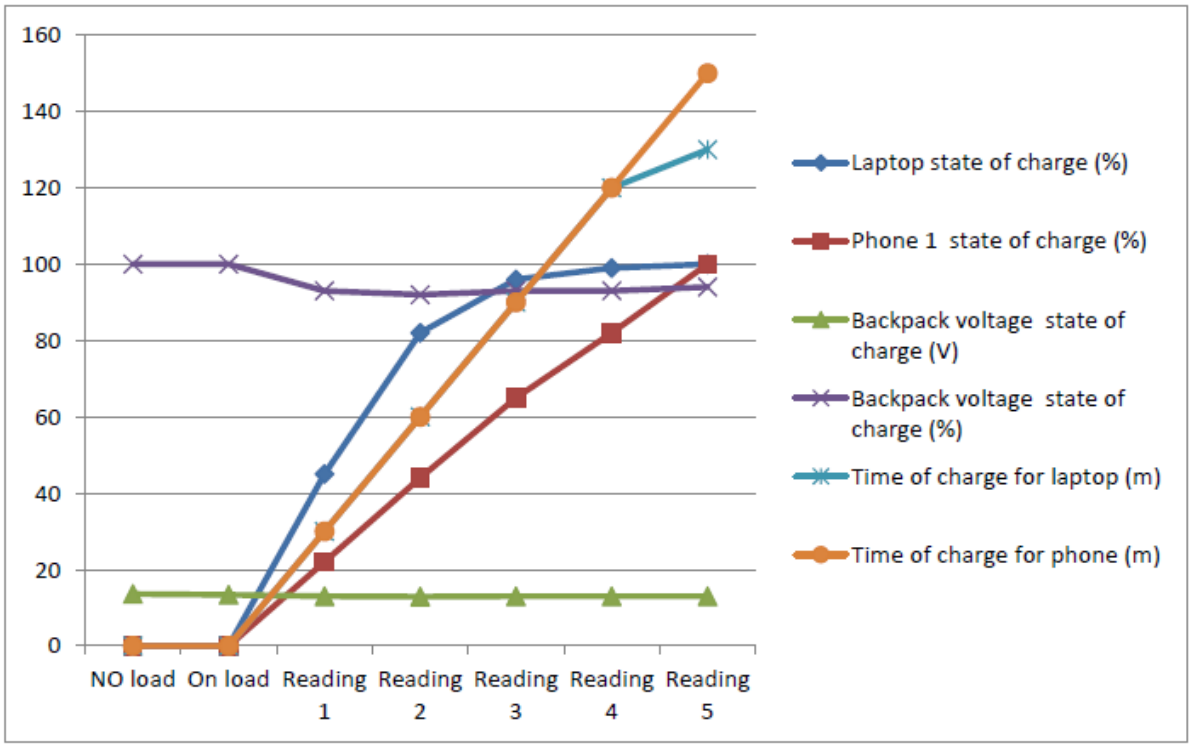

Fig 3: Simultaneous charging of a laptop and a smart phone

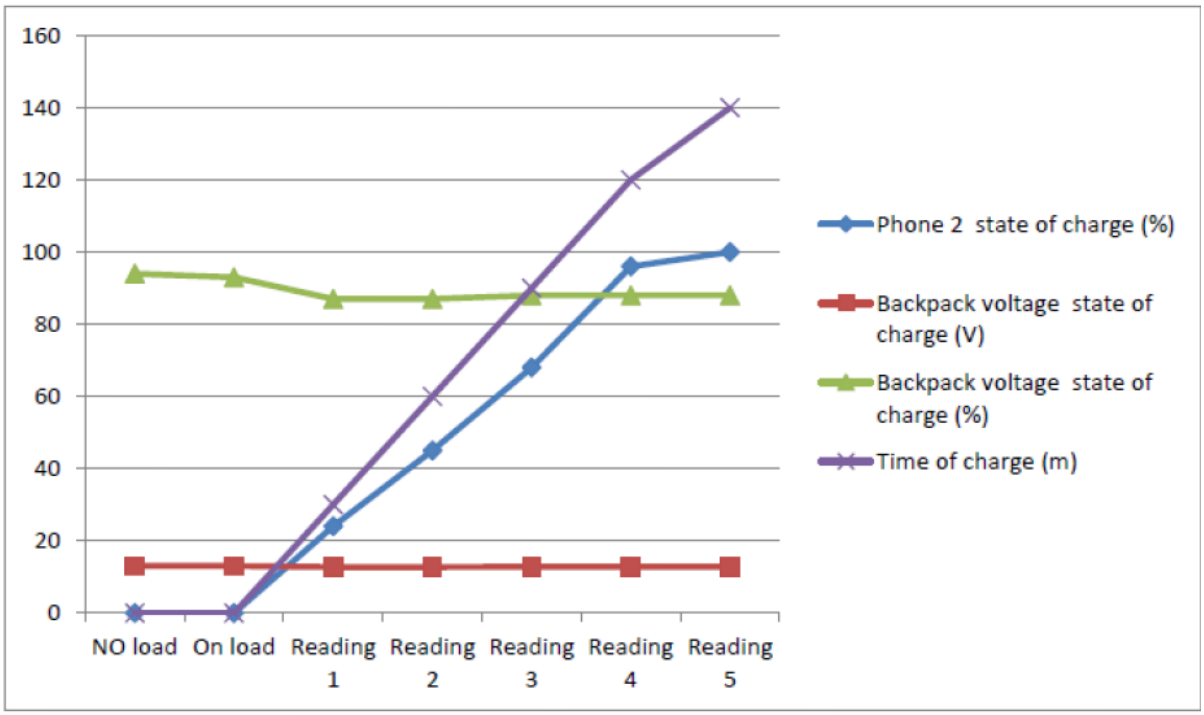

Fig 4: Charging of the second smart phone using the remaining state of charge of power bank

5. Estimated Budget

Table 1 shows the estimated budget for the commercialization plan.

Table 1: Estimated budget

S/N	Budget Item	Unit cost	Qty	Estimated Cost (₦)
1	Component procurement (solar modules, batteries, modems, converters, casing)	365,500	510	186,405,000
2	Pilot production setup and tooling			10,000,000
3	Product testing, safety and certifications			5,000,000
4	Engagement with stakeholders			15,000,000
5	Packaging, branding and intellectual property registration			15,300,000
6	Field deployment to 10 African universities for further performance validation			5,000,000
7	Research team training, logistics, data collection and analysis			15,000,000
8	Marketing, outreach, commercialization and documentation			20,000,000
9	Contingency (10%)			27,170,500
	Total Estimated Budget			**298,875,500**

6. Work Plan

The work plan for the execution of the commercialization of the project is shown in Table 2.

Table 2: Work plan for the commercialization

S/N	Activity	Deliverables	Timeline (Months)	Lead Responsibility
1	Prototype optimization and final design improvements	Final design for Version 1.0	1–2	NSEL R&D Team
2	Component sourcing and procurement	Procurement of components and materials	2–3	Procurement unit & R&D Department
3	Pilot production setup and tooling	Functional pilot assembly line established	3–4	Production and R&D Departments
4	Fabrication and field deployment of 10 pilot units	Pilot units produced and deployed for validation	4–6	Production and R&D Departments
5	Field feedback and performance review	User performance reports and recommendations	6–8	R&D Collaboration Team
6	Product refinement and commercial packaging	Improved user-friendly design	8–9	TBD and R&D Departments
7	Quality testing and regulatory certification	SONCAP, NEMSA, SON and NCC approvals	9–11	Quality Control Department
8	Market launch and stakeholder engagement	Product launch and MoUs with partners	11–12	TBD and R&D Departments with Media unit

7. Expected Impact

This project, if granted this grant and executed, it will impact in the following areas:

i. Uninterrupted power and connectivity for education and research.
ii. Stimulation of local manufacturing, innovation and entrepreneurship.
iii. Enhanced participation in e-learning, access to electricity and internet connectivity.
iv. Strengthened regional collaboration in Africa.

v. Contribution to United Nations' SDGs: 4 (Quality Education), 7 (Affordable Clean Energy), 9 (Industry, Innovation & Infrastructure) and 13 (Climate Action).

8. Conclusion

The Solar Powered Internet-Enabled Power Bank Project stands as a practical and timely solution to one of Africa's major educational and infrastructural challenges, that is, unreliable power and internet connectivity. With validated performance, academic recognition and cross-institutional collaboration it is ready for commercial rollout. Therefore, support from NASENI through the NASENI Research and Commercialization Grant Programme will transform this innovation from a tested prototype into a mass-market product. This will empower millions of learners, researchers and entrepreneurs while promoting NASENI's and Nigeria's leadership in renewable energy innovation.

References

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