

Node Bawa

[English/noun]: A central point in a network, or the structural junction where a leaf and stem join on a plant.

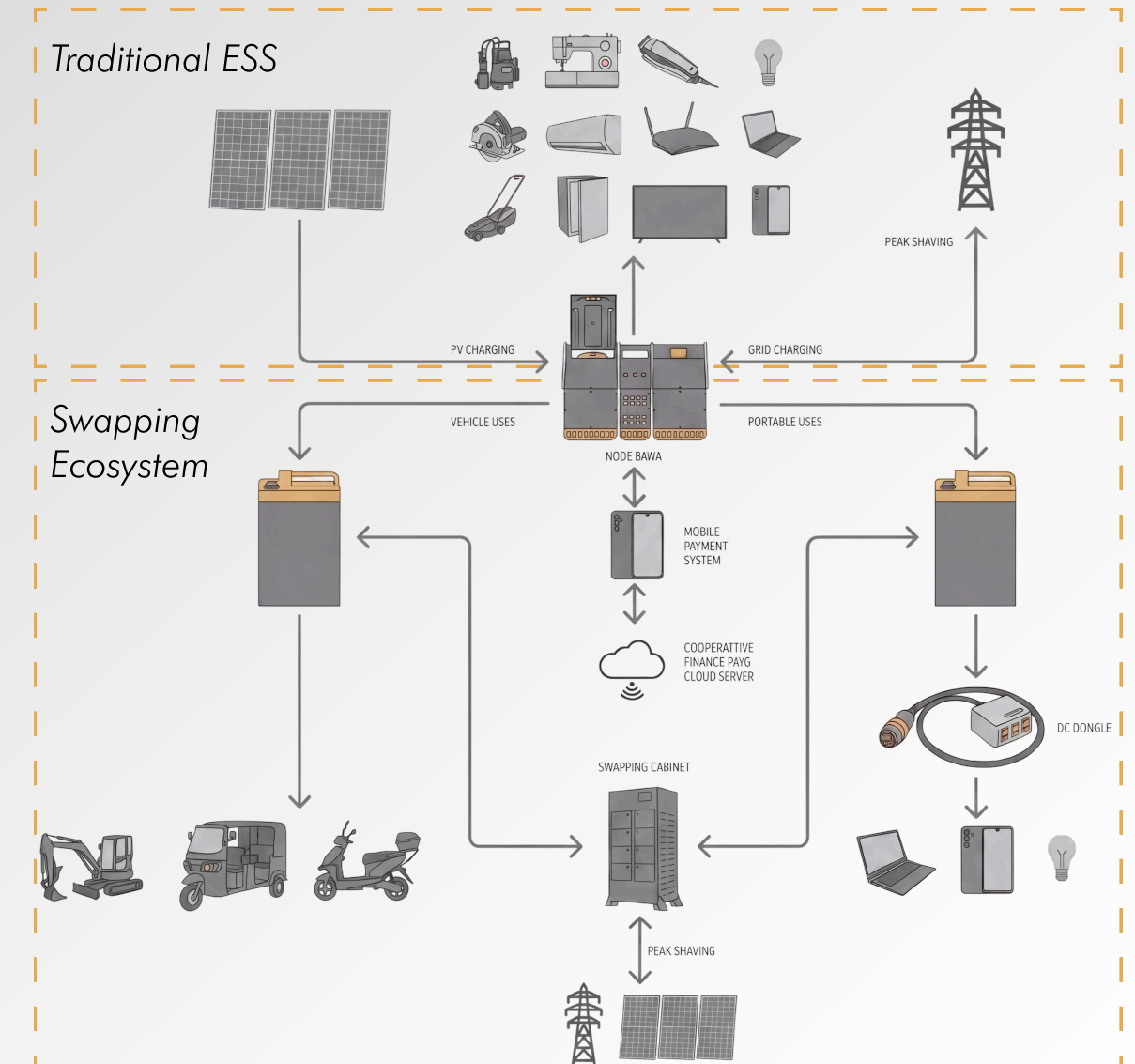
[Indonesian/verb]: To bring, carry, or transport along.

Repairable, Modular, and Open-source Hybrid Energy Storage System for Weak-Grid Regions of the Global South

In weak-grid regions of the Global South, millions of people rely on fossil-fueled **backup generators (BUGS)** to maintain their livelihoods, creating a **shadow grid** that accounts for significant local air pollution and health risks. Despite these environmental costs, BUGS persist as **Dirty & Open** systems: they are mechanically simple and highly repairable through vast informal economies of local mechanics. Conversely, modern clean Energy Storage Systems (ESS) are typically **Clean & Closed**, utilizing proprietary **black-box** architectures that prevent local servicing, leading to a mounting solar e-waste crisis when minor components fail.

This thesis presents **Node Bawa**, a repairable, modular, and open-source hybrid energy storage solution designed to provide a **Clean & Open** alternative. The concept leverages the imminent transition toward **Light Electric Vehicles (LEVs)** by utilizing standardized swappable batteries as the system's primary energy carrier. By bridging the gap between stationary home storage and mobile swapping ecosystems, Node Bawa serves as a central hub that supports both productive needs and personal mobility.

The research utilized a multi-disciplinary approach, including comparative disassembly mapping of industrial archetypes, factory visits in the manufacturing hub of Suzhou, China, and ethnographic field research in Bali, Indonesia. The resulting design features a split-module architecture consisting of an independent **Inverter Module** and a customizable **Docking Module**, connected by an ergonomic, tool-less coupling mechanism. Validation through iterative prototyping and thermal simulations confirmed the system's ability to manage high-power loads safely while maintaining an intuitive experience for users without formal technical training. Ultimately, Node Bawa demonstrates that sustainable energy autonomy can be achieved by aligning modern hardware with the resilient, informal repair rituals of the Global South.



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