Publication: PV Magazine Online
Date: 13 May 2025
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Researchers found multiple benefits after distributing free solar panels and battery systems with USB ports to 800 rural households in Ghana.

For a household in Ghana without electricity, a tiny solar panel paired with a battery that provides indoor lighting and charges mobile phones can save the equivalent of $70 per year, exceeding the one-time hardware cost of the solar-plus-battery kit, researchers found.

About 800 households in rural Ghana received free solar kits through a study by university researchers, titled “Impact of solar lighting kits on the lives of the poor,” published by the Kleinman Center for Energy Policy at the University of Pennsylvania. The nonprofit Elumis Foundation, which provides solar kits to families without electricity in developing countries, collaborated on the study.

Each kit came with a solar panel, one or more light bulbs, and a battery with two USB ports that could be used to charge mobile phones, radios, and other devices such as flashlights.

The kits, each with a PV capacity ranging from 12 W to 20 W and a battery capacity of 38 Wh to 56 Wh, were manufactured by JUA Energy, based in Shenzhen, China.

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The researchers found that making solar kits available to poor populations “has multiple positive effects” on expenditure patterns, children’s education, safety, and security. They concluded that supporting penetration of solar kits “is attractive” from several perspectives.

Off-grid solutions

While the one-tenth of humanity without electricity waits for grid electricity to become “accessible, cheaper and reliable,” off-grid electricity can be an effective solution, said a joint statement by study authors Serguei Netessine, a professor at the University of Pennsylvania, and Bhavani Shanker Uppari, a professor at Singapore Management University.

The authors, who had previously evaluated rechargeable solar lamps in Rwanda, found that while solar home systems cost more than solar lamps, they also have much higher benefits.

If solar-plus-battery kits are donated, “our study shows that we do not need to donate costlier kits to result in larger impacts.” The kits only need bulbs that are bright enough, and USB ports to recharge lights, batteries and radios, said the researchers.

Some firms sell solar kits to low-income populations on a “pay-as-you-go” basis, the researchers noted, adding that Uppari is conducting research on how to effectively design PAYGo models.

Elumis Foundation CEO Manny Sakellakis said the data gathered in the study would “give us and other nonprofits an easier path in fundraising efforts,” and could also be useful to solar manufacturers.

Household benefits

To evaluate how the solar kits impacted the 800 households, field officers collected monthly data on household expenditures and education for these households, and for a control group of about 200 households without solar kits, over 12 months.

The researchers found that households with solar kits saved an average of $70 per year by eliminating expenditures for batteries and mobile phone recharging, reducing transportation expenditures, and nearly eliminating expenditures for flashlights and solar lamps. At the same time the families increased their spending on USB devices such as rechargeable flashlights.

The $70 in a family’s annual savings exceeded the cost of the solar-plus-battery kits, which had an average cost of $51. The study did not quantify the labor costs for recruiting participating households and installing the kits.

Children in households with indoor lighting powered by solar kits studied more minutes per day and received higher grades in school than children in control households, the study said.

Households with solar kits typically accumulated their savings over one or two years, and “almost all” of these households spent an average of $76 either to farm more land, hire more farm labor, or purchase more farm chemicals and fertilizers.
The average household participating in the study earned the equivalent of $340 per year, the study said.