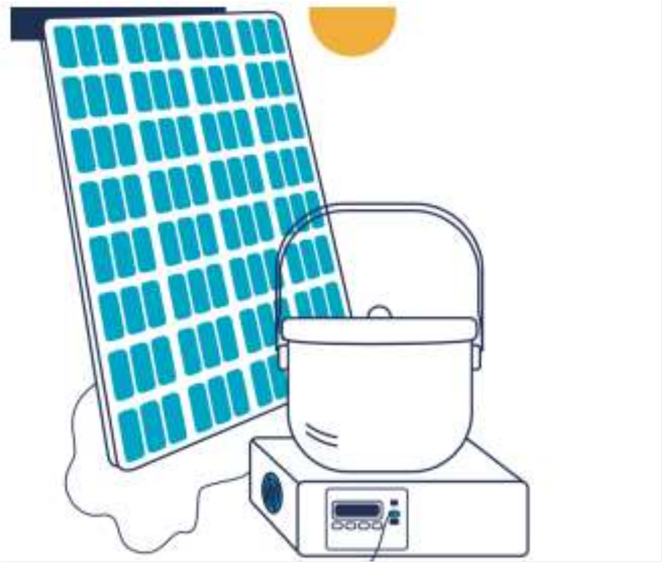
Solar-electric cooking: Status August 2022



Exemplary visualization of solar-electric cooking equipment (Photo: Pesitho ApS)

Solar-electric cooking is a new and promising technology in the field of Clean Cooking. Using solar electricity prevents indoor air pollution, deforestation and reduces greenhouse gas emissions. UNHCR assessed the current technology readiness of solar-electric cooking: Various successful field trials have been conducted, but full commercial viability is not achieved yet.

A need for clean cooking

It is estimated that some 85% of displaced populations in camps use unsustainably harvested biomass, such as firewood, for cooking[1]. This presents a variety of risks to human life and health including indoor air pollution and conflict with local communities, while women, girls and boys are exposed to the risk of SGBV when out gathering firewood.

Furthermore, the unsustainable harvesting of biomass can lead to deforestation, increased vulnerability to natural hazards, loss of natural habitats and biodiversity, and greenhouse gas emissions.

Solar cooking prevents the adverse effects of biomass burning, and can make cooking cleaner, safer and more sustainable.

Different types of solar cooking

Solar radiation can be used in different ways for cooking (cf. figure on next page). For instance through solar-thermal cooking, when reflectors concentrate direct sunlight and convert it into heat. Or with solar-powered forced draft stoves, which use biomass combustion for cooking but allow to regulate the combustion process through in-built small solar-powered ventilators. Solar-thermal cooking has the drawback of strongly relying on the availability of direct sunlight. Depending on the global location, solar reflectors will not provide sufficient heat on a cloudy day, or in morning or evening hours. Solar-powered forced draft cooking still requires biomass, ideally even pre-processed biomass.

What is solar-electric cooking?

Solar-electric cooking is based on the usage of solar panels and its conversion of light into electric current. The electricity produced by the solar panels is then stored in a battery and used to run electric cooking equipment, e.g. induction stoves or pressure cookers.

Clean cooking	Solar energy	Prevention of indoor air pollution	Prevention or deforestation	Reduction of greenhouse gas emissions

Solar-electric cooking

(Photo: Pesitho ApS)

- electricity from solar panel stored in battery and used for cooking

Solar-thermal cooking

(Photo: UNDP)

- solar heat for cooking

Solar-powered forced draft cooking

(Photo: UNHCR)

- biomass for cooking
- solar-powered fan to regulate combustion

Due to its battery, solar-electric cooking has the advantage of being usable anytime of the day and also during bad weather conditions. Solar-electric cooking commonly refers to a standalone off-grid system comprising of panel, battery and electric cooking device. If electric cooking devices are connected to a solar mini grid or a solar home system, then it is considered as electric cooking.

Challenges of solar-electric cooking

All the key components required for solar-electric cooking are commercially available: solar panels, batteries, electric cooking devices etc. Nevertheless, the concept of combining these components in a solar-electric cooking system is rather new: the cost of the electronic equipment, especially solar panels and batteries, has long been assumed to be too high. In addition, a lack of maintenance and disposal services eventually leading to unmanaged and hazardous e-waste - especially in low-income contexts - has rightfully created concern.

UNHCR's stocktaking activities

Based on the promising advantages of solar-electric cooking and in line with its efforts to make UNHCR operations more environmentally sustainable[1,2,3], UNHCR evaluated the technology and product readiness of solar-electric cooking. This evaluation included desk-based research including a market analysis as well as the launch of a "Request for information" tender [15].

Stocktaking results

Technological readiness

UNHCR's inquiries revealed that the research and development of standalone off-grid solar-electric cooking equipment has started, but is still ongoing. Different products are currently under development either focusing on an application in low-income settings or for outdoor activities. A small number of products underwent field-testing so far. One product has been tested in displacement settings in Uganda[4,5,6] and Myanmar[6,7], as well as with UN staff in urban settings in Burundi[8]. Another product has been tested in rural settings in Haiti[9]. And a third product for the outdoor activity market has not been field-tested yet, but might also be of interest for usage in displacement settings[10].

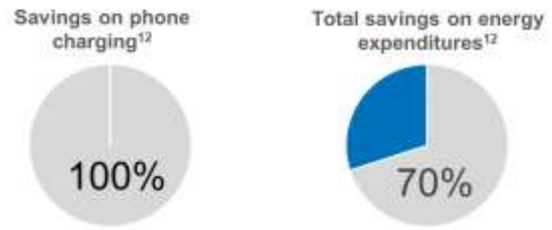
According to the available documentation, the field tests of the solar-electric cooking equipment were in general successful. In some cases, difficulties were reported with regard to the preparation of staple food with longer cooking durations[6]. Due to the limited battery or charging capacities, users were not able to solely rely on solar-electric cooking and still used biomass on the side. Some cooking practices, e.g. stir-frying, could not be performed by the solar-electric cooking equipment. Overall, users seemed to adapt well to this new technology[6].

Commercial viability and market availability

Despite successful pilot projects and achieving the technical proof of concept, solar-electric cooking has not reached yet full commercial viability. At present, one of the mentioned products can be procured locally in one country and from selected suppliers. But overall, none of the products can be procured off-the-shelf, at a global level and in large quantities. It remains unknown when solar-electric cooking equipment will become fully market available.

Affordability and financing

Compared to other cooking technologies, the large capital cost of solar-electric cooking equipment (at least 500 USD per item) has an impeding effect on its implementation and spreading. Nevertheless, once put into operation, it has next to no operational costs.
A study from 2015 claimed that by 2020, the price for solar-electric cooking equipment expressed as a monthly instalment will be comparable to charcoal expenditures[11]. A recent willingness-to-pay pilot project in a displacement setting in Uganda with subsidized solar-electric equipment showed similar results[12]. Investment costs where repaid by households with monthly payments, mostly in a 2-year repayment mode (of 8.5 USD per months). The payment of monthly instalments was facilitated by significant time savings from firewood collection (cf. figure below). The saved time could be used for other purposes, including income-generating activities or educational opportunities. Furthermore, the solar-electric cooking equipment has an USB port for the charging of small electronic devices. This lead to a 100% reduction in expenditures for phone charging for households, and also provides an opportunity for income generation. These positive effects have been observed in different field tests[4,6,12], and can facilitate monthly payments.



Positive effects of solar-electric cooking equipment use identified in a willingness-to-pay pilot project[12].

For solar-electric cooking devices with metered energy consumption, there is also an opportunity to use pre-paid or Pay-As-You-Go schemes. This provides more flexibility to users compared to monthly instalments.
In order to lower the initial investment costs of solar-electric cooking, there is a need for innovative financing. This is especially the case in displacement settings, in which end users may not be able to afford monthly repayments. One approach to offset investment costs might be the usage of carbon credits: through the usage of solar-electric cooking equipment, unsustainable biomass consumption can be reduced which mitigates greenhouse gas emissions. A new standard for carbon credits based on metered energy cooking devices has been released in 2021[13]. With the Refugee Environmental Protection (REP) Fund, UNHCR also launched a carbon credit based funding programme for reforestation and clean cooking initiatives[14].

Maintenance, repair and disposal service

In order to ensure that solar-electric cooking is environmentally sustainable and affordable, it will be essential to provide maintenance, repair and disposal services on site, e.g. through Extended Producer Responsibility schemes. Otherwise, solar-electric cooking will cause hazardous e-waste, and reduced usage periods will not enable the offsetting of initial investment costs.

Conclusions

- First successful field trials of solar-electric cooking equipment have been conducted. Several products are currently under development.

- So far, solar-electric cooking did not reach full commercial viability.
- Innovative financing and payment schemes will be necessary for the implementation in displacement settings to offset investment costs.
- Onsite repair and disposal services will be key to ensure full environmental sustainability.

References

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Solar electric cooking equipment for a household (Photo: Pesitho ApS)