

# EFFICIENCY FOR ACCESS RESEARCH AND DEVELOPMENT FUND: INNOVATOR SERIES

## EMPOWERING SMALLHOLDER FARMERS BY DEVELOPING AN OFF-GRID SOLAR EGG INCUBATOR



As the off-grid solar market continues to expand, the range of products and applications is becoming more diverse. These range from the use of small solar systems in households for mobile phone charging, radios and TVs to solar-powered appliances focused on the agricultural value chain. This helps empower smallholder farmers to increase production and earn a better living.

With climate change making it harder for farmers to rely solely on seasonal crop harvests, which are often affected by extreme weather patterns, enhancing livestock production with solar-powered appliances could significantly improve farmers' productivity and food security at a country level, by diversifying their income.

### DID YOU KNOW?

Smallholder farmers living in the Global South produce up to one third of the world's food.

### A modular solar egg incubator for poultry farmers

Canadian company OVO Solar is on a mission to empower smallholder farmers by providing affordable, income generation products that will help break the cycle of poverty. Prior to starting OVO in 2019, the founders had been working in the Pay As You Go (PAYG) solar industry in Zambia, where they saw first-hand the value of being able to use solar-power to provide income generating opportunities.

Providing solar products for lighting and phone charging is an important step towards rural electrification, but OVO also recognised the opportunity to support Zambian farmers with more traditional solar products. There is a clear need for productive use solar appliances that can empower farmers to generate more income; with many rural households already involved in the poultry value chain, focusing on a solar egg incubator solution to help increase production became the priority.

### DID YOU KNOW?

Changing temperatures driven by climate change can impact poultry egg fertilisation.

In 2020, the Efficiency for Access Research and Development Fund supported OVO to continue developing and further refining its solar-powered egg incubator to increase energy efficiency and lower costs.

The affordable, PAYG-enabled solution helps small-holder farmers to raise more chickens, earn more money, and enhance food security.

By enabling access to productive use solar appliances like egg incubators, OVO helps to provide smallholder farmers in rural, off-grid locations with a means to increase their earning potential and income (which is critical to reducing poverty), increase food security, and improve their resilience to climate change.

### OVO Solar:

“The support we received from the Efficiency for Access Research and Development Fund was crucial to continuing our product development efforts to increase energy efficiency and lower costs. The funding helped us invest in the tooling we needed to be able to reach a price point that made sense for all stakeholders.”

-Scott Martin, Founder at OVO Solar

## HOW DOES IT WORK?

### Improving efficiency and lowering costs through further product development

Prior to working with the Efficiency for Access Research and Development Fund, the team at OVO had gone through several product development stages as part of this project. They had completed initial prototype testing in Zambia and had moved on to an interim product design (the ‘A32’) that worked for medium-scale production.

However, this product still used off-the-shelf components and was produced using more costly production methods that were convenient at lower volumes.

With support from the Efficiency for Access Research and Development Fund, the next stage in the product development cycle was to implement a complete fit-for-purpose design across all components, helping to lower costs, improve efficiency, and improve product performance.

### Overcoming product design challenges

To successfully incubate eggs, specific environmental conditions that simulate a brooding hen are required. The correct temperature and humidity must be maintained, the eggs need to rotate, and there must be sufficient air exchange to allow the eggs to breathe. The primary energy demand is ensuring that the temperature remains constant, as a drop in temperature will significantly reduce hatch rates.

It was important to insulate the incubation chamber to improve energy efficiency and help offset heat losses. Since battery storage and solar capacity are the two most costly parts of this product, improvements in energy efficiency also have a direct impact on the production cost, which was important with a lower income market in mind.



**OVO Solar Egg Incubator with the yellow egg holders that rotate the eggs with regulated temperature control to ensure consistent hatching rates.**

After successfully optimising cost and efficiency, the next challenge was to integrate modular functionality into the design to enable farmers to efficiently scale production. Starting with a 32-egg solar base unit, when production increases and farmers generate more income, they can then reinvest in expanding their egg incubation capacity by purchasing a second 32-egg module that stacks neatly on top of the base unit.

This newly developed ‘X32’ model can stack up to 6 total layers (1 base unit, 5 additional modules), allowing farmers to incrementally scale their incubation production from 32 to 192 egg capacity.



With economies of scale in both the cost and energy efficiency of stacking layers, cost savings can be passed on to the end user, allowing smallholder poultry farmers to scale production efficiently and affordably.

Overall, OVO designed a product that met the needs of their prospective customers, recognising the financing challenges, but also opportunities that arise when smallholder farmers can grow their income.

### Investing in tooling to significantly lower component costs

Throughout the project, OVO was able to continue working towards the main project aim of completing product development to prepare for scaled commercialisation and conducting in-field testing to validate product performance.

By conducting several design iterations throughout the product development phase, the team was able to test a variety of different design elements, such as insulation materials, heating sources, product sizes and capacities, and air exchange systems, with the goal to increase efficiency and lower costs, without sacrificing reliability.



**The new module of the Egg Incubator can be stacked up to 6 layers with 32 eggs stored in each layer.**

Reliability of the air exchange and humidity control system was particularly important, as this is a critical environmental condition that must be adaptable over the course of the incubation cycle. Temperature control is easier to manage, as there are fewer external factors that influence the internal temperature. However, it was important to maintain a sufficient energy supply to avoid power cuts during the evening, when heat losses are greatest. The final 'X32' design reflects the learnings from the initial design phase, as well as improvements identified during product testing.

The Efficiency for Access Research and Development Fund was critical in allowing OVO to invest in the necessary tooling to significantly lower component costs. Being able to transition from thermo-formed plastic shells used in the previous 'A32' model, to injection moulded shells in the 'X32', not only allowed for significant cost savings but also enabled the company to integrate a custom designed, injection moulded egg tray and roller mechanism that integrates directly into the incubation chamber.

These product improvements have contributed to OVO's ability to design a fit-for-purpose egg incubator specifically for small-scale farmers living off-grid. Combining these developments with access to PAYG financing, through [OVO's partnership with Angaza](#), a collaboration that took place under Aganza Efficiency for Access Research and Development Fund, will help increase access to productive use solar technology in rural communities throughout Africa.



**One of the smallholder farmers using OVO Solar Egg Incubator.**



### WHAT DID WE LEARN?

#### Reliable humidity control is critical

Ensuring reliable humidity control across a range of ambient environmental conditions was the biggest learning in this project. Since humidity control is such a key factor in determining hatch rates, the OVO team created several design iterations before reaching the current solution. With the target market in mind, it was important to keep the solution as simple and effective as possible, to ensure costs remained low and efficiency was high.

After rigorous lab testing, the design team was able to adjust the water reservoir and air exchange systems to create a simple solution that requires low user interaction over the course of the incubation cycle.

#### Cost-effective insulation solutions are still being sought

With so many different types of insulation materials available, it was important for OVO to test a variety of materials to find a cost-effective solution that provided a high enough R-value, as well as ensure the manufacturing process was possible within the existing factory's capabilities. The team tested several different combinations, and while some were effective on a small scale, it was not possible to replicate for scaled production.

After the testing trial, OVO decided to keep using standard polystyrene injection moulding as it was much more cost-effective and suitable for the existing manufacturing process.

#### Broadening distribution partnerships to reach more farmers

The support from the Efficiency for Access Research and Development Fund has put OVO in a strong position to continue to scale beyond the scope of this project. Now that the 'X32' egg incubator has been fully developed, and initial in-field testing has been successful, OVO will be actively looking to broaden their distribution partnerships to bring their egg incubation technology to smallholder farmers looking to scale their poultry businesses with the help of innovative, solar-powered solutions.

### GET IN TOUCH

[EforAgrants@est.org.uk](mailto:EforAgrants@est.org.uk)

