

## RESEARCH AND DEVELOPMENT FUND PROJECT COMPLETION SUMMARY

### HARNESSING THE POWER OF WATER TO PROVIDE COOLING TECHNOLOGY IN DEVELOPING COUNTRIES

Access to refrigeration can help people earn more income, extend the shelf life of fresh produce, and reduce time spent shopping or preparing food. However, many people living in developing countries cannot afford appliances available on the market. In Kenya, for example, an off-grid refrigerator and system can cost at least US\$1,000. As a result, only 4% of households without access to the electricity grid in sub-Saharan Africa own a refrigerator.

The Sure Chill Company won funding from UK aid through the Efficiency for Access Research and Development Fund in 2019 to develop its Smart Box refrigeration control platform. It aims to reduce the overall costs of domestic refrigeration, which helps to make it more affordable for households in developing countries. The project aimed to deliver a prototype device that could be scaled for mass production.

The Smart Box combines with Sure Chill's patented cooling technology to provide a versatile refrigeration system that can be used in rural communities without access to electrical grids or urban areas with unreliable power supply.

### WHAT THE PROJECT ACHIEVED

The Sure Chill team developed a series of devices, that were tested in their labs and later in field trials in Kenya. The latest version, the GEN2 Smart Box, has the following core functions:

- **Versatile interoperability:** The GEN2 Smart Box can be used in applications ranging from battery-less solar direct-drive and small solar home systems to mini- and weak-grids and enables integration with existing Pay As You Go (PAYGO) solar home systems.
- **System monitoring and management:** The GEN2 Smart Box monitors the state of the refrigerator, thermal storage and incoming power supply. This feature enables it to enhance the compressor's performance, which helps the refrigerator maintain the right temperature without compromising other loads on the system.
- **Compressor driver protection:** The GEN2 Smart Box acts as an interface between the power supply and the brushless DC compressor driver. It protects the driver from electrical faults and power surges and is compatible with a wide range of DC compressors. Other currently available DC compressors are not protected against electrical faults and power surges which makes them completely unusable in areas with a weak connection to electrical grids or with intermittent power supplies.

### WHY IS THIS IMPORTANT?

#### Smart controllers help to bring down the overall cost of systems

The integration of the smart controller into Sure Chill's off-grid domestic refrigerator led to a 32% cost reduction for the compressor control system. The controller also performs additional functions, such as driving the user interface, providing a robust supply protection and solar home system authentication, optimising fridge cycle control. These functions enhance the performance of the refrigerator for use in households without access to electricity grids.

#### Control platforms can further enhance interoperability

Although they can increase the efficiency and reduce operating costs for appliances, using brushless DC compressors in off-grid appliances is an emerging trend. The Sure Chill GEN2 Smart Box can be used with any brushless DC compressor driver and in a variety of system configurations. Developing such controllers can help facilitate the growth of an open and competitive appliance market.

#### The authentication protocol integrates seamlessly into existing Pay As You Go (PAYGO) models

Sure Chill worked closely with two solar home system distributors to integrate an authentication protocol into the GEN2 Smart Box. This enables Sure Chill's domestic refrigerator to fit seamlessly into PAYGO systems which are used extensively across off-grid solar domestic markets. This will help attract new customers and enable existing customers to upgrade their existing solar home system by adding new appliances, such as refrigerators, enhancing access to domestic refrigeration at a large scale.