

RESEARCH AND DEVELOPMENT FUND PROJECT SPOTLIGHTS

COOLING CALL

APRIL 2020

EFFICIENCY FOR ACCESS COALITION



CONTENTS PAGE

	Page no.
AMPED INNOVATION	1
LOW COST EFFICIENT DC DRIVES FOR OFF-GRID FRIDGES	
DEVIDAYAL SOLAR SOLUTIONS	2
TRUCK-MOUNTED SOLAR REFRIGERATORS: ENABLING ENTREPRENEURS TO REACH MARKETS THROUGH TECHNOLOGY	
EQUATORIAL POWER	3
IDJWI ISLAND COLD CHAIN CATALYST	
FOSERA	4
PELTIER-BASED SOLAR COOLER	
GREENLIGHT PLANET	5
ACHIEVING 24-HOUR REFRIGERATION	
HARNESS ENERGY	6
AN ENERGY EFFICIENT AND RECHARGEABLE SOLAR PEDESTAL FAN	
ISR - UNIVERSITY OF COIMBRA	7
DESIGN AND DEVELOPMENT OF SUPER-EFFICIENT REFRIGERATORS WITH PHASE CHANGE MATERIALS (PCMS)	
PHASE CHANGE MATERIAL PRODUCTS	8
SUST-FRIDGE: A NOVEL REFRIGERATORS UNIT FOR DEVELOPING COUNTRIES	
PROMETHEAN POWER SYSTEMS	9
INCREASING ACCESS TO RELIABLE REFRIGERATION FOR A SUSTAINABLE DAIRY SUPPLY CHAIN	
REFRIGERATION DEVELOPMENTS AND TESTING (RD&T)	10
RADIANT COOLING FOR ARID LOCATIONS (RADICAL)	
SMART VILLAGES RESEARCH GROUP	11
EFFICIENT LOW-COST COLD STORAGE FOR RURAL COMMUNITIES	
SOLAR COOLING ENGINEERING	12
KEY COOLING COMPONENTS AND ENGINEERING FOR IMPROVED ACCESS TO REFRIGERATION	

RESEARCH AND DEVELOPMENT FUND PROJECT SPOTLIGHT

AMPED INNOVATION

LOW-COST EFFICIENT DC DRIVE FOR OFF-GRID FRIDGES

This project will pilot its new high-efficiency solar fridges that provide an affordable cold storage solution for off-grid businesses. Amped's high-efficiency, smart DC compressor driver design is modular so customers can tune their battery and solar panels.

Amped Innovation is designing low-cost circuitry, which will help ensure that DC compressors are suitable for a wide range of environments. The circuitry will also optimise the temperature within the food/beverage compartment using the smallest amount of energy required. It will be integrated directly with the refrigerator and can be run using a PAYGO system or its stand-alone system. The product also provides feedback to customers on their optimal energy needs (whether they need more or less battery power or solar energy).

In addition, the product uses four 40 Watt solar panels and a battery capacity of 20Wh - 200Wh. Users can adjust both solar panels to meet their needs, helping to reduce cost. Since customers adapt the product to their energy needs over time, there is potential for them to reduce their monthly PAYGO fees. Some customers may also choose to utilise an 'ice battery' inside the fridge to reduce the size of the lithium battery further.



AT A GLANCE

R&D Partner

Amped Innovation

Efficiency for Access Funding

£161,801

R&D Funding Unlocked from Amped Innovation

£ 167,237

Project Locations

Cameroon, Kenya,
Zimbabwe, Uganda

RESEARCH AND DEVELOPMENT FUND PROJECT SPOTLIGHT

DEVIDAYAL SOLAR SOLUTIONS

TRUCK-MOUNTED SOLAR REFRIGERATORS: ENABLING WOMEN ENTREPRENEURS TO REACH MARKETS THROUGH TECHNOLOGY

The project will create a cold chain ecosystem by using truck-mounted solar refrigerators and a smartphone operated Demand and Distribution system. This will enable local women entrepreneurs and farmers to reach new markets.

This project's main objective is to enable women entrepreneurs and farmers to get the best price for their produce and reduce food spoilage. This project has four aims: reduce the levels of food wastage, improve energy access, help alleviate poverty and tackle gender inequality. To achieve these aims, the project will organise and manage the technology from procurement to distribution at a pilot scale using our tested solar DC refrigerators.

To create the transportable cold chain system, solar panels will be mounted on each vehicle which will be connected to a charge controller and battery for the DC refrigerator. The market linkages will be made in collaboration with Lateral Praxis using a Demand and Distribution (DND) app. The project's approach is to train the local Internet Saathis (associates) using on the ground partners and a smart phone enabled system. The project will also implement training to help local women entrepreneurs grow their businesses.

The project plans to use a flexible design for the cold chain system. This will help users manage different produce simultaneously and easily change produce when needed. It will also help transport agricultural produce.



AT A GLANCE

R&D Partner

Devidayal Solar Solutions

Efficiency for Access Funding

£160,000

R&D Funding Unlocked from Devidayal Solar Solutions

£68,531

Project Locations

India, Tanzania

RESEARCH AND DEVELOPMENT FUND PROJECT SPOTLIGHT

EQUATORIAL POWER

IDJWI ISLAND COLD CHAIN CATALYST

Equatorial Power's Cold Chain Catalyst tests the use of sustainable productive power to support the growth of agricultural value chains from industrial park ice to local shop refrigerators on Idjwi Island.

Equatorial Power plans to create a cold chain intervention on Idjwi Island in the Democratic Republic of Congo. This will be achieved with Equatorial Power's operational 30kW/300 connection PV mini-grid and a 30kW Productive Power Generation Site, which will enable the growth of businesses and communities across the island.

Ice will be provided to fishermen and made available in marketplaces by using an ice machine, ice storage with freezers and cold boxes. Cold chain interventions at fishing and market level could create positive effects for the value chain through the storage of goods and enable further sales. This will reduce the loss of goods in transport to mainland markets and thus increase business revenue. Equatorial Power will work with communities, including dairy producers, shop owners and restaurant owners, by providing refrigeration to create business growth and enable access to power.

A local team on Idjwi Island will run this project. This has two main benefits. First, a local team's involvement can help spur economic growth of the community through job creation. Second, local managers will help monitor the project and ensure sustainability throughout its operations and growth following proof of concept.



AT A GLANCE

R&D Partner
Equatorial Power

**Efficiency for Access
Funding**
£180,850

**R&D Funding Unlocked
from Equatorial Power**
£20,094

Project Location
Democratic Republic
of Congo

RESEARCH AND DEVELOPMENT FUND PROJECT SPOTLIGHT

FOSERA

PELTIER-BASED SOLAR COOLER

Peltier-based cooling technology has many benefits and can meet the off-grid solar market's needs. Fosera aims to develop a cooling product that is ready for this market.

Most available solar refrigerators work with compressors. Peltier cooling is a semi-conductor-based cooling technology, which is inexpensive and requires less maintenance compared to existing technologies. Peltier coolers can be transported easily and have no mechanical moving parts except for fans. In addition, they can be quickly assembled and repaired on-site. Peltier coolers are also quieter and do not contain greenhouse-gas emitting refrigerants.

Fosera wants to bring Peltier technology to the off-grid solar market. The technology increases appliances' efficiency and implements a smart energy management algorithm. This means that the Peltier cooler can be powered by smaller and cheaper batteries compared to other refrigerators. When the cooler is connected to a solar home system, Peltier technology enables energy-efficient refrigeration.

By creating a small and affordable design for coolers, Fosera aims to meet Tier 2 households' demands on the electricity access multi-tier framework.

Access to cooling brings a wide range of benefits to rural communities. Refrigerators and cold storage allow end-users to store food for longer and generate income by selling cold food and drinks.



AT A GLANCE

R&D Partner
Fosera

**Efficiency for Access
Funding**
£103,087

**R&D Funding Unlocked
from Fosera**
£44,180

Project Locations
Germany, Kenya, Malawi,
Zambia

RESEARCH AND DEVELOPMENT FUND PROJECT SPOTLIGHT

GREENLIGHT PLANET

ACHIEVING 24-HOUR REFRIGERATION

Greenlight Planet aims to develop an affordable, high-quality, 24-hour refrigeration solution, targeting off- and weak-grid customers.

The need for cooling solutions is high in residential households and for small business owners. Whether it be for food storage or retail, current solutions are inappropriate for end-users' needs.

Greenlight Planet's objective is to develop and demonstrate a cost and energy-efficient refrigeration solution for households and small businesses in off- and weak-grid areas in Sub-Saharan Africa.

Once designed and produced, the prototype will be trialled in Sub-Saharan Africa. Feedback from users will be collected and analysed to improve this prototype subsequently.

Ultimately, this project could unlock affordable, high-quality 24-hour refrigeration at the lowest upfront and running cost for customers.



AT A GLANCE

R&D Partner
Greenlight Planet

**Efficiency for Access
Funding**
£ 200,000

**R&D Funding Unlocked
from Greenlight Planet**
£250,813

Project Locations
China, Kenya



RESEARCH AND DEVELOPMENT FUND PROJECT SPOTLIGHT

HARNESS ENERGY

AN ENERGY EFFICIENT AND RECHARGEABLE SOLAR PEDESTAL FAN

This project will develop a robust solar fan. It will be powered by a Brushless DC (BLDC) motor, which will run on a standalone basis or within a solar home system.

Pakistan is one of the hottest countries in the world where demand for ventilation and cooling represents about half of all electricity usage annually. Over 25% of households live in off-grid settings and scorching heat for eight months of the year. Fans that run for 18-20 hours per day are needed to avoid dehydration and help children sleep in peace. Fans dominate Pakistan's solar market, but there is no focus on efficiency.

This project aims to address this challenge by developing an indigenous rechargeable solar fan powered by a BLDC motor. Robust materials will be used to ensure it can withstand rough outdoor usage in rural areas without compromising on quality and service. The project will first focus on introducing a BLDC motor, which will drastically improve the fan lifespan compared to existing alternatives.

This fan will be able to run on a 12V solar system, any battery, or on any AC/DC adapter. The battery will have a rechargeability feature and will be integrated inside the fan. This will enable it to produce five- six hours in back-up time at night. This technology can help dramatically improve quality of life for over 100 million Pakistanis who live in very hot, off- and weak-grid areas.



AT A GLANCE

R&D Partner
Harness Energy

**Efficiency for Access
Funding**
£ 71,200

**R&D Funding Unlocked
from Harness Energy**
£ 7,303

Project Location
Pakistan



RESEARCH AND DEVELOPMENT FUND PROJECT SPOTLIGHT

ISR - UNIVERSITY OF COIMBRA

DESIGN AND DEVELOPMENT OF SUPER- EFFICIENT REFRIGERATORS WITH PHASE CHANGE MATERIALS (PCMS)

This project will develop an affordable, super-efficient refrigerator suitable for off- and weak-grid areas. It will use a variable speed compressor and PCMs. Furthermore, a smart control system will be developed to manage the refrigerator charge/discharge.

The project will develop both a vertical and a horizontal refrigerator. The outer shells of these refrigerators will be based on existing low-cost, energy-efficient, AC refrigerators.

Refrigerators will have PCMs and fittings, which allow for flexible load control. Furthermore, a variable speed compressor with a smart controller will allow end-users to manage the on-time and charge time of the refrigerators.

Additional features include the ability to handle voltage spikes, as thunderstorms are very frequent in many African countries. The refrigerators will also have two temperature-differentiated cold storage areas. Using PCMs with different phase change temperatures will also make temperature layering possible.

To help people with disabilities reach every item in the refrigerator, there will be a metallised, thin-film, non-condensation mirror installed inside the cover door. Special picking handles offer additional support and will be especially useful in the horizontal model.

For quality assurance, a test chamber will be used to simulate the conditions of temperature and humidity in most Sub-Saharan African countries. The project's main objective is to develop an affordable super-efficient refrigerator for off- and weak-grid settings, powered by a PV system, with charging periods managed by a smart controller.



AT A GLANCE

R&D Partner

ISR - University of Coimbra

Efficiency for Access Funding

£102,881

R&D Funding Unlocked from ISR - University of Coimbra

£11,431

Project Location

Portugal

**RESEARCH AND DEVELOPMENT
FUND PROJECT SPOTLIGHT**

PHASE CHANGE MATERIAL PRODUCTS

SUST-FRIDGE: A NOVEL REFRIGERATOR UNIT FOR DEVELOPING COUNTRIES

This project will combat food loss post-harvest by developing Sust-Fridge, an innovative refrigerator which keeps produce cool for an extended period of time. This is for customers living in off- and weak-grid settings.

Food spoilage is a significant problem in most African countries. Half of all food in Sub-Saharan Africa is lost post-harvest or before it reaches markets. Ineffective cooling technologies in hot climates are the primary reason for this loss.

Phase Change Materials Products Ltd aims to develop a novel refrigeration unit, which be used for food or medicine. The Sust-Fridge will be designed to achieve the desired temperature in off- and weak-grid settings. This will be done by incorporating a phase change material (PCM) inside the refrigerated chamber, as well as a micro-compressor and a highly efficient condenser unit. By introducing PCM into the system, the Sust-Fridge will maintain low temperatures for an additional 10–18 hours.

By minimising food loss post-harvest, farmers can sell more produce in the market, allowing them to become more productive. This can help foster economic growth and boost farmers’ savings, which would ultimately have a positive impact for local communities.



AT A GLANCE

R&D Partner
Phase Change Material
Products

**Efficiency for Access
Funding**
£139,890

**R&D Funding Unlocked
from Phase Change
Material Products**
£59,953

Project Location
United Kingdom, Ghana



RESEARCH AND DEVELOPMENT FUND PROJECT SPOTLIGHT

PROMETHEAN POWER SYSTEMS

INCREASING ACCESS TO RELIABLE
REFRIGERATION FOR A SUSTAINABLE DAIRY
SUPPLY CHAIN

This project will test a new model for increasing access to reliable refrigeration for dairy farmers in rural villages across India. It will achieve this through the use of thermal energy storage systems and remote monitoring technology.

Promethean Power Systems has developed a thermal battery technology as an alternative power solution for cooling and transporting milk. The dairy supply chain in India currently relies on diesel generators to chill milk in rural villages due to unreliable electricity. However, diesel generators are expensive, polluting and inefficient to operate. As a result, many farmers face spoilage issues and have poor access to markets. For consumers, milk quality is affected by the lack of refrigeration at the source.

Promethean Power Systems has resolved this problem with a battery that stores thermal energy and has a remote monitoring capability to ensure uptime. The thermal energy storage system eliminates the use of diesel generators to refrigerate milk in rural areas. The project aims to create a new model, which brings reliable refrigeration to milk-producing villages in an economical and sustainable manner. This new technology, remote monitoring and business model will remove the cost of diesel generators. It will enhance equipment maintenance and uptime and reduce operational expenses. This solution links villages and smallholder farmers to milk chilling technology in an economically viable way.



AT A GLANCE

R&D Partner

Promethean Power Systems

Efficiency for Access Funding

£160,000

R&D Funding Unlocked from Promethan Power Systems

£220,713

Project Location

India

RESEARCH AND DEVELOPMENT FUND PROJECT SPOTLIGHT

REFRIGERATION DEVELOPMENTS AND TESTING LTD (RD&T)

RADIANT COOLING FOR ARID LOCATIONS (RADICAL)

The RADICAL project aims to identify the potential for radiant cooling and define and build the first-stage prototype for further development.

The main aim of the RADICAL project is to manufacture and operate a radiant cooling system that is affordable, robust and can be maintained and repaired locally.

Many developing regions have hot-arid climates, with very high day to night temperature swings. Furthermore, night skies tend to be clear. During clear nights, thermal radiation occurs, causing surfaces to cool rapidly.

Traditionally, thermal radiation during the night has been used to make ice in special shallow ponds. However, the process is labour-intensive, incurs water loss, and can be unhygienic.

This project aims to develop a useful, affordable and self-powered radiant cooling device, based on phase change thermosiphon heat transfer. The only moving component will be the working fluid, which is cheap and commonly available. The device will be low maintenance, as it will only require external cleaning of the heat exchange surfaces.

The RADICAL project is a feasibility study to undertake work to identify the potential for the technology and define and build a first stage prototype. The partners involved are RD&T, Practical Action and ACTS (African Centre for Technology Studies).



AT A GLANCE

R&D Partner

Refrigeration Developments and Testing (RD&T)

Efficiency for Access Funding

£88,564

R&D Funding Unlocked from Refrigeration Developments and Testing (RD&T)

£9,840

Project Location

United Kingdom

RESEARCH AND DEVELOPMENT FUND PROJECT SPOTLIGHT

SMART VILLAGES RESEARCH GROUP LTD

EFFICIENT LOW-COST COLD STORAGE FOR RURAL COMMUNITIES

This project will develop affordable, low-tech cold storage for off- and weak-grid rural communities in East Africa. This project aims to improve agricultural productivity and achieve greater food security.

Small Villages Research Group Ltd intends to develop and test improvements to EcoLife Foods' innovative, low-cost, cold storage solution. Through this project, the partnership will create an appropriate cold storage solution for widespread adoption. I will do this by focusing on improving cooling technology, locally sourced insulation and building materials and construction techniques. It will also use an innovative pre-cooling phase. The project will create productivity gains for local users including innovative uses of the waste heat generated by the hub (e.g. for drying produce and providing hot water) and the excess solar PV generated.

Smart Villages Research Group Ltd plans to:

- 1) Test manufacturing feasibility and thermal performance of insulation material from local waste.
- 2) Test the performance of stabilised earth blocks as an alternative to concrete or clay bricks, and optimise design for the walls, roof and sand foundations of the cold storage facility.
- 3) Research internal partitioning of the cold storage facility to produce zones of different temperatures, which will optimise the preservation of a range of products.
- 4) Research the design of a passive pre-cooling chamber that will reduce the energy and thermal demand on the cold store itself.
- 5) Research optimum productive uses of the heat waste generated from the system and excess PV.



AT A GLANCE

R&D Partner

Smart Villages Research Group

Efficiency for Access Funding

£88,000

R&D Funding Unlocked from Smart Villages Research Group

£10,940

Project Location

Uganda

RESEARCH AND DEVELOPMENT FUND PROJECT SPOTLIGHT

SOLAR COOLING ENGINEERING

KEY COOLING COMPONENTS AND ENGINEERING FOR IMPROVED ACCESS TO REFRIGERATION

This project will support the development of affordable key cooling components tailored to the diverse needs of value chain actors. Its other objective is to generate employment opportunities by building local capacity.

Access to refrigeration is essential for farmers to reduce post-harvest losses, scale up and explore new business opportunities. Yet commercially available cooling systems are often imported without consideration of the local context. The systems available to farmers are not tailored to their needs. They are also considerably more expensive due to the high cost of shipping, duties and taxes. Solar Cooling Engineering seeks to address these challenges by promoting solar cooling solutions that are assembled and adapted locally. In this way, the diverse needs of farmers and other value chain actors become a business advantage.

Solar Cooling Engineering is a spinoff company of the Institute of Agricultural Engineering of the University of Hohenheim. Since 2014, it has developed and assessed small and medium-scale solar cooling systems for the Agri-food sector. In partnership with its official distributor, Phaesun, Solar Cooling Engineering has made several key components have been made commercially available. This allows for a flexible and modular design of cooling systems.

Over the life of the project, Solar Cooling Engineering aims to:

- Reduce production cost of the actual solar SelfChill® cooling unit
- Implement remote monitoring and PAYGO compatibility
- Develop control algorithms for different applications and energy sources including direct drive (no batteries)
- Assess further medium-scale example systems for training purposes
- Establish face-to-face and on-line technical training courses
- Promote local production through field trials



AT A GLANCE

R&D Partner

Solar Cooling Engineering

Efficiency for Access Funding

£ 200,000

R&D Funding Unlocked from Solar Cooling Engineering

£26,298


Project Locations


Kenya, Mali, Colombia,
Germany



CONTACT US

 efficiencyforaccess.org

 EforAgrants@est.org.uk

 [@EforA_Coalition](https://twitter.com/EforA_Coalition)