

# Initial equipment partners, ACES Rubirizi campus Summer 2024

This summer we are also installing  
a state-of-the-art Environmental Test Chamber  
and Refrigeration Training Centre

*To talk to us about deploying cold-chain equipment  
for demonstration or testing, please contact  
[t.peters@bham.ac.uk](mailto:t.peters@bham.ac.uk)*



# A unique centre

ACES is the only Centre of Excellence of its kind globally with a focus on holistic and sustainable system of systems cold-chain solutions. It is a uniquely situated 4-hectare headquarters campus (operated by the ACES Institute) in Kigali, and will be equipped with:

- a state of the art in-market technology test and demonstration centre;
- working with IFC and industry, the largest single demonstration centre of sustainable cold-chain equipment;
- a fully equipped refrigeration (including refrigerants) and data telematics training centre to provide the technical skills; collaborative undergraduate and teaching facilities established at IPRC Kigali.
- quality, safety, and postharvest management laboratory to conduct tests to evaluate and monitor quality, safety and storability potential of local crops, guaranteeing that they meet international and established standards;
- an adjacent nearly 200-hectare model Smart Farm that will allow research of cooling in the Water- Energy-Food Nexus and wider climate adaptation challenges including diversifying crop cultivation for increased farmers' income and more resilient sustainable food systems, which will inform scaling of approaches to broader farming communities and food systems.

## Research

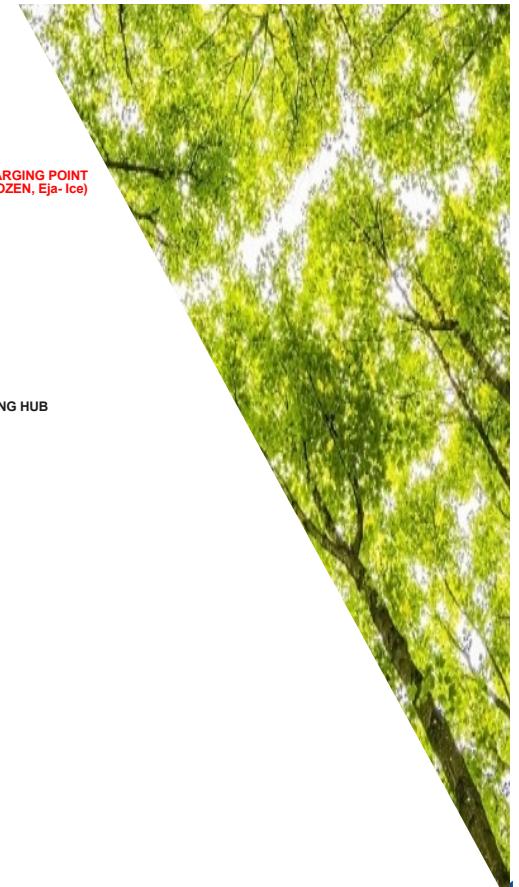
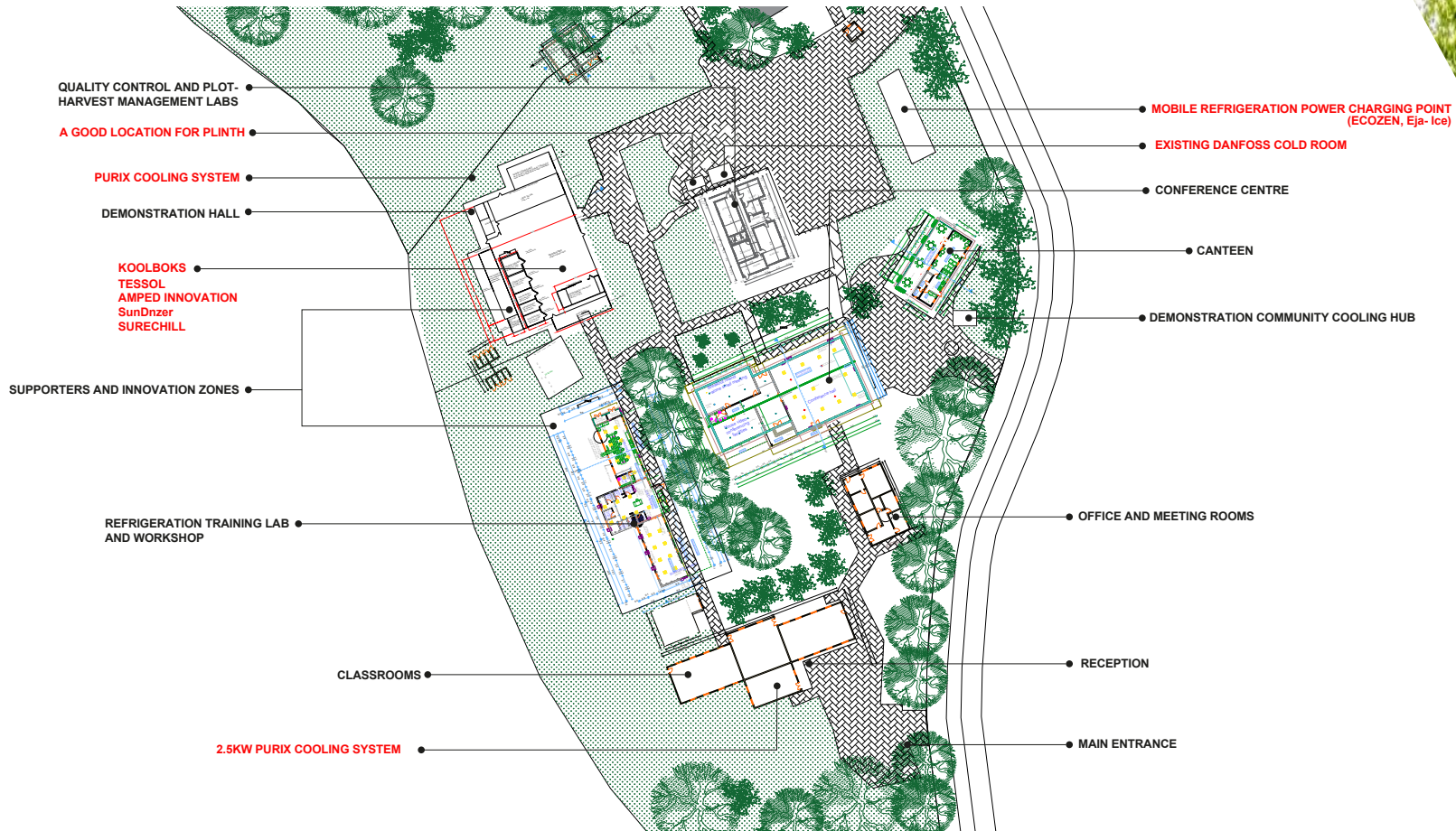
From a technology research perspective, ACES will primarily focus on four integrated technology areas - demand mitigation; conversion to renewables; thermal energy storage; data and control systems.

There is a specific aim to work with smaller / early-stage companies (including internationally) to develop their technology for market-driven solutions and transition to lower GWP refrigerants.

And a key cross-cutting theme is to consider the decarbonisation of road freight and in this context understand the interaction between cold-chain provision and electrification of transport including.

- Vehicle range and payload constraints change the dynamics of cold-chain network design.
- Vehicle energy supply is more limited and therefore motive power and in transit cooling demands need to be balanced creating a significant efficiency premium.
- Locations for charging infrastructure need to be identified and this can impact routes options and transit durations, the latter having implications for in transit cooling technologies.

# Site plan



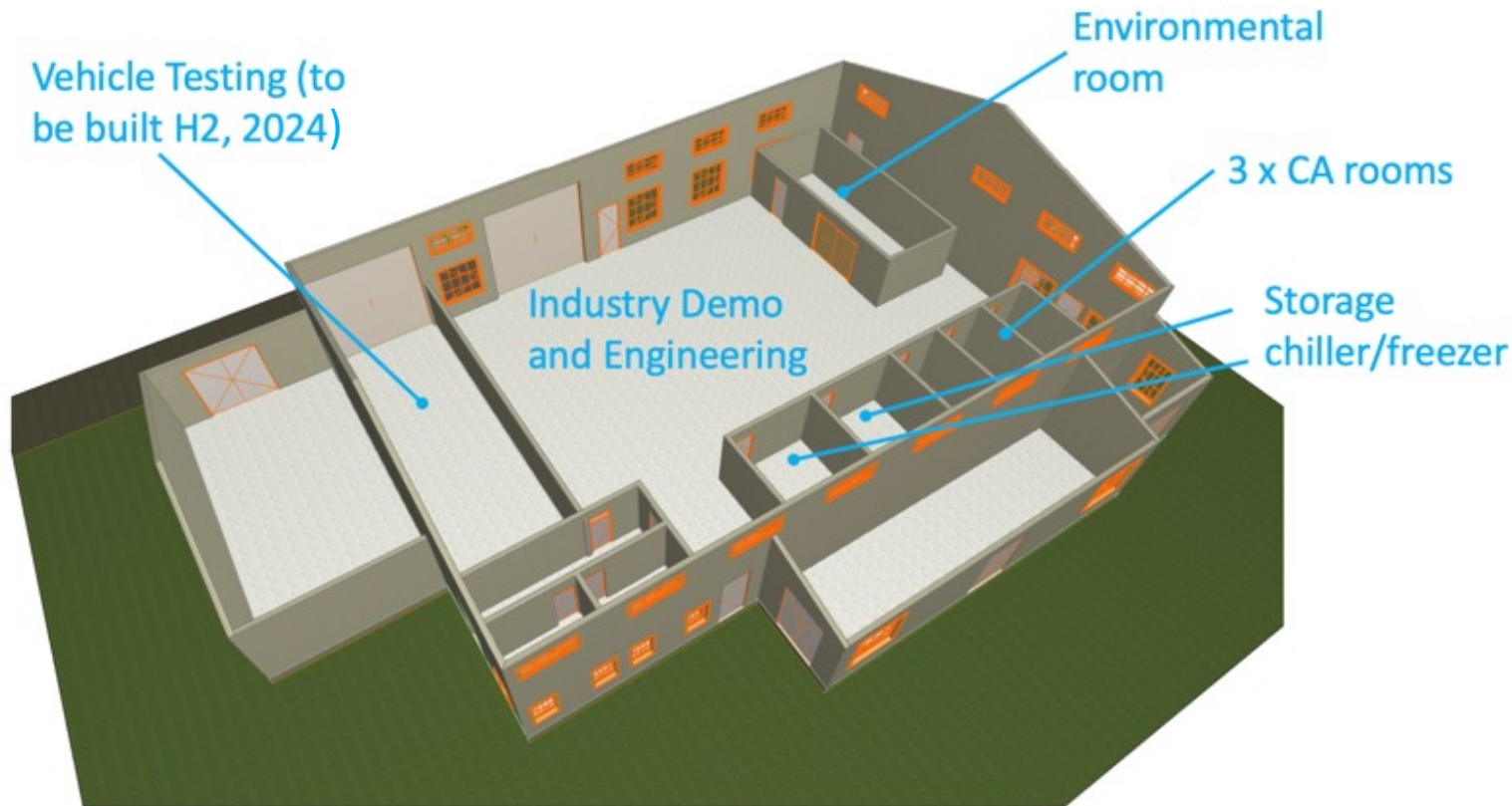


# Demonstration Hall

Main Hall 20m by 20m by 6m

Environmental Room 9.8m by 3.8m by 3.5m

VT Rooms 4m by 2.5m by 2.5m



The Environmental Test Chamber is designed to test a range of integral and remote commercial, professional and domestic refrigeration equipment. Although specified to primarily comply with EN23953, the room/chamber is designed to be capable of operating at between 16°C and 50°C



# Off-grid solution freezer

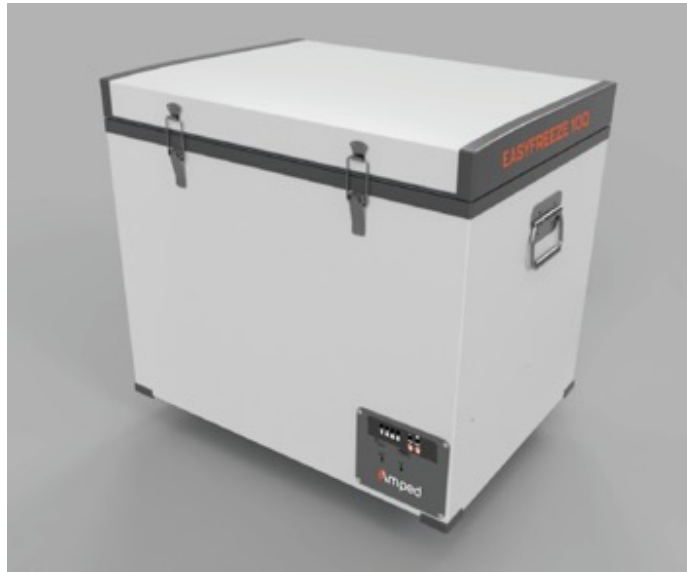
Solar powered chest freezer with thermal and battery power backup



## Key features

A high-performance 100L fridge for home or business use. 20 minutes to reach fridge temperatures below 8°C and under one hour to reach freezer temperatures below 0°C. Stays cold for up to 40 hours during power blackouts or rainy days. Performs 2X better than the best Verasol-tested fridges on cooling autonomy and speed to cool down.

- 40 hours of cooling without any power inputs.
- Tight mechanical interface of ice pack and evaporator coils for best thermal performance.
- Up to two 5.5L ice packs.



Off-grid cold storage

Off-grid (PV and Li battery) cooling

- Tested at above 32°C to ensure fast pulldown in the harshest environments
- Easy-to-use phone application for live diagnostic monitoring (coming soon).
- PAYGO keypad.
- EV Grade Battery, LiFePO4.
- Up to 250 W solar panel.
- Data Logging EasyFreeze has internal data logging for 30 days.



# Hybrid sustainable refrigeration for long-haul transportation



## Eutectic cooling with solar PV and Li-ion battery, and IOT monitoring system



### Key features

ATC International is an engineering, R&D services, and manufacturing company producing various cold storage/transport solutions. ATC aimed at extending cooling times for long-haul transportation through a combination of thermal and electric batteries (PCM/eutectic plates and Li-ion) and Solar Photo Voltaic (Solar PV). The hybrid system is designed to be charged before the journey starts and maintain cooling requirements during a 70+ hour journey (at -18°C). The solution eliminates fossil fuel consumption for refrigeration and enables zero GHG emissions during transport. Key features of the solution:

1. 50 feet (13.6m long) containerized solution having an internal space of and 83m<sup>3</sup> and a load carrying capacity 25 MT.
2. Eutectic plates (thermal batteries) with a cooling capacity of 20-24 hours after charge of 8-12 hours by an on-board compressor; 35kWh Li-Ion battery pack, supported by 5.4 kWp solar panels on the roof of the container.
3. Remote, real-time system (temperature, battery charge, etc.) monitoring and control enabled by industrial grade IoT.

Long-haul cold transportation

Temperature controlled logistics

### Impacts

- Economic impact: cost savings from reduced energy consumption.
- Environmental impact; zero GHG emissions; and reduced food waste.
- Social impact: improved access to food in rural areas and food deserts.

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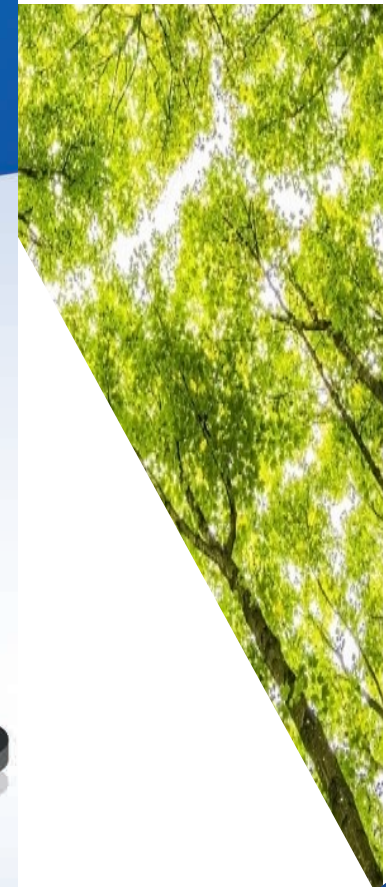
*Carrier*

CONNECTED  
COLDCHAIN

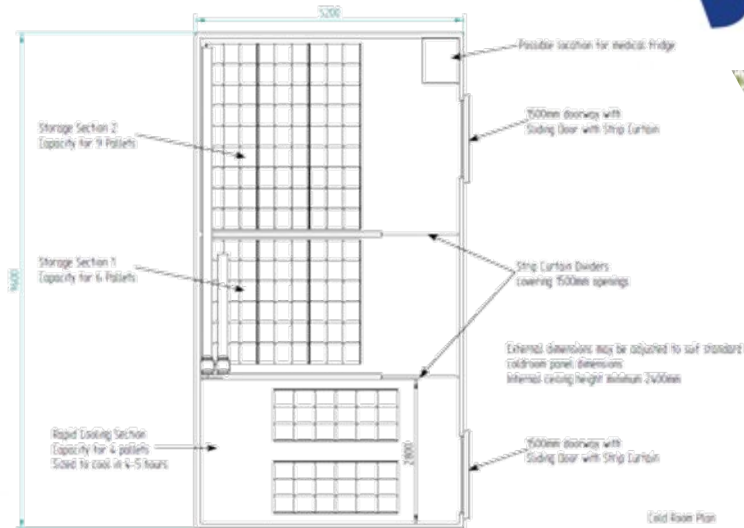
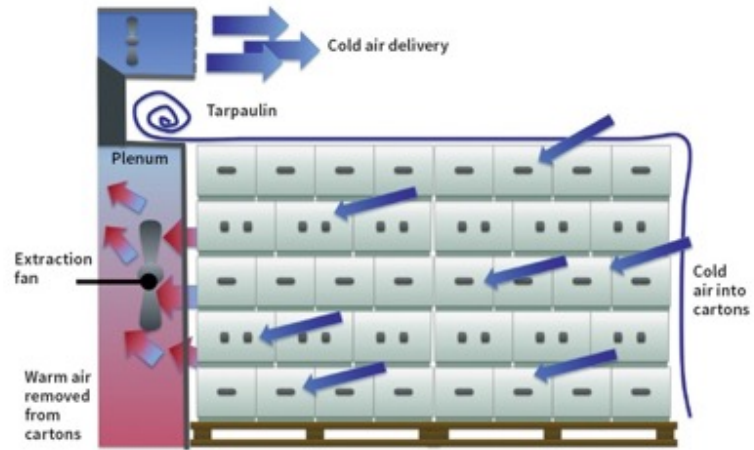
## OPTIMIZE YOUR OPERATIONS WITH CONNECTED COLD CHAIN SOLUTIONS

- Gain end-to-end cold chain visibility
- Reduce total cost of ownership
- Maximize efficiency and sustainability
- Seamless integration

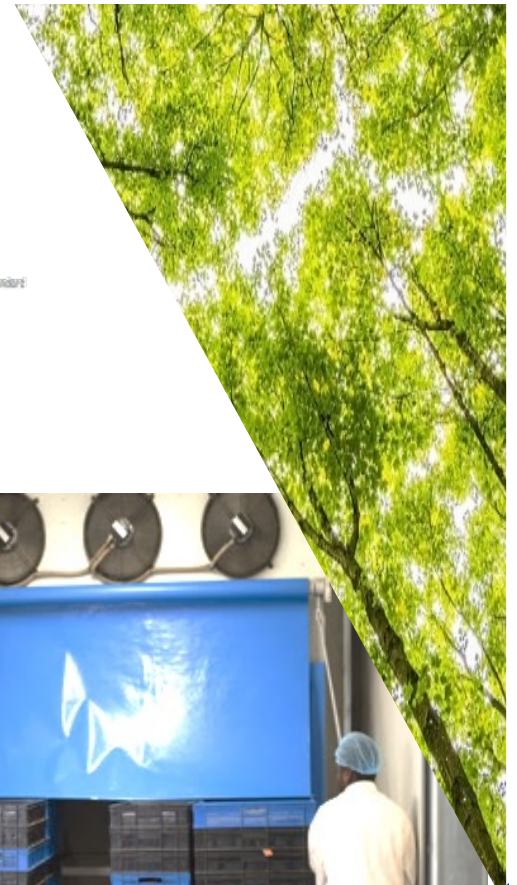
**LYNX**  
FLEET



# Community Cooling Hub



- Air blast cooling
- Pre cooler (3 tonnes horticultural product/day)
- Storage for 15 pallets of produce
- Storage temperature between 5 and 12°C
- Solar panels
- Thermal storage
- Datalogging and monitoring system
- Natural refrigerant
- Associated cooling for milk/ice making where required





ENGINEERING  
TOMORROW

*Danfoss*

## Complete solutions for **drive-up cold rooms**



[www.danfoss.co.za](http://www.danfoss.co.za)



# Solar cold storage room

An off-grid fully autonomous farmgate cold store solution with pre-cooler for rapid cooling of farm produce



## ecozen



### Key features

1. A trailer mounted cold room with a refrigeration system and a computer-controlled fan system to selectively act as a pre-cooler or cold store.
2. A curtain system ensures full flow of air for rapid cooling to remove the field heat.
3. Solar panels with an independent stand for mounting on the ground, with arrangements to dismantle for relocation.
4. The thermal batteries with low-cost water based PCM materials for cooling during the night.
5. A full stack suit to remotely monitor all the vital parameters using an IOT device.

Farmgate Cooling Solution

Market Linkage & IOT

### Impacts

- Economic impact: reduced food waste and cost effectiveness through better capacity utilization.
- Environmental impact: zero GHG emissions and avoidance of use of fossil fuel.
- Social impact: affordable access to cold storage and transport when needed – increase income for farmers

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# Electrical cooling for last mile cold transportation



## Solar powered refrigeration and IOT enabled system monitoring



### Key features

Eja-iCe is a cold chain engineering and innovation company that develops cooling solutions based on solar powered refrigeration for last mile delivery to support food and pharmaceutical companies to mitigate food waste and reduce overall GHG emissions. Eja-iCe has developed a multi-purpose containerized solution on a tricycle for temperature controlled last mile delivery of fresh food and pharmaceuticals. Main features:

1. 400 kg load, thermally insulated container (mounted on a tricycle).
2. A small commercial refrigeration system.
3. A PV system (primary power source) composed of 2 or 3 solar panels to power the refrigerator.
4. A Li-ion battery (power backup system) to power the refrigerator during limited solar irradiation and at night. The battery is charged from the PV system.



Last mile cold transportation

Off-grid (PV and Li battery) cooling

### Impacts

- Economic impact: cost savings from reduced energy consumption and reduced waste during transport.
- Environmental impact: reduced food waste and zero GHG emissions from the refrigeration system because fossil fuels were not used.
- Social impact: improved access to temperature sensitive products.

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# Off-grid solution for deep freezers and coolers

Solar powered chest freezers & coolers with thermal and Li-ion battery power backup

**KOOLBOKS**  
Life is Kool !

## Key features

Koolboks is a French innovator that provides retail storage solutions based on solar powered refrigeration. The company has developed chest freezers and coolers for the retail sector in Africa that operates 24/7 completely off-grid. Key features of the solution include:

1. A standard commercial refrigeration system with DC motors and components.
2. Primary power: a PV system with multiple panels to power the refrigerator.
3. Power backup: Li-ion battery charged by the PV system to power the refrigerator when solar irradiation is inadequate, especially at night
4. Thermal backup: a phase change material (PCM) based thermal storage system.
5. 2 LED light bulbs and USB ports for charging mobile phones.
6. The PCM-based thermal storage system allows the freezers and coolers to operate for an additional four to seven hours without sunlight and after the Li-ion battery is depleted. The system is also equipped with IOT for remote monitoring of the temperature and battery power and is offered as a “pay-as-you-go” system with monthly/weekly instalments.



Off-grid cold storage

Off-grid (PV and Li battery) cooling

## Impacts

- Economic: cost savings from reduced energy consumption.
- Environmental: no fossil fuels, reduced food waste.
- Social: access to food/pharmaceuticals in rural areas, reduced food waste.

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# Solar thermal based absorption cooling

## PURIX

### Key features

Purix, a manufacturer of absorption cooling systems, has developed solar-thermal based absorption cooling technology that offers energy saving of up to 80% compared to conventional cooling systems. The absorption cooling solution does not include an energy consuming compressor unit and can be easily integrated with a variety of indoor cooling devices in new or existing buildings, thereby reducing installation and maintenance costs.

The system is composed of two solar thermal panels and a 2.5 kW single-phase absorption chiller that uses the natural refrigerant R718 (water) for heat transfer. Solar thermal panels provide heat for cooling, while electricity of about 150 W is needed to drive pumps and control systems. Combined with solar photovoltaic panels, the system can deliver 100% off-grid cooling. Where needed, a patent pending thermal backup system based on phase change material (PCM) can enable cooling during night hours.

The modular configuration of the cooling system enables combination of several units, to deliver cooling capacity of up to 160 kW. That combination makes it widely applicable for small, medium, and large sized space cooling.



HVAC

Absorption and eutectic cooling

### Impacts

- Economic impact: reduces energy consumption, and cost savings by up to 80% during daylight hours.
- Environmental impact: reduces GHG emissions and carbon footprints by excluding use of F-gases based refrigerants.
- Social impact: offers a solution for space cooling in areas with limited, or no access to energy.



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# Solar powered refrigeration

## Next generation of off-grid vaccine refrigerators



DC-Powered Refrigeration  
**SunDanzer**

### Key features

SunDanzer manufactures medical vaccine refrigerators. All models are provided complete with power systems and all necessary components for installation.

All SunDanzer medical refrigerators meet or exceed W.H.O. autonomy standards (PQS) for off-grid vaccine storage.

Refrigerators apply a zero-maintenance, brushless, thermostatically controlled DC compressor. A phase change material is applied for long term off grid storage. No condenser fan is necessary, so there are less components to fail. Refrigerators have powder-coated galvanized steel exterior and a cleanable aluminium interior.



Off-grid cold storage

Solar direct drive medical refrigerator

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# Patented thermal energy cooling

Revolutionary cooling that offers constant and consistent cooling without the need for expensive batteries or harmful PCMs



## SureChill.

### Key features and benefits

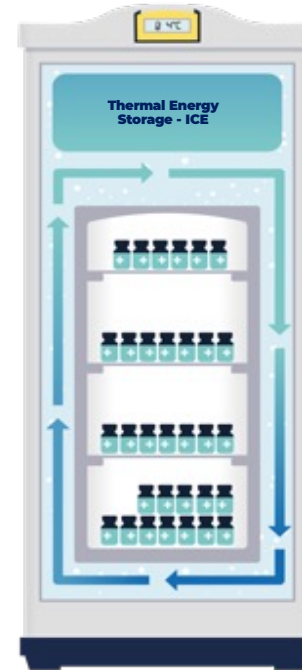
SureChill is focused on revolutionising cooling technology using the power of nature to create positive environmental and social impact. We're passionate about enabling access to cooling for all.

Operating in over **75 countries** and with over a **15 years of experience** in medical refrigeration in the harshest and remotest of environments. SureChill has expanded into the domestic and small commercial refrigeration market creating solutions for solar, weak-grid and mini-grid – some of our fridges can last **12 days** without power.

All SureChill refrigerators contain a unique patented technology that harnesses the natural energy storage properties of water so that they can offer **constant and consistent cooling**.

We offer cooling **24/7** without the need for expensive batteries or harmful PCMs.

The built in **PAYGo functionality** allows customers to pay for the fridge in installments and help distributors manage their risk as it controls the access to cooling.



Domestic and medical refrigeration

Innovative service models – cooling as a service

### Impacts

- Economic: cost savings from reduced energy consumption **60% less energy** than conventional AC fridges.
- Environmental: zero GHG emissions; **71% lower** emissions than other conventional fridges and reduced food waste.
- Social: improved access to food in rural areas and income generation.
- Energy access: cooling without the need for constant energy.
- Reliable: **freeze free cooling**, without the need for expensive batteries.

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Available products offering greater lifetime value to the customer.

# Last-mile delivery of frozen/ refrigerated products



Insulated boxes for last mile delivery of frozen/refrigerated products with up to 48 hours transit time



## Key features

Based on their proprietary PCM material, Tessel has built a range of insulated rugged boxes (rotomolded LLDPE), available in different sizes ranging between 15L – 100L.

The boxes use specially designed PCM cartridges that can be engineered to specific temperature ranges between +1°C to as low as -31 ° C and are inorganic in nature, non-toxic and non-flammable. To ensure rapid turnaround and operational efficiency, Tessel also provides a blast freezer for charging their cartridges with rapid pull-down. Tessel also provides a homegrown asset management platform that integrates hardware and software for monitoring of the entire cold-chain, covering cold rooms to vehicles to last mile delivery boxes.



Cold transportation and storage

Last mile delivery solutions

## Impacts

- Economic impact: cost savings from eliminated usage of fossil fuels for refrigeration during transport.
- Environmental impact: reduced GHG emissions, and product waste.
- Social impact: extended shelf-life of produce, improved food safety and quality.



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