**Conditions are Ripe for Solar Vegetable Chilling in Zimbabwe**

In August 2019, under the GreenTech project implemented by SunDanzer Refrigeration, Winrock staff visited Zimbabwe to conduct a market feasibility study for solar cold rooms for smallholder vegetable farmers. We found the country suffering from a serious electricity crisis, with 18 hours of load shedding a day. While this situation is terrible for the citizens of Zimbabwe, it may accelerate the scale-up of solar, which could be a long-term solution for residents and businesses who would no longer have to depend on the centralized grid.

***Electricity crisis***. Zimbabwe's electricity is generated mainly from hydropower and coal plants. Since May 2019 Zimbabwe has been generating only about one-third of its capacity for electricity. The Kariba hydroelectric plant is generating only 358 MW of its usual capacity of 1,050 MW due to low water levels, and the Hwange coal plant is operating at about 50 percent of its usual capacity due to equipment in disrepair.[1] As a result, most customers receive electricity only six hours a day, from 11 p.m. to 5 a.m. Electricity transmission and distribution lines do not receive sufficient maintenance and repair, and theft of transformers is a problem in many areas.

> "With the energy problems in Zimbabwe, everyone is now moving to solar."
>
> - Jane Mugwira, Managing Director, Tsimba Handling Services

***Businesses running on diesel.*** The major grocery store chains and vegetable aggregation companies Winrock visited were all running on massive diesel generators, except for businesses located at the international airport in Harare, which always has power. One vegetable exporter told us that the normal electricity bill for their packing and cold storage facility just outside Harare would be US $5,000 a month, but since the power cuts they have been spending $20,000 a month on diesel fuel alone. They are also still paying for electricity six hours a day, as well as generator maintenance costs. Another aggregator that sells to grocery store chains told us they are using 200 liters of diesel fuel a day to power their packing and cold storage facility in Harare, at a cost of US $188 a day.

***Cold storage for vegetables.*** As in many developing countries, major commodities in Zimbabwe suffer from an incomplete cold chain. Dairy processors, vegetable exporters, slaughterhouses and other aggregators have grid-connected cold storage and may own or hire refrigerated trucks; but small producers do not have access to cold storage or refrigerated transport. Winrock interviewed smallholders participating in two irrigation schemes (Negomo and Exchange), which were

*Winrock staff with board members of the Negomo Irrigation Scheme and officers of the IFAD-funded Smallholder Irrigation Revitalization Programme*

[1] https://www.businesslive.co.za/bd/world/africa/2019-06-18-ailing-zimbabwe-reels-as-18-hour-power-cuts-bite/

each located more than two hours from major cities. They reported selling their produce directly in local village markets, and sometimes sharing the cost of hiring a truck to transport produce to Harare. From interviews with smallholders and discussions with aggregators, it is apparent that the lack of access to cold storage adversely affects smallholders in several ways:

- Smallholders must sell their produce within a day or two of harvesting it, which means they are not able to try to time the market to get a better price.
- Because of chronic and severe fuel shortages in Zimbabwe, smallholders may not be able to hire a truck to take their produce to market or an off-taker on the day of harvest.
- It is harder for smallholders to serve as a reliable supplier to an aggregator or grocery chain because:
    - produce that has not been chilled to remove the field heat is less likely to meet the off-taker's quality standards by the time it reaches the off-taker; and
    - aggregators prefer to send a refrigerated truck (typically three tons) to pick up produce only if the entire truck can be filled. This is possible only if the grower has on-site chilling that can store at least two days of harvested produce.

***Introducing solar cold rooms***. The current electricity generation crisis in Zimbabwe is compromising even grid-connected cold storage, however. The current landed solar panel price in Zimbabwe is approximately US $0.30/Watt, making solar much cheaper than diesel as an alternative to grid electricity. SunDanzer and Winrock aim to introduce grid-tied solar cold rooms with thermal storage to aggregation companies seeking to reduce their costs from diesel generators. The pilot grid-tied cold room, which could be a 20- or 40-foot container, would use grid electricity at night to freeze ice in plastic ice packs lining the walls. During the day, a small solar array would do two things: 1) power a small direct-current compressor to keep the ice packs frozen, and 2) power fans to circulate air inside the container. This design could be easily converted for off-grid use by increasing the size of the compressor and the solar panels.

***Ensuring commercial viability of solar cold rooms.*** SunDanzer and Winrock have both seen markets for new solar technologies fail or suffer setbacks when equipment is donated or heavily subsidized when it is introduced. Once farmers see their neighbor receive a new technology free or at a greatly discounted cost, it is difficult to ask them to pay the full cost once the technology becomes commercially available. In our experience, a better model is to seek commercial sale of even the very first demonstration units. A lead farmer or business may be given a grace period to use the equipment free of charge, after which it is auctioned for sale to the highest bidder, or the user can purchase it through a lease-to-own agreement. SunDanzer and Winrock will pursue this arrangement with local partners who will test the solar cold rooms in Zimbabwe.

In Zimbabwe, solar cold rooms offer producers and aggregators the promise of decreased post-harvest losses, increased income and – perhaps equally importantly, given the current electricity crisis – independence from the unreliable electrical grid.