Photo 1. Newly constructed building in Rumphi, northern Malawi containing a low cost "flat pack" cold room powered by solar energy and an area for receiving, sorting and selling

Lessons Learned from Implementing Solar Powered Walk-in Cold Rooms for Smallholder Agriculture in Zimbabwe and Malawi

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SunDanzer DC-Powered Refrigeration

IFAD Investing in rural people

Executive Summary

Under the auspices of the *IFAD Green Technologies to Facilitate Development of Value Chains for Perishable Crops and Animal Products* grant, SunDanzer Refrigeration and its in-country partners in Zimbabwe (IFAD SIRP and TechnoServe) and Malawi (Malawi Fruits) have been working to design and install solar powered walk-in coolers to support smallholder agriculture by preserving the quality and preventing post-harvest loss of produce as part of a complete value and cold chain solution. The overarching project goal is to specify and commercialize a solar cooling product that would increase income and improve living standards (successfully be used for Productive Use). While our work exposed what we extrapolate to be the **commercial non-viability of solar powered cold rooms in the context of smallholder agriculture at this point in time**, it also affirmed the great need in Sub-Saharan Africa for an agricultural cold chain in the context of a complete value chain solution, with emphasis on access-to-market.

The key findings of this research are summarized below:

- The lowest cost, practical solar powered cold room solution was about $40,000 USD, much higher than a target of $10,000 USD, where the capital expenditure "pencils out"
- Cold rooms are secondary to and supportive of a viable business model that effectively markets the produce grown, which addresses all aspects of the value chain
- Cooling-as-a-Service by itself, in our assessment, is not a viable, sustainable business model as it does not take a systemic approach and intervene throughout the value chain. It needs to be integrally connected with access-to-market.
- Social enterprises like Malawi Fruits and Sustainable Growers in Rwanda, in our assessment, are examples of entire value chain business models that are the best fit for enabling technology like solar powered cold rooms
- Due to the high cost of solar powered cold rooms and long payback period, subsidies to social enterprises supporting smallholder farmers are essential for the foreseeable future
- Based on our limited experience, we strongly believe committed and capable partners make the difference between success and failure; also, the fewer partners in a project, the higher the probability of success
- Turnkey, solar powered, containerized cold rooms cost around $100,000 USD by the time they arrive to their destination and have several disadvantages besides cost; the biggest being their single purpose design
- Do-It-Yourself solar powered cold rooms based on the CoolBot technology address cost, but are impractical to implement, to a great extent because of the complexity of coordinating the multiplicity of products and services required
- Custom, site-built, multi-purpose building combined with off-the-shelf, flat pack cold rooms were found to be the most practical and cost-effective solution

In conclusion, the holy grail of cooling and a cold chain to reduce post-harvest losses for smallholder farmers and enable them to participate in commercial value chain, in our estimation remains elusive. Till it is discovered, the best option is to subsidize the cold chain efforts of social enterprises that provide smallholders with access to commercial markets.

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1. Background

SunDanzer Refrigeration is the recipient of the multi-year, 2.2M USD IFAD grant Green Technologies to Facilitate Development of Value Chains for Perishable Crops and Animal Products (GreenTech). The GreenTech grant focuses on solar powered cooling solutions for dairy farmers and artisanal fishers and smallholder farmers in East and Central Africa.

In November of 2019, Winrock International published two studies entitled "Malawi Market Needs, KAP and Technology Assessment Report" and "Zimbabwe Market Needs, KAP and Technology Assessment Report" in support of GreenTech's goal to specify and commercialize a solar cold room for use by smallholder vegetable farmers to minimize post-harvest losses and increase incomes. Their research provided useful insights into the market and general information and served as a jumping off point for our follow-on work, which was to identify implementing in-country partners for commercial pilots. However, their favorable financial analysis (using internal rate of return) was premised on a cooling solution that cost $10,000 USD, which turned out to be very unrealistic; we discovered that $40,000 USD was the lowest cost solution and had to rethink and recalculate the economics.

This report chronicles our experience and captures what we learned as well as the most salient of our opinions and assessments regarding the commercial viability of cold rooms linked to smallholder agriculture.

2. Focus and Scope

While the GreenTech grant focuses on sustainable, market-based solutions, our experience and subsequent assessment (elaborated in the following Lessons Learned section) was that **solar powered cold rooms are simply an enabling technology in a highly complex and capital intense business solution** that was far beyond the scope and budget of the grant. Unlike fridges and freezers used for Productive Use and distributed, financed and supported by Last Mile Distributors through established infrastructure and business model, cool rooms in support of smallholder agriculture lack a clear business vehicle to hitch a ride on. Instead, many NGOs and early stage pioneering companies are all trying to develop something roadworthy. Thus, we soon found ourselves stranded on the roadside.

We gave up the holy grail notion of orchestrating and being part of a groundbreaking sustainable business solution. Instead, we started looking for worthy existing projects that we could contribute to where we could learn a thing or two about "What is the best cool room technology approach to use in rural Africa?"

This document captures our initial Lessons Learned from the early stages of the project to the point of pilot implementation; additional post-pilot Lessons Learned will be published at the conclusion of the project.

3. Lessons Learned

3.1. Solar Powered Cool Rooms are Part of an Existing Complete Value Chain Solution

What became apparent early on was that serving smallholders with cold storage needed be part of a systemic, complete value chain solution, of which access-to-market was the most important piece. What we also discovered (the hard way) was that it was completely unrealistic to expect existing businesses to expand their business by providing cooling services to smallholders (more on this in a following section).

The reason can best be summarized by saying the amount of effort involved is significant. It is not incrementally expanding an existing business, but rather starting up an entirely new business. One example is the training and capacity building required to have smallholders grow the high-quality produce that both African urban and international markets require. The underlying assumption in the preliminary work by Winrock International was that SunDanzer could partner with businesses and they could make the investment to enter the market. Our assessment was that the resources and time required are beyond the scope of companies like vegetable aggregators, Last Mile Distributors or providers of cool rooms. **The only viable option in our opinion is to plug into an existing project or business that already exists for the purpose of connecting smallholders with markets.**

3.2. Solar Powered Cold Rooms are Cost Prohibitive

Given our experience as a best case, $40,000 USD for an installed solar powered cool room, the only viable scenario of attaching to an existing project or business is if they are subsidized, so the end cost is $10,000 USD. At this price, the numbers start to work as evidenced by Winrock's analysis below. This supports a view that cooling-as-service to smallholders is not a viable sustainable business (see next section for an elaboration).

	Year1 Q1	Year1 Q2	Year1 Q3	Year1 Q4	Year2 Q1	Year2 Q2	Year2 Q3	Year2 Q4
Fixed Costs								
Cooled chamber $4,000 (container or concrete/stone building with shelves); $6,000 for solar-adapted monoblock, controller, panels, insulation for container, installation; total cost $10,000	3,222	1,222	1,222	1,222	1,222	1,222	1,222	1,222
Operator salary	150	150	150	150	150	150	150	150
Total Fixed Costs	3,372	1,372	1,372	1,372	1,372	1,372	1,372	1,372
Revenue								
Price of chilling ($/kg/day)	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005
Day of chilling	90	90	90	90	90	90	90	90
Solar cold room capacity (kg)	10,000	10,000	10,000	10,000	10,000	10,000	10,000	10,000
Kg stored (40% of total capacity)	4,000	4,000	4,000	4,000	4,000	4,000	4,000	4,000
Total Revenue	1,800	1,800	1,800	1,800	1,800	1,800	1,800	1,800
Gross Profit	(1,572)	428	428	428	428	428	428	428
Internal Rate of Return (IRR)	19%							

Table 1. Financial analysis from Winrock International's report: Malawi Market Needs, KAP and Technology Assessment Report

3.3. Cooling-as-a-Service to Smallholders is Not a Viable Business Model, Yet

The capital-intensive nature, long payback period and value chain intervention required, in our opinion, preclude a sustainable, profitable business providing cooling services to smallholders, even for social enterprises with the mission of supporting smallholder farmers, and even if they can provide access to market. The following bullets contain further commentary based on high level assessments of existing commercial efforts in Nigeria and Kenya, where *ColdHubs* and *FreshBox* are trying to leverage local marketplaces that smallholders already sell through and target small distributors and retailers as well as farmers. These are the problems we see in their approach:

- Rolling out solar powered cold rooms throughout a region or country is extremely capital- and logistics-intensive. Doing so requires major investment on the front end; one that may pay back in ten years and is full of risk.
- Access to existing local markets as opposed to the more lucrative urban markets does not maximize the income of the smallholder, only incrementally adds to it. It also limits the amount that a smallholder can pay for cooling.
- Weak links in the value chain and cold chain require strengthening, which add cost and complexity to an operation. A good example is ColdHubs adding a fleet of refrigerated trucks (we assume to increase utilization of their cold rooms).
- The jury is out regarding whether many people will purchase cooling services. While front-end research indicates a high percentage would pay for having vegetables cooled, it is uncertain whether many potential users really understand the value of the service and would pay in actuality. In Dedza, Malawi a 40’ containerized cold room was added to a community mini-grid for Productive Use by NGO United Purpose. So far, it is underutilized.
- We are skeptical whether expensive cool stores can provide a Return on Investment in 3-5 years, particularly if they are underutilized and repair or maintenance is considered. This implies that continual investment is required when these start-ups fail to deliver on overoptimistic projections.

Inspira Farms, which we think is the oldest and most successful company providing solar powered cold room solutions to Africa, has a business model where they provide asset-based finance for the sale of their products to medium and larger farms and food distributors. They are essentially an equipment provider to established agri-businesses.

EcoZen sells a complete value chain solution to farmers: solar water pumps for increasing production, solar cold rooms for managing and preserving crops and an app to help market the produce. However, such a product solution is financially and technically beyond smallholders and does not address the capacity building and training needed to switch to cash crops and the business of marketing them. So, like Inspira Farms, their solutions are suitable for medium to large, successful agri-businesses.

3.4. Complete Value Chains Business Models (not Technology)

The previous sections highlight the imperative to find a business model that is sustainable that can support smallholder agriculture. In our limited experience opinion, this is not cooling-as-a-service, but rather a social enterprise that trains smallholders to grow and markets their produce under their own brand. Our Malawi partner Malawi Fruits (described in detail later) is exemplary of this approach. It is further mirrored and validated by the success of *Sustainable Growers* in Rwanda with their for-profit arms *Question Coffee* and the Coffee Training Academy. Over a period of six years, they developed a complete value chain solution where women smallholders are trained and supported to grow high quality coffee, which is sold through Question Coffee in Kigali and its network of trained partners. All the coffee is sold domestically; the international market is not needed.

Photo 2. Malawi women growing high quality tomatoes in greenhouses for Malawi Fruits, who markets the produce in the city of Mzuzu

3.5. Farmers are not Capable of Maintaining the Systems

Our grantor IFAD believes that smallholder cooperatives can be trained and as a community operate and maintain on-farm cold rooms. Based on our limited experience in this project, we respectfully disagree. Our assessment is that smallholder farmers need to be 100% focused on making the transition to growing high quality cash crops, becoming better farmers in other words. In the business world, this is commonly referred to as developing and focusing on core competencies. The cold room is an enabling technology in the business of selling top quality, branded produce. It is our opinion that it needs to be owned and operated by a socially responsible business and not growers.

3.6. Finding a Viable Technical Solution

3.6.1. First Investigated Solution: Pre-built, Turnkey Containerized

Arriving at a cost-effective technical solution was an odyssey that spanned over a year. Having reviewed research, pilots and existing fledgling commercial efforts, our initial effort was driven by two conclusions: 1) access-to-market was more important than technology and 2) technology was readily available; no need to "reinvent the wheel". So, we first evaluated containerized, turnkey cold rooms. We thought these to be an obvious solution because they could be built and tested in a proper manufacturing environment and then easily shipped and transported to the site.

There were a number of offerings on the market, but the one that attracted our attention were those from *Black Stump Technologies* in Melbourne, Australia. Black Stump had years of broad experience, used quality components and had innovative design features. Their solution seemed perfect until we were given an initial estimate of approximately $100,000 USD per 20’ container unit landed in-country.

The high cost of this solution eliminated it from consideration. Clearly, such a high price would not pencil out in market-based scenarios such as providing cooling-as-a-service; the payback period would be far too long. In addition, unknown to us at the time, there were inherent cons to using a containerized cool store solution. These are summarized later in the section entitled Final Solution: Custom Built Packing Shed and Off-The-Shelf “Flat Pack” Cold Rooms.

Photo 3. Pre-built, turn-key containerized cold room from Black Stump Technologies, well-conceived and built, but expensive

3.6.2. Second Investigated Solution: CoolBot controlled DIY Container

We returned to the proverbial drawing board and conceptualized our second solution addressing the most obvious shortcomings of a pre-built, turnkey solution: high cost and minimal contribution to local African economies.

The concept was based on a proven, do-it-yourself approach utilizing the *CoolBot walk-in cooler controller* and low cost, consumer air conditioners. The CoolBot controller “hacks” the factory controls of an air conditioner so that it does not turn off at 15 degrees Celsius and shuts off before the cooling fins freeze. Moreover, it has been successfully implemented/combined with shipping containers (*https://www.youtube.com/watch?v=9VMwBemNhmE*).

This excerpt from the StoreItCold website further explains the approach:

> The CoolBot transforms any well-insulated room into a walk-in cooler by harnessing the cooling power of a standard air conditioner.

Traditional walk-in cooler refrigeration systems can cost several thousand with installation and electrical setup. Traditional systems use a “brute-force” approach to cooling: lots of coolant (which is bad for the environment), a big motor, a large surface area, and multiple fans (which can account for up to 60% of the cost of operating electricity).

Why not just use an A/C unit then? First, they are electronically limited so that they can’t go below 60°F. With some electrical bravery and skill, you could snip, solder and bypass the electrical controls so you could go lower. It will work better, but still not very well, as your ability to actually utilize that cooling power drops drastically as you approach 60° F. This limitation at 60° F vs. a traditional walk-in cooler refrigeration system is driven by the lack of extra fans and surface area built into traditional walk-in cooler compressor/condenser/evaporator units which dissipate the cold without freezing up the fins of the unit. As your temperature goes down you increase the chances of freezing the coil and you need to find a way to tackle that second hurdle. Not a simple task for those without the electrical bravery and skills previously mentioned.

> The CoolBot’ s patented technology intelligently controls your air conditioner – so you can harness its cooling power and keep temperatures in the 30s without freezing up your air conditioner.

The CoolBot uses multiple sensors, a heating element and a programmed micro-controller to direct your air conditioner to operate in such a way to cool the room to 36° F without ever freezing up. Additionally, our innovative interface which links the CoolBot controller to your air conditioner allows for 5 minute installations without any training, cutting, soldering or even taping.

CoolBot cannot give you 100% use of the listed BTUs on your air conditioner, so you will need to buy a higher BTU air conditioner than the BTU size you would buy on a traditional cooler compressor. However, **the price of a larger air conditioner and a CoolBot is a fraction of the cost of a traditional walk-in cooler compressor**, saving you $1,000s in upfront equipment costs.

Most importantly, when the air conditioner is close to freezing or when the room has reached the desired set temperature, the CoolBot is programmed to shut off the compressor on your A/C unit, so **you do not pay for extra electricity that you won’t use!** That saves you money on your monthly electricity bill and helps the environment. As long as you size your air conditioner correctly following our sizing guidelines and insulate your cooler well, you’ll have no problem keeping your room as cold as you want it to be.

Photo 4. Cold room utilizing an inexpensive window air conditioner with a CoolBot controller

We realized that all the components and materials to build a solar powered walk-in cooler were readily available in any African country: used shipping container, rigid insulation, metal fabrication and welding, solar panels, solar power electronics, batteries, even the CoolBot. We thought this approach would: keep costs to a minimum, utilize in-country resources/contribute to the local economy, save time by eliminating international transport and avoid the bureaucracy and cost of importation. SunDanzer's role would be to design and engineer a solar + storage system and container retrofit, then document and open source it. This seemed a very novel approach and we were excited to pioneer it.

Like many concepts that seem like a great idea, we encountered problems that effectively rendered our approach naïve and impractical when implementation was attempted in Zimbabwe:

- Window air conditioners were hard to find and those available were typically from Chinese manufacturers whose models were not tested to be compatible with the CoolBot.
- Potential fabrication partners who could source and customize shipping containers did not respond to RFQs and meeting requests.
- Our in-country partner did not perform in their role as project manager (and we ended the relationship).
- Our in-country partner did not have the people or resources to launch a business distributing produce from smallholders, although they did have a viable plan.

After three months and negligible progress, we concluded that the reason was only partially because of the lack of capability of our partner, but that some of our main assumptions were incorrect; the biggest of which was that such a relatively complex project and its demand of timely cooperation and coordination was just not practical in Zimbabwe (where even simple business basics like accessing cash or paying with a credit card were often not possible). The first experience in Zimbabwe left us mystified: how a country so sorely in need of income could fail to take advantage of a project with funds at the ready? We believe it just required too much effort and involved too many parties. Zimbabwe is perhaps an extreme example, but it prompted a complete reevaluation of our approach.

3.6.3. Final Solution: Custom Built Packing Shed and Off-The-Shelf “Flat Pack” Cold Rooms

After the failure to implement the innovative DIY concept, we came to the conclusion that we needed a pre-built system similar to our original containerized solution, but significantly less expensive. Pre-designed, panelized cold rooms are widely available around the world. These cold rooms come in modular panel sections that lay flat and can be easily shipped along with the refrigeration components. Designing and sourcing a solar + storage system to power such a pre-fabricated cold room is straightforward. We found a South African mini grid company that had experience integrating cold rooms with solar power systems and delivering them as a complete solution. We were ready to pay $40,884 (see Option 1 summary below) plus approximately $3,500 for installation for their solution, but the deal fell through when they wanted to keep the specifications and performance of their solution proprietary. Note that this price did not include the cost of a building, shipping from Cape Town to Mzuzu and cold room assembly, which we estimated to be $20,000 USD.

Option 1
10kWp solar / 5kva battery inverter / 15kWh battery
1.75 HP
300mm insulation
Rand 619,295
Discount -30,965
Total 588,330 (USD $40,884 in today's exchange)

Their innovative idea was to increase the insulation thickness of the cold room to reduce the size of the panel array and battery capacity of the solar power system. We also decided to have the systems be tied into the grid as a back-up to the minimalist approach to the battery bank, the batteries being by far the most expensive part of the system. The system needed to be solar powered for two reasons: grid power is expensive and very unreliable in both Zimbabwe and Malawi; it is suitable as a back-up source only.

While the price was roughly half of a containerized solution assembled abroad and ocean shipped, the cold room still needed to be housed in a structure. In Malawi we were able to build a structure that not only housed the cold room, but served as a place to receive, grade, weigh and sell produce (in this case tomatoes) for approximately $12,000 USD. This structure is pictured on the title page of this report. The simple building plan is shown below. In addition, we were able to purchase a good quality cold room with extra thick 200mm polyurethane (best quality, does not absorb moisture) insulation for $7,800 from Cool Africa and ship to Malawi for $1,200 USD. Team Planet designed, sourced and installed the solar power system for $18,204 USD. The total cost was approximately $40,000 USD, about a third less if we sourced the aforementioned similar solution from the South African mini-grid company. Our Malawi partner Malawi Fruits had recently purchased through a PREO grant a 40’ turnkey containerized cold room solution for $86,959 USD plus $11,217 USD for transport from South Africa, insurance, concrete pad, electrical labor. They also had to contract with the Malawi military for crane services.

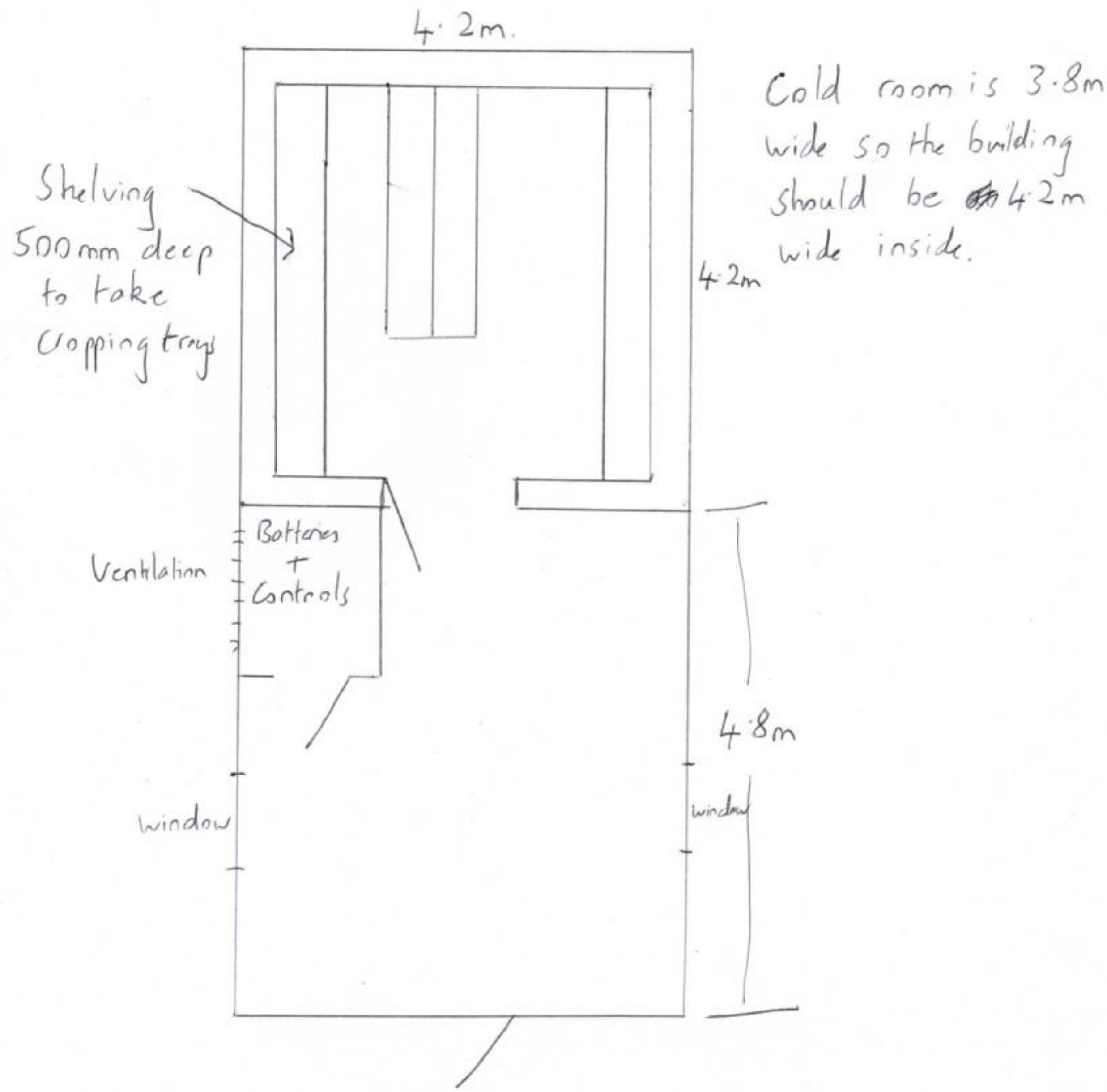

Figure 1. Simple drawing used to guide construction of multi-purpose in Malawi built in just a few months (in contrast to Zimbabwe where it took many months just to produce a CAD drawing)

In comparing our approach to container solutions, we determined several advantages besides a substantial cost saving:

- Containers are not multi-purpose like the brick building in Rumphi, Malawi
- Local materials and labor were used for the building
- The solar + storage system and its installation were also sourced locally
- The brick building provided greater insulation and shading than the metal walls of a container

- Containers need a large crane to unload, not readily available in Malawi
- The insulation of containers cannot not be increased without sacrificing internal storage space

There were also some cons:

- A container can be moved if necessary; the threat of moving it can be advantageous
- A container is somewhat more secure than a building
- A container is easier to import (in Malawi)

We look forward to comparing the performance of the cold room in the purpose-built building with the containerized cool room.

3.7. Finding Viable Partners

In our experience implementing the GreenTech grant, the number one Critical Success Factor is finding the right in-country partner. There are two primary considerations from our perspective:

3.7.1. Compatibility in Working Together

This entails not only a values match, but a “chemistry” communicating and interacting. Perhaps most importantly, sharing a common purpose with similar levels of priority. Sharing the same sense of urgency is perhaps the most difficult to find. While pilot implementation is the primary goal of GreenTech, partners frequently have other priorities that can take precedence. We found that making sure that the pilots have the potential to bring major benefit to partners and is closely aligned with their strategy and business model.

3.7.2. Ability to Walk-The-Talk

Additionally, a partner has to do what they say. Our experience in GreenTech is that there are many Talkers, but relatively few of those Talkers are Doers. When there is a source of funding, Talkers tell you what you want to hear. Doers mean what they say and have the capability to meet their commitments. It is somewhat hard to distinguish between the two at the onset, but it is quickly revealed in the early stages of working together. Our experience and recommendation is that it is best to take corrective action at the first “red flag” and, if necessary, cut one’s losses at the earliest opportunity.

The solar powered walk-in cooler project provides an illustrative example. Both Zimbabwe and Malawi are known to be notoriously difficult countries to work in, but we were able to deploy a pilot in Malawi in record time while efforts in Zimbabwe continue to proceed at a glacial pace and a pilot is months, if not years, away. The differences can be attributed to a variety of factors, but in our observation the principal difference is the will of the partner combined with their competence. Although there are many difficulties and obstacles in both countries, there is always a way to get things done by the country-savvy operator who has strong desire and determination, as well as continually acting upon it with know-how.

After parting ways with our initial partner in Zimbabwe, we have joined forces with sister *IFAD grant SIRP* (Smallholder Irrigation Revitalization Program) who were working with NGO TechnoServe and the Zimbabwean governmental agency AGRITEX. (“The Department of Agricultural, Technical and Extension Services (AGRITEX) is the Zimbabwean government's principal extension agency and the largest public rural intervention agency with representatives at the national, provincial, district and village levels.”) The project we’re contributing to is, hopefully, supplying two cool stores to a cluster of smallholder cooperatives near Gweru. One near the farms at Insukamini and one at Linfield Farm, the off-taker in the town of Gweru, providing a complete cold chain for smallholder produce grown for the European export market. It is both a showcase and landmark project that one would think everyone would be motivated to implement as well as take advantage of available funding. After visiting the country in May 2021 and meeting with stakeholders, we quickly engaged a cool room partner *Ref-Air* in Bulawayo and solar design and installation partner *Solar Shack* in Harare with a timeline to install the systems in July and October. As of December 2021, minimal progress has been made as we (SunDanzer, Ref-Air, and Solar Shack) are still waiting. As a telling example of the many delays in the project, we are still awaiting the final draft of the MOU we submitted to SIRP in the summer (follow-up emails went unanswered). We attribute this poor performance to one main cause: no one is committed enough to pay attention, drive this project and problem solve every obstacle that comes up. It is, in our opinion, a classic case of Talkers vs. Doers. Our belief in the merit of the project and compassion for the plight of the people are the principal reasons we remain engaged, albeit with low expectations.

The previous endeavor is in complete contrast to Malawi, where our effort began at the same time and we now have a functioning cold store in a newly constructed, purpose-built brick building. It was our very good fortune to be introduced to Kevin Simpson, the CEO of NGO *Malawi Fruits.* Malawi Fruits have a project that empowers women in the North to grow high quality tomatoes in greenhouses (refer back to Photo 2) and their social enterprise subsidiary Modern Farming Technology (MFT) acts as the off-taker, distributing the produce under the Malawi Fruits brand. The greenhouses are rent-to-own by women, allowing them to fully participate in the agri-economy even when they don't have access to farmland. In 2020, MFT established the first solar powered chill store in Northern Malawi to enable crops to be chilled when harvested from the greenhouses and irrigated land. The chill store, based in Mzuzu, acts as an aggregation point for fruit and vegetables, extends shelf life by up to 14 days, and acts as a wholesale market to a variety of buyers in the city.

MFT, as part of its function to provide access-to-market, needed a cold room to store tomatoes and other vegetables at its Rumphi office, its northernmost facility. The cold room would enable it to keep and sell produce locally as well as preserve quality until a truck arrives to take the produce to market, significantly reducing post-harvest losses. This chill store will complement the one in Mzuzu and allow an expansion of greenhouse farming in a 25km radius of Rumphi. While the facility is connected to the grid, power is both intermittent and relatively expensive. Therefore, a solar powered cooler with battery storage is the most reliable and economical solution with the grid serving as back-up. Rather than implementing a containerized solution, Malawi Fruits, since it owns the land, wanted to build a building to house the walk-in cooler as well as provide covered space for sorting, weighing, selling and housing electronics and batteries. A site-built approach also has the added advantage of being able to implement thicker insulation for the walls to be able to reduce the amount of battery storage required and thus lowering cost. We were delighted to contribute the chill store for Rumphi.

An agreement was drafted and signed in a matter of days in late May. The cool store and solar + storage system were specified and quotes were solicited immediately afterward. Funds were dispersed shortly after quotes were approved and equipment ordered. Plans were drafted for the building and construction began in August while MFT waited for the equipment to arrive in-country. Malawi Fruits Development Executive Atusaye Kayuni capably addressed issues as they came up. For example, when the flat pack cool room was held up in customs by the Malawi Revenue Authority, he traveled to Lilongwe to prove the cold room was for agricultural purposes and got the hostage cool room released without paying VAT. Moreover, Atusaye was able to effectively coordinate construction, deliveries, Team Planet and a refrigeration technician (the latter two having to come from distant Lilongwe). Our positive experience in

Malawi, from initial discussions to working solar powered cold room in seven months, now serves as the benchmark for what is possible.

Photo 5. Another view of the multi-purpose building and solar powered cold room in Rumphi, Malawi

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