Attachment 1
Energy Free Cool Storage

Purpose: The purpose of this document is to elaborate on questions posed in the comments section and provide additional clarification on key aspects of Energy Free Cool Storage.

Topic Overview:

(1) How will farmers find out about this product?
(2) How will farmers pay for the product?
(3) Prototype status
(4) Soil temperature data and details

Topic 1: How will farmers find out about this product?

As explained in the Beneficiary Feedback phase, the model that we will be prototyping is aimed at community aggregators who will rent out the cold storage to farmers. Through iDE Zambia (where two team members have professional connections), there is a network of aggregators that are trained as Farm Business Advisors (FBAs). These FBAs are rural-based community members who are highly trained by iDE field officers in selling inputs, providing extension services, serving as aggregators to sell bulk amounts of produce to markets, and many more services. Then, FBAs are linked to key private sector players, such as seed suppliers and buyers, and they make commission from the private sector on services performed on their behalf. Each FBA has on average 80-100 farmer clients in his/her community that s/he serves. iDE Zambia currently has over 250 FBAs throughout the country and this number is growing rapidly. The FBA network will be our primary channel of getting the word out to farmers. We will prototype the first model with a number of FBAs, and after proof of concept is developed, we will market the technology to other FBAs and farmers throughout Zambia to scale the business. We will also use channels such as local radio, and adverts on relevant platforms to get the word out to farmers and aggregators about the technology, but these will be secondary to the FBA network, which is our biggest advantage in bringing this product to market.

Topic 2: How will farmers pay for Energy Free Cool Storage?

There are two payment models that have to be considered for this technology. One is around the aggregator (who in the beginning stages will be an FBA as well) who will purchase the technology, and the other is around the farmer, who will rent space in the technology. The most important and likely most challenging payment model to determine is that around the aggregator. There is the more traditional route of partnering with Micro-Finance Institutions (MFIs) to provide loans to aggregators which are paid back over time, but these usually have high interest rates and are structured wholly to benefit the institution and not address the needs of the consumer. Taking that into account, there are two options that should be prioritized for pilot in the distribution of this technology.

a. In this model, the technology is not bought directly by aggregators, but instead by bulk produce buyers. In this model, the bulk buyers would sign a supply contract with the aggregator to buy a stated amount of produce by a stated date. The EFCS business team would ensure that the right pieces are in place to allow aggregators to meet these amounts, such as extension support, seeds, fertilizers, and equipment. Then the aggregator would pay off the technology (for very low or no interest) to the bulk buyer through the payments made to the aggregator for produce. After the payment period has ended, the aggregator would be the rightful owner of the technology. Models such as this where bulk buyers are paying for the cost of technological inputs are becoming more and more common in Zambia, and this could be a viable financing model for the EFCS. An added benefit is that the aggregator would have a secure market to which to sell his/her produce, reducing loss even further.

b. In this model, the technology is given to the aggregator on receipt of a down payment, and paid back to the EFCS business team over a mutually agreed upon term. This again assumes low or no interest, depending on the design of the payment terms, and would again include the EFCS business team linking aggregators and farmers to the required inputs to successfully build their income through produce.

For farmers, the prices they would pay will be affordable for them (such as 2 ZMW - 5 ZMW per crate of vegetables). This would mostly likely be paid to the aggregator at the time of sale of produce. This speaks to the design principle of making these technologies extremely affordable, and more than that, extremely durable. Aggregators will see the most value in a product that lasts 5+ years and can bring in return on their money in 2 years or less.

In terms of pricing of the EFCS, the price point will depend on various items, such as unit size; required depth (location-specific); availability of existing/used/reclaimed components that can be incorporated into the design (for instance, the model of shipping container farms uses a commodity shipping item readily available during global economic downturns or import/export imbalances); and structural and materials engineering input. This would allow us to determine the appropriate design and strength so as not to over-engineer and thereby save costs.

However, using underground storm shelters, pre-existing structures that could be converted (water storage containers or shipping containers), or pre-fabricated ground fridge designs as a proxy for potential costs, our target price-point would be under $5,000 USD for the first model – then we would work to reduce this price as we develop smooth manufacturing processes. In analyzing this high capital expenditure, it is important to consider extremely low operating costs, the potential for shared costs/rents, payment plans which spread the costs over time, and the increased value of agriculture outputs created by a technology of this scale.

Topic 3: Prototype status

We have not been able to build our first prototype yet as we have not yet obtained funding. As we work to obtain funding, we have been researching all aspects important to creating prototypes - such as looking as possible roof types and structures to adhere to soil pressure and subterranean soil temperatures in Zambia; getting farmer and expert feedback on prototype design; identifying what building materials could be produced locally here in Zambia and what would need to be imported; scoping out locations to serve as our prototype hub, etc.

Topic 4: Soil Temperature Data and Details

While we have not been able to conduct a subterranean soil temperature experiment in Zambia because we do not have financial resources (and updated subterranean soil temperatures are not available), we are using data from academic journals, previously conducted experiments, and underground home resources to estimate temperatures for early-stage planning purposes. At about 2 meters below the surface, ground temperatures will fluctuate seasonally almost with air temperatures (this information was confirmed by a U.S.-based geotechnical professor). However, at lower depths -- 3 to 4.5 meters -- ground temperatures generally stabilize around the mean annual air temperature. In an earth-sheltered home journal, a yearlong test showed the differences in ground temperatures at depths of 2.5, 5, 7.5, and 10.5 feet below the surface. The results demonstrate that there is a marked difference between 2 and 3 meters and at each interval their sensors tested. Thus, our Zambia prototypes will likely be over 3 meters below the surface, depending on the specific installation location. Initial testing might find that even lower depths are required for stabilization closer to 10-14 degrees C. In other African countries, the installation could be successful much closer to the surface at 2 to 3 meters.

In fact, data published by Olgun and McCartney's 'Outcomes from Thermoactive Geotechnical Systems for Near-Surface Geothermal Energy: from research to practice' demonstrates the clustering of subterranean ground temperatures at 10.6 degrees C, the average annual temperature for the study's l approximately 4.5 meters or below. Of course, the average temperature in Zambia is higher than Virginia, so the storage temperatures will be higher at the same depth. That being said, it is important to take into account our key crops targeted with this technology (with one of the biggest crops being tomatoes), and to note that many of these crops suffer from storage temperatures below 10 degrees C for a period longer than 6 days. These are all things we are taking into consideration.

We are also looking into additional low-cost features, such as above-ground tents over the storage area, that help to maintain cool temperatures during months with high levels of sun and heat. We have already identified one key resource through the IDEO challenge who we will be in touch with to discuss further possibilities regarding this.

A key component, in addition to just the temperature figure, is the stability of temperatures and humidity levels that can increase the storage life of produce long enough to sell. Even at temperatures higher than 10 degrees C, the stabilization of temperatures and humidity will increase the quality and life of post-harvest outputs.