VacSeeing Green

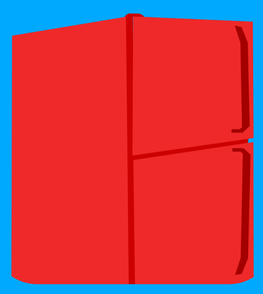
Grid-Independent Vaccine Refrigeration in Uganda

Colin Ancalmo (ME), Eva Bove (CHE), Manasi Danke (CS), Aislinn Harte (ME)
Advisor: Professor Brian Savilonis (ME), Professor Geoffrey Pfeifer (HUA)

Abstract

Vaccines save millions of lives each year and are instrumental in helping humanity thrive. People in underdeveloped regions such as Uganda, however, lack access to vaccines. When non-governmental organizations bring vaccines to villages, such as Arua and Tororo in Uganda, it is difficult to refrigerate the vaccines since these areas are very poor and lack access to electricity. We propose implementing the solar direct-drive compression system, a pragmatic and sustainable solution that can mitigate the issue of vaccine spoilage.

Refrigeration Systems



Domestic

- Requires constant electricity
- Unreliable internal temperatures

Biomass Absorption

- Pressurized gas phase-change system requiring concentrated heat
- Open flame produced by burning biomass

Vaccine Carrier

- Currently utilized
- Insulated cooler using frozen gel
- Not a permanent solution
- Refrigeration lasts 48-96 hrs

Solar Compression

- Solar energy utilized to run compressor
- Direct-drive functions 3-10 days without energy

Background

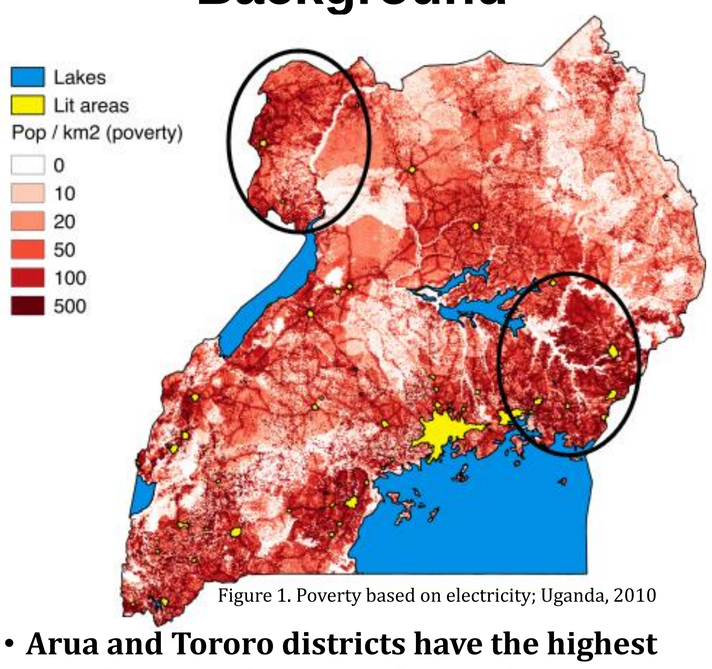


Figure 1. Poverty based on electricity; Uganda, 2010

- **Arua and Tororo districts have the highest population and poverty density.[1]**
- **Both have less than half the immunization rates of Kampala.[2]**
- **Number of health facilities are much lower than the country's capital.[3]**

Problem

Uganda needs Vaccination

The vaccine-preventable pneumococcal disease alone claims the lives of over 24,000 children each year in Uganda itself.[4]

Vaccines needs to be regulated to between 2 to 8 degrees Celsius to prevent them from spoiling and becoming impotent.[5]

Conventional refrigeration needs Electricity

BUT: **Uganda lacks proper electrical infrastructure**

It is difficult for non-governmental organizations to refrigerate vaccines in poor areas that lack access to electricity.[5]

Uganda needs grid-independent refrigeration

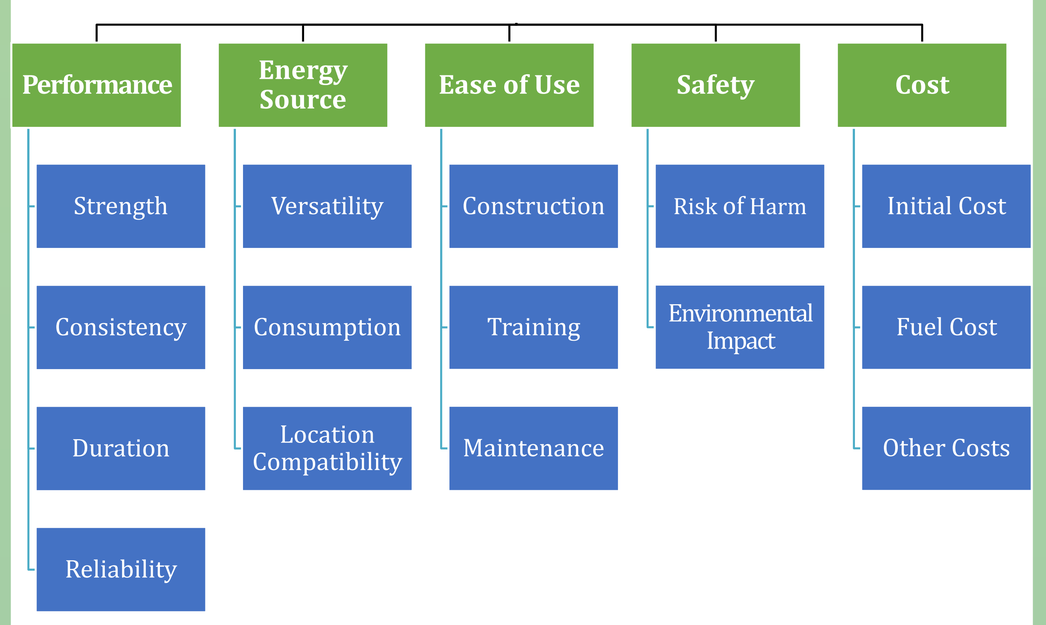
Methodology

We utilized a decision matrix to quantitatively determine which selected refrigeration system would be most beneficial for vaccine usage in the districts of Arua and Tororo in Uganda. Each system was analyzed in five categories of characteristics, each scored on a scale of 1-10, 10 being desirable.

Matrix System Scoring

Systems:	Vaccine Carrier	Solar Compression (Direct Drive)	Absorption Biomass	Domestic
Performance (x4)	4	9	6	2
Energy Source (x3)	4	7	8	2
Ease of Use (x2)	9	3	2	7
Safety (x2)	8	9	2	7
Cost (x1)	9	5	8	7
Total	71	86	64	49

Matrix Category Breakdown



Results

- **The best system is the Solar Direct-Drive Compression System.**
- **Solar compression scores low for ease of use, but scores the highest in terms of performance -the most important category to prevent vaccine spoilage.**
- **Solar has higher cost, more efficient than traditional or absorption refrigerators.**
- **This system is compatible with Arua and Tororo's sunny climate and can be implemented effectively.**

Recommendation

- **World Health Organization and PATH should share the overall benefits of using the solar direct-drive compression system.**
- **Replace traditional vaccine carriers by implementing solar compression refrigeration in more HCII and HCI areas for better, safer coverage.**

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