

Solar Cold Hubs

The innovative technology Cold Hubs is a modular, solar-powered walk-in cold room, for 24/7 off-grid storage and preservation of perishable foods. The system is designed to address the problem of post-harvest losses in fruits, vegetables and other perishable foods. Cold Hubs can be installed in major food production and consumption centers such as food markets. This technology allows for farmers to extend the freshness of their harvest from approx. 2 days to 21 days. The foods are placed in clean plastic crates which are stacked inside the cold room for a daily fee.



1. Background

1.1. Technology

The solar powered walk-in cold room is made of 120mm insulating cold room panels to retain the low temperature. Energy from solar panels mounted on the roof-top of the cold room are stored in high capacity batteries which feed an inverter which in turn feeds the refrigerating unit.

1.2. Food Security in Nigeria

Nigeria is the most populous country in Africa and the seventh most populous country in the world¹. The agricultural sector contributes to 40 percent of Nigeria's GDP and employs approximately two-thirds of the country's total labour force². However, there are many issues affecting the agricultural sector, leading to severe implications.

Although 71 million hectares is estimated to be cultivable land, only half is currently used for farming. An additional issue is that merely 7 percent of irrigable land uses irrigation techniques: most of the small farms are depending on seasonal rainfall². These have however become more unreliable as climate change heavily affects the agricultural sector. Droughts are common in the north, while erosion and flooding are major problems in the south². This increases the vulnerability of the population, particularly in rural areas³.

In addition, lack of cold storage leads to enormous food losses in an already fragile situation. Although Nigeria produces 23 million tons of fresh fruit and vegetables each year, post-harvest losses reach up to 45 percent. This adds to the food insecurity in the country and leads to significant income losses for about 50 million smallholder farmers.

Poverty affects more than half the population with over 60 percent (around 110 million) living under the poverty line¹. The lack of job opportunities is at the core of high poverty levels, of regional inequality, and of social and political unrest in the country³.

The 2018 Global Hunger Index ranks Nigeria 103rd⁴ out of 119 qualifying countries. With a score of 31.1⁵, the severity in Nigeria is stated to be serious⁶. As such, Nigeria is one of the world's most food-insecure countries⁷. Population growth is further threatening the food production, as it demands more resources².

1.3. The Project

Eleven solar cold hubs have been installed in Nigeria, including three on markets in Owerri, Orlu and Obowo (all in Imo state), and two on cooperative level in the Kano region. The technology has been developed by the ILK Dresden and installed by the Smallholders Foundation. The Nigerian company ColdHubs supplies markets and cooperatives with the cold rooms. The pilot project has been implemented in the framework of the initiative “Powering Agriculture—An Energy Grand Challenge for Development” (PAEGC)

This summary represents the findings of an analysis of the financial viability of the solar cold room. It is crucial to assess whether the implementation of Cold Hubs is financially profitable without external funding in order to ensure its upscaling potential. If so, it would be an important and sustainable innovation to minimize food waste, increase farmer incomes and reduce environmental impacts: being a sustainable solution for the future to come

Each Cold Hub has the capacity to store approximately 2 tons of perishable food (150 crates). The two Cold Hubs analysed exceeded the maximum storage capacity by 161 crates on average. This maximum capacity was in general filled by 3 to 4 customers. Most of the users used the rooms intermittently: The majority used the cold room once a month and less than 10 percent (4 out of 44) were storing products more than five times per month.

With roughly 429 markets in Nigeria, there is a large potential market. One of the analysed cold hubs in the Relief market indicated to have 45 monthly customers, of which 30 were regular. However, since the area hosts at least 100 fruit- and vegetable traders, the solar cold room would not have the capacity to accommodate them.

The current cooling fee of 100 N/crate (approx. 0, 27 USD) was seen as acceptable by the interviewees. The initial cost for installing a cold hub varies between \$28,500 and \$33,500, depending on what kind of financial model is used. In addition, a viable scenario analysis indicate that these cost may further decrease or increase depending on how the cooling fee, interest rate and equity financing is adjusted.

2. Business Model Analysis

In order to assess the financial profitability of Cold were evaluated the current ownership model as well as a potential third-party/user- and a franchising model).

2.1. Status Quo: The Ownership Model

ColdHubs currently operates under an owner-ship based business, meaning the supplier ColdHub both owns and operates all facilities. In this business model, based on the key performance indicators, the initial investment of 28,500 USD is profitable (Table 1). The utilization rate of 110% reflects the high productivity, exceeding the theoretical full capacity of the Cold Hub. The financial model revealed that the investment would be profitable as long as the utilization rate is above 94%. The current high productivity only adds to the viability of the innovation.

At the moment, extensive use leads to a faster discharge of the batteries compared to the usual durability of six years. However, even when battery replacement is assumed after every three years, the Internal Rate of Return (IRR⁸) still exceeds 40% which adds to the robustness of the business model and proves the profitability of the innovation.

Internal Rate of Return (IRR) after 20 yrs.	48%
Debt Service Coverage Ratio (DSCR)	1.36
Utilization Rate	1,1

Table 1: Key Performance Indicators based on ownership model (Own composition)

2.2. Alternative Business Models

Profitable but Investors Are Reluctant Due to Higher Risks

In a **third-party/user** model, the users would purchase the cold hub and finance it through either a loan (bank/supplier), alternatively through a lease-to-own model where they would pay a monthly leasing fee to the supplier Cold Hub. The initial investment/selling price would be 33,500 USD in order to secure a profit margin of 17.5% to the supplier Cold Hub. This would result in decreased key indicators for the new owners (Table 2). The Debt Service Coverage Ratio (DSCR)⁹ would be brought down under 1, making bank loans implausible.

Internal Rate of Return (IRR) after 20 yrs.	41%
Debt Service Coverage Ratio (DSCR)	0.79
Supposed Utilization Rate	1.1

Table 2: Key Performance Indicators based on Third Party/User model (Own composition)

In order for this model to be more attractive for bank investors, the sensitivity analysis offers a range of solutions including raising the cooling fee price, gaining specific interest rates on loan/leasing fees and increasing the down payment of the initial investment (equity financing). These measures would make the business model more profitable.

A franchising model would mean Cold Hubs leasing the branding and technology to franchisees, who then would operate the hubs and collect the cooling fees. This business model would allow faster upscaling. However, the franchising model would result in a lower profitability (IRR) from the franchisees standpoint (Table 3).

Internal Rate of Return (IRR) after 20 yrs.	39%
Debt Service Coverage Ratio (DSCR)	0.74
Supposed Utilization Rate	1,1

Table 3: Key Performance Indicators based on Franchising model (Own composition)

In order for this model to increase the DSCR, the sensitivity analysis suggests reduced investment costs combined with higher cooling fees. Alternatively, the franchisees could increase the down payment or raise the cooling fees to 130 N/crate.

3. Conclusion

In general, the financial report shows a promising future with upscaling potential. The financial analysis shows that all three business model scenarios are profitable. However, both alternative models result in negative DSCR which means that banks would be reluctant to invest in the innovation due to its higher risk. Therefore, the ownership model remains the most viable one. Nevertheless, the sensitivity analysis presents some alternatives which would enable the implementation of alternative models for a faster upscaling. In particular, the franchising model would accelerate the expansion. One possibility would be the increase of the cooling fees – this would be feasible, taking into consideration the potential earnings from decreased food waste and higher selling prices from fresh foods.

Business Model	IRR	DSCR
Ownership: <i>ColdHub owns all facilities</i>	48%	1.36
Third Part/User: <i>User buys facility and finance the purchase with either bank loan or a leasing model.</i>	41%	0.79
Franchising <i>ColdHub leases branding and technology to franchisees in return for a monthly fee.</i>	39%	0.74

Table 4: Comparison of the three analysed models: The current ownership model and the two hypothetical models (Own composition)

In its' strive to find the most profitable upscaling strategy, the sensitivity analysis suggests a **business model mix** combining the current ownership- and franchising model. By combining 100 units based on the current ownership model and 50 units based a franchising model, a moderate upscaling path could be achieved by year 2023.

Learn more about this project

Cold Hubs: <http://www.coldhubs.com/>

¹ World Food Programme, “Nigeria” Accessed Sep. 25, 2019 <https://www.wfp.org/countries/nigeria>

² Food Security Portal, “Nigeria”, Accessed Oct.10 2019
<http://www.foodsecurityportal.org/nigeria/resources>

³ World bank, “The World Bank In Nigeria”, Last modified Apr 09, 2019, Accessed Sep. 25 2019
<https://www.worldbank.org/en/country/nigeria/overview>

⁴ Higher numbers indicates severer hunger situations.

⁵ ≤ 9.9 =Low, 10.0–19.9=Moderate, 20.0–34.9=Serious, 35.0–49.9=Alarming, ≥ 50.0 =extremely alarming

⁶ Global Hunger Index, “Nigeria”, Last modified 2019, Assessed Oct. 10 2019
<https://www.globalhungerindex.org/nigeria.html>

⁷ Famine Early Warning Systems Network, „Acute Food Insecurity: Near Term (August-September 2019) “, Accessed Sep.25 2019. <http://fews.net/>

⁸ The IRR is used to estimate the profitability of potential investments. The internal rate of return is a discount rate that makes the net present value (NPV) of all cash flows from a particular project equal to zero.

⁹ The DSCR indicates how easily the lender is able to pay back the loan. The ratio states net operating income as a multiple of debt obligations due within one year, including interest, principal, sinking-fund and lease payments. The ratio should be above 1, where 1 indicates that there is cash flow to cover 100% of annual debt payments.