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St.Gallen, 14. August 2017

Your ref: 4682 –GEF/UNEP SolarChill

## Project Title: SolarChill B Development, Testing and Technology Transfer Outreach

Duration: June 2016 to December 2018

Submitted to the Local **Authority (Ministry) in Swaziland, Kenia and  
Colombia respectively**

Submitted by

Skat foundation (henceforth also referred to as Skat) on behalf of the  
GEF SolarChill project

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## OBJECTIVE

Implementation of SolarChill B related activities under the GEF project: 4682; SolarChill Development, Testing, and Technology Transfer Outreach in Swaziland.

Facilitation of the procurement, installation and monitoring of SolarChill B refrigerators in Swaziland, Kenya and Colombia.

## PROJECT BACKGROUND

In regions of the world without reliable electricity, preservation of temperature sensitive vaccines and food is problematic. Until recently, the market for vaccine refrigerators in remote areas without reliable electricity has been dominated by kerosene operated units. These refrigerators present a number of problems related to operating costs, effectiveness in maintaining appropriate temperatures, and environmental impact. In remote areas, obtaining kerosene on a timely and consistent basis has proven to be quite challenging and expensive.

In addition, fossil fuel (mostly kerosene but also propane gas or diesel) powered vaccine refrigerators result in greenhouse gas emissions through normal operation and emit toxic fumes that are dangerous to humans when in enclosed spaces. These refrigerators are also more susceptible to catching on fire as compared to electric and solar refrigerators. Finally, many solar vaccine refrigerators that are currently available on the market rely on lead acid batteries to store energy. These batteries are typically the weakest link in solar direct drive systems in developing countries because they break down frequently, especially in hot climates. Batteries are also vulnerable to theft and pose an environmental hazard upon disposal.

### 1.1 The solution: SolarChill

SolarChill is a technology- and product-centred initiative with the mission to create a refrigerator design that mitigates problems arising through the use of fossil fuels (gas or kerosene).

The SolarChill technology uses solar panels directly connected to the refrigerator without the need of batteries. The energy is stored in a thermal storage (e.g. ice-banks) which allow autonomy for at least 60 hours. SolarChill units are environmentally friendlier and have lower life cycle costs, as the combined costs of upfront and running costs, over the reference baseline technology of fossil fuel powered off-grid absorption refrigerators.

The first generation of SolarChill units was demonstrated at the World Summit on Sustainable Development in Johannesburg in 2002. This model for vaccine storage, the so called SolarChill A, is already commercialised.

#### Facts:

**Off- grid installation:** SolarChill units can be installed off the grid as they receive their energy directly from the installed solar panels.

**No batteries:** The unique feature of SolarChill is that the energy is stored with environmental friendly phase changing materials, such as particularly water and ice, instead of in batteries. The stored thermal energy (ice) keeps the cabinet at desired temperatures during the night. Thus, the **sun's energy is captured by PV solar panels** to power a compressor, which runs the refrigeration cycle. For medical appliances, ideally, the appliance will be able to produce ice in ice packs that can be used for carrying vaccines into the field for vaccination campaigns.

**Environmentally friendly:** SolarChill incorporates environmentally friendly Greenfreeze refrigeration technology. Greenfreeze was developed and made freely available to the world by Greenpeace in the early 1990s. Greenfreeze utilizes hydrocarbons for the insulation foam and the refrigerant cycle, and thus bypasses the reliance on ozone layer depleting and potent global warming fluorocarbons, such as HCFCs and HFCs. Additionally, no other hazardous materials such as heavy metals deployed within SolarChill units.

## 1.2 SolarChill B

Taking the next step, the SolarChill technology will be applied to food storage and small commercial business refrigerators. The new type, SolarChill B, offers access to refrigeration and food preservation to people living in off-grid regions who previously had no access to this technology.

SolarChill B will not need to undergo the same level of rigorous testing and certification standards as required for WHO PQS pre-qualified vaccine refrigerators SolarChill A and will thus target the potentially larger household and light commercial market segments.

The introduction and advancement of both SolarChill models represent a strong value proposition for manufacturers and investors to consider for multiple market segments.

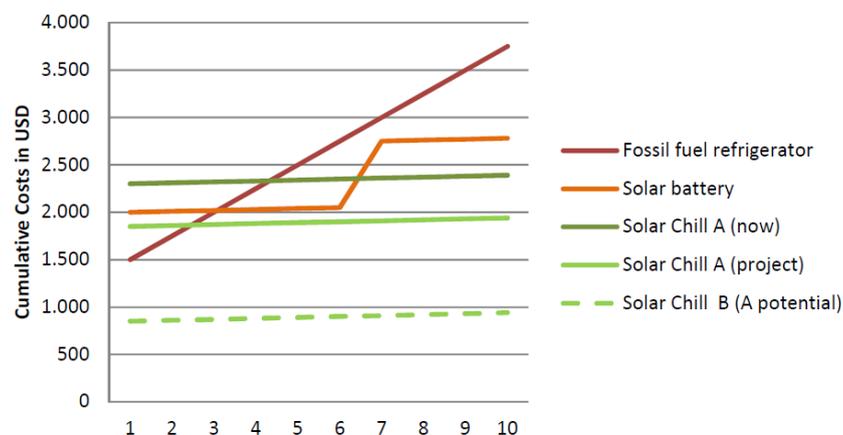


Figure 1: Comparative cumulative costs of conventional and SolarChill refrigerator over lifetime.

## The GEF SolarChill project

The aim of the GEF SolarChill project is to bring the SolarChill technology to a broader breakthrough, that it finally reaches a much higher market penetration for the health market as well as for the domestic and small business market with the focus on off-grid areas.

Even though SolarChill A units have reached higher market penetration, there has not been a coordinated monitoring and evaluation program of these units. Solar direct driven refrigerators lack a standardized field testing procedure, to clearly demonstrate across different countries and climate zones, and across different brands that the technology is working in a technical reliable way.

The project promotes the objectives by deploying solar-powered vaccine refrigerators (SolarChill A) and solar-powered domestic/ small commercial refrigerators (SolarChill B) in three countries (Kenya, Swaziland and Colombia) and by monitoring of their performance. The monitoring data will be used by the SolarChill project for outreach activities, primarily in developing countries, with the need for off-grid solutions mainly in the global sun-belt region. The results will be used to proof that the SolarChill technology is robust and run reliable in different climatic zones.

### **1.3 SolarChill B within GEF**

The results of the field tests will further be used to provide valuable feedback to SolarChill producers both for enhancing the properties of Solar Chill A units and for the R&D and design of SolarChill B units.

Several refrigerator manufacturers already have expressed interest in producing the SolarChill food refrigerator. This product requires further testing and optimization but it is estimated that the potential global market for the SolarChill food refrigerator is much larger than that for the SolarChill vaccine cooler, as it has applicability for domestic, commercial use.

The data will be used to develop calibrated promotional material, based on actual performance and user experience to promote market supply and demand. It is targeting at key stakeholder critical for the supply and demand of solar refrigerators including manufacturers, distribution-service companies offering SolarChill appliances and pay-as-you-go financing scheme and supporting government and non-government institutions.

#### **1.3.1 Marketing and outreach activities in project countries and globally**

The project will support partnering manufacturers in Swaziland and Colombia with their outreach campaigns. The scope of the project involves the three countries partners (Swaziland, Kenya and Colombia) Connect manufacturers with supporting micro-financing facilities. It is planned to engage with at least one micro-financing organization a pilot scheme for the distribution of SolarChill B units.

Capacity building is envisaged with government ministries and initiatives for rural development as well as to establish connections with NGOs.

#### **1.3.2 Co-development Initiative**

The GEF SolarChill project is promoting the development of SolarChill commercial units through a Call for Proposal and Co-development Initiative. Pioneering manufacturers and developers are requested to submit their proposals in a co-development of SolarChill domestic & commercial fridges.

There is a growing demand for ice-lined battery free SolarChill refrigerator worldwide. The GEF SolarChill supports the development of these units through defining uniform high-quality performance standard, lab and field testing the refrigerators under uniform conditions.

The participating manufacturers will benefit in multiple ways:

- Gain recognition through participation at the SolarChill Partnership Initiative
- Testing their product under uniform lab and field testing conditions
- Financial support on the deployment of the unit under field test conditions in Kenya, Colombia and Swaziland
- Participation and recognition in published field testing report
- Receiving a certificate on the successful testing of their units

Qualification for this project is achieved via a prototype tested by Danish Technological Institute (DTI). This prototype is evaluated and receives a test report.

The success of the first generation of Solar Direct Drive units for medical purposes is obvious, there are more than 15,000 units installed worldwide. The market potential for SolarChill B units is even greater as there are 2.5 billion people in off-grid areas with the need for solar refrigerators.

### 1.3.3 Additional information:

**Manufacturers:** In addition, governments will assist in developing relationships with potential SolarChill refrigerator manufacturers and distributors. Stakeholders will assist in disseminating awareness materials developed to educate on the benefits of SolarChill and promote consumer uptake of the technology and expansion of production capabilities by manufacturers.

Table 1: Project Results Framework

Description	Indicators	Assumption
Increased availability and use of SolarChill B food refrigerators (for domestic and small-scale businesses)	Number of marketed SolarChill B refrigerators and available brands.	Increased availability of qualified SolarChill B refrigerators will increase accessibility and introduction of SolarChill. Increasing introduction of off-grid efficiency products will lead to reduction in carbon emissions.
Collect design and test information from SolarChill B candidate manufacturers.	Refrigerator specification and test results available.	SolarChill B units that meet test requirements will be available for purchase.

#### Outlook:

As outlined in this document, Solar Chill B units are technical less demanding (lower requirements on combined freezing and refrigeration, temperature control). The cost reduction potential for Solar Chill B units is high. New sustainable market opportunities will be created.

## PROJECT PARTNERS, KEY STAKEHOLDERS AND ROLES

The project is supported through its partners, UNEP, Skat Foundation, Danish Technological Institute (DTI), HEAT (Habitat, Energy, Application & Technology), United Nations Children's Fund (UNICEF), the World Health Organisation (WHO), Greenpeace International, the Gesellschaft für Internationale Zusammenarbeit (GIZ), and the Program for Appropriate Technologies in Health (PATH).

For the implementation of the SolarChill B demonstration in Swaziland, Kenia and Colombia following key stakeholders are identified:

**Country coordination:** HEAT GmbH in cooperation with the local authority in each partner country.

In order to execute the country coordination in close cooperation with the local authority and the country managers (one for each country) were contracted by HEAT. .

#### Key stakeholders:

##### Local Authority (Ministry)

The local authority will vary according to each country, but in all cases, it will be undertaken by a Ministry (Ministry of Natural resources, of environment, of Industry, etc.)

## METHODOLOGY

The GEF SolarChill Project “SolarChill Development, Testing, and Technology Transfer Outreach” promotes the SolarChill technology both for medical and commercial refrigeration. The project focuses on the promotion of the SolarChill development of technology, the technology transfer to cooperating

manufacturing partners, the thorough testing of the technology across different brands and deployment conditions and the dissemination of the technology.

The GEF SolarChill project intends to:

- introduce state of the art, reliable solar direct drive technologies (seek the deployment of several brands in each of the markets for the wider technology diversity)
- fully test SolarChill B units to demonstrate the reliable and cost effective operation of the units under different climatic and operational conditions
- allow the technology transfer from the Solar Chill A refrigerators to Solar Chill B refrigerators with participating manufacturers in Swaziland and Colombia
- fully establish the technology with the local manufacturer Palfridge Ltd./ The Fridge Factory
- allow the sustained and continuous development of the technology, through the support of local manufacturers to allow technology enhancements with the scale up of production, to lower product costs over time through improved R&D, design and sourcing of components, and to reach full commercial competitiveness of solar direct drive refrigerators
- support the increased market penetration of solar refrigerators through supported marketing and financial brokering efforts
- demonstrate a successful, reliable and costs effective use of the technology with reference-able test results

## **1.4 Outcome**

**Procurement, installation and field testing of up to 15 SolarChill B units in Swaziland, Kenia and Colombia.**

### **Output 1.1:**

Demonstration experience and cross-comparison of available SolarChill products (especially SolarChill B units) under field conditions in representative sites to ensure that safe food storage conditions are met.

One of the project goals is to provide meaningful field test experience to position and advance this SolarChill technology in developing-country markets.

Performance and user information obtained through field tests will be incorporated into a broad marketing, advocacy, and communication plans for SolarChill.

So far, a larger field test across several countries and deploying various leading solar direct drive brands has not taken place. This standardized field testing is much needed to have primary data to identify the weaknesses for improvement, and demonstrate the reliability and feasibility of the technology, as appropriate.

### **Output 1.2:**

Support participating manufacturers in their efforts to market Solar Chill units and support their efforts to increase the costs competitiveness of the units.

Participating manufacturers will be supported to improve the business case to sell solar fridges. This will include support through SolarChill with market data and marketing support. Further the project aims to share information and support manufacturers to enhance their R&D and design features to lower costs.

## 1.5 Activities

Following activities will be carried out to achieve above mentioned outputs.

- 1. Site selection:**  
List of potential sites will be provided by Ministry of Commerce, Industry and Trade with former consultation of Ministry of Natural Resources and Energy.
- 2. Site validation:**  
The developed site selection protocol will be used to evaluate the suitability of a site for GEF SolarChill monitoring purposes. Evaluation will be carried out by the country manager in close cooperation with Swaziland Environment Authority (SEA) and MCIT.  
A site selection guide will be shared with MCIT.
- 3. Procurement:**  
The procurement will be carried out through the GEF SolarChill project and the equipment will be sent by the manufacturers.
- 4. Procurement and shipment of units:**  
Skat will be submitting the procurement request on behalf of Swaziland and directly pay for procurement.
- 5. Training on installation, monitoring, maintenance and repair of SolarChill B units:**  
A training on the SolarChill technology for health facility technicians is planned within another outcome of the GEF SolarChill project. A training plan for this is under development. MCIT and MNRE are requested to name representatives to attend a training on the technology to get familiar with it.  
A training on maintenance and usage of the equipment is planned to be carried out on-site during installation.
- 6. Distribution/Transportation of units to selected sites:**  
The units will reach Swaziland at one central collecting storage. From this central storage, the units need to be distributed to the selected installation sites. A specific distribution plan will be drafted, once the units will be available for installation.
- 7. Installation of units:**  
The installation of the units will be carried out by the GEF SolarChill technical country manager in Swaziland.
- 8. Monitoring and keeping track of units:**  
All units installed will be monitored. An automatic remote monitoring system will collect and submit respective data via GSM. The data will be edited and analysed.

## 1.6 Specific request for contribution of the Local Authority (LA)

The GEF SolarChill project intends to be of great benefit to the people of Swaziland, Kenya and Colombia.

The resources to carry out this project, however, are limited. The project therefore kindly requests for a contribution to the SolarChill project by each Ministry. This contribution will be highly appreciated and include the following:

### 1.6.1 Cooperation with GEF SolarChill partners

The Local Authority will cooperate with the SolarChill partnership representatives which include UNEP, SKAT, the Danish Technology Institute, The World Health Organisation, UNICEF and HEAT. HEAT is assigned by SKAT as technical consultant and coordinator for the project's country related activities.

### **1.6.2 Assistance in the provision of a list of potential sites**

All sites selected for the installation of SolarChill B units in Swaziland, Kenya and Colombia will be sites listed with the LA. The LA is kindly requested to provide the necessary information on regions with low electrification or even off-grid.

The LA is kindly requested to provide a list of potential sites for the installation which subsequently will be evaluated on their suitability for unit installation within this project according to the given site selection tool (see **Fehler! Verweisquelle konnte nicht gefunden werden.**). This site selection tool will be used to validate the sites.

### **1.6.3 Signing MoU with Skat foundation**

All units to be procured will be a donation to the Local Authority (LA). The LA will be the official consignee/receiver of the equipment. Skat on behalf of the GEF SolarChill project will be the donor of the equipment including SolarChill B refrigerators and monitoring equipment. Skat will directly pay for procurement of materials on behalf of LA.

A draft of a Memorandum of Understanding will be submitted by Skat.

### **1.6.4 Facilitation of tax exemptions for the procurement of equipment**

The project kindly requests the LA to facilitate the Customs/Tax exemption process since all equipment is donated to the Government of each partner country and people by United Nations Systems (UNEP).

### **1.6.5 Training on SolarChill equipment**

The GEF SolarChill project furthermore intends to support capacity building of country government and faith based technical personnel on the installation, monitoring and maintenance of SolarChill units. The planned training will include capacity building on installation, monitoring, maintenance and repair of SolarChill refrigerators. This training will be mainly carried out by the technical local country manager hired by HEAT. The technicians to attend this training can be determined by the LA.

The project requests the LA to provide a list of technicians to participate the training and , a venue for the training and if possible the travel and accommodation of dedicated technicians to attend the training.

### **1.6.6 Distribution/ In- country transportation of equipment**

The procurement of the selected SolarChill equipment including monitoring is budgeted and will be paid for by the project. This will include the transportation of the equipment to a central collection point dedicated by the LA. The further distribution and in- country transportation of the equipment will be within the responsibilities of the LA. The project therefore kindly requests, that the LA and HEAT/Skat will support the transportation of the fridges and monitoring equipment to selected locations for installation.

A distribution plan will be drafted, once the sites are identified and the equipment is available for installation.

## PROJECT TIME LINE AND IMPLEMENTATION PLAN

The project will be implemented from June 2016 to December 2018. Due to several reasons, the specific implementation of SolarChill B in each partner country was delayed and could only start from January 2017. Following timeline therefore only includes the years 2017 to 2018.

The SolarChill B related activities are currently planned to be carried out according to following timeline:

Table 2: SolarChill B timeline Swaziland

		2017												2018											
Activity		1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4	5	6	7	8	9	10	11	12
1	Site selection	■	■	■	■	■	■	■	■	■															
2	Site validation								■	■	■														
3	Procurement and shipment (once products are available)										■	■	■												
4	Training								■	■	■														
5	Distribution/ Transportation											■	■	■											
6	Installation												■	■	■										
7	Monitoring													■	■	■	■	■	■	■	■	■	■	■	

## MONITORING AND EVALUTION

The project activities and progress will be evaluated following UNEP and GEF requirements for project monitoring, reporting and evaluation processes and procedures, including continuous monitoring of outcomes throughout the project.

This includes meeting minutes, bi-annual progress reports, annual summary progress reports and a final evaluation.

All in-kind contributions of the country need to be reported, the project will provide a template and kindly requests the LA to keep record of any contribution submitted to the project.