

# SolarChill A Development, Testing and Technology Transfer Outreach

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## 1 OBJECTIVE

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

Facilitation of the procurement, installation and monitoring of SolarChill A refrigerators.

## 2 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 possess several 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 challenging and expensive.

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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 catch 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.

SolarChill is a technology- and product-centered initiative with the mission to create a refrigerator design that mitigates these problems. The SolarChill technology uses solar power to run a direct current (DC) hydrocarbon- based refrigerator compressor. Hydrocarbons, used as refrigerants, are safe for the ozone layer and for the climate. The compressor-driven refrigerant cycle freezes an ice bank in the walls of the SolarChill unit. The ice bank and thick insulation enables the unit to maintain the required temperature range for four to five days, even without any sunlight, thus batteries are not needed in the design.

SolarChill offers efficient use of limited solar energy and is free of emissions that may threaten human health or the environment. Finally, the SolarChill consortium has adapted a conventional, mass-produced cabinet to reduce the cost of these units compared to other solar vaccine refrigerators currently on the market, which are typically custom made. Thus, the introduction and advancement of SolarChill models represents a strong value proposition for manufacturers and investors to consider for multiple market segments.

## 2.1 Definition of SolarChill

**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 are deployed within SolarChill units.

SolarChill A vaccine refrigerators included in this project will require WHO Performance Quality and Safety (PQS) approval. PQS has established an industry and country standard for refrigerator performance. Qualification of an appliance requires meeting a minimum set of specifications and independent laboratory tests. WHO PQS approval ensures a level of quality for refrigerators that are used to store temperature sensitive vaccines and essential medicines. By including only PQS approved refrigerators in the GEF project, immediate procurement from the UNICEF Supply Division can take place and countries will be assured of a level of quality set by UN authorities. Thus, adoption of these refrigerators and deployment can be rapidly executed.

### 3 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 A demonstration in Colombia, Kenya and Swaziland. following key stakeholders are identified:

**Country coordination:** HEAT GmbH in cooperation with the local Authority of each country.

**Ministry of Health:** Ministry of Health will be the receiver/ consignee of the SolarChill A units

**Health facilities:** The selected health facilities will be the beneficiaries of the SolarChill A units. Units will be installed within their facilities and serve the purpose of the storage of vaccines.

### 4 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 assorted 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 A units to demonstrate the reliable and cost-effective operation of the units under different climatic and operational condition
- 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
- allow the technology transfer from the Solar Chill A refrigerators to Solar Chill B refrigerators with participating manufacturers in Swaziland and Colombia
- 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

#### 4.1 Outcome

**Procurement, installation and field testing of up to 66 SolarChill A units in Colombia, Kenya and Swaziland.**

##### **Output 1.1:**

Demonstration experience and cross-comparison of currently available SolarChill products (especially Solar Chill A units) under field conditions in representative health centers to ensure that safe vaccine 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.

## **4.2 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 Health
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 the local Environment Authority (SEA) and/or MoH.  
The site selection guide will be shared with MoH.
3. **Unit selection:**  
For the unit selection, a survey tool was developed to evaluate the specific need of a selected site. Additionally, a procurement protocol was developed to ease the process of selection.  
This protocol includes a list of potential units
4. **Procurement request:**  
The procurement will be carried out through the UNICEF Supply Division. A procurement request must be submitted to UNICEF to receive a cost estimate and further initiate the procurement.  
MoH will be the receiver/ consignee of the procured units.
5. **Procurement and shipment of units:**  
Skat will be submitting the procurement request on behalf of each participant country and directly pay to UNICEF for procurement. If there are any balances with UNICEF, it will be directly returned to Skat for the use of the project.
6. **Training on installation, monitoring, maintenance and repair of SolarChill A units:**  
A training on the SolarChill technology for health facility technicians is planned. A training plan will be set up.
7. **Distribution/Transportation of units to selected sites:**  
The units will reach each participant country 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.

**8. Installation of units:**

The installation of the units will be carried out by the GEF SolarChill technical country manager in each country.

**9. Monitoring and keeping track of units:**

All units installed will be monitored. An automatic monitoring system will collect and submit respective data via GSM. The data will be edited and analysed by DTI.

### **4.3 Specific request for in-kind contribution of Ministry of Health**

The GEF SolarChill project intends to be of great benefit to the people of each participant country.

The resources to carry out this project, however, are limited. The project therefore kindly requests for an in-kind contribution to the SolarChill project by the Ministry of Health (MOH). This in-kind contribution will be highly appreciated and include the following:

#### **4.3.1 Cooperation with GEF SolarChill partners**

Ministry of Health 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.

#### **4.3.2 Signing MoU with Skat foundation**

All units to be procured will be a donation to the MOH, MOH will be the consignee/ receiver of the equipment. Skat on behalf of the GEF SolarChill project will be the donor of the equipment including SolarChill A refrigerators and monitoring equipment. Skat will directly pay to UNICEF for procurement of materials on behalf of Ministry of Health and if there are any balances with UNICEF, it will be directly returned to Skat for the use of the project.

A draft of this MoU will be submitted by Skat.

#### **4.3.3 Provision of a list of potential sites**

All health facilities selected for the installation of SolarChill A units in each country will be sites listed with MOH. MOH 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 Annex 1). This site selection tool will be used to validate the sites.

#### **4.3.4 Survey on cooling needs and unit selection**

The GEF SolarChill project requests to hold a survey to identify the cooling needs of the selected health facilities. This survey will help identifying the specific equipment to be procured. The GEF SolarChill project kindly request the facilitation of this survey to take place and to be carried out by the project manager of each country. This step might be skipped to keep the tight timeline of the project.

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

The project kindly requests MOH to facilitate the Customs/Tax exemption process through the MOH, since all equipment is donated to the Government of each participant countries and people by United Nations Systems (UNEP).

#### **4.3.6 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 country manager hired by HEAT. The technicians to attend this meeting can be determined by MoH. It may include technicians in charge of the health facilities chosen under this project.

The project requests MoH 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.

#### 4.3.7 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 MoH (see procurement request). The further distribution and in- country transportation of the equipment will be within the responsibilities of MOH. The project therefore kindly requests, that MOH, in consultation with HEAT/UNICEF/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 and the equipment are identified and the equipment is available for installation.

## 5 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 A in all participant countries were delayed and could only start from January 2017. Following timeline therefore only includes the years 2017 to 2018.

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

**Table 1: SolarChill A timeline**

		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	Unit selection/ Survey							■	■	■															
4	Procurement request								■	■	■														
5	Procurement and shipment										■	■													
6	Training											■													
7	Distribution/ Transportation											■	■												
8	Installation												■												
9	Monitoring													■	■	■	■	■	■	■	■	■	■	■	■

## **6 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 MoH to keep record of any contribution submitted to the project.