



GEF Solar Chill

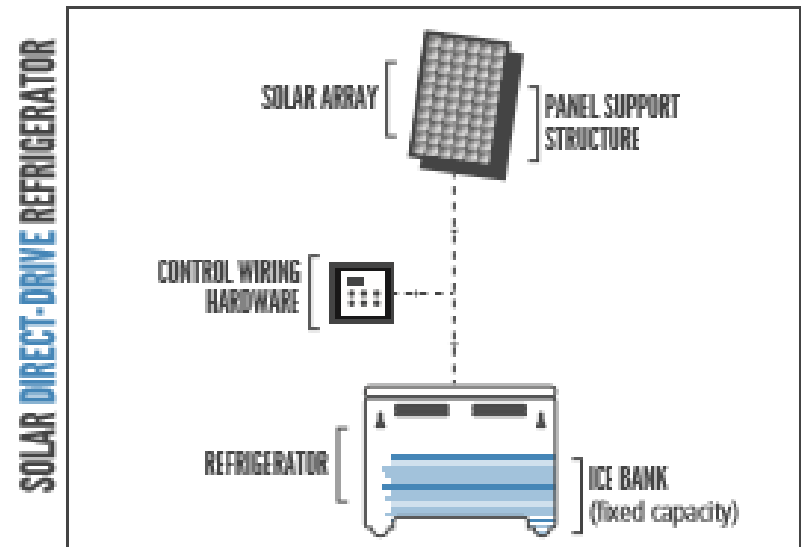
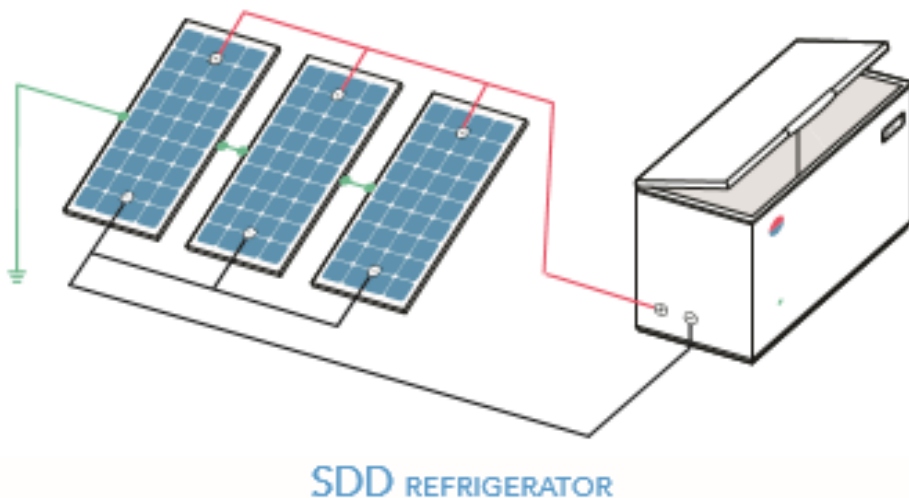
Training Module 1

INTRODUCTION INTO THE SDD TECHNOLOGY



SOLAR DIRECT DRIVE REFRIGERATOR

- No need of battery
- Compressor works only during the day with direct energy from the solar panels, which cools down the refrigerator and the PCM
- The PCM (Phase Change Material) maintain the vaccines cooled during periods without sun





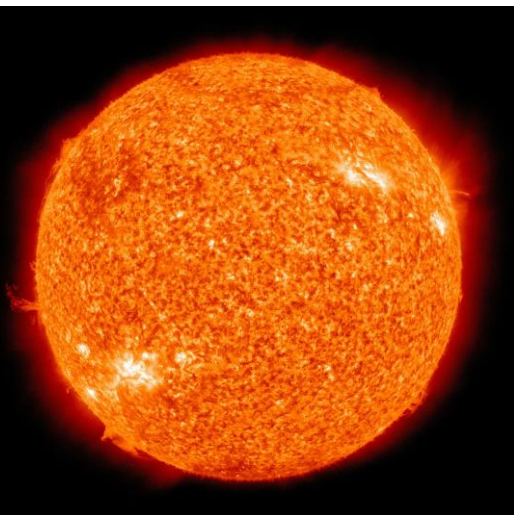
EARTH



FRIENDLY

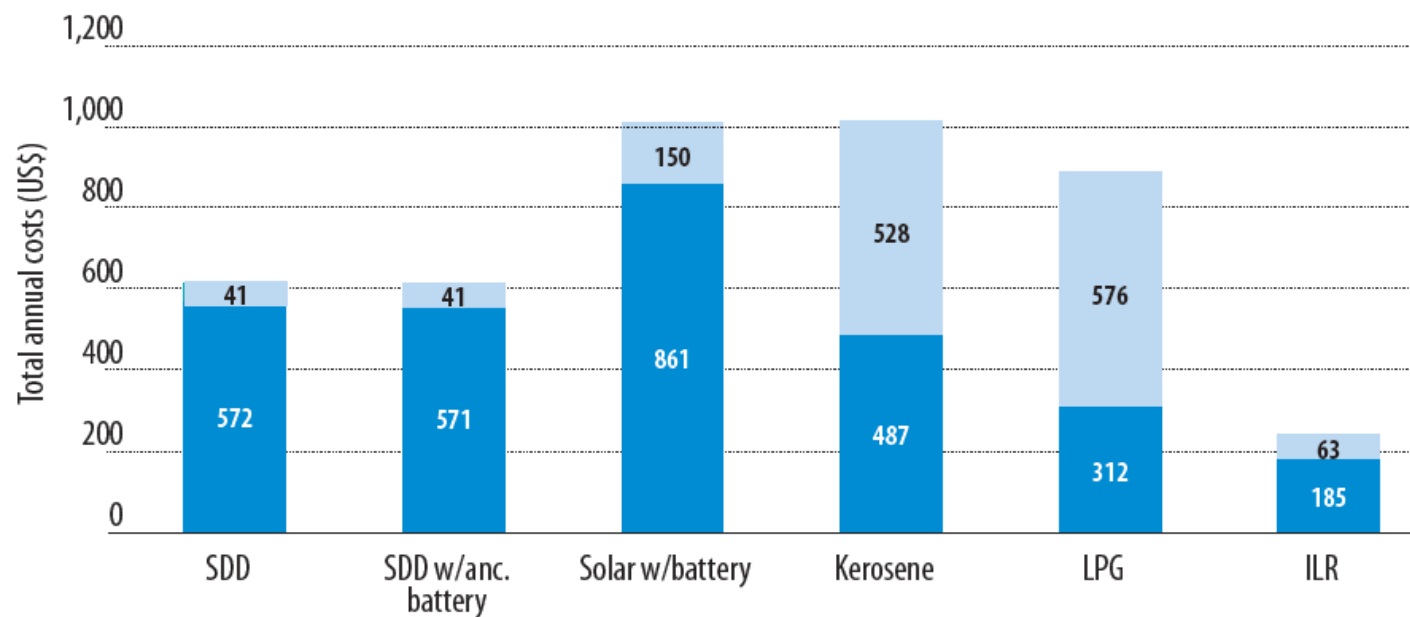
MAIN CHARACTERISTICS OF SDD

- Off-grid installation
- NO batteries
- High autonomy with poor solar irradiation (minimum of 3 days for SolarChill A units)
- Environmentally friendly: Use natural refrigerants and renewable energy to run
- Low Life Cycle Cost



COST OF THE SDD

- Higher initial cost, but low annual operational cost



Acronyms: SDD – solar direct-drive; LPG – liquid petroleum gas; ILR – ice-lined refrigerator.
 Source: Cold Chain Equipment Total Cost of Ownership tool (under development by PATH).

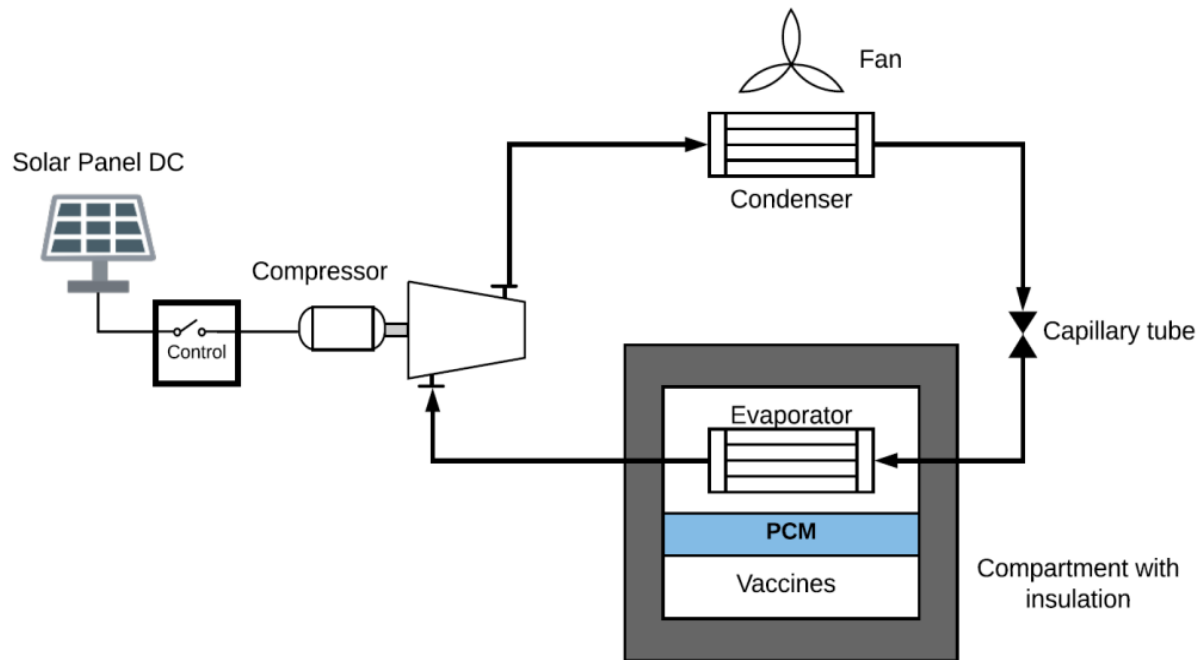
MAIN TYPES OF SDD REFRIGERATORS

- SolarChill A units to store vaccines
 - With frozen compartment for ice pack freezing
 - Without frozen compartment
- SolarChill B units to store food
 - Type depends on application



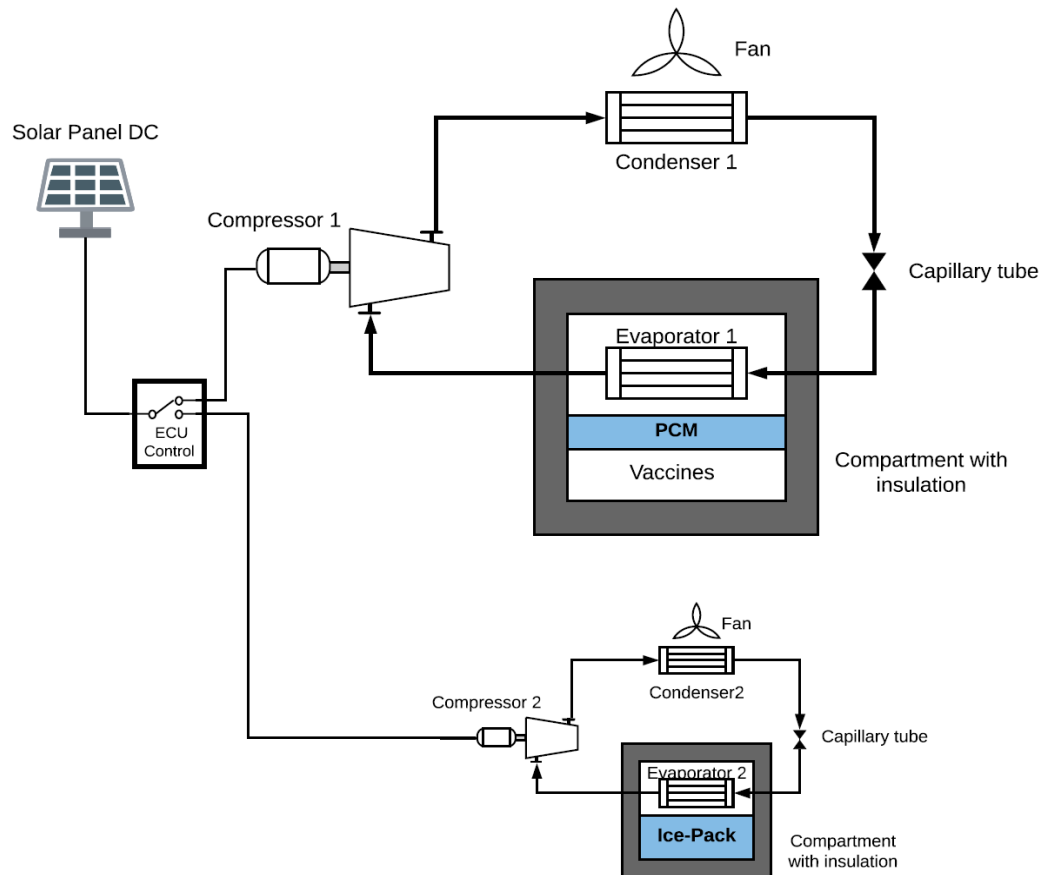
SOLARCHILL A WITHOUT FROZEN COMPARTMENT

- Refrigerant circuit similar to standard refrigerator, but with running with SDD and storing “Cold” in the PCM



SOLARCHILL A WITH FROZEN COMPARTMENT

- Two compartments needed



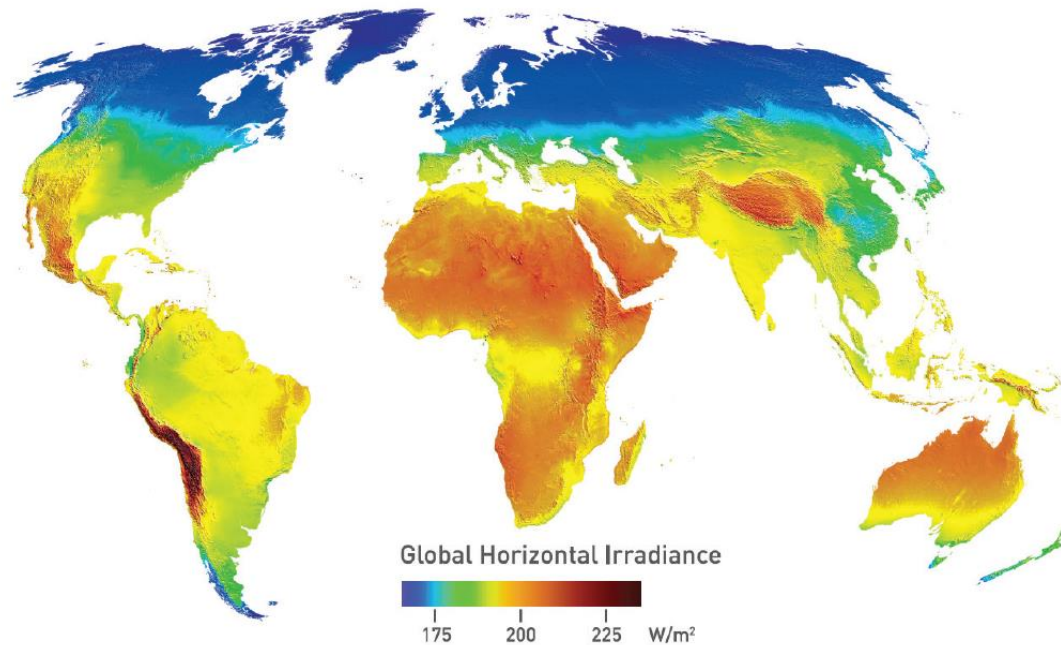


WHO TEST REQUIREMENTS

- Operating temperature: 2°C to 8°C
- Operating at ambient temperatures between 10°C and 43°C
- Minimum autonomy time of 72 hours with poor solar irradiation
- Minimum freezing capacity (if present) of 1.6 kg of ice, or 2.4 kg per 50 liters of freezer gross volume
- Solar module voltage: Maximum 45 V
- Daily energy during laboratory test is 3.5 kWh/m² per day (partly cloudy day)

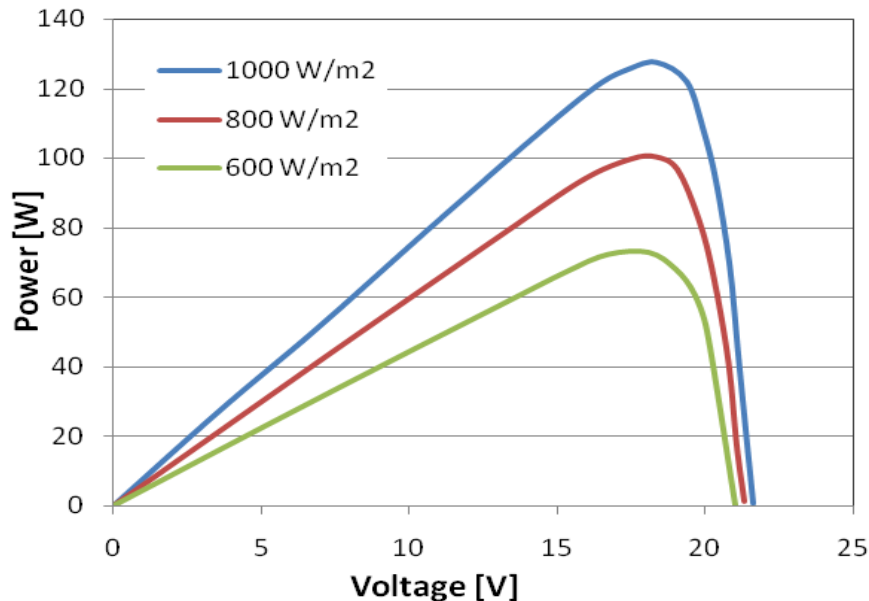
SOLAR SYSTEM

- Even though irradiation changes depending on location, the WHO test is done at 3.5 kWh/m² per day, corresponding to a partly cloudy day



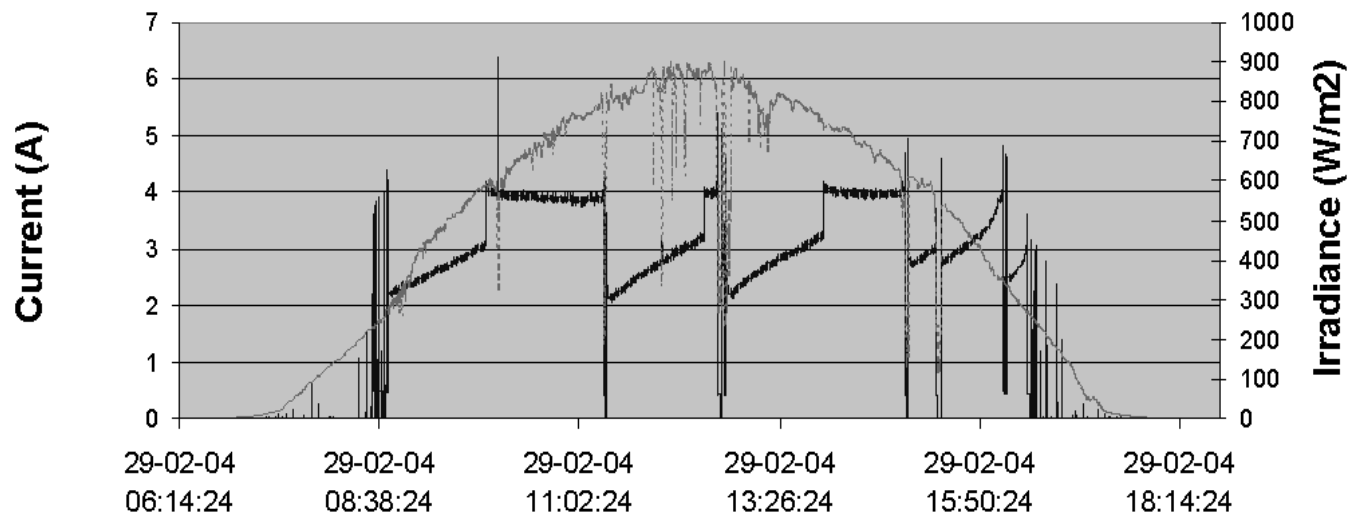
SOLAR SYSTEM

- Irradiation changes during the day, changing the power output
- Solar panel should be sized in such a way that the unit can run normally during a partly cloudy day
- Installation should be done properly



COMPRESSOR

- During the working hours, the compressor will cover both: the cooling during the day and also will have to freeze the required mass of PCM for the nonworking hours
- Special compressor for solar panels: Adapt speed to solar irradiation and solar mode start



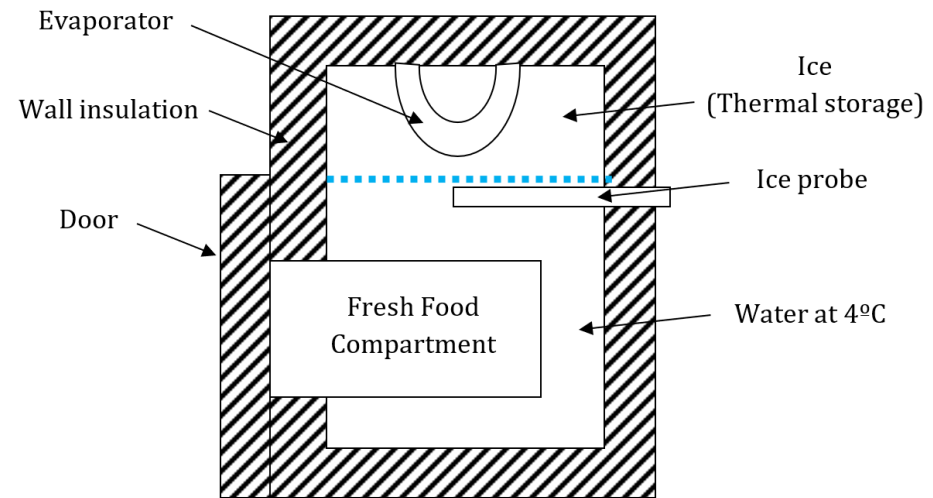
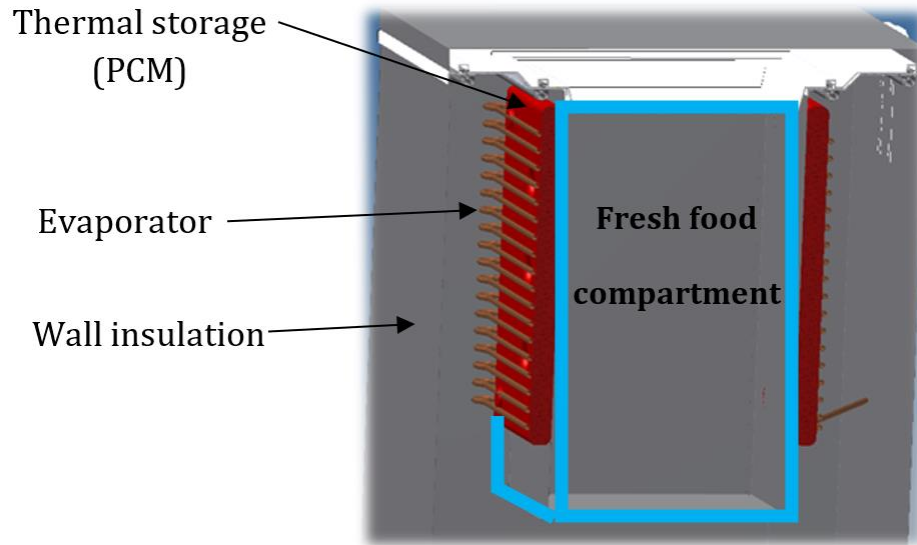


PCM DESIGN (PHASE CHANGE MATERIAL)

- The amount of thermal storage will depend mainly on the cooling demand, the latent heat of the PCM and the specifications for the hold over time (minimum of 72 hours)
- Water is used typically as PCM (latent heat of 334 kJ/kg)
- A unit with good insulation will need less PCM for the same autonomy time
- For a SolarChill B, if goods need to be cooled down during off compressor time, needs to be considered in the PCM amount calculation

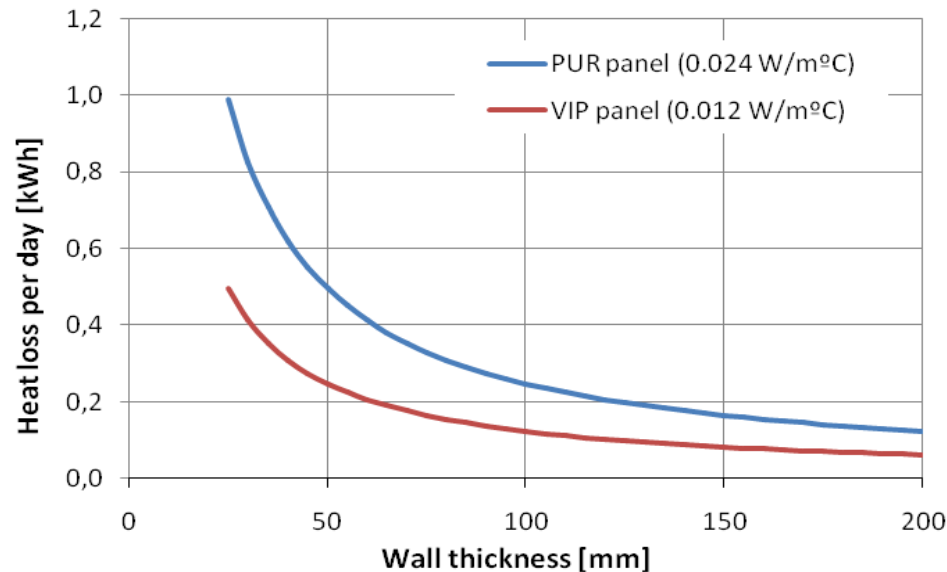
TYPES OF PCM DESIGN

- Two main designs in the market
 - PCM confined in ice-packs
 - PCM is confined in a single volume around the refrigerator compartment



INSULATION

- Heat loss can be reduced through the wall by
 - Increasing wall thickness
 - Using high quality insulation, for instance, vacuum panels
- Reduce heat loss with high quality gaskets
- Chest opening units have less losses during door opening

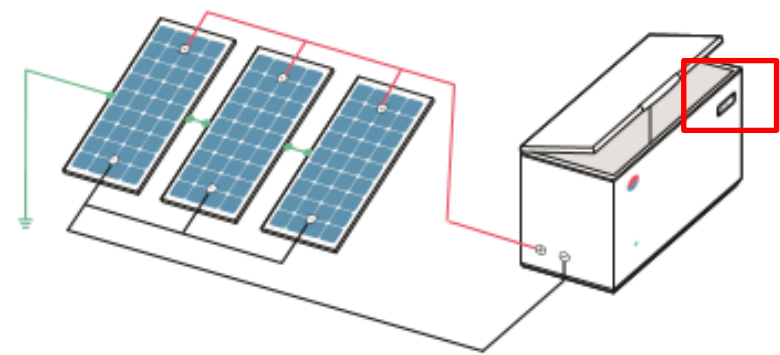


CONTROL OF THE UNIT

- Depends on type of unit
- Allows the control of the unit to be within the required temperature range and froze the required amount of PCM
- For refrigerators with frozen compartment, the control unit should freeze the ice-packs giving priority to the temperature in the vaccine compartment



Photo:www.bmedicalsystems.com




SDD REFRIGERATOR


Photo: unicef

CERTIFIED UNITS

- All units certified by WHO can be found on their website

https://apps.who.int/immunization_standards/vaccine_quality/pqs_catalogue/categorypage.aspx?id_cat=17


PERFORMANCE QUALITY SAFETY



E003: **Refrigerators and freezers**

PQS code: E003/074

Type of appliance: Solar direct drive combined refrigerator/freezer

Manufacturer's reference: HTCD 90 SDD

Manufactured in: China; People's Republic of

Company: Qingdao Haier Biomedical Co., Ltd

Address: Room 703D, Brand Building, Haier Industry Park, No. 1 Haier Road, 266101 Qingdao, China; People's Republic of

Telephone: +86-532-88937169

Email: wenming.wang@haierbiomedical.com

Web address: <http://www.haiermedical.com>

Specifications

Climate zone:	Hot	Min rated ambient temp:	+5°C
Refrigerant:	R600a	Energy source:	Solar direct drive
Appliance tested at:	+43°C	Ext dimensions (HxLxD)	87.5 x 112.8 x 65.4 cm
Performance at:	+43°C	Fuel and cycle type:	Electric - compression
SOLAR DIRECT DRIVE REFRIGERATOR		AND / OR FREEZER	
Vaccine storage capacity (Liters):	37.5	Gross volume (Liters):	32
Gross volume (Liters):	58	Waterpack freezing capacity:	2.08 Kg/24h
		Waterpack storage capacity:	

Photo: unicef



Thank you for your attention!