Gavi
The Vaccine Alliance

COLD CHAIN EQUIPMENT OPTIMISATION PLATFORM

TECHNOLOGY GUIDE

Current as of December 2020

ABOUT THIS GUIDE

This guide aims to provide you with clear advice on new CCE technologies to help you make purchasing decisions. It is intended for use in health facilities and lower levels of the immunization supply chain.

In addition, it overviews the CCE devices that comply with platform requirements, and will help you choose the cold chain solutions that match the needs of your country's health facilities.

IF YOU HAVE QUESTIONS OR IF YOU WOULD LIKE MORE INFORMATION, PLEASE CONTACT CCEPLATFORM@GAVI.ORG OR VISIT › www.gavi.org

TABLE OF CONTENTS

COLD CHAIN EQUIPMENT OPTIMISATION PLATFORM TECHNOLOGY GUIDE

INTRODUCTION

STEP 1: CATEGORISING YOUR HEALTH FACILITIES BASED ON COLD CHAIN EQUIPMENT NEEDS

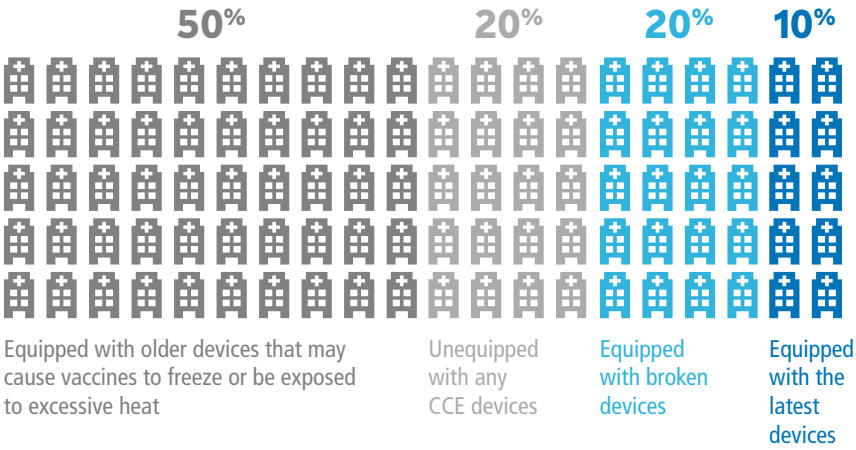
STEP 2: CHOOSING YOUR DEVICE TYPES, THEN YOUR DEVICE MODELS

STEP 3: DEVICE SELECTION

This guide is current as of December 2020. As information and platform eligible equipment will be updated periodically, please reference http://www.gavi.org/support/apply/ to check for the latest version.

INTRODUCTION

The Challenge:
In 2014, in a number of Gavi-eligible countries up to 90% of health facilities were not equipped with adequate cold chain equipment.[1]



Strong and efficient supply chains – equipped with reliable cold chain equipment (CCE) – are vital to helping countries increase immunisation coverage and equity, reaching children with life-saving vaccines and protecting them against deadly diseases. To ensure that vaccines are widely available and remain cold, safe and effective throughout the entire supply chain, each country's immunisation programme needs access to high-performing and well-maintained cold chain equipment. Such cold chain equipment, when available at the required cold chain points-in-country, will increase vaccine availability, potency, and safety. This will help to improve immunisation coverage.

Some older technologies have high operating costs and/or poor temperature control that can lead to vaccine wastage if vaccines are exposed to very high or freezing temperatures. To support countries in improving their cold chains, Gavi, the Vaccine Alliance established the Cold Chain Equipment Optimisation Platform (CCEOP) in January 2016.

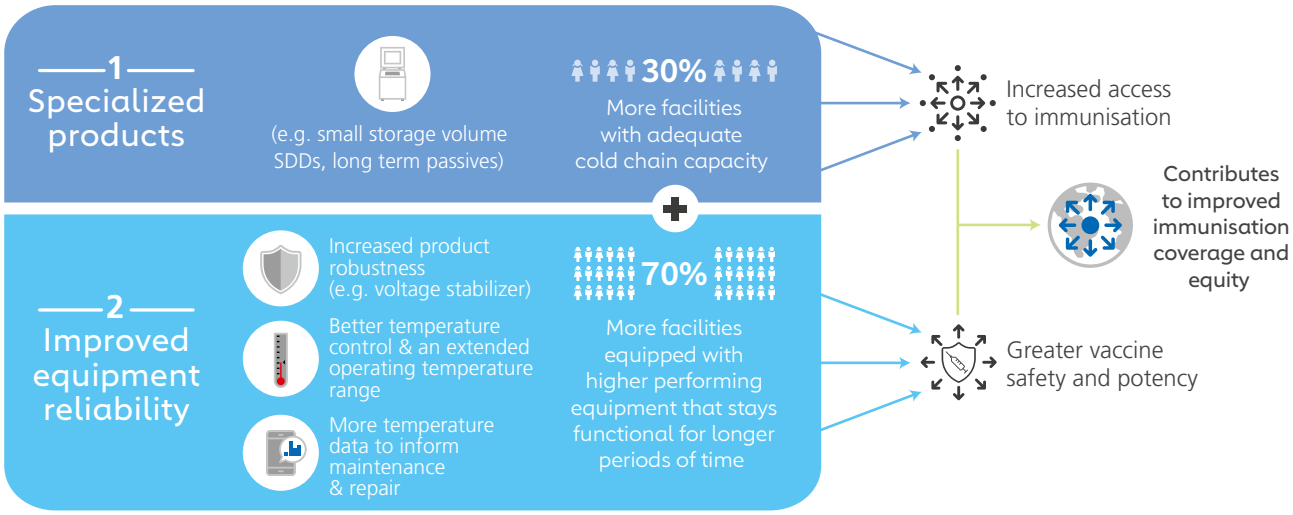
Through the platform, Gavi has committed US $250 million for a five year period between 2017-2021 to jointly invest with countries to purchase and install equipment that meets specific technology requirements (see page 16). Under the CCEOP Gavi is requiring manufacturers to deliver the successful implementation of the service bundle for Ice-Lined Refrigerators (ILR), Solar Direct Drive (SDD) and temperature monitoring device (TMD) products (30-day temperature recorders (30-DTR) or remote temperature monitoring devices (RTMD)). By investing in new cold chain equipment, countries can ultimately save money over the average ten-year lifespan of the equipment. These technologies satisfy a higher standard of performance criteria beyond minimum WHO PQS requirements, and are also referred to as platform-eligible cold chain equipment. In addition, in 2020 the Alliance added 'country ownership of data' as a CCEOP platform eligibility requirement for all equipment performance data that is generated by CCE purchased with Gavi-funded support.

Investing in new cold chain equipment is key to improving:

- Sustainable, equitable, immunisation coverage (by extending equipment availability into remote areas and better enabling outreach activities)
- Reliability, device up-time and overall device lifespan
- Vaccine safety and effectiveness through better temperature control

[1] Bill & Melinda Gates Foundation analysis based on data from 57 Gavi-eligible countries, 2014.

IMPROVED CCE CONTRIBUTES TO COVERAGE AND EQUITY OF VACCINES



Gavi CCEOP database, September 2019

New and improved CCE available and being implemented in countries today have important capabilities to improve performance and safety, such as:

- Mains-powered ILR fridges and freezers that keep vaccines cool and safe even if the power is intermittent or out for multiple days;
- SDD fridges and freezers that do not need batteries while keeping vaccines cool and safe;
- Grade A freeze protection and freeze preventive technology that makes accidental freezing of vaccines in storage and transport very unlikely, contributing to reductions in closed vial wastage;
- Devices (built in and standalone) that send automatic alerts to health facility staff and/or national maintenance centers when fridges and freezers are not working properly, helping ensure that equipment receives quick attention so that vaccines stay protected;
- SDDs with energy harvesting control (EHC) that provide extra electricity for cell-phone charging, lighting, fans, etc.;
- Voltage protection for mains-powered refrigerators, which is more reliable and robust to challenging power conditions.

Suppliers are continuing to develop CCE with even more advanced features, which will be available in the coming years.

DEVICES COVERED

This guide covers devices that are used at service delivery points (e.g. health facilities and hospitals) or small cold stores, and which meet specific platform-eligibility requirements. Larger scale storage (such as walk-in cold rooms and freezer rooms) are excluded. Specifically, you will find information about the following types of devices:

- **Ice-lined refrigerators (ILRs):** these vaccine refrigerators run on mains electricity or power from a generator. The latest models are designed with longer holdover times to keep vaccines cool during prolonged periods of power outage (often for more than two days). During normal conditions, many of these new ILR models require only eight hours of power per day to keep vaccines within the required temperature 2-8 degrees C range. However, less than eight hours of power per day may reduce holdover time.
- **On-grid freezers:** these vaccine freezers run on mains electricity or power from a generator. They are designed to have better temperature control and reliability than standard domestic freezers.
- **Solar direct drive (SDD) refrigerators and freezers:** these vaccine refrigerators and freezers run on solar power. In the latest generation, each one of these devices comes with a solar panel that is mounted on either a pole or on the roof of the health facility, and is connected to the device by a power cable. They do not need batteries and, as a result, they require less maintenance. Some SDDs come with integrated energy harvesting control (EHC), which allows extra solar power to be available for a variety of uses at the health facility, including charging cell phones, laptops, radios and battery-powered lanterns, or power devices such as fans and lighting.
- **Long-term passive devices:** these vaccine storage devices are designed to keep vaccines cold for long periods without any source of power. They do not require direct solar panels, batteries, electricity, gas or other fuels. They typically have limited vaccine storage capacities (of 10 l or less) and keep vaccines cool using a set of ice packs that must be refrozen every three to five weeks.
- **Freeze-preventive cold boxes and vaccine carriers:** these insulated containers are used to transport vaccines between facilities or during field immunisation sessions. These new devices prevent freeze damage to vaccines and do not require user-intervention such as ice pack preconditioning to do so, which saves time when preparing vaccines for transport.
- **Temperature monitoring devices (TMDs):** these devices are used to continuously measure and record temperature readings from cold chain equipment. They display current temperature readings and instances of unacceptable temperature excursions. 30-day temperature recorders (30-DTRs) log temperatures and alarms locally on the device. Data can be downloaded manually by the user. In addition to the 30-DTRs' capabilities, remote temperature monitoring devices (RTMDs) also have the ability to transmit SMS-based alarms (in case of excursions) and/or upload temperature data to logistics management information systems (LMIS) or cloud-based servers.
- **Voltage stabilizers:** these devices are used to protect refrigerators and freezers powered by mains electricity from damage caused by fluctuations in the electricity supply. They protect the refrigerators and freezers from voltage and frequency levels that are either

too low or too high for reliable functioning, as well as from lightning strikes. Some refrigerator and freezer manufacturers choose to integrate voltage stabilizers in the bodies of their devices, while others choose to use a standalone, external voltage stabilizer with their devices. This guide only lists voltage stabilizers of the external type, since integrated stabilizers are a de facto option determined by the refrigerator or freezer manufacturer.

For details about cold chain devices that are not included here, please reference the World Health Organization (WHO) performance quality safety (PQS) catalogue.

This guide focuses on equipment selection primarily for service delivery points (e.g. health facilities). Equipment selection for higher levels of the health system (e.g. national or regional stores) involves additional considerations for vaccine storage and transportation and is not addressed here.

OTHER AVAILABLE TOOLS

While this guide is about choosing the right technology to meet your country's cold chain needs, additional tools are available to help you in other ways.

- **WHO performance quality safety (PQS) catalogue**: this catalogue provides detailed specifications on each WHO PQS prequalified cold chain device, as well as WHO guidelines for device selection. PQS prequalification means that a device has passed a set of performance, quality and safety tests set by WHO.
- **WHO vaccine volume calculator**: This tool determines the total supply chain storage volume needed for the set of vaccines included in a country's vaccination programme.
- **WHO Effective Vaccine Management (EVM) initiative website**: this website provides materials and tools to manage, monitor, and assess vaccine supply chains and help countries to improve supply chain performance. It includes background and training resources, EVM standard operating procedures, EVM assessment tools and user guides, and lessons learned from EVM country assessments. It also contains the Vaccine Management Handbook (below).
- **WHO EVM initiative vaccine management handbook**: this handbook provides technical advice on immunisation logistics, including the use of cold boxes, vaccine carriers and coolant packs for transport and outreach, and how to monitor temperatures in the supply chain.
- **PATH total cost of ownership (TCO) tool**: this tool calculates purchase, delivery, installation and operating costs for a variety of cold chain devices over their expected lifetimes. This tool was developed with input from numerous partners and experts and is hosted on the PATH website. This is the only tool in use today that has been approved by Gavi. There may be other tools in use but these are independent of Gavi or the CCEOP. It is essential that countries conduct the total cost of ownership analysis with the PATH TCO tool during planning and budgeting of their CCEOP applications. TCO varies by country due to country specific factors such as labour and energy costs. Therefore, this tool should be customized by using country-specific inputs to produce TCO estimates that correspond to their country context. For further details, please refer to P.19 in this Technology Guide.
- **UNICEF cold chain support package**: these documents provide commercial and technical guidance for you to use during procurement of cold chain equipment through the UNICEF Supply Division.

- **UNICEF supply catalogue**: in its "Cold Chain Equipment" section, this online catalogue contains many types of devices and includes technical specifications and pricing for each one.
- **TechNet-21**: TechNet-21 is a network of immunisation professionals from around the world. The goal of the network is to strengthen immunisation services by sharing experiences, coordinating activities, and helping to formulate optimal policies. The website provides a variety of useful tools, including a forum to discuss important topics and recent developments in immunisation and an area for members to review WHO PQS-prequalified cold chain equipment. The Technet-21 online library of immunisation resources includes journal articles, photographs, videos, useful links and tools.
- **"Introducing solar-powered vaccine refrigerator and freezer systems" guide**: this document, created by WHO and UNICEF, provides managers in national immunisation programmes with guidance on how to implement solar-powered vaccine refrigerator and freezer systems.
- **Freeze-preventive passive devices guide**: This interim guidance on selecting, commissioning and using freeze-preventative vaccine carriers was created by WHO and UNICEF to guide countries on the selection of freeze-preventive vaccine carriers or standard vaccine carriers based on local context to maintain vaccine quality, especially at service delivery points.

OVERVIEW OF HOW TO MAKE PURCHASING DECISIONS

This guide is designed to help you think through which equipment to purchase.
Please use the following key steps to help you complete the decision-making process:

Step 1: Categorize your health facilities based on CCE needs

Learn how to divide the health facilities in your country into different groups.

Step 2: Choose your device types

For each facility group, learn how to determine what types of devices are appropriate.

Step 3: Choose your device models

For each type of device, see what models are currently available in the lists for each CCE product, and weigh trade-offs.

Additional steps and considerations are also outlined for selection of passive devices used for transport or long term storage of vaccines.

STEP 1

CATEGORISING YOUR HEALTH FACILITIES BASED ON COLD CHAIN EQUIPMENT NEEDS

CATEGORISATION QUESTIONS

Before making any purchasing decisions, it is necessary to inventory your country's existing cold chain equipment. First, this process will help you sort out which facilities need CCE, and which do not. Second, this process will also help you assess which makes and models will complement your existing CCE. Standardising equipment across facilities results in benefits such as simpler training program design and common maintenance networks.

Choosing the correct cold chain solutions for your country's health facilities will require you to assess each facility's characteristics. For purchasing fixed storage devices (i.e. non-portable devices such as refrigerators, freezers and long-term passive devices), the following three questions will help you categorise your health facilities:

1

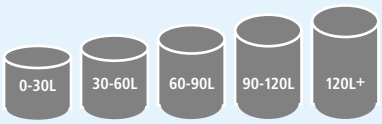
Does the facility have access to reliable electricity?

2

Does the facility need to either freeze or chill cool water packs to support outreach?

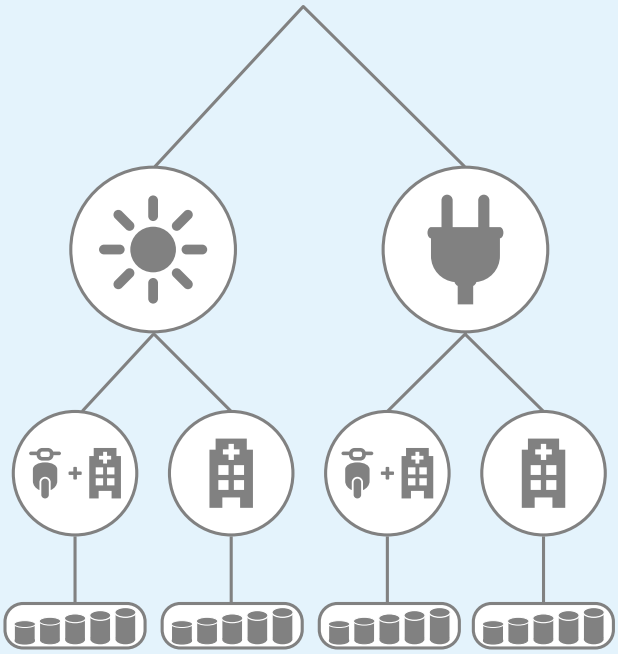
3

What is the required vaccine storage capacity of the facility over the next 5-10 years?



Accurately categorising your country's health facilities before purchasing any equipment will help you ensure that the diverse needs of facilities are met, and that you understand the total cost of ownership (TCO) and appropriately budget for CCE operating costs. To note, TCO is a key consideration, but it should not be the sole decision making criterion for determining what CCE is most appropriate for your country (see below for the full set of criteria to consider).

DECISION TREE SAMPLE



1

DOES THE FACILITY HAVE ACCESS TO RELIABLE ELECTRICITY?

Begin by dividing your country's full set of health facilities in need of CCE into two segments based on access to electricity via mains or generator.

On-grid
On-grid facilities can access a minimum of eight hours of electricity per day from mains and/or generator power, and experience power outages of less than 48 hours.

Off-grid
Off-grid facilities access less than eight hours of electricity per day or experience recurring power outages that last more than 48 hours.

PURCHASING IMPLICATIONS

On-grid facilities should use mains-powered devices – such as ILRs and on-grid freezers – since they have a lower TCO than solar or passive devices for the same amount of storage.

Between on-grid facilities, you might see variation in the degree and reliability of electricity access. Your choice of devices should correspond to the number of hours of electricity that a facility can access per day, and the length of electricity outages it experiences.

Number of hours of electricity per day: after a few days of near-continuous power to fully freeze its ice lining, a typical mains- or generator-powered ILR requires at least eight hours of electricity per day to keep its lining frozen and maintain a long holdover time. For facilities that can access more than eight hours of electricity per day, you can choose from a wide variety of ILRs. However, facilities with only four to eight hours of electricity per day will require specially-rated ILRs or may be better served by off-grid solutions. When considering individual models, it will be important to first check how many hours of electricity each model requires. Planning conservatively is key, as

actual conditions where a device is used may be more demanding than those where it was tested, and in some locations, devices may need more hours of electricity per day than their supplier rating indicates.

Length of power outages: choose devices that have a holdover time longer than expected power outages. Current WHO PQS requirements require ILRs to have a minimum holdover time of 20 hours. If you expect that a given health facility will experience long power outages, you will need to select an ILR with an appropriately long holdover time.

Another consideration is the ability of on-grid facilities to reliably pay for power. For facilities where reliable payment is not possible, off-grid solutions might be more advisable.

Off-grid facilities should use devices that can generate their own power (such as SDDs) or keep vaccines cold for long periods of time without power. These devices often cost much more to purchase than on-grid devices, and their operational costs tend to be higher than for those of ILR devices. For example, SDDs require more routine maintenance practices, such as regular cleaning of the panels, and long-term passive devices require regular ice pack replenishment. However, they also either greatly reduce or completely eliminate electricity costs.

2

DOES THE FACILITY NEED TO EITHER FREEZE OR CHILL COOL WATER PACKS TO SUPPORT OUTREACH?

After you narrow down your device categories based on facilities' power access, you can further divide facilities by whether or not they need to produce coolant packs (i.e. freeze ice packs or chill cool water packs) for outreach.

Fixed-post immunisation facilities
These facilities rarely rely on outreach and conduct nearly all immunisations on site. As a result, they often do not need to freeze or chill water packs on site. For rare occasions when cool water packs are needed, they can be provided by the district store.

Fixed-post immunisation and outreach facilities
These facilities conduct immunisations on site and through multiple outreach sessions per month. They need appropriate on-site capacity to freeze or chill cool water packs for outreach activities.

The choice of coolant pack type depends on the type(s) of vaccines being provided and the temperature in the area where the device is used. WHO currently recommends using water-filled coolant packs. If freeze-preventive cold boxes or vaccine carriers are used, ice packs should not be conditioned before use. However, for standard cold boxes or vaccine carriers, ice packs should be properly conditioned before use so vaccines do not freeze. For more information on choice, preparation and use of coolant packs for transport and outreach, please reference WHO vaccine management handbook, Module VMH-E7-02.1: "How to use passive containers and coolant packs for vaccine transport and outreach operations."

PURCHASING IMPLICATIONS

Fixed-post immunisation facilities do not need to produce coolant packs on site, as they conduct little to no outreach. You need only to consider refrigerators or long-term passive devices for storage. For the rare outreach sessions, coolant packs should be provided by the district store.

Fixed-post immunisation and outreach facilities conduct more than one outreach session per month. For these facilities, you can assess whether coolant packs need to be either frozen or chilled on site, or whether it might be more cost-effective and programmatically feasible to freeze or chill them off site in other reliable refrigerator or freezer spaces. You can compare the costs of nearby options in the local community or at the district store with the cost of purchasing a dual compartment fridge-freezer or additional fridge or freezer unit for the facility.

It is important to note that coolant packs should not be stored in the same compartment as vaccines. Facilities should use either a dual compartment device, or two separate devices – one for storing vaccines and one for storing coolant packs. The table below will help you factor the coolant type into your device choice.

COOLANT	APPROACH	DEVICE FOR VACCINE STORAGE	DEVICE FOR COOLANT PRODUCTION
Ice packs	Two devices	Fridge or long-term passive device	Freezer
	One dual compartment device	Dual compartment fridge-freezer	
Cool water packs	Two devices	Fridge	Fridge

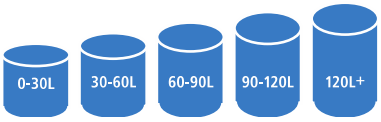
Devices used to freeze or chill cool water packs should be selected based on the volume and number of packs needed, and their type according to the container used. These devices should be able to completely refreeze or re-chill the required number of packs in the time between sessions.

3

WHAT IS THE REQUIRED VACCINE STORAGE CAPACITY OF THE FACILITY?

The required storage capacity determines the right device size for a facility. The required vaccine storage capacity takes into account three factors:

- Volume of vaccines per fully immunised child (or per capita);
- Target population size;
- Vaccine supply frequency and reliability.



In assessing these factors, it is important to plan not only for current needs, but also for future needs over the lifetime of the device. Considerations could include:

- Expected population growth;
- Expected new vaccine introductions, including non-infant immunisations such as human papillomavirus (HPV) vaccines;
- Improved coverage targets;
- Supplemental immunisation activities, such as campaigns.

To calculate required vaccine storage capacity, you can use the WHO vaccine volume calculator and the WHO series of modules on immunisation training for Mid-level Managers.

PURCHASING IMPLICATIONS

If you are making purchases for multiple facilities, it will be useful to group devices into storage capacity bands, or size segments (0-30 l, 30-60 l, 60-90 l, 90-120 l and more than 120 l). This might enable you to receive volume discounts from bulk purchases.

On-grid facilities should consider ILRs, dual compartment ILR refrigerator-freezer and on-grid freezers that have the capacity to store the required number of vaccines and produce the required amount of coolant packs. Facilities with very large storage requirements (e.g. state or district stores) might also consider cold rooms and freezer rooms.

Off-grid facilities should consider SDD refrigerators, SDD dual compartment fridge-freezers or SDD freezers. Off-grid facilities requiring less than 5 to 10 l of storage – and that have the ability to receive regular ice pack replenishments – may also consider long-term passive devices.

OTHER CONSIDERATIONS FOR DEVICE SELECTION

In addition to the three questions on page 7, before selecting the correct CCE for your health facility please consider the following additional factors:

- **Ambient temperature range:** It will be important to select a device that is PQS tested to operate across the full range of temperatures in the area where the device is being used.
- **Ability to use solar devices:** Solar devices are not suitable for all facilities. Some facilities might be surrounded by buildings or trees that would block solar panels from receiving direct sunlight. Others may not have strong

enough sunlight all year round. If you are considering purchasing solar devices, having a site evaluation conducted will help you determine whether a solar device will receive enough power. Solar panels can be mounted on either the roof of the facility, if strong enough and receives adequate sunlight during the day, or on a separate mounting pole. While a separate mounting pole may mean additional costs, it offers more flexibility for panel placement. When preparing an operational deployment plan, it is critical to note whether a pole or roof mount will be necessary at a given facility based on site evaluations and the distance from the pole mount to the intended installation point of the refrigerator. The number of pole and roof mount installations should be specified in the operational deployment plan so that appropriate resources can be mobilized for installation. To ensure long-term reliability and performance, consideration should be given to the availability of service providers to provide maintenance.

If you find that none of the options in this guide are appropriate for a particular facility, a WHO PQS representative can help you choose the right device. PQS representatives can be contacted via email at pqsinfo@who.int. They can provide support, advice and guidance to help you purchase the most suitable equipment for a given facility's field conditions.

SELECTING THE RIGHT PASSIVE TRANSPORT DEVICES FOR YOUR IMMUNISATION PROGRAMME

Vaccine carriers and cold boxes are a vital part of immunisation cold chains. The CCEOP only supports Grade A 'freeze preventive' vaccine carriers and cold boxes. Choosing the correct Grade A passive cold chain solution for your country's facility supply chain transport needs will require you to assess the specific transport use-cases and then determine the most appropriate product characteristics that fit the intended objective for delivering adequate quantities of vaccines safely to each facility and from facilities as part of outreach services. For purchasing freeze preventive transport solutions, the following two questions will help you categorize and select your device options:

1

Do vaccines need to be transported between higher and lower level facilities or transported for last mile fixed and outreach immunization sessions?

2

What is the required vaccine volume that needs to be transported for delivery across multiple facilities or for fixed and outreach session activities?

When choosing between vaccine carriers and cold boxes for transport or outreach, consider the following factors in your decision:

- Compliance with platform requirements, which determines eligibility for platform funding and reflects a model's higher level of technological capability
- Duration of cold life to keep vaccines at safe temperatures for an entire transport or outreach session (including travel to and from the outreach session)
- Required capacity based on the volume of vaccines that must be transported at any one time for outreach or transport between facilities, and the number of transport or outreach activities that must be supported at any time
- Size, type and number of coolant packs required, and their compatibility with other coolant packs used in the country

ADDITIONAL CONSIDERATIONS FOR LONG-TERM PASSIVE DEVICES

Long-term passives are mostly used by small, off-grid facilities because of their limited storage capacity. They are not suitable for facilities that perform high levels of outreach unless paired with a separate freezer, as they cannot freeze or chill cool water packs.

Long-term passive devices need a regular and predictable supply of large volumes of ice packs. Some also require special types of ice packs, which are larger than standard WHO-approved ice packs and shaped differently. Long-term passive devices have two major requirements in order to receive ice packs:

1. Ice pack delivery hub: A nearby delivery hub that can produce enough ice packs per month for each long-term passive device it supports. As each device's ice packs must be replenished every three to five weeks, this process often involves having a spare set of ice packs and using a freezer at the delivery hub. The number of devices that one delivery hub can support will vary. This number should be evaluated based on the existing or planned freezing capacity at the hub, as well as the ice demands of the device(s) being supported.
2. Ice pack delivery system: A delivery system capable of delivering a monthly shipment of enough ice packs (the ice must be transported in a box that can keep it frozen). Motorcycles may not be able to transport large shipments, which can limit ease of access to last-mile facilities. The distance and road conditions between the delivery hub and facility also need to be considered when evaluating the cost and sustainability of this delivery system.

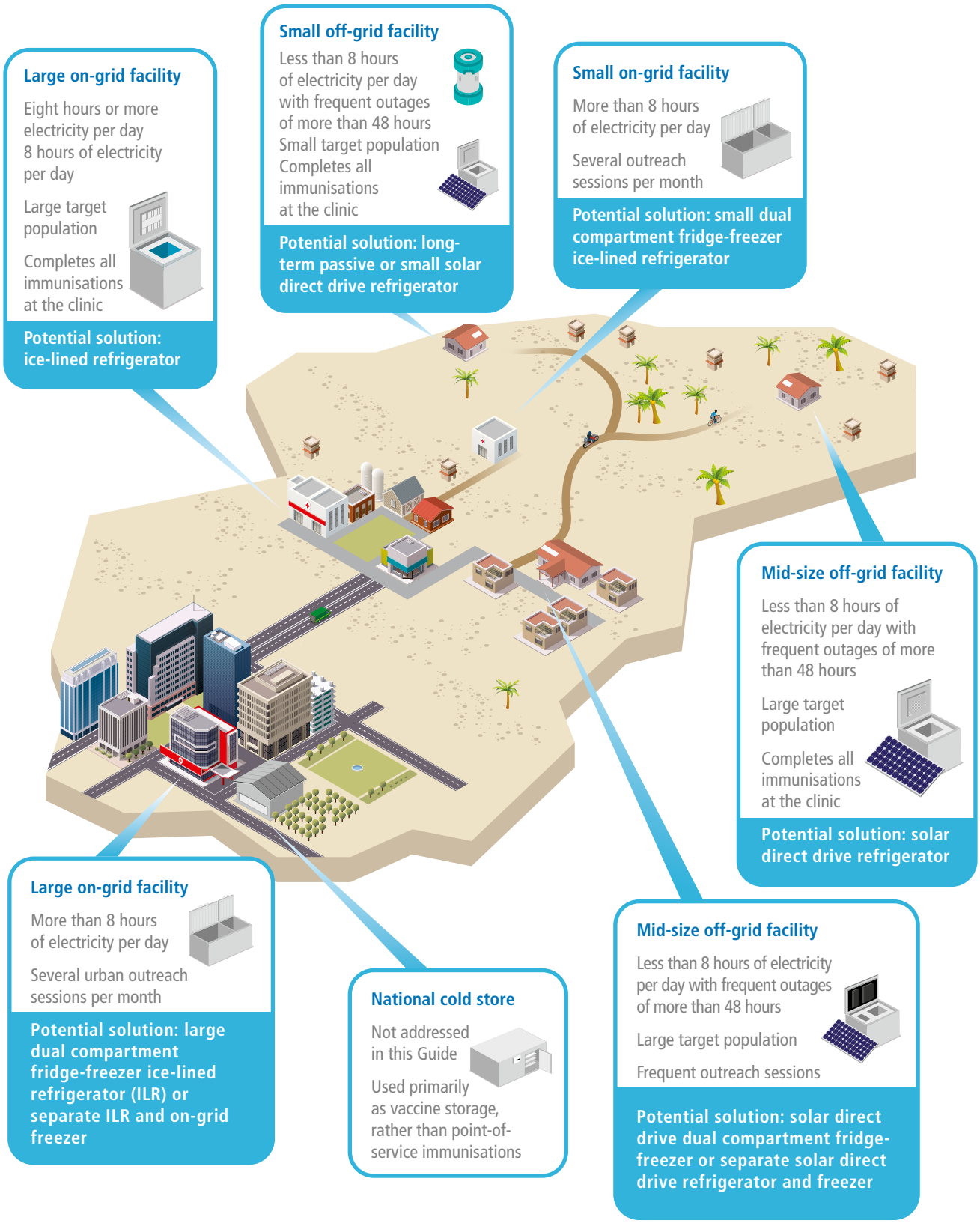
If either one of these requirements is not met, there is a risk for vaccine wastage as well as for interruptions in immunisation service at the facilities served by the delivery hub.

Given these restrictions, **a SDD device should be chosen over a long-term passive device unless a facility meets all of the following conditions:**

- An SDD device is inappropriate for a particular site or population (e.g. due to insufficient exposure to sunlight);
- On-grid, dependable freezing of ice packs is possible at a nearby supply point;
- Routine and cost effective delivery systems are capable of stable ice delivery;
- The required vaccine storage capacity is less than 10 l and storage needs are not likely to increase over 10 L over the next 5-10 years.

FACILITY CATEGORISATION MAP

Once you have categorised your country's health facilities by CCE needs, the next section of this guide will assist you in choosing the appropriate device types, and then specific device models. Below, please find some hypothetical examples to help illustrate device selection. These examples are not representative of any specific country,but rather, are intended to help you start assessing the attributes of your facilities.



WORKSHEET

Categorising your country's health facilities will help you group those with similar traits together. This activity is designed to prepare you to use the next section to choose the right CCE devices and models. By filling out the worksheet below, you can divide your country's full landscape of health facilities into categories and count how many fit into each group.

How many health facilities are in need of new cold chain equipment?

_____

On-grid facilities

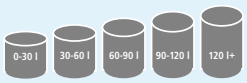
_____

Off-grid facilities

_____

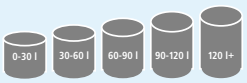
Immunisation and outreach facilities

_____



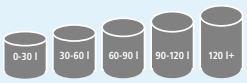
Immunisation facilities

_____



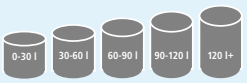
Immunisation and outreach facilities

_____



Immunisation facilities

_____



STEP 2

CHOOSING YOUR DEVICE TYPES, THEN YOUR DEVICE MODELS

COLD CHAIN EQUIPMENT OPTIMISATION PLATFORM (CCEOP) REQUIREMENTS

Through the CCEOP, Gavi has committed funds to co-invest with countries to equip facilities for the first time with CCE, and for facilities already equipped, to upgrade aging or non-functional equipment to higher-performing equipment and expand capacity if needed.

1. **User-independent ("Grade A") freeze protection.** WHO PQS defined three grades of freeze protection: A (user-independent), B (requiring one user intervention to prevent freezing), C (requiring more than one user intervention to prevent freezing). The CCEOP subsidises equipment that is Grade A only, ie, not requiring any user intervention to prevent freezing;
2. **Extended operating temperature range.** This requirement matches what is currently defined by WHO PQS: +10°C to +43°C for refrigerators and long-term passive devices; +15°C to +43°C for freeze-preventive cold boxes and vaccine carriers;
3. **Temperature monitoring and logging.** The platform currently requires only Type 1 (the most basic) temperature monitoring devices to be provided with the refrigerator. However, the platform subsidises Types 1, 2, 3, and 4;
4. **Voltage stabilizing (for on-grid devices only).** WHO PQS requires every on-grid ILR to be provided with a PQS pre-qualified voltage stabilizer; and
5. **Country ownership of data:** Countries are considered the owners of data generated by CCE procured through the CCEOP.

1. USER-INDEPENDENT FREEZE PROTECTION

This feature ensures that vaccines are not exposed to freezing temperatures.
WHO PQS certifies devices for Grade A freeze protection.

USER INDEPENDENT FREEZE PROTECTION		MEETS PLATFORM REQUIREMENT
GRADE A	When the device is used within its rated ambient temperature range, the user does not need to perform any actions to protect vaccines from freezing temperatures. For example, the device would not require removable baskets to protect vaccines from freezing. However, baskets may still be used to sort vaccines in the device.	✓
GRADE B	When the device is used within its rated ambient temperature range, the user must perform one action to protect vaccines from freezing temperatures.	✗
GRADE C	When the device is used within its rated ambient temperature range, the user must perform more than one action to protect vaccines from freezing temperatures.	✗

2. EXTENDED OPERATING TEMPERATURE RANGE

This feature keeps the equipment operating correctly even during large changes in ambient temperature.

EXTENDED OPERATING TEMPERATURE RANGE		MEETS PLATFORM REQUIREMENT
MODERATE	The device operates at a steady 27 °C ambient temperature and over a 27 °C/10 °C day/night cycling temperature range.	✗
TEMPERATE	The device operates at a steady 32 °C ambient temperature and over a 32 °C/15 °C day/night cycling temperature range.	✗
HOT	The device operates at a steady 43°C ambient temperature and over a 43 °C/25 °C day/night cycling temperature range.	✗
EXTENDED	The device satisfies the requirements for hot zone operation above (43 °C), and can also operate at a continuous rated minimum ambient temperature of at most 10 °C.	✓

Note: for freeze-preventive cold boxes and freeze-preventive vaccine carriers, the required extended operating temperature range is +15C to +43C, in accordance to PQS standards. For additional details on operating temperature ranges, please reference the WHO PQS catalogue, as well as the target product profiles for specific devices on the WHO PQS catalogue specifications web page.

3. TEMPERATURE MONITORING AND LOGGING

Once in the field, the refrigerator compartment must be equipped with a temperature recording device that supports the transfer of data to a logistics management information system (LMIS) for analysis. This device can be provided in two ways: 1) as a fully integrated part of the refrigerator or 2) as a separate, standalone device, but shipped along with the refrigerator.

Temperature monitoring and logging		Meets platform requirement
TYPE 1 Standalone logger	The device includes a country-selected and pre-qualified disposable 30-day temperature logger.	✓
TYPE 2 Integrated logger	The device includes a supplier-selected and fully-integrated 30-day temperature logger built into the refrigerator body.	✓
TYPE 3 Standalone Remote Temperature Monitoring Device	The device includes a country-selected and pre-qualified remote temperature monitoring device, which in addition to temperature monitoring and logging, can also send SMS alarm messages and potentially be integrated with an LMIS platform.	✓
TYPE 4 Integrated Remote Temperature Monitoring Device	The device includes a supplier-selected and fully-integrated remote temperature monitoring device, which in addition to temperature monitoring and logging, can also send SMS alarm messages and potentially be integrated with an LMIS platform.	✓

4. VOLTAGE STABILIZATION/STABILIZER (FOR ON-GRID DEVICES ONLY)

This feature protects equipment from electrical damage. All voltage stabilizers must meet WHO PQS certification requirements.

Voltage stabilizers are used between the electric power outlet and the refrigerator and freezers. Stabilizers are designed to protect AC-powered refrigerators from a range of power-related issues, including voltage or frequency fluctuation (e.g. when using a generator) or voltage surges (e.g. due to power transmission issues in the grid). This protection from AC power issues can safeguard a refrigerator's or freezer's electronic control unit (ECU), compressor, fuses, and other electronic components from damage, and can thereby increase the refrigerator's and freezer's lifetime in the cold chain. A built-in or stand-alone voltage stabilizer must always be used when connecting an on-grid refrigerator or freezer to mains power.

Voltage Stabilization/Stabilizer (for on-grid devices only)		Meets platform requirement
STANDALONE	A separate voltage stabilizer is bundled with the purchase of a refrigerator or freezer.	✓
INTEGRATED	A voltage stabilizer is built into the refrigerator or freezer.	✓

After a power cut, all voltage stabilizers have a delay in restarting. This delay protects equipment from voltage fluctuations as the power grid re-stabilizes. Depending on power quality, this delay can range from three to six minutes. As of March 2018, WHO PQS has published updated requirements for voltage stabilizers that are required for use with AC-powered fridges and freezers. Voltage stabilizer devices are evaluated and pre-qualified against specifications and testing protocols found here.

5. COUNTRY OWNERSHIP OF DATA

Countries are considered the owners of data generated by CCE procured through the CCEOP, including but not limited to equipment performance data. This ownership of data is meant to give governments full control of data, including definition of terms of access and use of data by the manufacturer and other third parties, storage, data protection requirements, transmission and internal processing throughout the full lifespan of data.

All manufacturers of CCEOP platform-eligible equipment recognise this principle through relevant procurement agreements. Manufacturers' access to relevant data is maintained for maintenance or fulfillment of CCE warranties, default access to manufacturers as part of operating RTM portals, equipment monitoring systems (EMS) and other online systems, etc.

As the major funder of CCE in the Gavi-supported countries and with a mandate to market shape in the CCE market, the Alliance has an interest in understanding the aggregated performance of Gavi-funded CCE deployed in Gavi-supported countries and ensuring that countries have control of and access to such data. Gavi and Alliance partners access to and use of any data is and will be governed by separate agreements with countries as the owners of the data.

SOLAR ENERGY HARVESTING

Solar energy harvesting is not a requirement for platform compliance, but it is an innovative new feature offered on some current SDD devices – and that several other suppliers are considering incorporating into future models.

Frequently, the solar panels installed with an SDD generate more power than is needed to run a refrigerator or freezer unit. Energy harvesting allows health facilities to use excess power from solar panels for other purposes. Depending on voltage specifications, health workers can use devices with energy harvesting to charge cell phones, laptops, radios and battery-powered lanterns, or power devices such as fans and lighting. This excess power may be made available via power outlets located on the SDD or via standalone devices that are connected to the SDD systems. Standalone energy harvesting devices are not currently CCEOP eligible.

Solar energy harvesting is an especially promising capability, as it can evolve an SDD device from a cold chain solution to a potential power hub for other devices at an off-grid clinic.

As of May 2017, WHO PQS has updated requirements for devices offering energy harvesting. SDDs featuring energy harvesting technology are evaluated using the specifications and testing protocols found here.

OVERVIEW OF FUTURE DEVICES

The platform gives countries the opportunity to upgrade their cold chains with the best and most appropriate equipment available today. Looking ahead, additional exciting cold chain technologies are expected to arrive on the market in the coming years. These devices and features are designed to address user needs and better protect vaccines.

This guide includes a brief summary of expected new CCE devices or device features that are still in design and testing phases or in the pipeline for future platform-eligibility. There are also emerging technologies and new device categories that are not mentioned in this guide because their development and commercialisation timelines are still uncertain.

New platform-eligible equipment will be added to this guide as they becomes available.

STEP 3

DEVICE SELECTION

In the previous section, the worksheet on page 15 helped you to divide your health facilities into categories based on electricity access, outreach activities and storage capacity requirements. In the pages that follow, you can identify the current devices that meet the needs of each group.

TOTAL COST OF OWNERSHIP (TCO)

Cost is an important component in selecting CCE. In particular, TCO is an important concept to consider. TCO refers to the overall cost of purchasing, installing and maintaining CCE over the expected lifetime of the equipment. It is important for countries to calculate the TCO of their desired cold chain equipment during the CCEOP application stage.

This TCO tool was developed by PATH and is the only tool currently in use that has been approved for use by the Alliance. All TCO figures for Gavi CCEOP eligible products should be calculated using the PATH TCO Tool.

Download the tool here or access an online version here.

Please note the online version does not yet offer the customisation to change assumptions or inputs compared to the excel version of the TCO tool (as of December 2020).

The TCO calculations assume an effective life of 10 years for all CCEOP eligible devices. However, a device's actual life will vary based on equipment reliability, local conditions and its maintenance schedule. TCO is expressed through three measures. Of the three measures of the TCO methodology, the purchase price is singular and applies to all countries. However, delivery and installation costs, as well as operational costs, will vary by country.

- Purchase price for the unit of equipment (Capex).
- Service bundle costs for delivery, installation and commissioning of the equipment, as well as training costs. Kit installation costs are also included with service bundles. This Guide includes estimated ranges of the service bundle cost.
- Operational expense (Opex), which includes the cost of spare parts, energy, maintenance and repairs for an expected lifetime of ten years. Manufacturer warranties are considered in the operational expense calculations. This is accomplished by exempting labor and spare part consumption under the warranty period proportionally over the useful life of a unit. Opex costs can be calculated using the PATH TCO tool and are not included in this Guide.

The excel and online version of the TCO tool include default estimates for installation costs. The excel TCO tool allows users to input values for service bundle costs. Please note these costs vary by country, technology and manufacturer. Please consult with UNICEF Supply Division for an estimate at sd.coldchain@unicef.org. TCO estimates are not provided for portable carriers, voltage stabilizers and temperature monitoring devices.

FOR QUESTIONS OR SUPPORT USING THE TCO TOOL PLEASE REACH OUT TO TCO@path.org

DEVICE SELECTION

For each entry in the device tables, you will find a link to the model's corresponding page in the UNICEF SD catalogue. Please check the UNICEF SD Catalogue for accurate and up-to-date purchase prices for CCEOP-eligible equipment. If pricing information is not found in the UNICEF SD catalogue, please refer to the CCEOP application budget template as a second reference. Also, the device tables offer two volume ranges (price per unit for orders of 1-9 units and 200-499 units respectively), as all suppliers currently offer volume based discounts. Please refer to the UNICEF SD catalogue to view the full list (11 volume ranges) of volume based discounts.

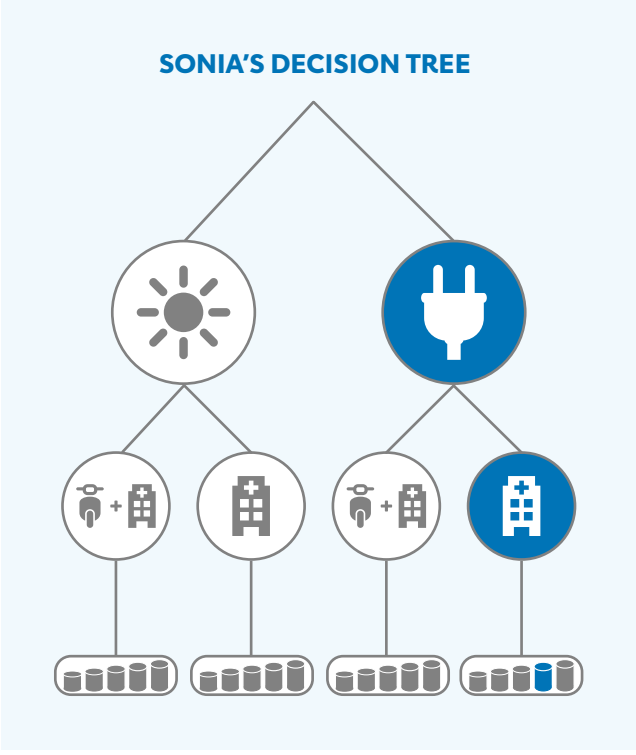
For the information in the device tables, please note the following considerations.

- **Freeze protection:** All refrigerators that are CCEOP platform eligible have been verified by WHO to meet the PQS Grade A freeze protection protocol.
- **Voltage Stabilizing:** All voltage stabilizers that are CCEOP platform eligible have been verified by WHO to meet the PQS protocol. Only PQS-prequalified voltage stabilizers may be purchased for use with on-grid, mains-powered CCE.
- **Equipment pricing:**
  - Where available, device pricing is taken from the UNICEF Supply Catalogue as a first point of reference. If not available in the UNICEF catalogue, the prices are sourced from the latest WHO PQS catalogue. These price points are cross referenced against manufacturers' direct quotes.
  - All pricing is based on orders of 1-9 units, and 200-499 units (unless otherwise noted), FCA INCOTERMS and plywood packaging.
  - The exchange rate used in this Guide is 1 Euro = 1.13 USD. All pricing is in US Dollars (USD) using UN exchange rates as of August 2020.
  - Prices for each device include the cost of a temperature monitoring device and a voltage stabilizer (where applicable).
  - Prices do not include any additional fees incurred when ordering from the UNICEF supply catalogue.

- **Service bundle costs:** estimated service bundle costs represent an expected range, but actual costs will vary by country (including intra-country variation). The shipment costs from supplier factory to country port or health facility have been estimated as a percentage of purchase price. For more expensive devices, this estimate may overstate delivery cost. In-country transport costs are treated as a fixed amount for each device category.
- **Portable devices:** for vaccine carriers, this guide only shows purchase price, since delivery and operational costs will vary by country and device use.
- **Two-mode devices:** some single-compartment ILRs can be set to operate as either a fridge or a freezer. These devices are included in the table for current ILRs and have a footnote to indicate that they can also operate as freezers.
- **Operating costs:** Opex costs can be estimated using the PATH TCO tool and are not included in this Guide.

DEVICE SELECTION

EXAMPLE 1



Sonia is a country-level decision maker who has to determine what device will be best for several large, on-grid facilities. These facilities conduct very little outreach and are not distribution points for vaccines or ice packs.

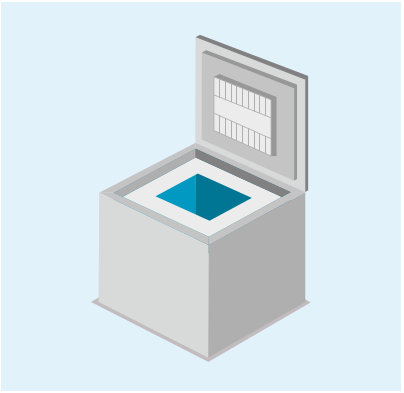
Decision process: although these semi-urban facilities consistently have access to more than eight hours of electricity per day, they have occasional power outages of up to 24 hours. A standard (non-ice-lined) refrigerator would be insufficient, but most ILRs can operate with eight hours of electricity per day.

Health workers primarily complete all immunisations at the facility. While they may do one outreach session per month, workers have access to a nearby store's refrigeration systems to obtain cool water packs. If needed, they can also collect frozen ice packs with their monthly vaccine pickup from the district store for little additional cost.

After grouping facilities according to their target population size (and accounting for population growth and new vaccine introductions), using WHO guidance on vaccine volume per fully immunised child and ensuring that vaccines can be reliably delivered on schedule, Sonia determines she needs devices with between 90 and 120 L in vaccine storage capacity.

Final Selection: Sonia chooses a platform-compliant ILR with storage capacity between 90 and 120 L for each facility. The ILR is rated to operate with only eight hours of electricity per day. With a holdover in excess of 100 hours, it can easily withstand power outages of three to four days. The ILR also has a much lower TCO than similarly sized solar devices. Since platform-compliant devices have Grade A user-independent freeze protection, Sonia knows there is minimal chance of vaccine wastage due to freezing.

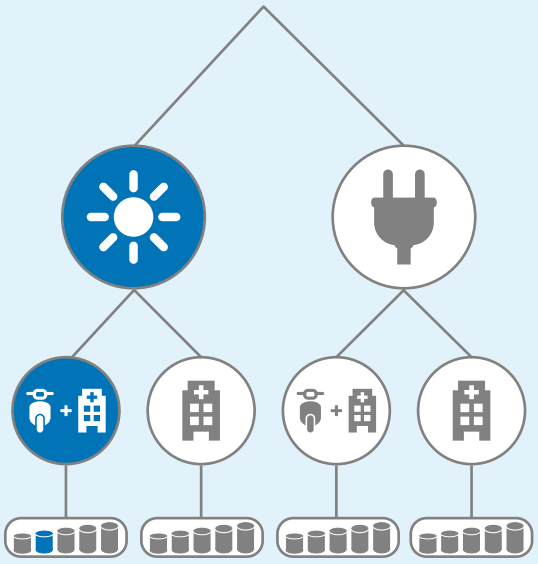
Additional considerations: Sonia must purchase and install high-quality voltage stabilizers with the ILRs to protect them from damage by power surges (either bundled with the ILRs or integrated into the devices she chose). Sonia must also purchase and utilise suitable temperature monitoring devices (at least type 1 or type 2, which come bundled with any fridge or freezer purchased through the platform) in order to: a) immediately know, when looking at the device's display, whether vaccines have been exposed to unacceptable temperatures and b) track the performance of the refrigerator, and to call a technician for maintenance and repair, if required.



DEVICE SELECTION

EXAMPLE 2

OLAMIDE'S DECISION TREE



Olamide is a country-level decision maker who has to determine what devices are best for a group of mid-size, off-grid facilities that complete weekly outreach sessions.

Decision process: these facilities rarely have access to more than a few hours of electricity each week. When they can access electricity, it is inconsistent and unpredictable. Only an SDD or a long-term passive device will keep vaccines at appropriate temperatures throughout these long periods without power.

Health workers at these facilities engage in weekly outreach activities in their communities. In most cases, there are no places nearby where workers can freeze ice packs (especially during Supplementary Immunisation Activities [SIAs]), and ice deliveries are too expensive. These facilities require devices with a freezer compartment that can freeze ice packs.

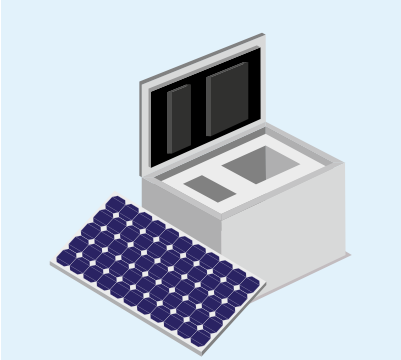
Olamide determines that he needs devices with at least 30 L in vaccine storage capacity. This capacity would require four to six long-term passive devices per facility, but only one 30 L or larger SDD device. Given the

need for freezer capability, the optimal solution would be either dual compartment SDD fridge-freezers or separate SDD refrigerators and SDD freezers.

Final Selection: Olamide decides to purchase a platform-compliant dual compartment SDD fridge-freezer for each facility. These devices can produce ice packs to support the facility's outreach sessions. Since they are solar powered, they are not affected by the lack of reliable electricity. Olamide also calculates that purchasing a dual compartment SDD fridge-freezer has a lower TCO than purchasing a separate SDD fridge and SDD freezer for each facility.

Additional considerations: to ensure solar compatibility, Olamide must have his sites evaluated for:

- Sufficient sun exposure for the SDD device to function correctly;
- A roof that can support solar panels and any special solar panel mounting equipment required;
- The length of cable required between solar panels and the device;
- Access to maintenance networks for repairs.



In addition, the freezer compartment of the SDD devices he purchases should be able to store the same size of ice packs (either 0.4 L or 0.6 L) that the vaccine carriers use for outreach.

DEVICE SELECTION

EXAMPLE 3

Michael is a country-level decision maker, who has to determine how to address freezing risk when transporting vaccines regionally.

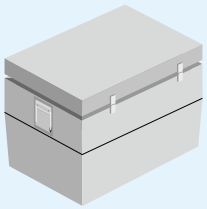
Decision process: a recent temperature monitoring study found that a number of shipments leaving the regional stores exposed vaccines to dangerous freezing conditions. The main contributors were:

1. Use of old styrofoam containers with no insulation between the ice and vaccines;
2. Inconsistent ice pack conditioning practices by staff.

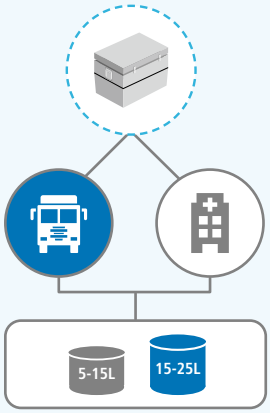
To prevent vaccine freezing, Michael initially considers switching to cool water packs as a lower-cost option. However, per the WHO guidance for mid-level delivery, cool water packs do not provide enough cold life for heat-sensitive vaccines on long delivery routes. For this reason, Michael decides to look at freeze-preventive cold boxes to ensure vaccine safety.

He needs to figure out the appropriate volume of the cold boxes, and how to account for different delivery routes. To collect this information, Michael surveys each regional store, and determines both the smallest and largest deliveries they make on a regular basis. On average, the smallest is 15 L and the largest is 30 L. To address differing route capacity requirements, he chooses two cold boxes so that the smaller and larger capacity routes can be served by one or two boxes respectively.

Final selection: Michael picks a capacity of 15 L for use in delivery from regional stores to districts, with each regional store to receive two 15 L boxes.



MICHAEL'S DECISION TREE



HOW TO CHOOSE BETWEEN MODELS

If you find more than one model that would meet the needs of a facility, the following factors can help you narrow down your decision:

Individual device characteristics:

- Compliance with platform requirements, which determines eligibility for platform funding and reflects a model's higher level of technological capability
- TCO, including purchase price of equipment, delivery, installation, training, commissioning, as well as lifetime operating costs (as calculated using the PATH TCO tool with your country-specific inputs)
- Holdover time for ILRs based on a facility's power reliability
  - ***– Devices with extended holdover time are preferable for facilities with less or unreliable electricity***
- Autonomy time for SDD devices based on regional climate factors
  - ***– Devices with extended autonomy time are preferable for facilities in regions with long periods of low sunlight***
- Freezer capacity for ice pack production
  - ***– Devices with a freezer compartment or a separate freezer are preferable for facilities that need ice packs for outreach or transport***
- Ease of use, including:
  - ***– Readability of control panels and displays by a standing health worker***
  - ***– Use of internal storage racks, boxes or drawers to help organise vaccines and separate other medicines that are stored in the device***
- Voltage stabilizer location
  - ***– Devices with integrated voltage stabilizers ensure voltage stabilizer security, but may present maintenance and repair challenges***
  - ***– Devices relying on standalone voltage stabilizers can be easily replaced if needed, but security of the voltage stabilizer must be considered***
- SDDs with solar energy harvesting capabilities

Support and standardisation considerations:

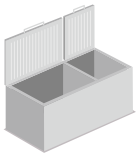
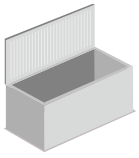
- Access to professional in-country installation and maintenance support, including availability of spare parts
- Quality of after-sales support from the supplier, including training for device users
- Makes and models of your country's existing cold chain equipment, as standardisation across facilities may enable you to leverage benefits like common maintenance networks
- Length and scope of the device's warranty. WHO requires a two year warranty for devices to be PQS prequalified; please note that warranties differ in terms and conditions, and countries should refer to the manufacturer for more information on terms and conditions covered under each warranty

PLATFORM COMPLIANCE

The CCEOP invests only in products that meet full platform compliance. This Guide lists only fully compliant products. The criteria for full platform compliance are the following:

- Grade A freeze protection: WHO-verified
- Grade A freeze protection: supplier-reported
- Extended operating temperature
- Temperature monitoring/logging and type (1, 2, 3, 4)
- Standalone voltage stabilizers
- Integrated voltage stabilizers

ON-GRID DEVICES

	ICE-LINED REFRIGERATORS (ILRS)	DUAL COMPARTMENT FRIDGE-FREEZER ILRS	ON-GRID FREEZERS
KEY FEATURES	This device has an internal lining of ice, ice packs or cold water-filled compartments Its internal compressor uses electricity to refreeze or re-cool its lining	This device is an ILR with a separate compartment to freeze ice packs	This device has a compression-driven system that uses electricity to create ice and freeze ice packs
OUTREACH CAPABILITY	Does not support outreach by itself, unless verified safe to cool water packs in the vaccine compartment	Supports low/medium levels of outreach	Supports high levels of outreach*
VACCINE STORAGE CAPACITY	**(27-240 L)**	**(30-60 L)**	**Only selected models currently recommended for vaccine storage. All models can be used for ice pack freezing and storage.**
NUMBER OF CURRENT PLATFORM-COMPLIANT DEVICES	26	4	8
ADDITIONAL CONSIDERATIONS	Most models require 8 hours of electricity per day to re-cool the lining Some new devices require only 4-6 hours to maintain safe storage temperature. However, more than 4-6 hours of power may be required to build longer holdover times for extended power outages This device should always be installed with a voltage stabilizer Some ILRs with a single compartment can be set to operate as either a fridge or a freezer	This device has an ice-making capability for outreach Most models require at least 8 hours of electricity per day to re-cool the lining Some new devices require only 4-6 hours to maintain safe storage temperature. However, more than 4-6 hours of power may be required to build longer holdover times for extended power outages This device should always be installed with a voltage stabilizer	This device has an ice-making capability for outreach Select models can be used to store freezable vaccines (e.g. oral polio vaccine) It cannot be used to store vaccines that require 2-8 °C storage It should always be installed with a voltage stabilizer

*Depending on freezer capacity when paired with a vaccine refrigerator.

FUTURE DEVICES

Several suppliers are developing new ILRs expected to arrive on the market in the coming years. Future devices in development and/or testing include features such as longer holdover times, new models across different volume band sizes, and dual compartment fridge and freezer models. Additional features such as integrated energy harvesting capabilities, and integrated RTMD or EMS, AC/DC dual models, and AC-DC voltage stabilizers are also expected soon in some ILRs currently available through the platform. Following PQS certification, new platform-eligible equipment will be added to this Guide on a regular basis.

CURRENT ICE-LINED REFRIGERATORS

The table below shows prices for platform-eligible products. The estimated range of service bundle costs is between USD 400 and USD 1,350. Estimated operating costs will vary by country and product, and are not included but can be estimated using PATH's TCO tool. Additional costs such as procurement agency fees are not included.

Supplier	Model	Vaccine storage capacity L	Holdover (days)	Voltage Stabilizer	UNICEF indicative price 1-9 units, USD	UNICEF indicative price 200-499 units, USD
Vaccine storage capacity, 120 L+						
Haier	HBC-120	120	5,3	Standalone	1700	1560
Haier	HBC 150	122,0	2,5	Standalone	918	838
Vestfrost	VLS 354A AC	127	2,30	Integrated	1201	1117
Zero (Sure Chill)	ZLF 150 AC	128,0	5,3	Integrated	2300	2254
Vestfrost	VLS 404A AC	145,0	2,30	Integrated	1293	1202
Dulas	VC 225 ILR	184,0	3,9	Integrated	3182	1009
Haier	HBC-240	200,0	3,6	Standalone	1800	1660
Haier	HBC-260	211,0	2,6	Standalone	1068	968
Godrej & Boyce (Sure Chill)	GVR 225 AC	225,0	2,3	Integrated	1910	1872
B Medical	TCW 4000 AC	240,0	3,2	Standalone	4500	4059
Vestfrost	VLS 504A AC	242	2,3	Integrated	2040	1897
Vaccine storage capacity, 90-120 L						
Godrej & Boyce (Sure Chill)	GVR 99 Lite AC	98,5	2,5	Integrated	1074	1047
Zero (Sure Chill)	ZLF 100 AC	99,0	4,7	Integrated	1950	1912
Godrej & Boyce (Sure Chill)	GVR 100 AC	99,0	12,5	Integrated	2355	2308
Vestfrost	VLS 304A AC	98	2,31	Integrated	1085	1009
Vaccine storage capacity, 60-90 L						
Haier	HBC-80	61,0	2,5	Standalone	718	638

Supplier	Model	Vaccine storage capacity L	Holdover (days)	Voltage Stabilizer	UNICEF indicative price 1-9 units, USD	UNICEF indicative price 200-499 units, USD
Godrej & Boyce (Sure Chill)	GVR 75 Lite AC	72,5	3,4	Integrated	1030	1005
Zero (Sure Chill)	ZLF 80 AC	77,0	4,4	Integrated	1990	1950
B Medical	TCW 80 AC	80,5	3,0	Integrated	3482	2864
Vestfrost	VLS 204A AC	60	2,25	Integrated	911	848
Vaccine storage capacity, 30-60 L						
B Medical	TCW 40R AC	36,5	5,1	Integrated	3230	2864
Godrej & Boyce (Sure Chill)	GVR 50 AC	46,5	7,6	Integrated	1642	1610
Aucma	CFD-50	50,0	5,6	Integrated	1400	1300
Godrej & Boyce (Sure Chill)	GVR 51 Lite AC	51,0	3,7	Integrated	999	$977
Vaccine storage capacity, 0-30 L						
Zero (Sure Chill)	ZLF 30 AC	27,0	3,2	Integrated	1250	1226
Godrej & Boyce (Sure Chill)	GVR 25 Lite	27,5	2,2	Optional	800	777

Note: All ILRs come with either an integrated voltage stabilizer or are bundled with an external PQS certified voltage stabilizer
All Sure Chill Products use integrated voltage stabilizers but can accommodate a standalone if requested
This table uses United Nations (UN) exchange rates as of August 2020.

*Sure Chill and Vestfrost models available with either integrated or standalone voltage stabilizers

CURRENT DUAL-COMPARTMENT ICE-LINED FRIDGE-FREEZERS

The table below shows prices for platform-eligible products. The estimated range of service bundle costs is between USD 400 and USD 1,350. Estimated operating costs will vary by country and product, and are not included but can be estimated using PATH's TCO tool. Additional costs such as procurement agency fees are not included.

Supplier	Model	Vaccine storage capacity L	Waterpack storage capacity L	Waterpack freezing capacity (kg/24hr)	Holdover (days)	UNICEF indicative price 1-9 units, USD	UNICEF indicative price 200-499 units, USD
"Vaccine storage capacity, 60-90 L							
B Medical	TCW 2000 AC	60,0	20 X 0.6	10,0	1,6	3710	3342
Vaccine storage capacity, 30-60 L							
Haier	HBCD-90	30,0	16	4	2,7	1650	1500
Vestfrost	VLS 064A RF AC	52,5	6 X 0.6	1,6	1,2	1360	1265
Godrej & Boyce (Sure Chill)	GVR 55 FF AC	58,0	14,4	2,4	4,7	1410	1310

Note: **This table uses United Nations (UN) exchange rates as of August 2020.**
*Sure Chill model available with either integrated or standalone voltage stabilizers

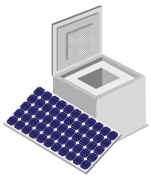
CURRENT ON-GRID FREEZERS

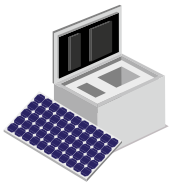
The table below shows prices for platform-eligible products. The estimated range of service bundle costs is between USD 400 and USD 1,350. Estimated operating costs will vary by country and product, and are not included but can be estimated using PATH's TCO tool. Additional costs such as procurement agency fees are not included.

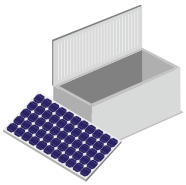
Supplier	Model	Gross volume L	Waterpack storage capacity L	Waterpack freezing capacity (kg/24hr)	Holdover (days)	UNICEF indicative price 1-9 units, USD	UNICEF indicative price 200-499 units, USD
Gross storage capacity, 120 L+							
Haier	HBD 116	121,0	136 x 0.6	12	0,1	533	510
Vestfrost	MF 214	171,0	160 x 0.6	7,2	0,1	633	614
B Medical	TFW 3000 AC	204,0	162 x 0.6	32		3382	3008
Aucma	DW-25W300	240,0	233 x 0.6	38,3	2,4	540	490
Vestfrost	MF 314	281,0	256 x 0.6	7,2	0,2	730	708
Haier	HBD 286	298,0	310 x 0.6	16,8	0,2	628	600
Gross storage capacity, 90-120 L							
Aucma	DW-25W147	96,0	124 x 0.6	14,5	0,3	450	400
Vestfrost	MF 114	105,0	64 x 0.6	7,2	0,1	553	536

Note: **This table uses United Nations (UN) exchange rates as of August 2020.**

OFF-GRID DEVICES







	SOLAR DIRECT DRIVE (SDD) REFRIGERATORS	DUAL COMPARTMENT FRIDGE-FREEZER SDD DEVICES	SDD FREEZERS
KEY FEATURES	This device is powered by solar panels It requires less maintenance than a solar battery refrigerator	This device is powered by solar panels It requires less maintenance than a solar battery fridge-freezer It has dual fridge and freezer compartments to support outreach	This device is powered by solar panels It requires less maintenance than a solar battery freezer
OUTREACH CAPABILITY	Supports high/low levels of outreach when accompanied by an ice pack freezer or compartment for chilling cool water packs*	Supports low/medium levels of outreach	Supports medium levels of outreach using ice packs
VACCINE STORAGE CAPACITY	**(14-220 L)**	**(16-102 L)**	**Only selected models currently recommended for vaccine storage. All models can be used for ice pack freezing and storage**
NUMBER OF CURRENT PLATFORM-COMPLIANT DEVICES	28	10	3
ADDITIONAL CONSIDERATIONS	This device requires installation by a trained technician A site evaluation is critical to determine whether solar technology is suitable for a health facility An alternate approach might be to use pole-mounted solar panels	This device requires installation by a trained technician A site evaluation is critical to determine whether solar technology is suitable for a health facility An alternate approach might be to use pole-mounted solar panels	This device requires installation by a trained technician A site evaluation is critical to determine whether solar technology is suitable for a health facility An alternate approach might be to use pole-mounted solar panels

*Depending on freezer capacity when paired with a vaccine refrigerator.

FUTURE DEVICES

Several suppliers are developing new SDDs expected to arrive on the market in the coming years. Future devices in development and/or testing include features such as autonomy time of 5 days, upright SDD frames, larger storage capacity, and additional models with energy harvesting capabilities. Additional features such as integrated energy harvesting capabilities and integrated RTMD or EMS are also expected soon in some SDDs currently available through the platform. Following PQS certification, new platform-eligible equipment will be added to this Guide on a regular basis.

CURRENT SOLAR DIRECT DRIVE REFRIGERATORS

The table below shows prices for platform-eligible products. The estimated range of service bundle costs is between USD 650 and USD 2,150. Estimated operating costs will vary by country and product, and are not included but can be estimated using PATH's TCO tool. Additional costs such as procurement agency fees are not included.

Supplier	Model	Vaccine storage capacity L	Autonomy (days)	UNICEF indicative price 1-9 units, USD	UNICEF indicative price 200-499 units, USD
Vaccine storage capacity, 120 L+					
Zero (Sure Chill)	ZLF 150 DC	128,0	5,5	5330	5224
Dulas	VC 200 SDD	132,0	3,3	4432	4261
Vestfrost	VLS 154A SDD	170	3,06	4702	4373
Haier	HTC-240	200,0	3,9	4150	4090
B Medical	TCW 4000 SDD	220,0	3,8	7775	6941
Vaccine storage capacity, 90-120 L					
Vestfrost	VLS 094A SDD	92	3,02	3669	3486
Godrej & Boyce (Sure Chill)	GVR 100 DC	99,0	7,3	4750	4656
Zero (Sure Chill)	ZLF 100 DC	99,0	7,1	4847	4751
Haier	HTC-120	100	4,6	3620	3500
Dulas	VC110 SDD	110,0	3,3	4205	3977
Vaccine storage capacity, 60-90 L					
Haier	HTC-112	75,0	3,9	2700	2430
Dulas	VC 88 SDD	88,0	3,3	4205	3977
B Medical	TCW 3043 SDD	89,0	4,9	7092	6348
Vaccine storage capacity, 30-60 L					
B Medical	TCW 40R SDD	36,0	3,4	5807	5170
Godrej & Boyce (Sure Chill)	GVR 50 DC	46,5	5,6	3450	3382
Aucma	CFD-50 SDD*	50,0	5,0	2600	2400
Dulas	VC 50 SDD	52,5	3,1	3125	2841
SunDanzer	BFRV-55 SDD	54,5	3,5	3165	3015
Vestfrost	VLS 054A SDD	55,5	3,02	3363	3127
Haier	HTC 110 SDD	59,0	4,0	2650	2380
Vaccine storage capacity, 0-30 L					
SunDanzer	BFRV 15 SDD	15,0	4,2	2420	2270
B Medical	TCW 15R SDD	16,0	3,4	4906	4351
B Medical	Ultra 16 SDD*	16,0	19,9	5947	5292
Haier	HTC 40 SDD	22,5	4,9	2400	2166
Dulas	VC 30 SDD	25,5	3,0	2898	2614
Vestfrost	VLS 024 SDD	25,5	3,4	3034	2822
Zero (Sure Chill)	ZLF 30DC SDD	27,0	3,2	2920	2862
Godrej & Boyce (Sure Chill)	GVR25LiteDC	27,5		2375	2141

* SDD includes Integrated Energy Harvesting capabilities

Note: **This table uses United Nations (UN) exchange rates as of August 2020.**

CURRENT DUAL COMPARTMENT SOLAR DIRECT DRIVE REFRIGERATOR-FREEZERS

The table below shows prices for platform-eligible products. The estimated range of service bundle costs is between USD 650 and USD 2,150. Estimated operating costs will vary by country and product, and are not included but can be estimated using PATH's TCO tool. Additional costs such as procurement agency fees are not included.

Supplier	Model	Vaccine storage capacity L	Waterpack storage capacity L	Waterpack freezing capacity (kg/24hr)	Autonomy (days)	UNICEF indicative price 1-9 units, USD	UNICEF indicative price 200-499 units, USD
Vaccine storage capacity, 90-120 L							
Haier	HTCD 160 SDD	100,0	18 x 0.6	2,08	5,1	5750	5250
Dulas	VC 150	102,0	20 x 0.6	2,04	3,2	6250	6023
Vaccine storage capacity, 60-90 L							
B Medical	TCW 2043 SDD	70,0	16 x 0.6	2,5	3,1	10299	9233
Vaccine storage capacity, 30-60 L							
B Medical	TCW 40 SDD	36,0	3.6 kg	1,8	3,4	6118	5472
Vestfrost	VLS 056 RF SDD	36,0	29 x 0.6	1,8	3,0	5466	5083
Haier	HTCD 90 SDD	37,5	20 x 0.6	2,08	4,8	3950	3610
Dulas	VC60SDD-1	57,0	23 x 0.6	2,4	3,5	5284	5057
Godrej & Boyce (Sure Chill)	GVR 55 FF DC	58,0	24 x 0.6	2,4	11,8	5500	5200
Vaccine storage capacity, 0-30 L							
B Medical	TCW 15 SDD	16,0	4 x 0.6	1,97	3,5	4944	4386
Vestfrost	VLS 026 RF SDD	20,0	29 x 0.6	1,8	3,1	5142	4782

Note: Dulas purchase price information is based on Type 1 temperature monitoring equipment. Additional costs will be associated with Type 4.

This table uses United Nations (UN) exchange rates as of August 2020.

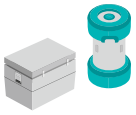
CURRENT SOLAR DIRECT DRIVE FREEZERS

The table below shows prices for platform-eligible products. The estimated range of service bundle costs is between USD 650 and USD 2,150. Estimated operating costs will vary by country and product, and are not included but can be estimated using PATH's TCO tool. Additional costs such as procurement agency fees are not included.

Supplier	Model	Gross volume, L	Waterpack storage capacity L	Waterpack freezing capacity (kg/24hr)	Autonomy (days)	UNICEF indicative price 1-9 units, USD	UNICEF indicative price 200-499 units, USD
Gross storage capacity, 90-120 L							
B Medical	TFW 40 SDD	64	11.24 kg	2,16	5	5402	4813
Gross storage capacity, 30-60 L							
Vestfrost	VFS 048 SDD	34,3	29 x 0.6	1,6	2	2966	2758
Haier	HTD 40 SDD	48	20 kg	2,4	5	2250	1890

Note: **This table uses United Nations (UN) exchange rates as of August 2020.**

OFF-GRID PASSIVE DEVICES



	LONG-TERM PASSIVE DEVICES
KEY FEATURES	This device has a cold life at 43 °C of more than 30 days It requires no active energy source (e.g. sunlight, batteries, electricity or fuel) It has low maintenance requirements It has no special installation requirements
OUTREACH CAPABILITY	Could support outreach
VACCINE STORAGE CAPACITY	**(5.4 L)**
NUMBER OF CURRENT PLATFORM-COMPLIANT DEVICES	1
ADDITIONAL CONSIDERATIONS	This device requires newly frozen ice packs monthly to maintain the appropriate storage temperature Current devices have a low storage capacity (less than 10 L)

CURRENT LONG-TERM PASSIVE DEVICES

Supplier	Model	Vaccine storage capacity L	Ice Required L	Cold life at +43°C (days)	UNICEF indicative price 1-15 units, USD
Aucma	Arktek YBC – 5	5,4	8	35	2193

* Coolant packs needed for the Arktek are available for USD $9

Note: The Arktek-YBC-5 requires conditioning of its ice packs before insertion, and is therefore not considered to have Grade A user independent freeze protection. Given the key features of the Arktek and its potential to satisfy specific supply chain needs, the platform will support its purchase on an exceptional basis.

The opex cost of a long-term passive device will depend on the cold chain in your country. An estimate can be calculated based on three components:

- The cost of any additional freezer equipment required at the district store;
- The cost of power use to freeze ice;
- The cost of labour and transport associated with picking up ice from the district store.

PORTABLE DEVICES

	FREEZE-PREVENTIVE VACCINE CARRIERS	FREEZE-PREVENTIVE COLD BOXES
KEY FEATURES	This device is an insulated container that prevents direct contact between ice packs and vaccine vials, and is used to transport and store vaccines for immunisation sessions	This device is a larger, portable, insulated container It is used for transportation between sites, storage during immunisation sessions and multi-day outreach activities, and campaigns
OUTREACH CAPABILITY	Supports high levels of outreach	Supports high levels of outreach
VACCINE STORAGE CAPACITY	 **(1-2 L)**	 **(15 L)**
NUMBER OF CURRENT PLATFORM-COMPLIANT DEVICES	3	1
ADDITIONAL CONSIDERATIONS	Coolant pack standardisation should be considered if multiple carriers are used. Before purchasing, consider the maximum acceptable fully loaded weight, durability, shape/size and how long vaccines stay cold/ cool when used with ice packs.	Coolant pack standardization should be considered if multiple cold boxes are used. Before purchasing, consider the maximum acceptable fully loaded weight, durability, shape/size and how long vaccines stay cold/ cool when used with ice packs.

FUTURE DEVICES

Several suppliers are developing new portable devices and these are expected to arrive on the market in the coming years. Future devices in development and/or testing include both large and small freeze preventive cold boxes and other portable storage containers with between 7-50 L storage capacity and a cold life of 2-5 days. Following PQS certification, new platform-eligible equipment will be added to this Guide on a regular basis.

CURRENT FREEZE-PREVENTIVE VACCINE CARRIERS

The table below shows prices for platform-eligible products. Additional costs such as procurement agency fees are not included.

Supplier	Model	Vaccine storage capacity L	Weight fully loaded (kg)	Cold life at +43°C (days)	Size of coolant packs (L)	UNICEF indicative price 1-9 units, USD	UNICEF indicative price 200-499 units, USD
AOV	AFVC-46	1,5	8	1,4	0,6	49 (sea) 48 (air)	39 (sea) 41 (air)
Qingdao LEFF International Trading Co	FFVC-1.7L	1,7	8	1,4	0,6	39	31,5
Blowkings	BK-VC-FF 1.6L	1,6	6,4	1,25	0,4	46 (sea) 47 (air)	44

FREEZE-PREVENTIVE COLD BOXES

The table below shows prices for platform-eligible products. Additional costs such as procurement agency fees are not included.

Supplier	Model	Vaccine storage capacity L	Weight fully loaded (kg)	Cold life at +43°C (days)	Size of coolant packs (L)	UNICEF indicative price 1-9 units, USD	UNICEF indicative price 200-499 units, USD
Qingdao LEFF International Trading Co	FFCB-15L	15,4	49,9	4,4	0,6	258	234

TEMPERATURE MONITORING DEVICES

Temperature monitoring devices (TMDs) are used to monitor the performance of CCE in maintaining the safe 2-8 °C range. Modern TMDs are designed to provide both a view of the current storage temperature, as well as a digital record of the temperatures – and high-risk events – over time.

In order to maintain vaccine quality, it is essential to monitor the temperature of vaccines throughout the supply chain. When done properly, this monitoring achieves the following goals:

- Identifies malfunctioning cold chain equipment, reducing risk to vaccines.
- Alerts health workers and supervisors to high-risk temperature exposures, so that corrective vaccine management and CCE maintenance actions can be taken (e.g. testing/disposal of vaccines, repair of CCE).
- Having a TMD is critical for achieving these goals.

30-DAY TEMPERATURE RECORDERS (30-DTRS)

For health facilities and subnational stores, WHO recommends the 30-day temperature recorders (30-DTRs)[1]. These devices display a) the current temperature, and b) a rolling 30-day history of all high-risk freezing and heat events[2]. This is a significant improvement over stem thermometers, which fail to alert health workers to events occurring between routine monitoring checks.

30-DTRs also facilitate more efficient reporting on CCE performance, using the monthly count of alarms. Some newer models also allow records to be downloaded and printed, by connecting the device to a PC via USB.

Note: 30-DTRs are battery powered, with devices lasting between two to five years (depending on model). As such, it is important to anticipate future procurement to replace units with run-down batteries within broader cold chain planning.

[1] Refer to the WHO Vaccine Management Handbook Module on How to Monitor Temperatures in the Vaccine Supply Chain 2015) (Module VMH-E2-01.1) for detailed guidance.

[2] A high risk freezing event is defined as >60 minutes below –0.5°C. A high risk heat event is defined as >10h above 8°C]

CURRENT 30-DTRS

Supplier	Model	Data download and interface	Battery shelf life (months)	Activated life (months)	UNICEF indicative price 1-9 units, USD	UNICEF indicative price 200-499 units, USD
Haier	HETL-01	USB	36 months from manufacture date	36 (24 , after a maximum shelf life of one year)	23	22
LogTag	VaxTag 30DTR	USB cradle	n/a	24-36	40 for logger Accessories: Standard Logtag Interface (docking station) and the Logtag Analyser Software. Price for interface cradle is 30.	30 for logger Accessories: Standard Logtag Interface (docking station) and the Logtag Analyser Software. Price for interface cradle is 28.
Berlinger	Fridge-Tag 2	USB	42 months from manufacture date	42 months from manufacture date	44	35 Scale pricing starts from 100 units
Berlinger	Fridge-Tag 2 E	USB	66 months from manufacturing date	66 months from manufacturing date	93 external sensor 73 internal sensor	78.65 external sensor 58.65 internal sensor Scale pricing starts from 100 units
ELPRO-BUCHS AG	LIBERO Ti1	USB	14	13	130	115

Note: all devices have a visual alarm and non-replaceable batteries.

Includes fees for all needed battery replacements for 5 years where applicable.

Total 5 year equipment and operating fees will depend on the country specifics and technical configuration of the systems.

Note: **This table uses United Nations (UN) exchange rates as of August 2020.**

REMOTE TEMPERATURE MONITORING DEVICES (RTMDS)

In addition to 30-DTRs, the platform also covers remote temperature monitoring devices (RTMDs). These devices use mobile phone networks to transmit temperature data to the cloud. The data can be accessed through a supplier-provided web portal or can be directed into the country's Electronic Logistics Management Information System (eLMIS), and enables tracking of the performance of the CCE in-country. This allows fridge suppliers to quickly identify fridges that have performance issues, and to direct their in-country service delivery partners to perform required repairs quickly.

The platform also covers integrated RTMDs, which are RTMDs built into the fridge or freezer. Countries may consider selecting such devices when programmatic and budgeting requirements for the recurring fees are met. Additional temperature monitoring devices including new standalone RTMDs are expected on the market in the coming years. Following PQS certification, new platform-eligible devices will be added to this Guide on a regular basis.

RTMDs are contracted with 3 years of access to online portals for remote management and tracking of equipment performance and data fees for transmitting of data from the equipment to these servers. This access also includes features such as remote SMS alerts to registered users for temperature alarms, among other features

The table below shows prices for available products. The estimated range of the service bundle is between USD 200 and USD 400. Estimated data and operating costs will vary by country and product. Additional costs such as procurement agency fees are not included. Countries should also consider budgeting for RTMD recurring costs after the 3-years of data and portal access costs that will be covered through the CCEOP.

Estimated total costs of RTMDs are not included in the table below, as these will vary by country and by the SIM card selected (e.g., global vs. local); estimates for communication costs for local and global SIM cards are provided separately. Please note most countries are expected to have costs at the lower end of the ranges provided in below table, but this should be confirmed with UNICEF Supply Division. **The values provided in the CCEOP Budget Template include a point estimate for data/portal costs for three years and may not be reflective of the actual costs to your country** or variations between local SIM and global SIM data costs. Countries should contact UNICEF Supply Division Cold Chain Unit to obtain country-specific global SIM costs and subsequently update the RTMD total cost estimate in the budget template accordingly.

CURRENT REMOTE TEMPERATURE MONITORING DEVICES (RTMDS)

Estimated data and operating costs are included for 3 years (with either global SIM cards or local SIM cards), will vary by country and product.

Supplier	Model	Number of wired temperature monitoring channels	UNICEF indicative price† 1-49 units, USD	Estimated fees for 3 years (web portal, Global SIM card, etc) USD per year*	Estimated fees for 3 years (web portal, Local SIM card, etc) USD per year*
Berlinger	Fridge-tag 3 GSM	1	254	619 – 3315	450 – 1320
Beyond Wireless	ICE3 (Model BC141)	4	250	365	365
Blulog	TDL2-5Y data logger	N/A (wireless)	339	649 – 4316	Local SIM card not offered
Haier	Haier U-Cool	1	101	270 – 450	Local SIM card not offered
Ikhaya	VM 1000	1	318	636 – 4618	519
Nexleaf	ColdTrace 5 (CT5)	5	225	243	243

Note: all devices have a visual alarm and non-replaceable batteries.

† If applicable, price includes fees for all needed battery replacements for 5 years

* Where range is indicated, the prices differ by country, the range represents the lowest and highest value quoted. Recurring fees are expected to fall toward the lower estimate in the majority of countries; please contact UNICEF Supply Division to confirm costs for your country

Note: **This table uses United Nations (UN) exchange rates as of October 2020.**

FUTURE DEVICES

Several suppliers are developing new RTMDs expected to arrive on the market in the coming years. Following PQS certification, new platform-eligible equipment will be added to this Guide on a regular basis.

VOLTAGE STABILIZERS

Voltage stabilizers are used to protect on-grid, mains-powered refrigerators and freezers from damage caused by fluctuations in the electricity supply. They protect the refrigerator or freezer's control unit, compressor, fuses and other electronic components against damage resulting from power fluctuations such as:

- Voltage levels that either too low or high
- Voltage spikes caused by nearby lightening strikes, switching effects, or improper grounding
- Frequency deviations

Some refrigerator and freezer manufacturers choose to integrate voltage stabilizers into the bodies of their devices, while others choose to provide a stand-alone, external voltage stabilizer along with their devices. This Guide only includes voltage stabilizers of the external type, since integrated stabilizers are a de facto option determined by the refrigerator or freezer manufacturer.

It is critical that all on-grid refrigerators and freezers are only used in combination with a PQS prequalified voltage stabilizer, as power fluctuations can substantially reduce the reliability and lifetime of this type of equipment, as well as increase its maintenance costs.

Additional voltage stabilizers, including both standard and extended range, are currently under development and/or testing, and expected on the market in the coming years. Following PQS certification, new platform-eligible equipment will be added to this Guide on a regular basis.

CURRENT VOLTAGE STABILIZERS

Supplier	Model	Input Voltage Type	Input Range Type	Power Rating (VA)	UNICEF indicative price 1-9 units, USD	UNICEF indicative price 200-499 units, USD
Sollatek	SVS04E-22 4A	110-285V Operating Input Voltage Range: 100-290V	Extended	1000	95	95
Sollatek	SVS04-22 4A	145-285V Operating Input Voltage Range: 150-278V	Standard	1000	65	65
Haier	HVS-1000	230V/50-60Hz	Standard	1000	68	68

Note: Standard range voltage stabilizers will continue to operate normally with input voltage fluctuations between 82V and 159V, 173V and 278V, or better. Extended range voltage stabilizers will continue to operate normally with input voltage fluctuations between 110V and 278V, or better.

CONCLUSION

Gavi's CCEOP has been designed to support countries with rehabilitating, expanding, and extending the cold chain by appropriately selecting, procuring, and deploying the optimised products presented in this Guide. Countries may benefit in three ways from these optimised products. First, the products should enable the cold chain to reach more facilities, including facilities that were previously hard-to-reach. Second, the products should offer improved temperature control to vaccines, including the elimination of the risk of freezing. Third, the products should remain functional in challenging operating conditions for longer periods of time; additionally, recorded temperature data should offer the potential to inform preventative maintenance and repair systems.

Lastly, all equipment performance data generated by the Gavi-supported CCE should be owned and accessed by the country.

Together, these benefits can help enable countries improve vaccine availability, increase vaccine safety, and maintain vaccine potency. As a result, more children in more locations may receive effective vaccines, contributing toward improving country immunisation coverage. This, along with the lower operating costs of many of the optimised products, should support countries with implementing more cost-effective and high-impact immunisation systems.

ACRONYM KEY

30-DTRS
30-day temperature recorders

CCE
Cold chain equipment

CCEOP
Cold Chain Equipment Optimisation Platform

EHC
Energy harvesting control

EMS
Equipment monitoring system

EVM
Effective vaccine management

GAVI
Gavi, the Vaccine Alliance

ILR
Ice-lined refrigerator

PQS
Performance, Quality and Safety

RTMD
Remote Temperature Monitoring Device

SDD
Solar direct drive

TCO
Total cost of ownership

TMD
Temperature Monitoring Devices

UN
United Nations

UNICEF
United Nations Children's Fund

WHO
World Health Organization

DEFINITIONS

Autonomy: The autonomy of a solar refrigerator measures the ability of the equipment to store vaccine during periods of heavy cloud. It is defined as the maximum number of days during which the refrigerator can maintain a full vaccine load at a temperature between 2 °C and 8 °C when the photovoltaic panels are not generating electricity.

Holdover time: In the event of power failure, the time in hours during which all points in the vaccine compartment of a vaccine refrigerator remain below 10°C, at the maximum ambient temperature of the temperature zone for which the appliance is rated, after the power supply has been disconnected. For vaccine freezers, the holdover time is the time in hours during which the vaccine compartment remains below -5 °C.

Cold life and cool life for cold boxes and vaccine carriers: Cold life applies when fully frozen water packs are used as the coolant. These will continue to be used for transporting oral polio vaccine and single antigen freeze-dried vaccines. Cool life applies when cool water packs are used.

- ***Cold life with frozen water packs:*** Cold life is measured from the moment when the container lid is closed until the temperature of the warmest point in the vaccine storage compartment first reaches 10 °C, at a constant ambient temperature of 43 °C.
- ***Cool life with cool water packs at 5 °C:*** Cool life is measured from the moment when the container is closed, until the temperature of the warmest point inside the vaccine storage compartment first reaches 20 °C, at a constant ambient temperature of 43 °C.

THE COLD CHAIN EQUIPMENT OPTIMISATION PLATFORM HAS BEEN DEVELOPED THROUGH THE COLLABORATION OF THE FOLLOWING VACCINE ALLIANCE PARTNERS:

Gavi The Vaccine Alliance

Bill & Melinda Gates foundation

unicef

World Health Organization

PATH

Clinton Health Access Initiative

Gavi
The Vaccine Alliance

www.gavi.org
Together,
we make #vaccineswork

@gavi @gavi_fr @vaccines
facebook.com/gavi
linkedin.com/company/gavi