ENERGY HARVEST CONTROL

A New Way to Power Health Facilities with Solar

Frequently asked questions

Who is this frequently asked questions guide for?

This document examines energy harvest control (EHC) systems and provides ministries of health, the World Health Organization (WHO) Expanded Programme on Immunization, and staff of global agencies concerned with cold chain technology with a brief overview of EHCs. It answers frequently asked questions and provides a high-level overview of the technology.

What is an energy harvest control?

An EHC is a new technology that collects excess energy from a solar direct drive (SDD)–powered vaccine refrigerator to power devices such as lights, fans, mobile phones, remote temperature monitoring devices, and select medical devices. An EHC can either be integrated into the refrigerator or be a standalone product. It provides a small amount of electricity to health facilities that might otherwise have unreliable or no electrical power. The EHC is part of a system that includes the SDD refrigerator, solar array, wiring and connections, the EHC itself, and the devices it powers.

What types of devices can an energy harvest control system power?

An EHC can directly power or recharge batteries for low-power devices such as remote temperature monitoring devices, lights, fans, phones, and select medical devices (see Figure 1), usually via USB or 12-volt direct current (12 V DC) adapter (see Figure 2, next page).

Figure 1. Examples of devices that can be powered by an EHC.

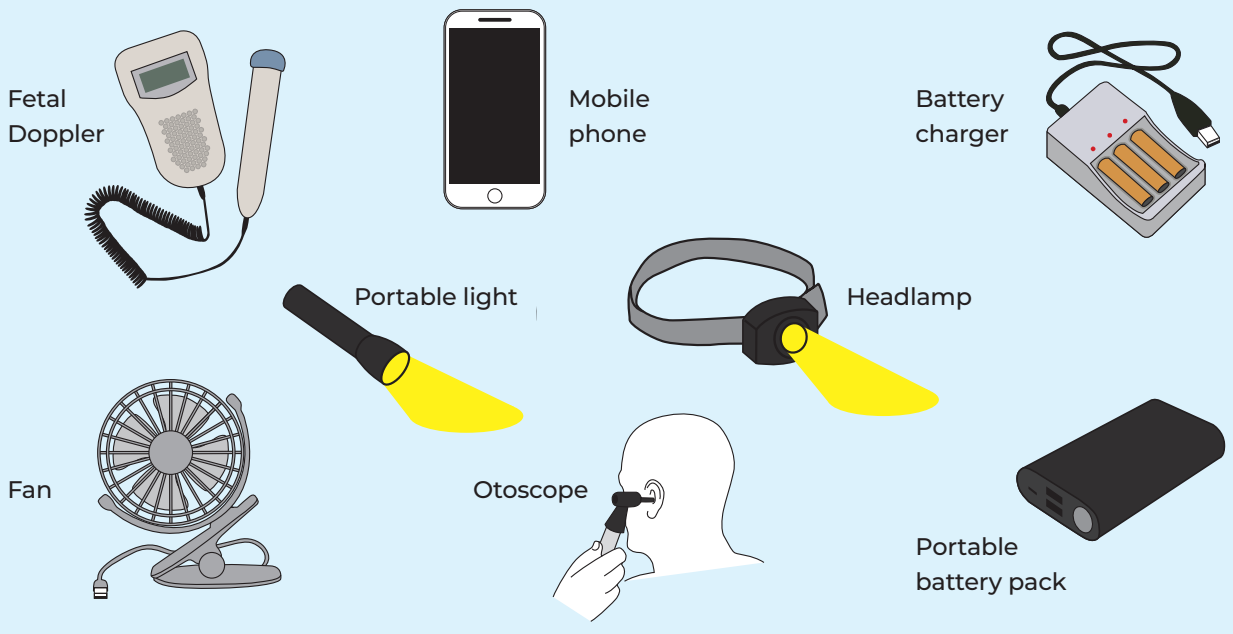
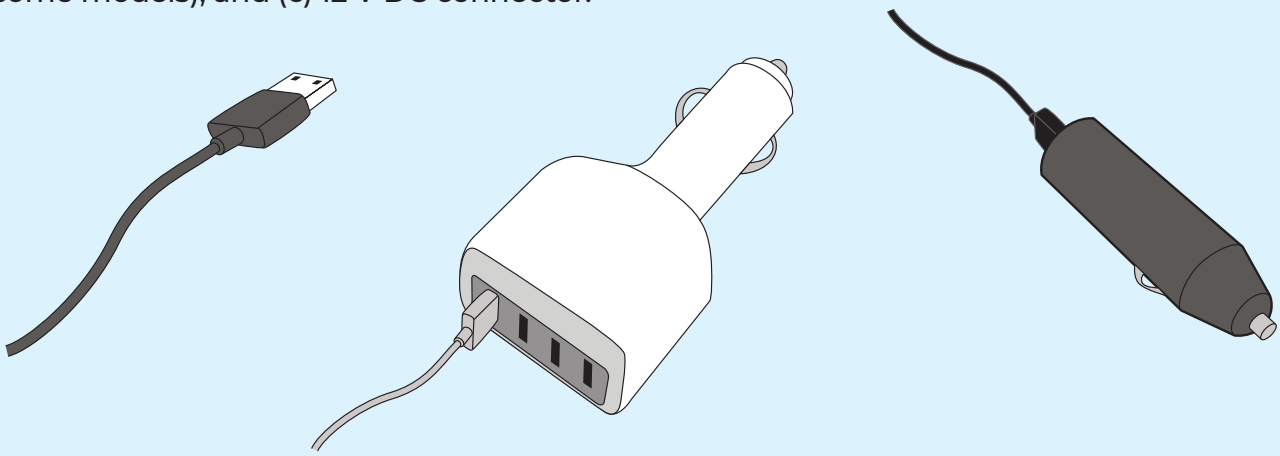


Figure 2. Some common connectors and adapters that can be used to power or recharge small devices from an EHC: (a) USB connector, (b) 12 V DC to USB adapter (available on some models), and (c) 12 V DC connector.



How much electricity can be provided?

All SDD EHC systems have a limited ability to provide power and will usually not have enough capacity to meet all of a health facility's power needs. A separate, larger solar power system is typically required to completely power a health facility. These solar power systems are costlier due to a larger solar array, larger battery, and more complicated installation, and they are more complex than EHC systems.

WHO Performance, Quality and Safety (PQS) testing establishes an estimated amount of electricity harvested by a specific SDD and EHC pair. This is then reported as watt-hours per day (Wh/day). In round numbers, this has ranged from 50 Wh/day to more than 500 Wh/day. For illustration, a 50-Wh/day harvest could directly power a small fan during the day or recharge the built-in batteries of multiple cell phones. Other combinations are possible. A 500-Wh/day harvest could recharge batteries that in turn power lights, small fans, and select medical devices, as well as recharge mobile phones. Each EHC will have a different test result, so you will need to compare options.

Are any energy harvest control systems approved by the World Health Organization?

Yes, the WHO PQS program has prequalified several EHC systems for use with specific SDD vaccine refrigerators. This equipment can be purchased through the United Nations Children's Fund Supply Division or directly from the manufacturers.

To see which EHC systems are prequalified, visit the WHO PQS catalogue:

http://apps.who.int/immunization_standards/vaccine_quality/pqs_catalogue/.

How does it work?

Frequently, SDD vaccine refrigerators cannot use all the solar electricity produced during the day. That excess electricity is wasted unless it is used immediately or stored for future use. The EHC captures this excess energy so that facilities can directly power or recharge a range of battery-powered devices. The EHC always prioritizes the energy needs of the vaccine refrigerator—its primary function. When there is excess energy available, the EHC can divert it for other secondary uses while always ensuring the refrigerator has the energy it requires for proper operation. For example, on a cloudy or rainy day, the system may only have enough power for the vaccine refrigerator, and in that case, the EHC would not provide power for other uses. The EHC ensures that the refrigerator has the electricity to operate.

Does the energy harvest control provide energy at night?

At night, the system does not generate any power, yet the SDD refrigerator stays cold because a cold storage element is built into its compartment (for example, a water or ice bank in the walls). If a battery is part of the EHC system or the devices have their own batteries and were recharged by the EHC system during the day, then they will be able to operate at night.

What if the energy harvest control fails?

When a WHO-prequalified EHC breaks, the vaccine refrigerator should continue to work. For an EHC to receive WHO prequalification, PQS requires that SDD vaccine refrigerators continue to operate normally even when the EHC fails, and this is tested by WHO-accredited laboratories.

What are the different types of energy harvest control systems?

Currently, there are two types of EHC systems available:

- **Basic.** A system in which the EHC and power ports are built into the SDD refrigerator with USB ports, 12 V DC sockets, or potentially other ports or sockets.
- **Energy harvest kit.** A system in which the EHC is part of a standalone appliance, including the EHC itself and preselected devices. Some kits may include integrated devices, a battery, and multiple power sockets.

Type 1—basic systems

In a basic system (see Figure 3), the control and power port(s) are built into the appliance. The user provides any devices that need a small amount of power (for example, fans, or devices with a built-in battery, such as a mobile phone, remote temperature monitoring device, fetal Doppler machine, or portable battery charger). Some basic systems can also recharge a customized battery system that then powers devices specifically required at a given location. Customization requires additional site assessment and will likely increase complexity and cost.

Figure 3. Example of a basic EHC system. The solar array sends power to the refrigerator and the built-in EHC sends power to charge two to three small devices at a time.

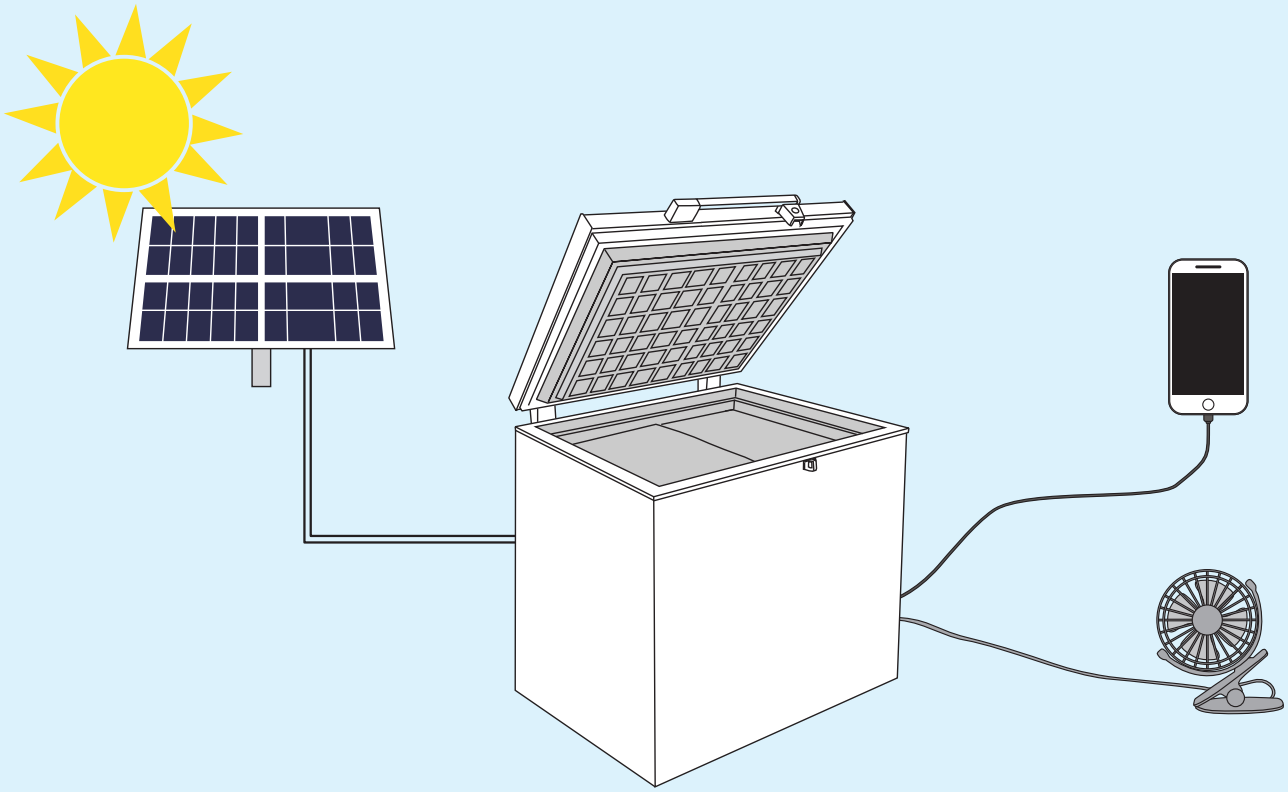
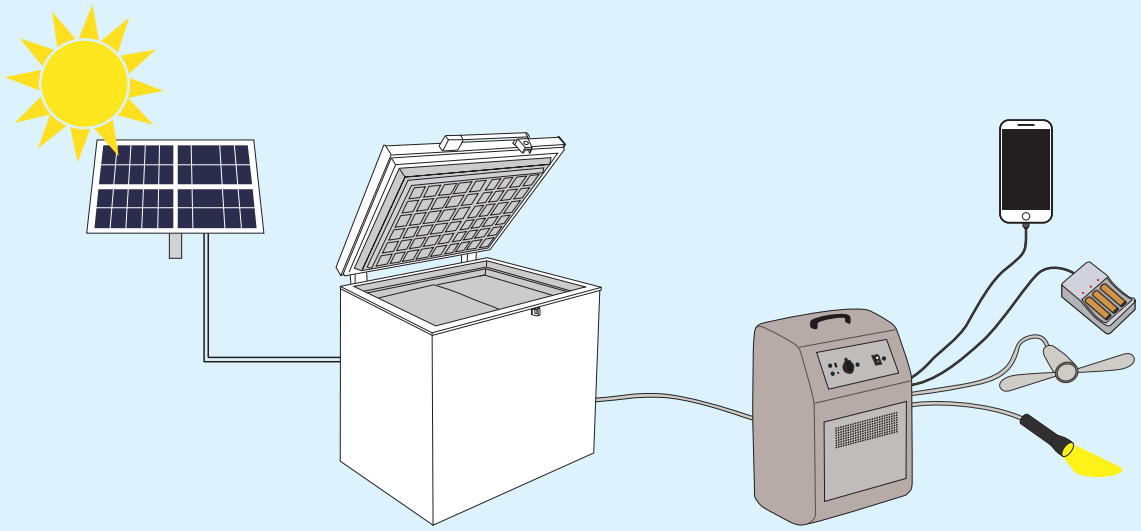


Figure 4. Example of an energy harvest kit system. The solar array sends power to the refrigerator, and the standalone EHC (the kit) sends power to small devices (some devices are integrated into the kit).



Type 2—energy harvest kit systems

A kit includes the EHC itself and preselected devices (see Figure 4). Some kits may include integrated devices that are wired permanently to the EHC, such as a battery in a safety enclosure, usually with multiple power sockets. The kit must be connected by electrical wiring to an SDD refrigerator with which the kit has been prequalified. Several currently available kits provide about 500 watt-hours of power per average day, which is enough to recharge the kit's battery in order to operate a small fan, several lights, mobile phones, and other user-selected devices.

How long will the energy harvest systems last?

WHO PQS requires the EHC to have a five-year warranty. If the system has components such as batteries, lights, and other kit parts, these components may be under a separate warranty (check with the manufacturer for full warranty details of components).

What do energy harvest systems cost to maintain?

The EHC should cost very little to install and operate and require minimal maintenance. However, if batteries are included, eventually they will need to be replaced. A majority of the maintenance costs will then be for replacing batteries.

In addition, any small devices powered by the EHC may have consumable parts and supplies. For example, a portable light may someday require a light bulb replacement, and a fetal Doppler heart monitor uses a gel that needs to be restocked periodically.

What are the next steps for this technology?

Several systems are now commercially available and have passed PQS laboratory testing. Field trials began in February 2019 to ensure EHCs perform as expected under real-use conditions. Future research may include testing of more comprehensive, custom EHC systems, in which the system powers more devices/equipment that are matched to the broader needs of a specific facility.

Where can I learn more?

A list of prequalified type 2 EHCs is available in the PQS catalogue's E007 category (https://tinyurl.com/yy2a464u). Within the catalogue's E003 category (https://tinyurl.com/cyjx9kt), more detail on the EHC will be included on the sheets for SDDs with integrated and prequalified type 2 EHCs.

Each manufacturer should have user's and technician's manuals that describe how their particular EHC works and the steps for proper maintenance. These manuals should be available from the manufacturer's website. Many of the small devices powered by the EHC are produced by separate manufacturers and those manufacturers may have support documentation on their websites.