SophiA

Sustainable Off-grid solutions for Pharmacies and Hospitals In Africa

Aims to improve quality of life of populations through better treatment & working conditions in rural and remote health facilities in Africa

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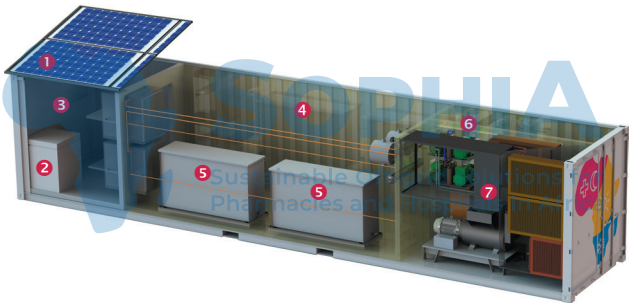
By providing:

- Ultra-low temperature storage of sensitive medication at -70°C
- Low temperature storage of blood plasma at -30°C
- Cooling of medicines and food at +5°C
- Cooling of surgical or intensive care units
- Emergency electricity supply for surgical and intensive care units
- Safe, clean drinking water and distilled water for medical purposes
- Hot water and steam production for hospital thermal requirements

Discover the SophiA Technologies :

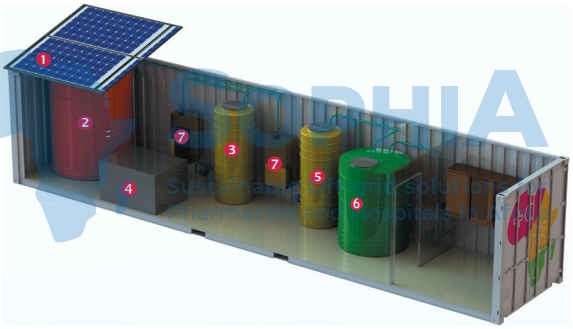
SophiA Solar Cooling Container

1. PV-Power systems
2. Storage at -70°C
3. Storage at -30°C
4. Storage at +5°C
5. Thermal energy storages
6. Machinery room
7. Emergency lithium batteries



SophiA Solar Water Container

1. PV-Power systems
2. Storage tank for drinking water
3. Deionized water storage tank
4. PVsteamCube
5. Buffer tank for UF treatment
6. Ultrafiltration (UF) tank
7. Capacitive deionisation (CDI) modules



The cooling containers will be equipped with the latest refrigeration technology to meet all the needs of a hospital in a sustainable way. A three-stage refrigeration cascade with the natural refrigerants propane, CO_2 and ethane reliably ensures the three temperature levels. The largest room inside the container is cooled down to +5°C. In there, the thermal energy storage is placed behind an intermediate wall to minimise heat loss. Lockable shelves on the wall provide storage for medicines and food products. The freezer chamber at -30°C is accessible only from the refrigerated room. Besides the storage possibility, there are two deep freezer boxes capable of cooling down to -70°C. Everything is powered by the PV-panels installed on the roof of the containers.

Solar Hot Water Generation

X-Sol Hot Water System

The X-Sol collector was chosen to produce hot water for bathroom and kitchen needs. It is a very robust, simple yet efficient solar collector. It consists of a hot water storage and an attached solar thermal collector that heats the stored water. No pump is needed as the water can circulate through the collector, driven by natural convection. Each collector has a capacity of 102 litres. For larger requirements, collectors connected in series can easily be added. The system is designed to be installed with existing overhead water storage tanks, commonly used in the target countries.

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HKA Laboratory Test Cooling Chamber

To simulate the operating conditions of the refrigeration cascade in different climate zones, a small refrigeration cell, instead of a 40-foot container, is being set up in the laboratory of the University of Applied Sciences in Karlsruhe. Components are therefore placed outside the cell. The propane circuit is enclosed and ATEX-classified ventilation constantly draws in air to ensure safe operation. A plate heat exchanger acts as a propane condenser. By regulating the water mass flow, the condensing temperature can be adjusted to simulate different ambient temperatures, to which the air condenser is exposed in Africa. Insulating panels divide the cell into +5°C and -30°C chambers. Electrical heating elements simulate the conduction of ambient temperature heat into the refrigerated container. The evaporator of the R744 cycle is housed in an enclosure with an innovative flap system. During the defrost cycle, the flap to the -30°C chamber closes, while the flap to the +5°C room opens. Defrosting thus removes heat from the room. When put in the -30°C chamber, a conventional freezer modified with an expansion vessel and an ethane compressor cools to -70°C. During testing, high-pressure shutdown is achieved when ambient air is at -25°C. To allow the cooling container operator a wider temperature range, ethane is mixed with a small amount of propane. New tests will show how the freezer performs with the new refrigerant, while the rest of the refrigeration cascade is being built.

PVmedPort

The PVmedPort is a self-sufficient station powered by photovoltaic energy. It can be: used to power existing small health facilities, implemented in the framework of outreach programs (awareness and vaccination campaigns, health and education programmes) or used as a fully equipped energy self-sufficient station (e.g. a dispensary or pharmacy). Four versions of PVmedPort are developed in the framework of SophiA: PVmedPort power, PVmedPort for mobile vaccination campaigns, PVmedPort multimedia and PVmedPort pharmacy. The equipment and interior of each version is different based on the purpose of use. The PVmedPort is scalable and can be implemented in 2kW peak modules, each providing up to 3kW of electric power at any time.

HKA Laboratory Water Treatmant

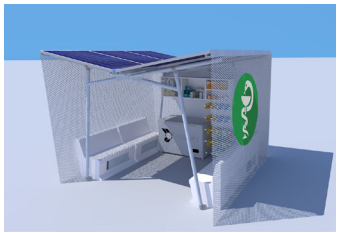
Typically used for membrane bioreactors, the submerged ultrafiltration (UF) membrane module from Martin Systems GmbH produces hygienically safe drinking water by rejecting suspended organic and inorganic impurities. Ultraviolet (UV) radiation keeps the treated water disinfected for storage. UF technology is demonstrated by Martin Systems' 0.45m² Aqua Mini Cube and 6.25m² FM6 modules setup in the HKA laboratory to filter water from model turbid suspension. Typically used to treat brine solutions, the membrane capacitive deionization (MCDI) technology is being studied in HKA to produce deionised water with a conductivity below 20 µS/cm for steam production.

PVsteamCube

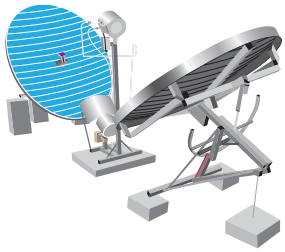
Photovoltaic electricity heats up a well-insulated metal block, where it is stored as heat at up to 400°C. The metal block serves as a heat exchanger, generating steam on demand at any time. Storage media are either aluminum or iron. In the SophiA solution for hospital requirements, a 40kWh PVsteamCube is integrated into the container, which also holds the technologies used to provide clean water. The PVsteamCube supplies steam to hospital consumers (such as autoclaves, hospital laundry and kitchen) with a higher temperature demand than solar hot water collectors can deliver.

Solar Steam from Scheffler Reflectors

Fully automated Scheffler Reflectors of the latest generation are combined into an array. Each 2.5m² reflector focuses on a cast aluminum steam generator, producing steam whenever the sun shines. The steam generators serve as interim storage to buffer fluctuations in sunshine intensity. The system is modular and can be adapted to different steam demands by adding individual reflectors. It presents an alternative to the PVsteamCube with greater adaptation to potential local manufacturing.



PVmedPort



Scheffler Reflector

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