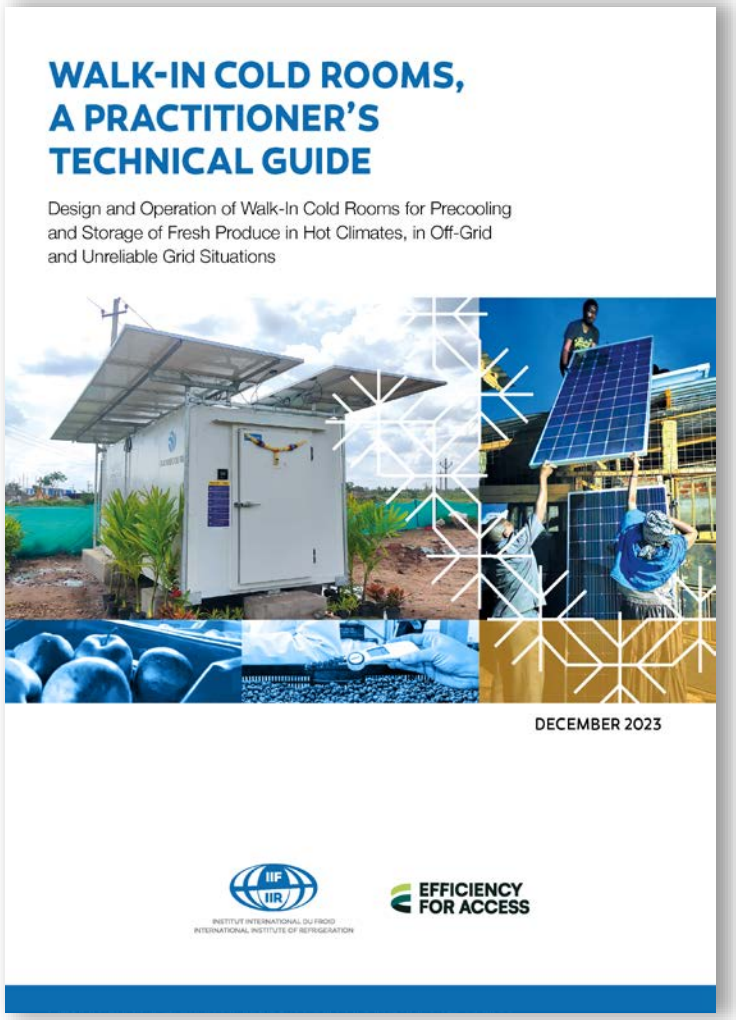
Walk-In Cold Rooms, a practitioner’s technical guide



Giovanni Cortella

University of Udine (I)

International Institute of Refrigeration

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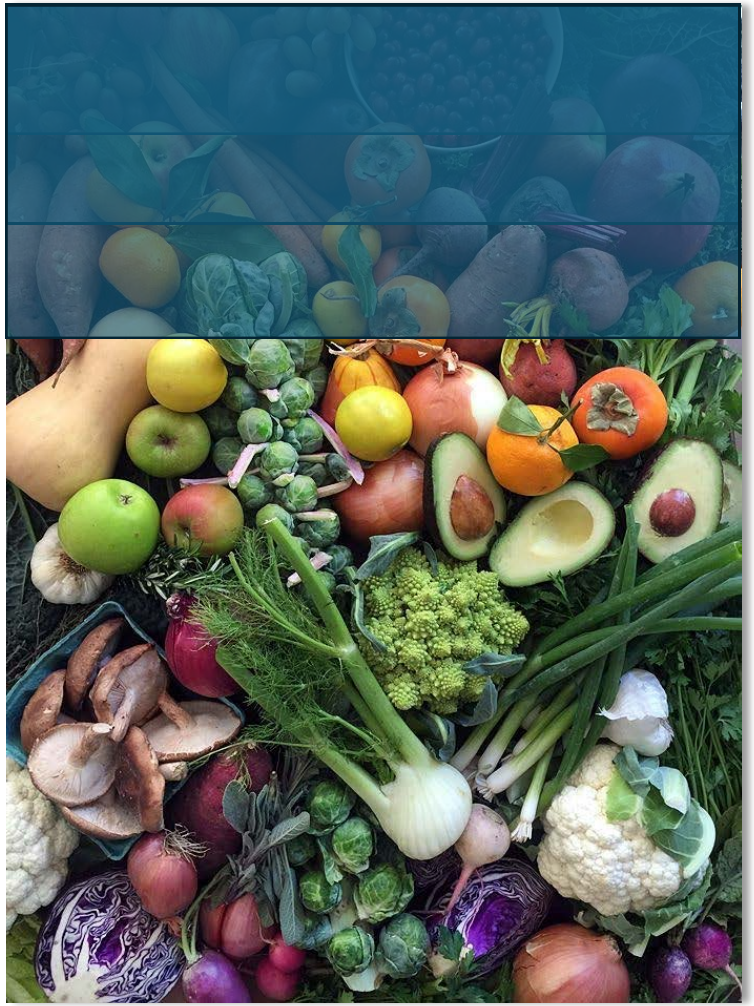

13% of food is lost in the world

21% of food is lost in sub-Saharan Africa…

… up to 33 %

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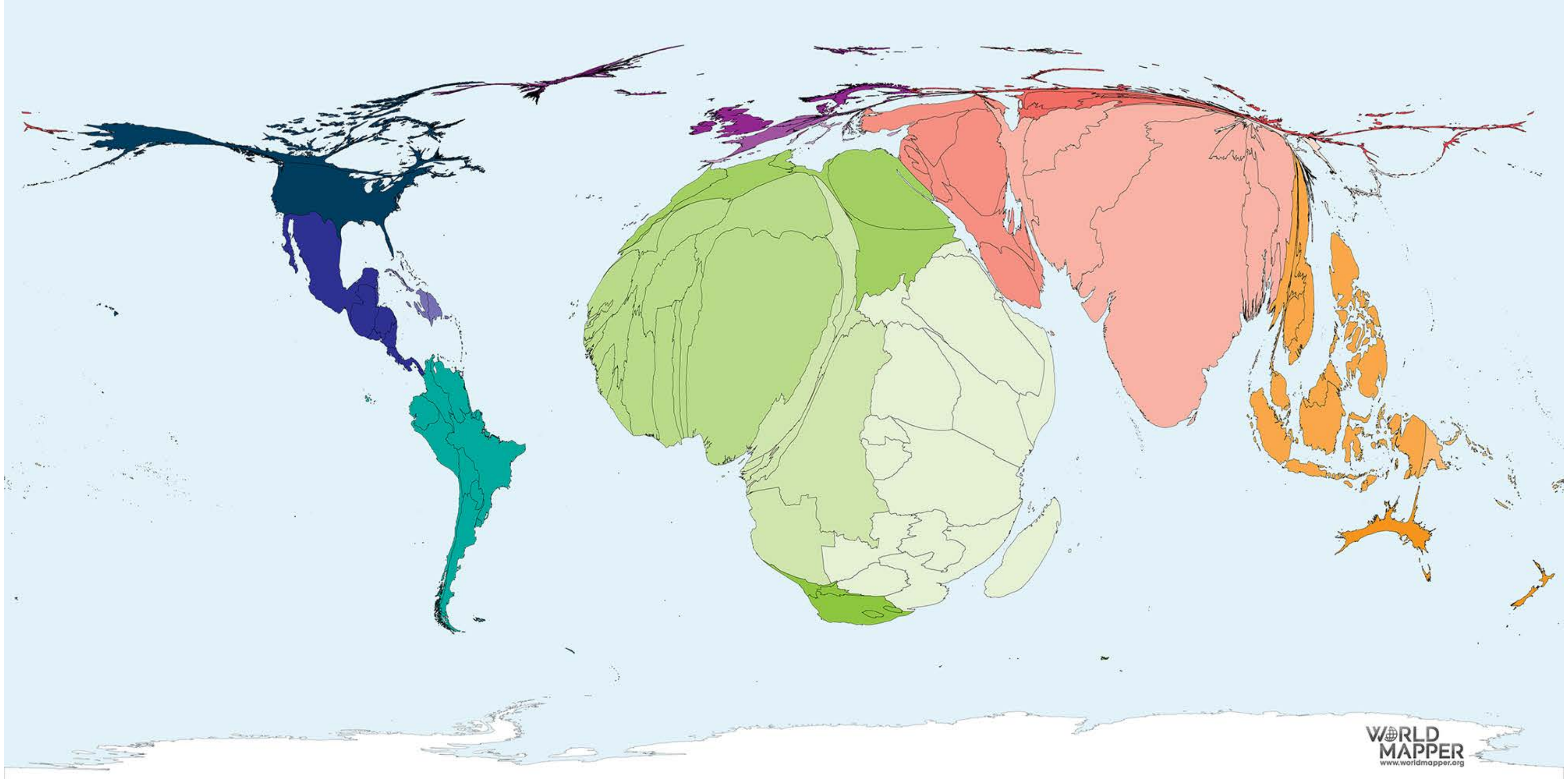

Expected population growth 2015-2050

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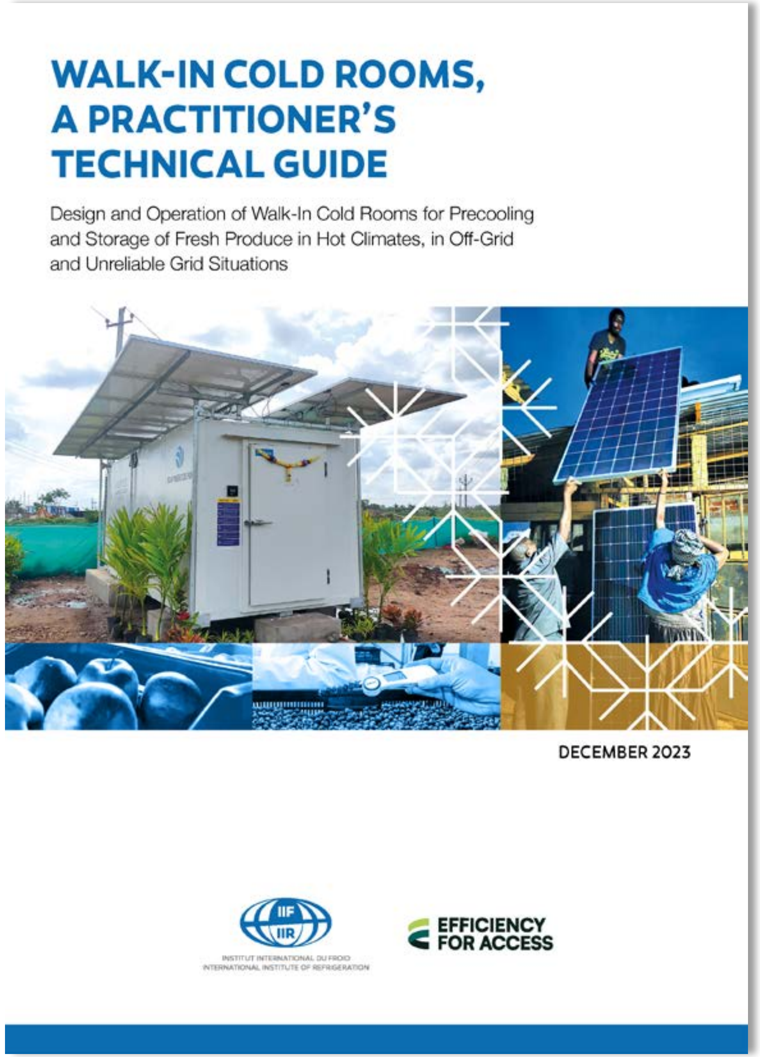

Walk-In Cold Rooms, a practitioner’s technical guide

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Monique Baha	International Institute of Refrigeration	**Dimitris Karamitsos**	The Basel Agency for Sustainable Energy (BASE)
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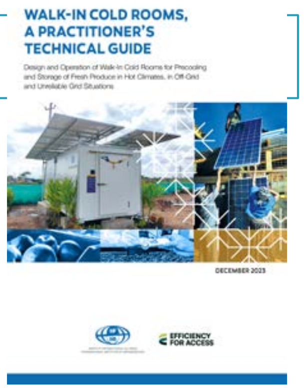

PLANNING

POLICY AND REGULATION

PUBLIC AWARENESS

DATA ANALYTICS

TECHNOLOGY & INNOVATION

An integral part of 'building back better' is developing holistic & integrated approaches to build Affordable & Effective Cold Chains

ACCESS TO APPLIANCES

PARTNERSHIPS

ACCESS TO FINANCE

CAPACITY BUILDING

MARKET LINKAGES

ESMAP Efficient Clean Cooling Program, 2023

Walk-In Cold Rooms, a practitioner’s technical guide

Purpose of the guide

To present **accessible, practical guidance** that enables **developers, owners, operators and suppliers** to **specify, install and operate effective and appropriate precoolers and cold rooms** that are as **economically viable** as possible in **off-grid, unreliable and limited power supply** situations.

Walk-In Cold Rooms, a practitioner's technical guide

Key points

- Walk-In Cold Rooms up to 80 m^3
- Horticultural and agricultural produce only (not meat, fish, milk, pharmaceuticals…)
- Chilled storage only
- Vapour compression refrigerating system electrically driven
- Reliability and affordability are priorities
- Innovative financing and business models are considered
- Suggestions for a correct planning

Walk-In Cold Rooms, a practitioner’s technical guide

Power supply

- Reliable grid, unreliable grid and off-grid solutions are considered
- Particular focus on solar photovoltaic energy source
- Energy storage:
  - Electrical energy storage
  - Thermal energy storage

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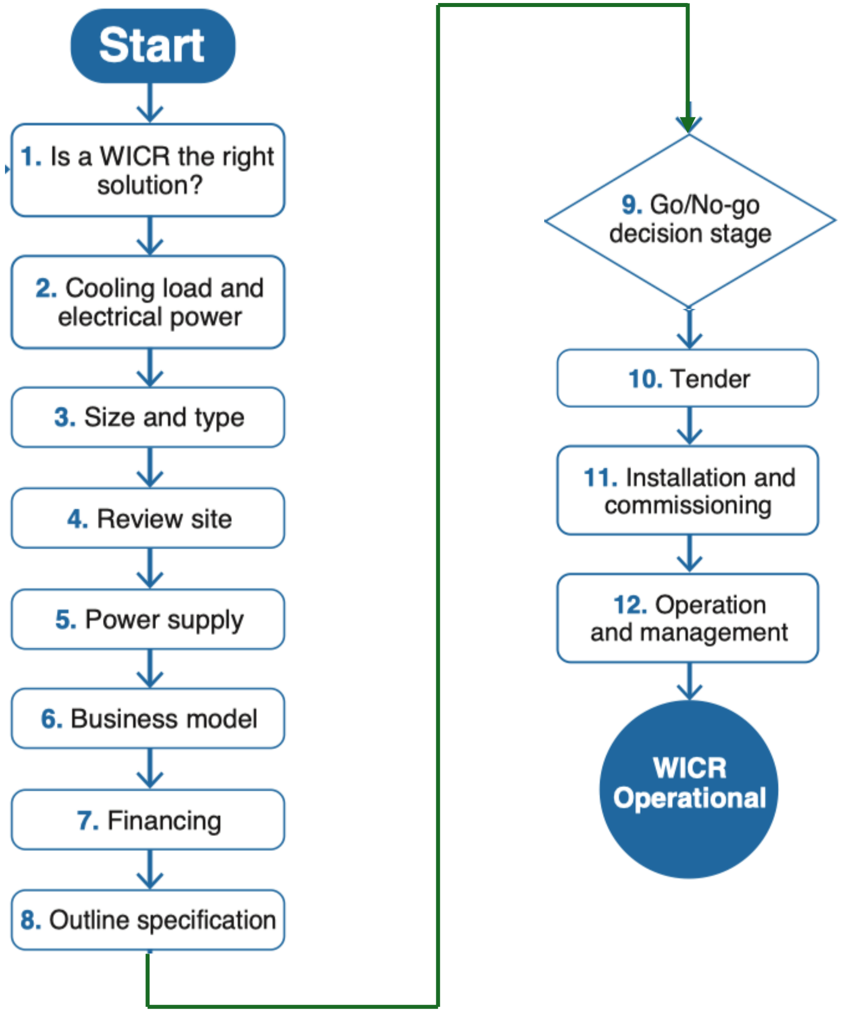

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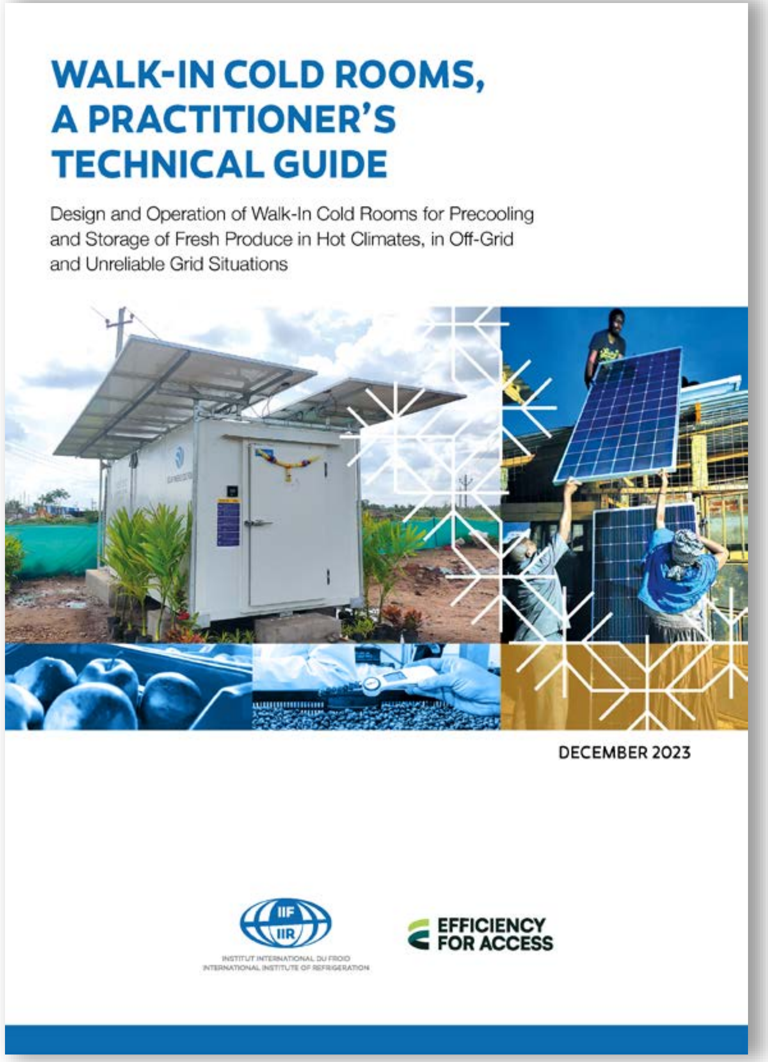

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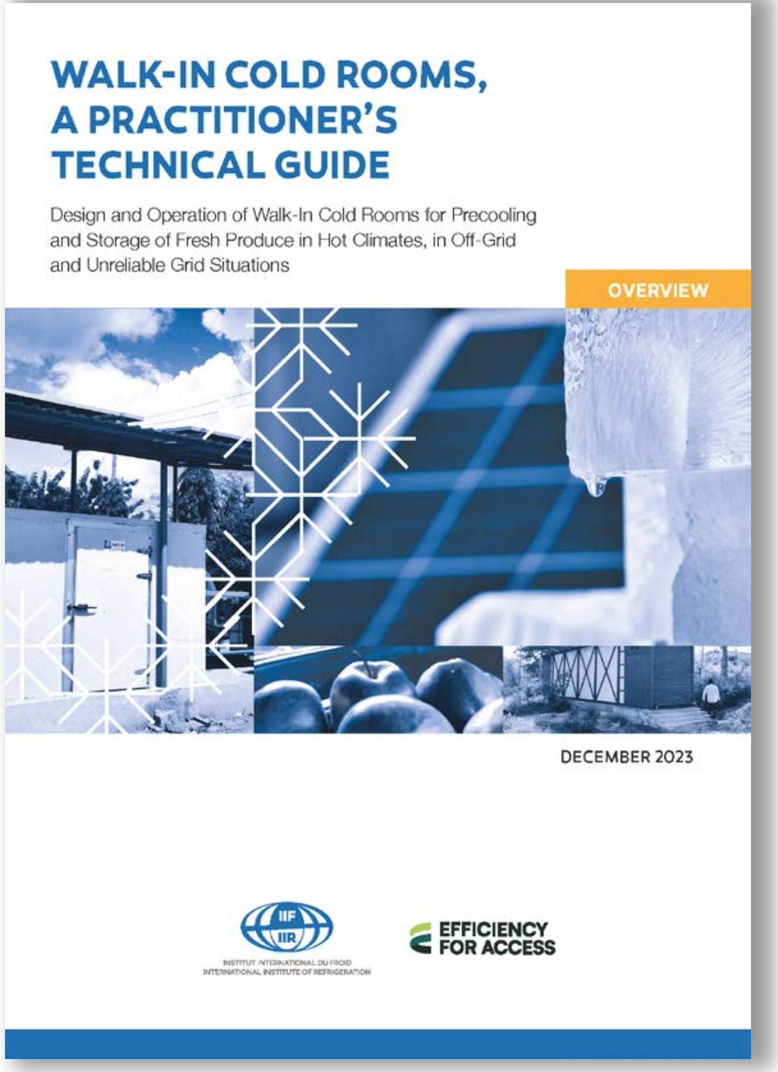
EFFICIENCY FOR ACCESS



Solar Cooling Solutions

PHAESUN KEY FACTS

- Founded in **2001** by representatives of the solar industry
- Based in **Memmingen,** Germany
- A team of **40 Off-Grid experts**
- Focus **on energy independence** through PV power supply
- Partners and projects in more than **80 countries**
- Comprehensive product portfolio with more than **3400 products**
- Phaesun Quality Management **ISO 9001-2015**

Phaesun

APPLICATIONS

Rural Electrification

1

Self consumption

2

Back up systems

3

Industrial systems

4

Leisure Market

5

Solar Cooling

6

Local needs assessment

A comprehensive needs assessment is crucial in the initial phase to be able to make a suitable system design.

Main technical design parameters:

- Target temperature
- Storage volume
- Extended scope of services
- **Daily input [kg/day]**

- Value chain
- Business model
- Socio-cultural considerations

Modularity for Cold Rooms

A modular approach allows for a low-CAPEX market entry, with the flexibility to expand as the business gains traction.

DC Cold Room

Thermal storage powered by SelfChill® Cooling Units

4 Units → 200 kg/day
6 Units → 350 kg/day
8 Units → 500 kg/day

DC-powered SelfChill® Cooling Units

Modularity for Cold Rooms

A modular approach allows for a low-CAPEX market entry, with the flexibility to expand as the business gains traction.

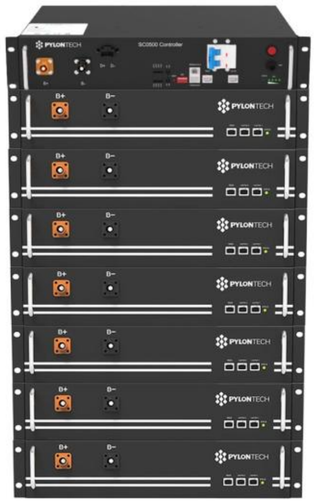
AC Cold Room

AC-powered Monoblock

1 Unit → 600 kg/day
2 Units → 1500 kg/day
4 Units → 3000 kg/day

Autonomy Considerations

The required level of autonomy ultimately results from a trade-off between reliable cooling performance and the potential economic loss in the event of a cooling failure.



Influencing parameters:

- Hybrid systems: probability distribution of power outages (frequency, duration, seasonality, day/night)
- Potential economic loss in the event of breakdown
- Equipment cost of extended autonomy (battery capacity / thermal storage)

Thermal vs. battery storage

Both alternatives present trade-offs that require careful consideration depending on the individual circumstances.

	Thermal storage	Battery storage
Energy efficiency	++	+
Cost-effective	0	0
Lifespan	++	+
Environmental impact	++	-
Flexibility	-	++

PLEASE CONTACT US!

STAY INDEPENDENT

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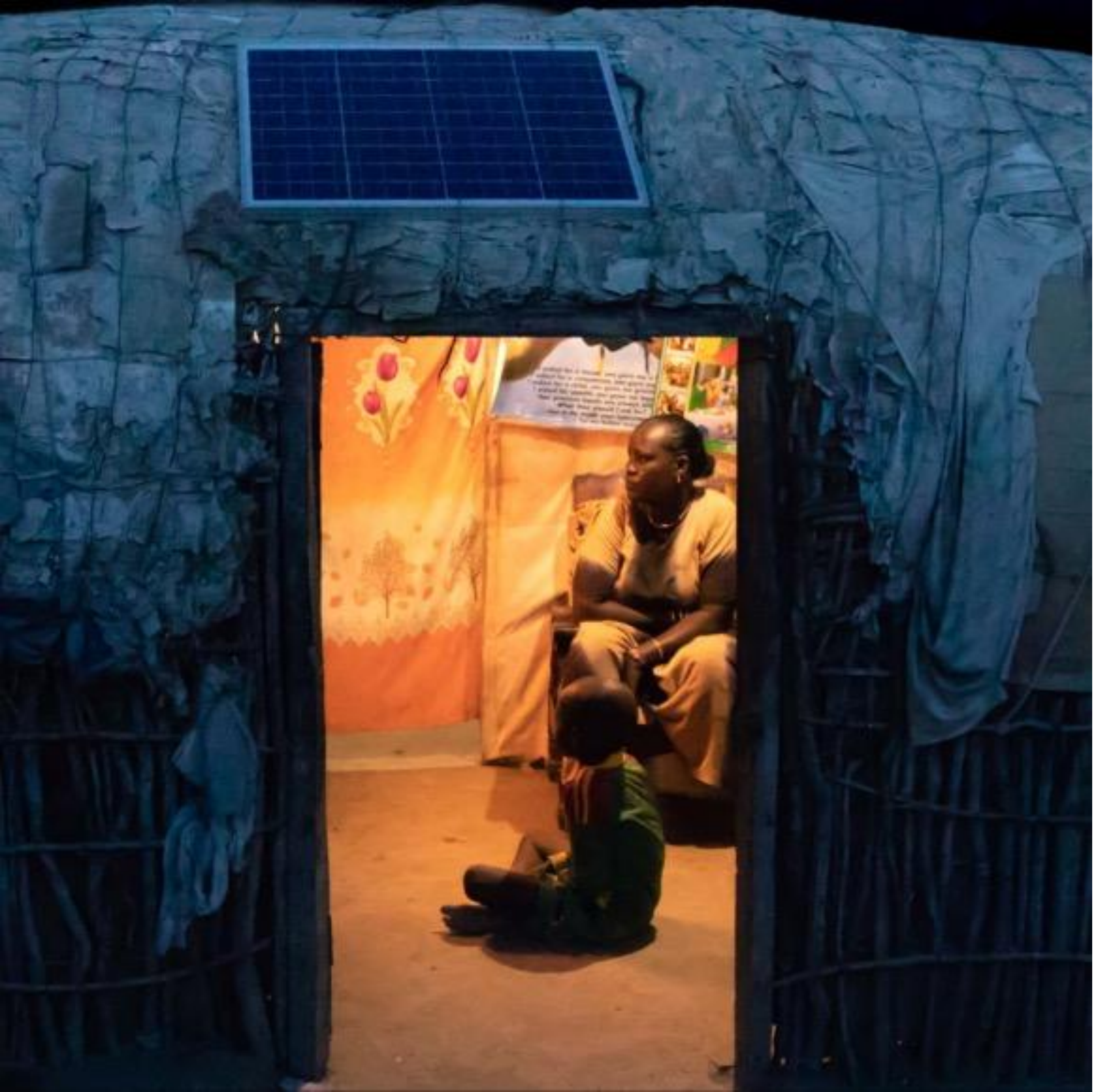
THANK YOU ...

VeraSol

VeraSol Quality Assurance Overview



VeraSol

Leaving no one behind

VeraSol works to increase access to modern energy services through high-quality off-grid solar products that build confidence in modern solar solutions and protect the most vulnerable consumers.

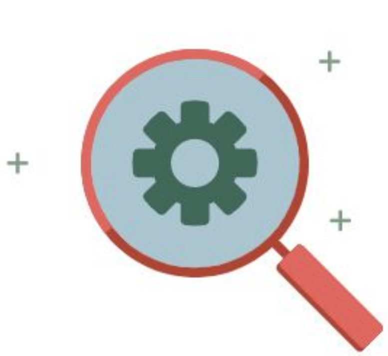
100 million people

currently have improved energy access from using VeraSol certified solar energy kits.

Why Quality Assurance?

Product manufacturers, distributors, policymakers, development partners, and other stakeholders use VeraSol to make smarter decisions that reduce risk, increase impact, and improve the efficacy of their work.

Enable Smarter Decisions



Reduce Risk

Increase Impact

Improve Efficiency

Elements of VeraSol Quality Assurance Framework

VeraSol

VeraSol is a quality assurance program that supports high-performing, durable off-grid solar solutions.

data.VeraSol.org

VeraSol Quality Assurance Framework

CERTIFICATION

Evaluate and confirm products meet quality standards

QUALITY STANDARDS

Determine and set baseline levels of product quality

TESTING & DATA

Generate product performance and quality data to inform actions

TEST LAB CAPACITY

Identify and support testing partners to provide testing services

TEST METHODS

Define how product quality and performance is measured

Why QA for WICR?

VeraSol

1. Ensure Performance & Reliability

- Protect perishable goods with consistent temperature control
- Reduce breakdowns and downtime

2. Safeguard Investments

- Cold rooms are high-value assets
- Quality assurance lowers lifecycle costs and ensures durability

3. Support End-User Confidence

- Farmers, distributors, and businesses can trust WICRs to deliver
- Builds market reputation for suppliers and installer

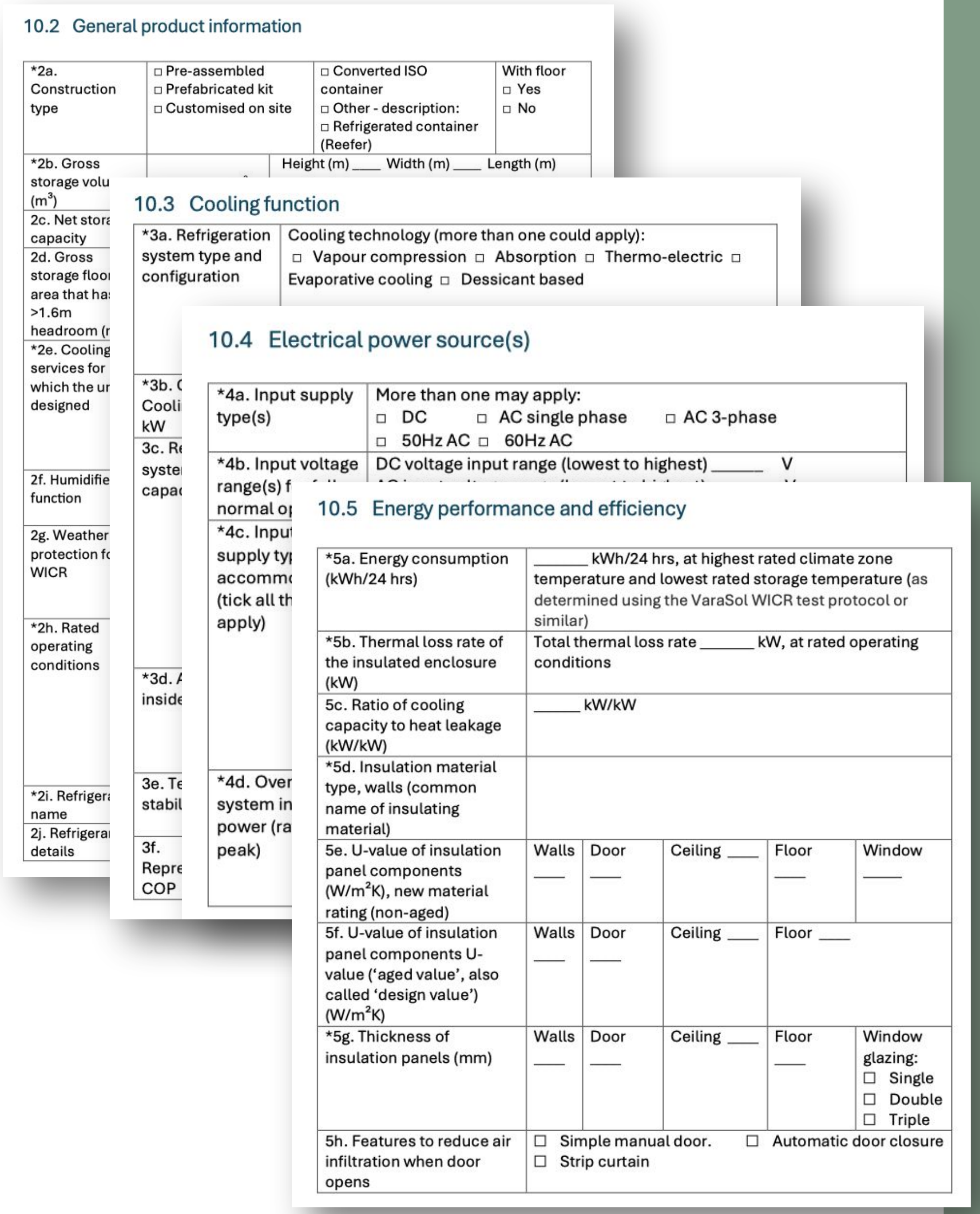
4. Enable Market Growth

- Standardized quality benchmarks foster fair competition
- Supports wider adoption of cold storage solutions in off-grid and weak-grid areas

Work to date – 2023 to now

VeraSol

- Survey of published WICR details and spec sheets
- Review of existing test protocols & studies -> landscape review
- Test method Expert Group - met 3 times drafting protocol
- Pilot lab test at Wageningen with final Expert Group meeting
- Field test protocol development ongoing; pilot Q4/2025



10.5 Energy performance and efficiency

*5a. Energy consumption (kWh/24 hrs)	______ kWh/24 hrs, at highest rated climate zone temperature and lowest rated storage temperature (as determined using the VaraSol WICR test protocol or similar)				
*5b. Thermal loss rate of the insulated enclosure (kW)	Total thermal loss rate ______ kW, at rated operating conditions				
5c. Ratio of cooling capacity to heat leakage (kW/kW)	_____ kW/kW				
*5d. Insulation material type, walls (common name of insulating material)					
5e. U-value of insulation panel components (W/m^2K), new material rating (non-aged)	Walls ____	Door ____	Ceiling ____	Floor ____	Window ____
5f. U-value of insulation panel components U-value ('aged value', also called 'design value') (W/m^2K)	Walls ____	Door ____	Ceiling ____	Floor ____	
*5g. Thickness of insulation panels (mm)	Walls ____	Door ____	Ceiling ____	Floor ____	Window glazing: ☐ Single ☐ Double ☐ Triple
5h. Features to reduce air infiltration when door opens	☐ Simple manual door. ☐ Automatic door closure ☐ Strip curtain				

WICR Product Information Sheet: A standard way to fully and fairly inform buyers

- Some parameters mandatory for VeraSol registration; others recommended
- Recommended for all suppliers to adopt

☐ Feedback to improve sheet is welcome, by 31. October

The WICR lab test protocol

Based on the ATP protocol for testing refrigerated containers, and a WICR test method of India

1. **Empty pull-down** test from 32°C to 1°C
2. Pull-down test with **dummy load** of 10% of capacity (bottled water in crates)
3. **Steady state effectiveness** test with fan heaters inside: temp. stability, energy consumption, cooling capacity, COP
4. **Autonomy** test: switch off and measure time taken for average temp. to rise by 5°C
5. **Heat leakage** test (k-value): steady state with fan heaters inside, adjusted to a target temperature difference inside/outside -> calculate k-value
6. **Air flow (fans)**: Check air speed and calculate flow and air changes per hour.

The WICR field test protocol

VeraSol

- Based on the lab testing protocol
- Simplified & shortened
- More affordable
- Possible to include in commissioning of WICR

✅ **Empty pull-down** test from ambient to 1°C

✅**Steady state effectiveness** test with fan heaters inside: temp. stability, energy consumption, cooling capacity, COP

✅ **Heat leakage** test (k-value): steady state with fan heaters inside -> calculate k-value

✅**Autonomy** test: switch off and measure time taken for average temp. to rise by 5°C

Visit our website:

VeraSol.org

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