IEA SHC Solar Academy Webinar

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Thermosiphon Systems in Southern Africa: Insights from IEA SHC Task 69

- **Inroduction**

- **Systems Design**
  - Direct
  - Indirect

- **Market Survey Extract**
- **Application**

- **Failure Mode Effect Analysis**
- **Quality and Standards**

- **Best Practice Case Studies**

- **Conclusion**

Thermosiphon Systems in Southern Africa: Insights from IEA SHC Task 69

9.85 million km²
406.59 million Inhabitants (5.0% of the world's population
An annual economic output of 779.68 billion US dollars,
https://www.worlddata.info/

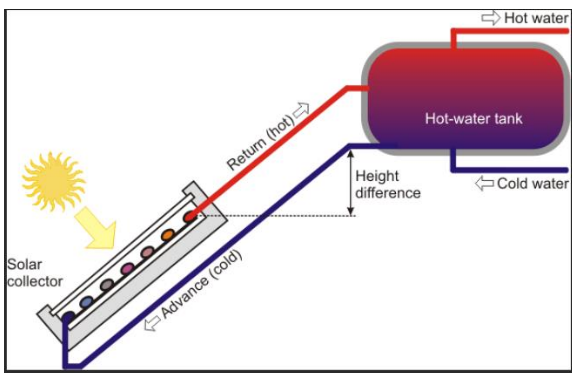
Southern African Power Pool (SAPP) (12 countries).
Total installed generation capacity of 80 GW.
The peak demand in the region is 57 GW
Available capacity is 48 GW

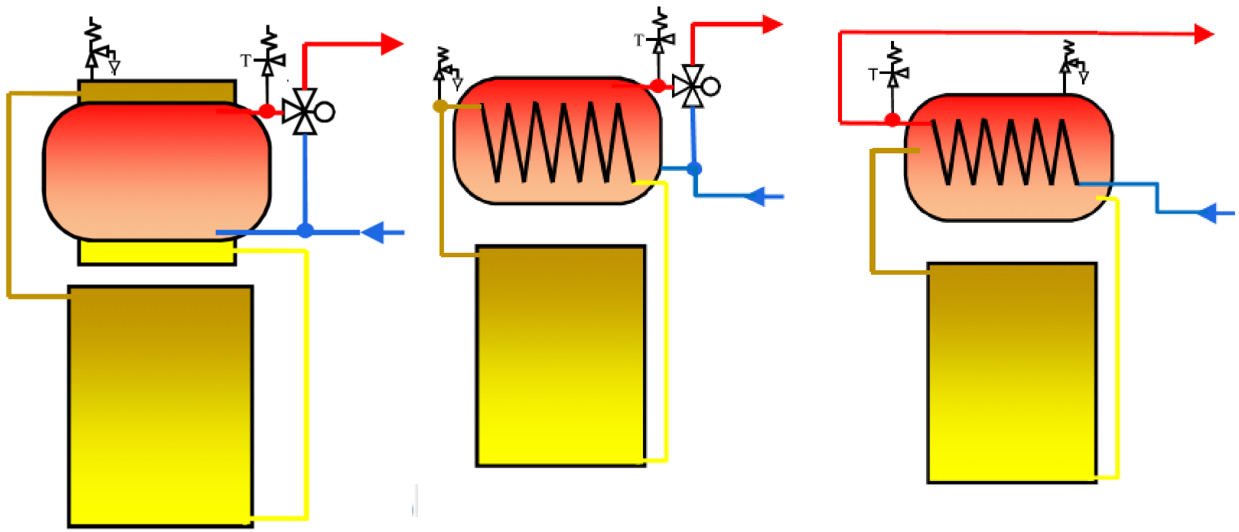
Introduction

- **Thermosiphon systems account for more than half of the total installed solar thermal capacity worldwide (Worldwide heat status at the end of 2022)**

System design

- Direct thermosiphon systems are common in Southern Africa region, where there is low risk of freezing in some countries.





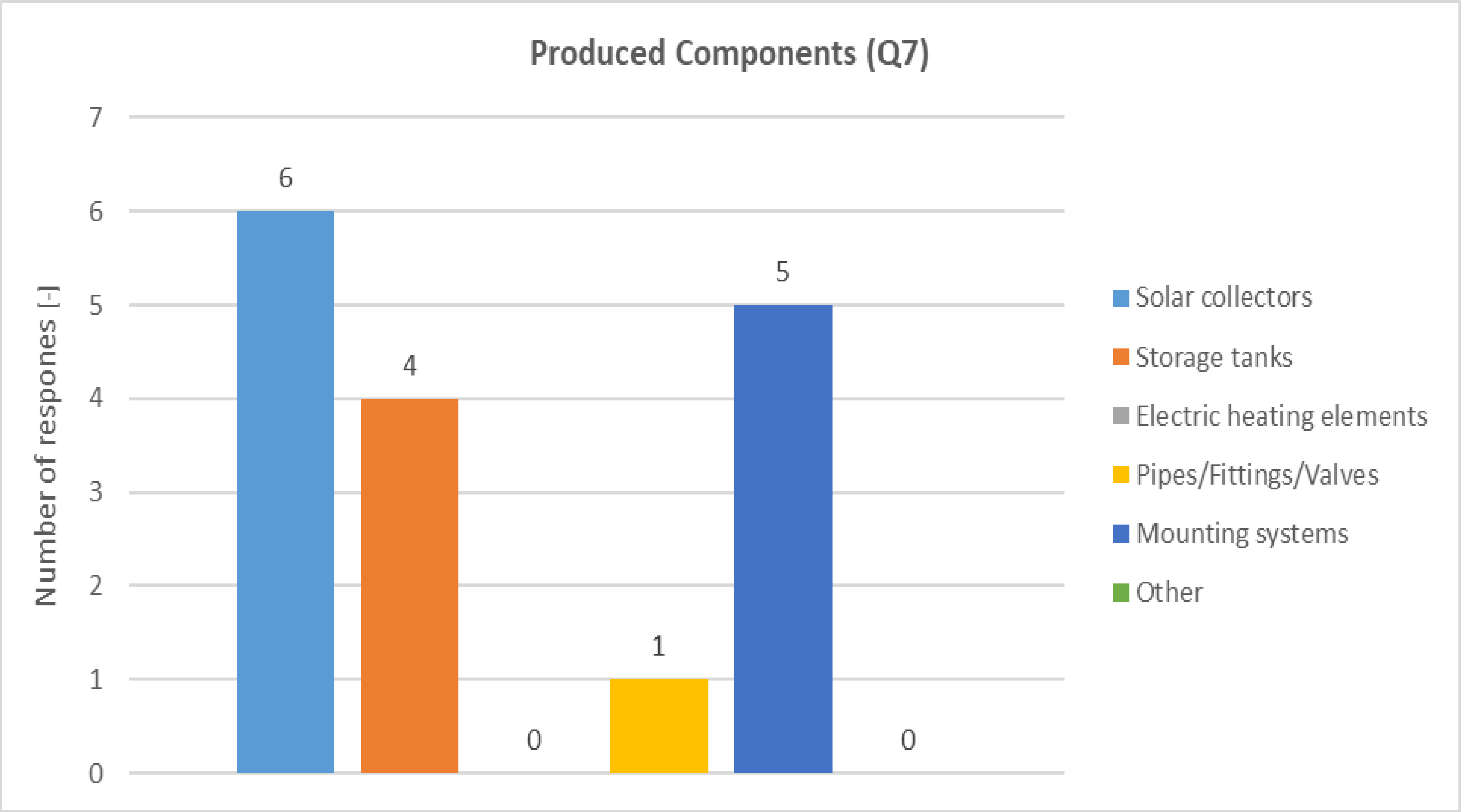
- Direct thermosiphon systems
- Indirect thermosiphon systems

System design (Continue)

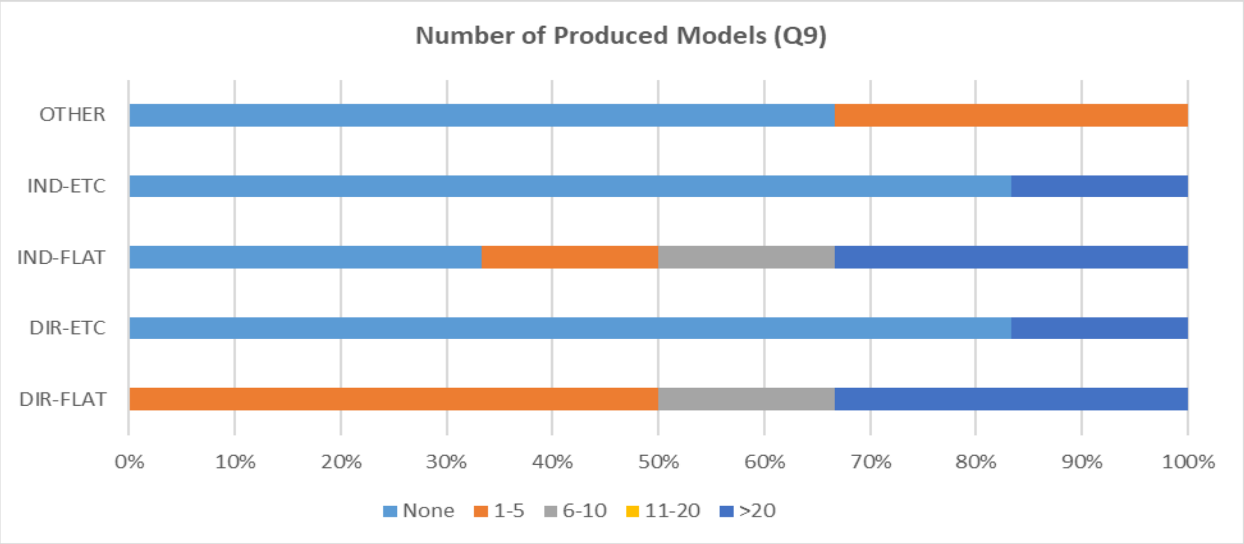
Evacuated Tube

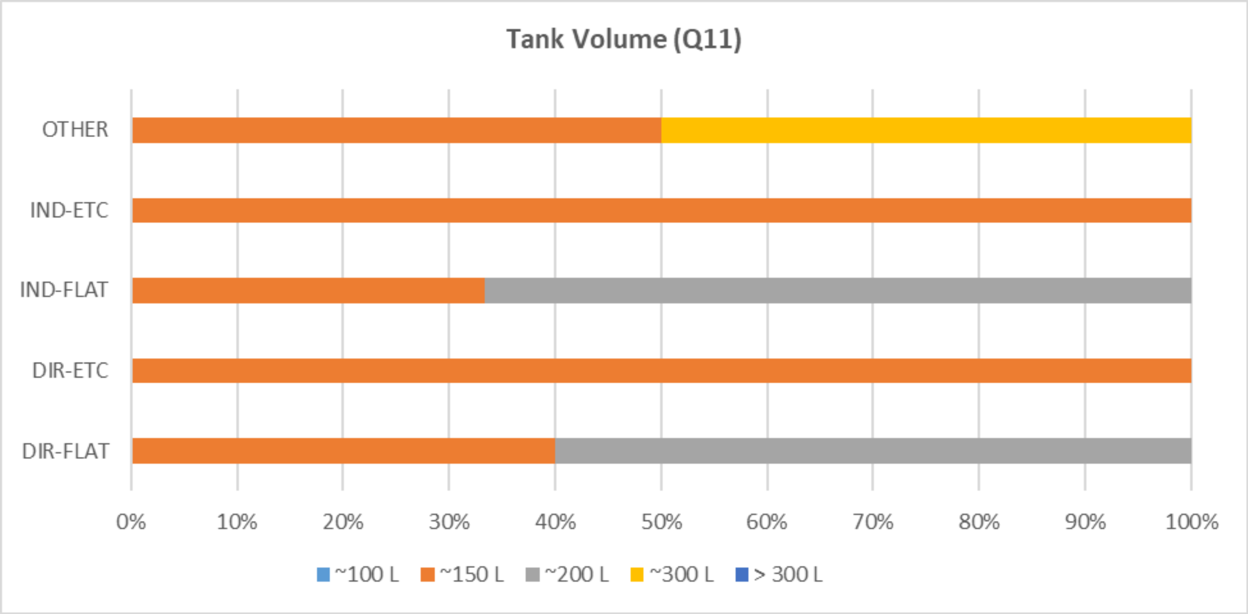
Flatplate Collector

Market Survey (SubTask A extract)

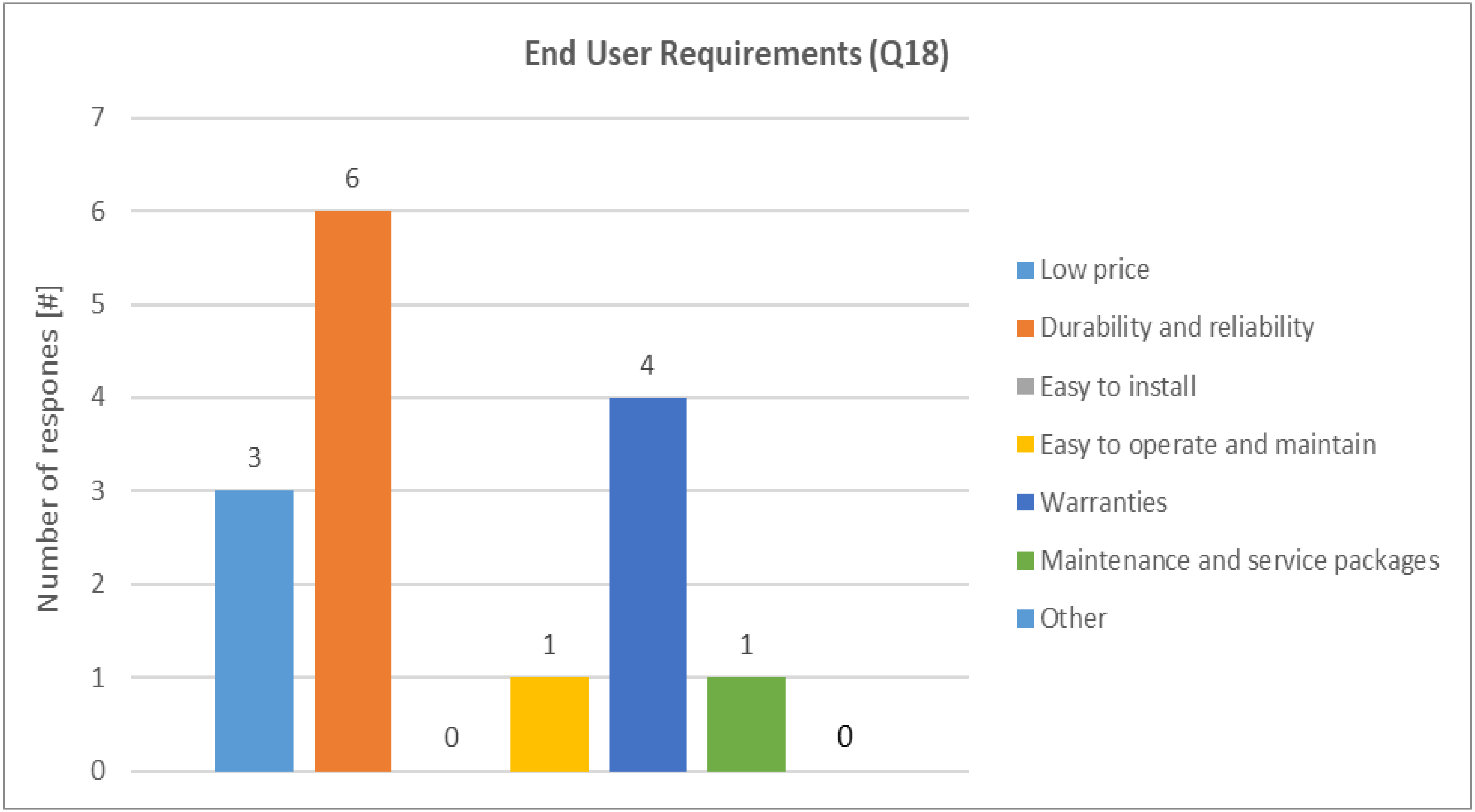


Market Survey

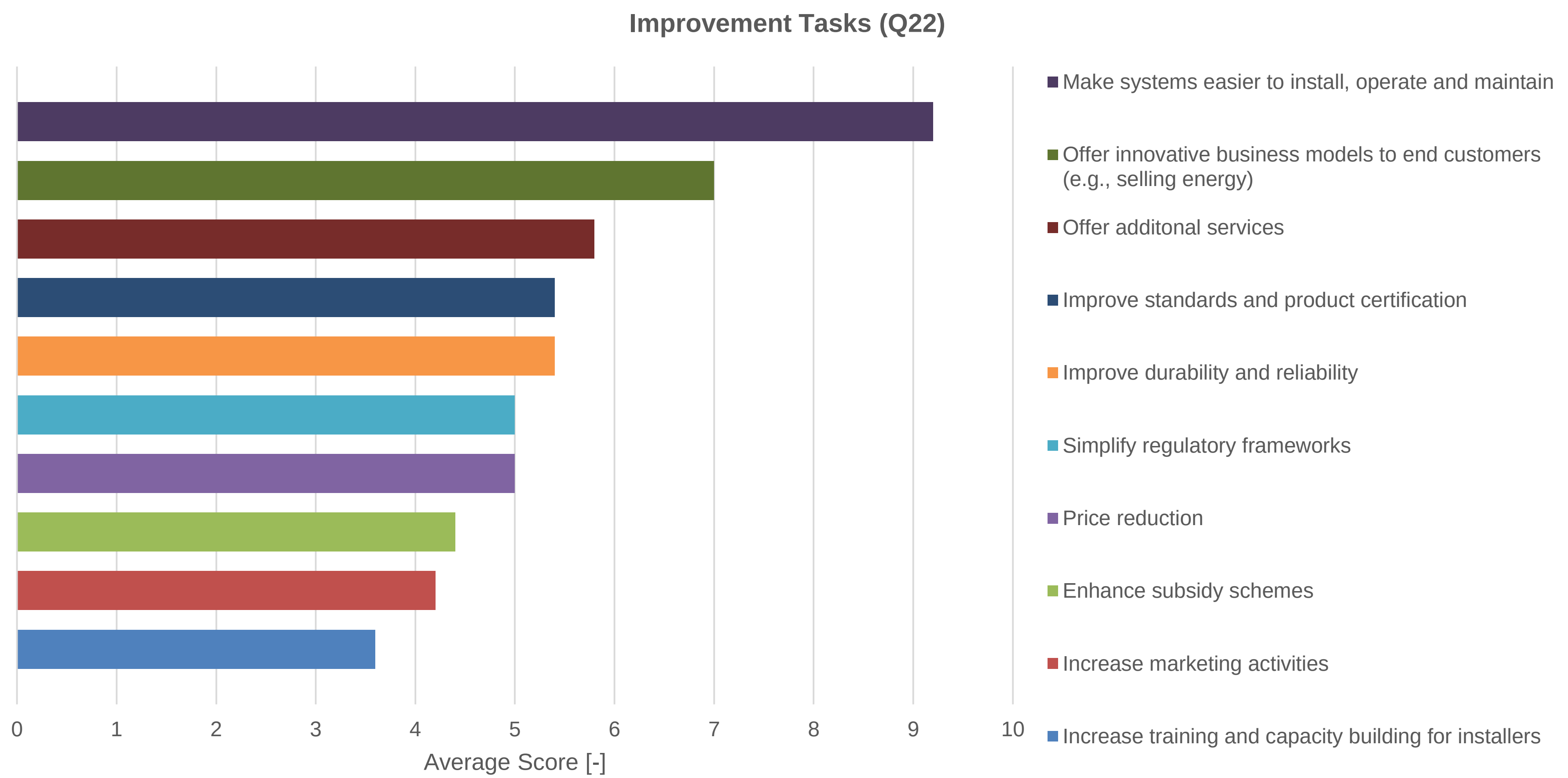




Market Survey



Market Survey



Mass Housing

NHE - Affordable housing program, Namibia
62 solar thermal systems

Osona Housing Development with 10,000 houses, Namibia

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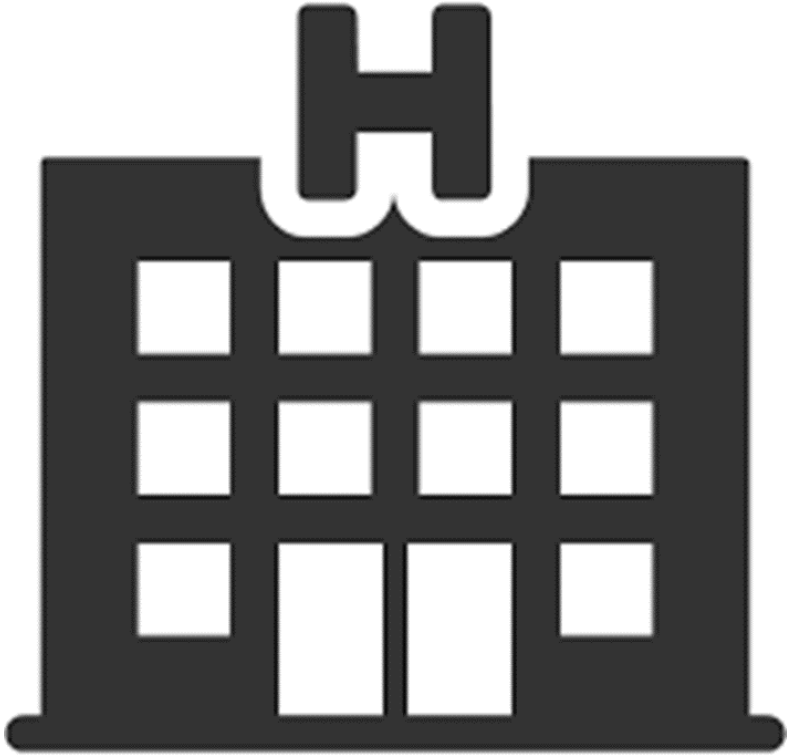
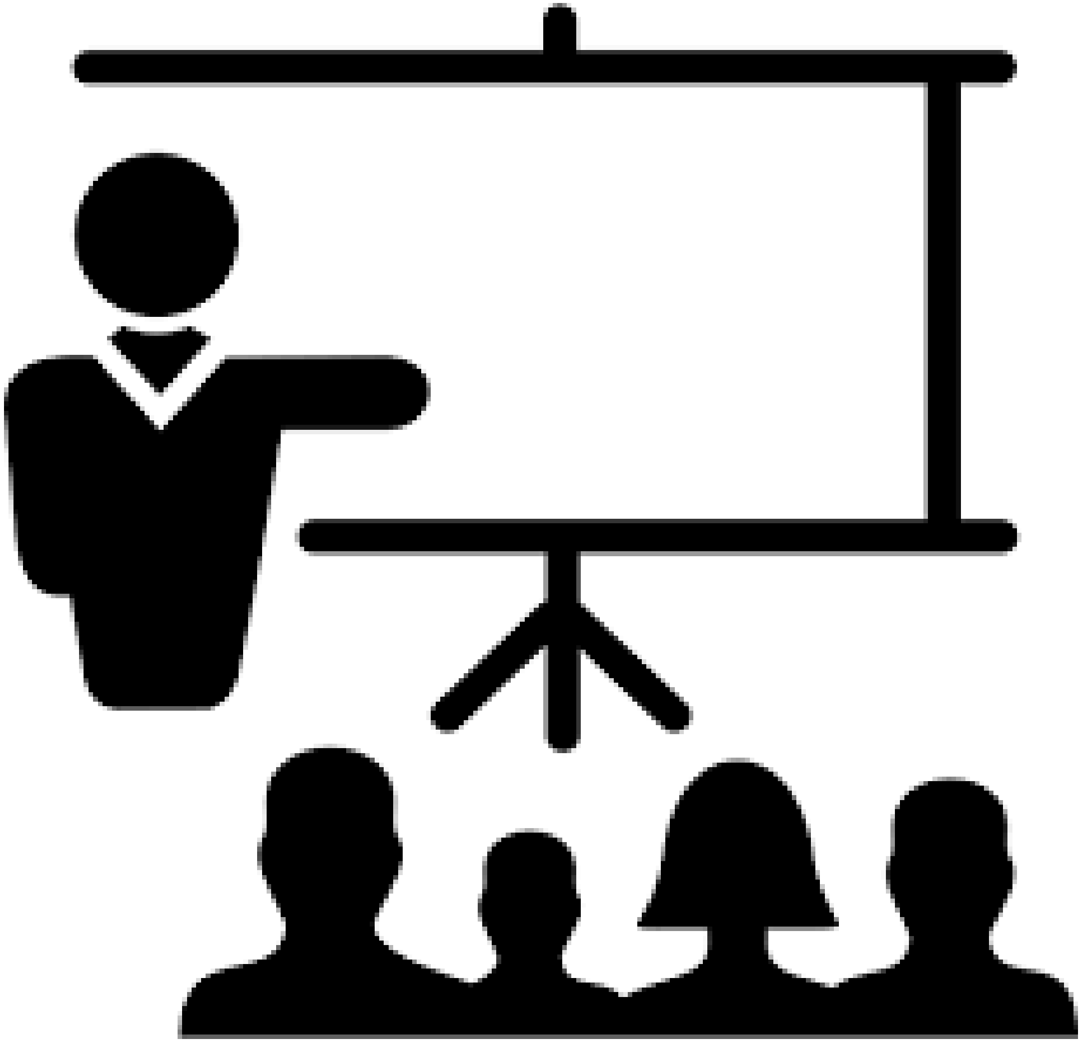
Hospitals and Clinics



Marondera Maternity Clinic (ZIM)

Education



St. Ignatius College, Eastlea, Harare

21 m² Thermosyphon system, Hot water storage: 1500 liter

Augustineum Secondary School, Namibia

Khomasdal, a suburb of Windhoek, 28 thermosiphon systems

Educational Institutions

Holy Trinity High School (LES)

Roosevelt Girls High School 1, Eastlea, Harare, Zimbabwe

Platinum Hotel, Botswana

5 distributed thermosyphon systems

SHC SOLAR HEATING & COOLING PROGRAMME INTERNATIONAL ENERGY AGENCY

Failure Mode Effect Analysis (FMEA)

#	Name	Remarks
Components		
1 2	Leakage due to component failures Direct Flat Plate systems	E.g., direct compact systems with evacuate tubes; weak glass used by local manufacturers Copper tank leakage along the circular joint on the edges Flat plat leakage due to bursting of flexible connecter along the bottom header pipe
Design and installation		
2	Incorrect system dimensioning	Stagnation in summer if over dimensioned, not enough supply if under dimensioned
3	Incorrect mounting support for components	System unstable, can lead to leakages, falling apart of components, etc.
4	Wrong positioning of pipes and components	E.g., defying the thermosyphon principle, laying of pipes directly through the roof Both water inlet and outlet into some tanks are located underneath the tank resulting confusion of which is inlet or outlet
5	Wrong positioning of vacuum breaker	Storage can be completely emptied, leads to stagnation of thermosyphon system, overheating of heating rod, etc.
6	Leakage due to wrong installation	E.g., incorrect connection of pipes
7	Missing insulation	Leads to higher heat losses
8	Deterioration of insulation due to missing protection	E.g., missing UV protection
9	Missing and wrong positioning safety devices	E.g., missing safety valves, pressure relief valves,

Failure Mode Effect Analysis (FMEA)

#	Name	Remarks
Operation		
10	Leakage due to missing or wrong concentration of antifreeze liquid	Leads to freezing, sometimes direct systems are used in region with temperatures below zero where an indirect system should be deployed
11	Wrong response pressure for safety valve	E.g., 8 bar pressure for safety valve
12	Missing inspection of antifreeze liquid	See #10
13	Unsuitable control of back-up heating device	E.g., storage is always kept hot, thermosyphon system in stagnation
14a	Corrosion phenomena solar thermal equipment	
14b	Corrosion phenomena solar thermal equipment	
15	Poor water quality especially for direct solar water heating systems	Leading to clogging of the pipes and stagnation
16	Disruption of water supplies in some areas	Leading to stagnation and complete failure of the system

Failure Mode Effect Analysis (FMEA) (Survey undertaken)

Failure Modes
–Facts and Effects
-Possible Causes
-Suggested
Technical Solutions

Proper Installation

SubTask D Solar Hot Water Standards and Certifications

Southern Africa
Countries with
National Standards
-Zimbabwe
-South Africa
-Namibia

The Solar Keymark
CEN Keymark Scheme

Quality control of the systems on site after commissioning

Functional check of the systems one year after commissioning

Two years warranty by the companies

Training of quality inspectors

Examples of Dual Training in Southern Africa to Support Quality Installations

Dual Training in Zimbabwe

Training in Mozambique

Trainings

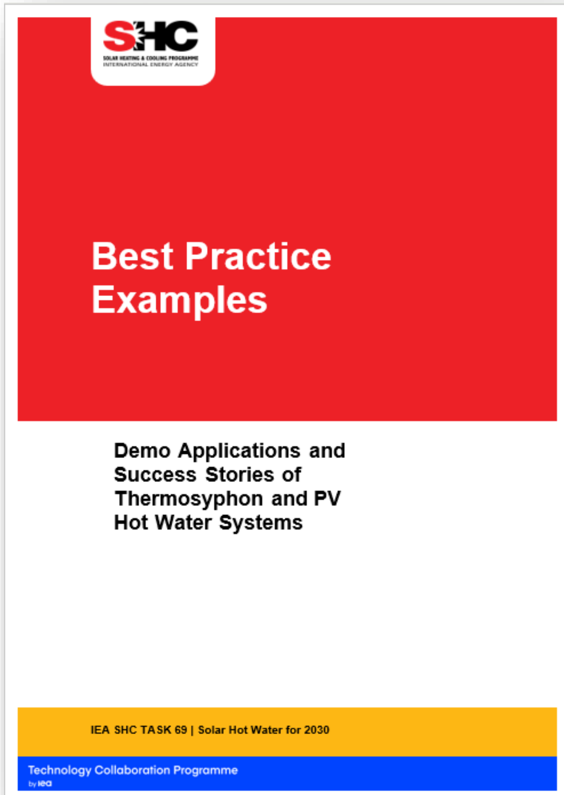
Under Soltrain+ Project there has been trainings since 2009 for Thermosyphon Systems Installation in :

- Zimbabwe, Botswana, South Africa, Lesotho, Namibia, Mozambique

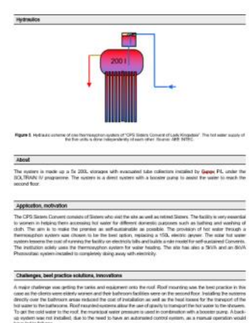
- Extension to other Southern Africa countries started in 2025:
  - Malawi, Swaziland, Zambia, Tanzania, Angola

Planned Training Subtask D in Sept 2025 Windhoek, Namibia, Southern Africa

D A.2: Best practice examples



- Scope: **Thermosyphon Systems** and **PV Hot Water Systems**, limited to systems in operation (e.g., best practice in terms of performance-efficiency ratio, design, social aspects, etc.)
- **Template for thermosyphon system available!** (CPS Sisters Convent of Lady Kingsdale (Zimbabwe))
- **Aim:** 2-5 systems per region



Best Practice Thermosiphon Installations

Aggluton, Harare 7x300L Direct Thermosyphon systems individually mounted on each housing unit

MyreckPark, Harare, 13x200L Thermosyphon systems

Conclusion

- Based on the High Irradiance in the Southern African region, the population and the drive by the region to meet domestic needs of energy supply by Demand Side Management and Energy Efficiency there is great potential to be tapped by local and international partners through solar Thermosiphon systems.

Acknowledgement

SOLTRAIN

THINK IN OTHER TERMS

AEE INTEC

SACREEE
SADC CENTRE FOR RENEWABLE ENERGY & ENERGY EFFICIENCY

Austrian Development Cooperation

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