Energy Consumption in Lodges and Guesthouses in Lesotho: Insights from Energy Audits and Solar Water Heating Modelling

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Reabetsoe Sehobai
Energy Research Centre
National University of Lesotho (NUL)

Austrian Development Cooperation

Background & Context

The hospitality sector is a fast-growing sector, and is also a growing energy consumer

Heavy reliance on grid electricity + LPG

Rising electricity tariffs affect business viability

Sustainability matters for tourism

Energy costs are a real competitiveness issue for the hospitality industry

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Objectives of the Audit Programme

Assess energy consumption patterns

Identify major energy demand drivers

Evaluate solar thermal potential for water heating

Support evidence-based investment decisions

Audits are decision-support tools; aiding investment readiness and technology selection

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Scope of Audits

Facility Name	Facility Type	No. of Rooms	Max Guests
KayTee	Guesthouse	4	14
Conmilla	Guesthouse	6	17
Scenery	Guesthouse	11	22
Tribute	Guesthouse	12	24
Grace	Lodge	12	32
Molimo-Nthuse	Lodge	15	45
Molengoane	Lodge	25	79
Mmelesi	Lodge	38	102

Facilities audited: 8 Guesthouses and Lodges

4 – 38 rooms per facility: 14 – 102 guests

24/7 operation

End-uses assessed: Water heating, space heating / cooling, lighting, cooking, etc.

The study covered eight facilities with varying sizes, but despite these differences, the energy use patterns were remarkably consistent.

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Audit Methodology

Onsite walk-through audits

Appliance inventory and load estimation

Staff interviews and operational data

Electricity bill analysis

https://www.inspectionstrack.com/three-types-of-energy-audits/

Robust and practical approach

Reliable estimation of facility energy consumption profiles

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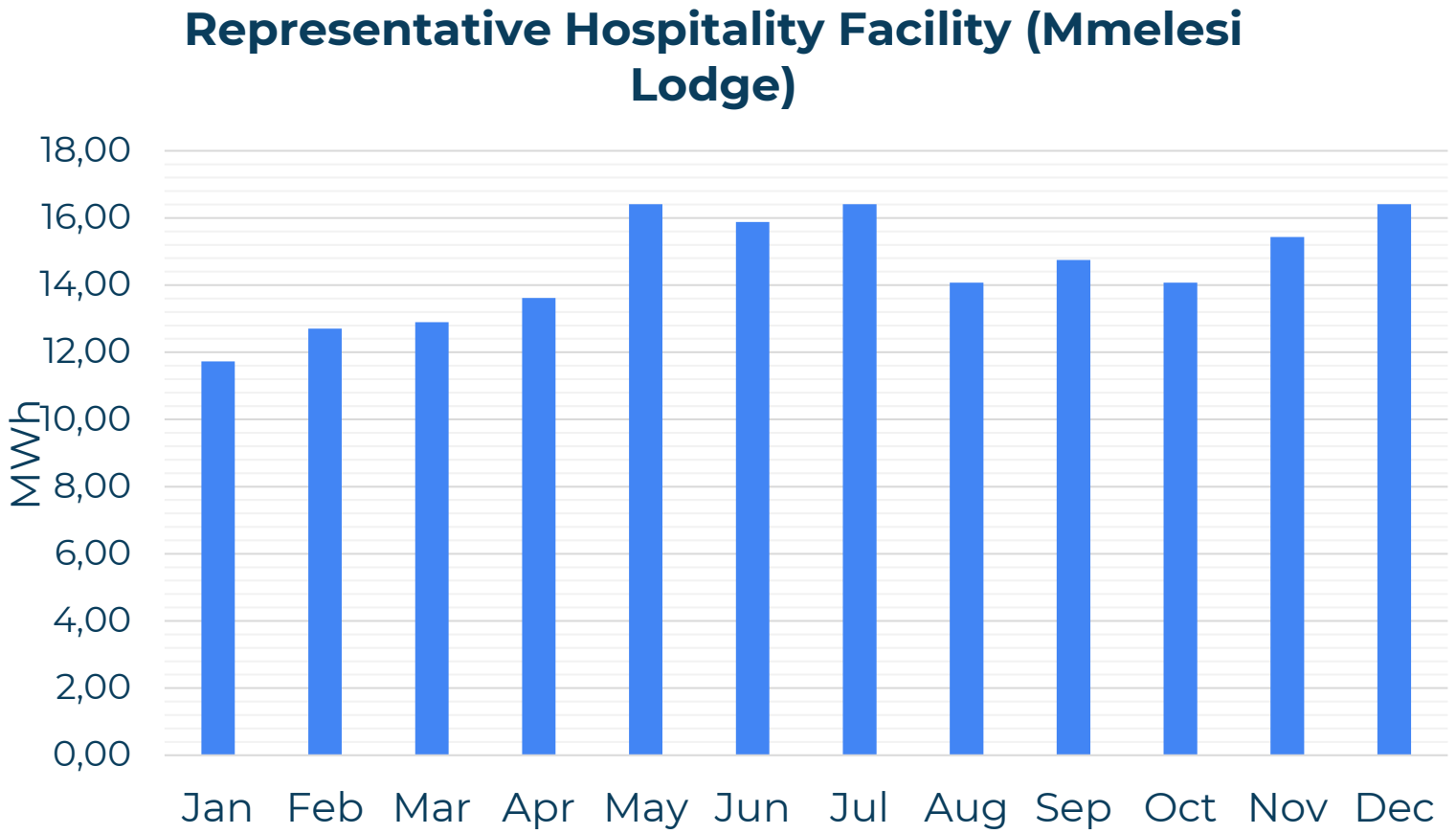
Typical Energy Consumption Profile

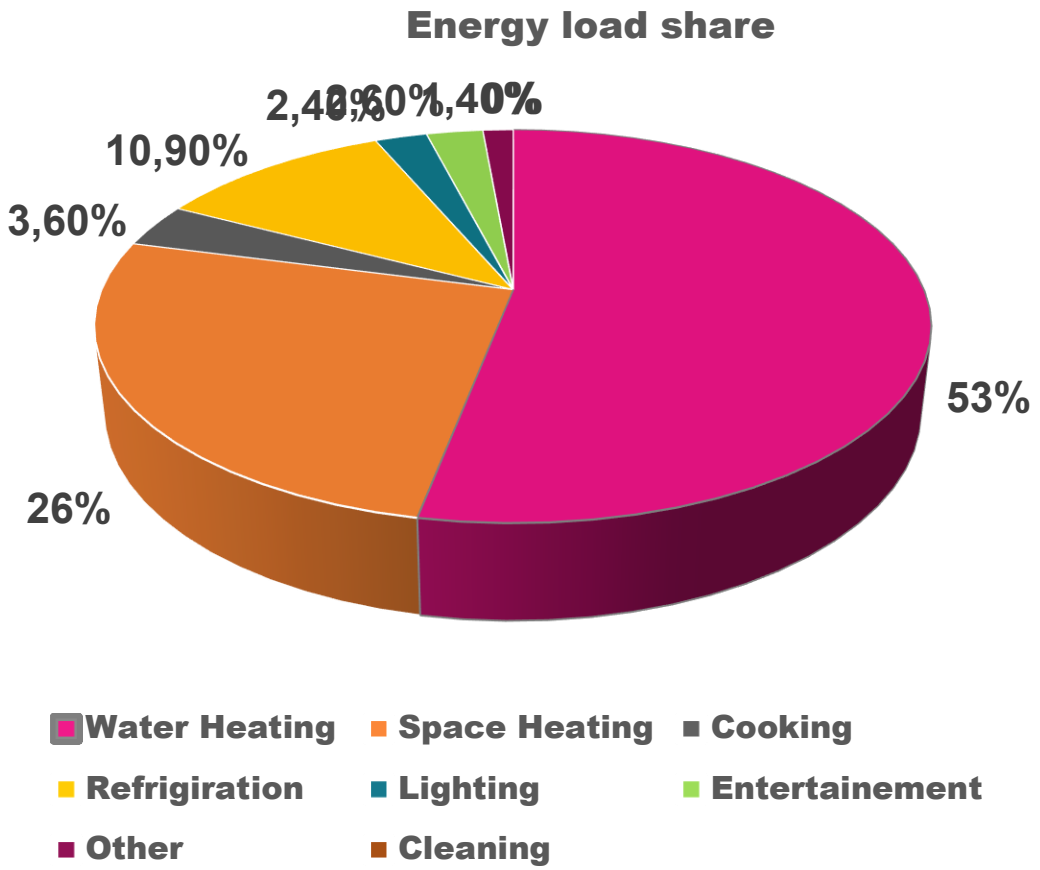


Electricity is the dominant energy source – Water heating | Lighting | Kitchen | HVAC

Strong seasonal variation linked to occupancy and winter temperatures

Across the audited facilities, the structure of energy demand is similar, with thermal loads dominating.

Key Finding: Water Heating Dominance



Water heating emerges as one of the largest energy end use

Water Heating Lood: 53% (35-65% across 8 facilities)

Largest opportunity for savings

Single biggest opportunity; directly linked to guest comfort expectations

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Cost Implications

Annual Electricity Consumption

7.6 – 94 MWh annually per facility

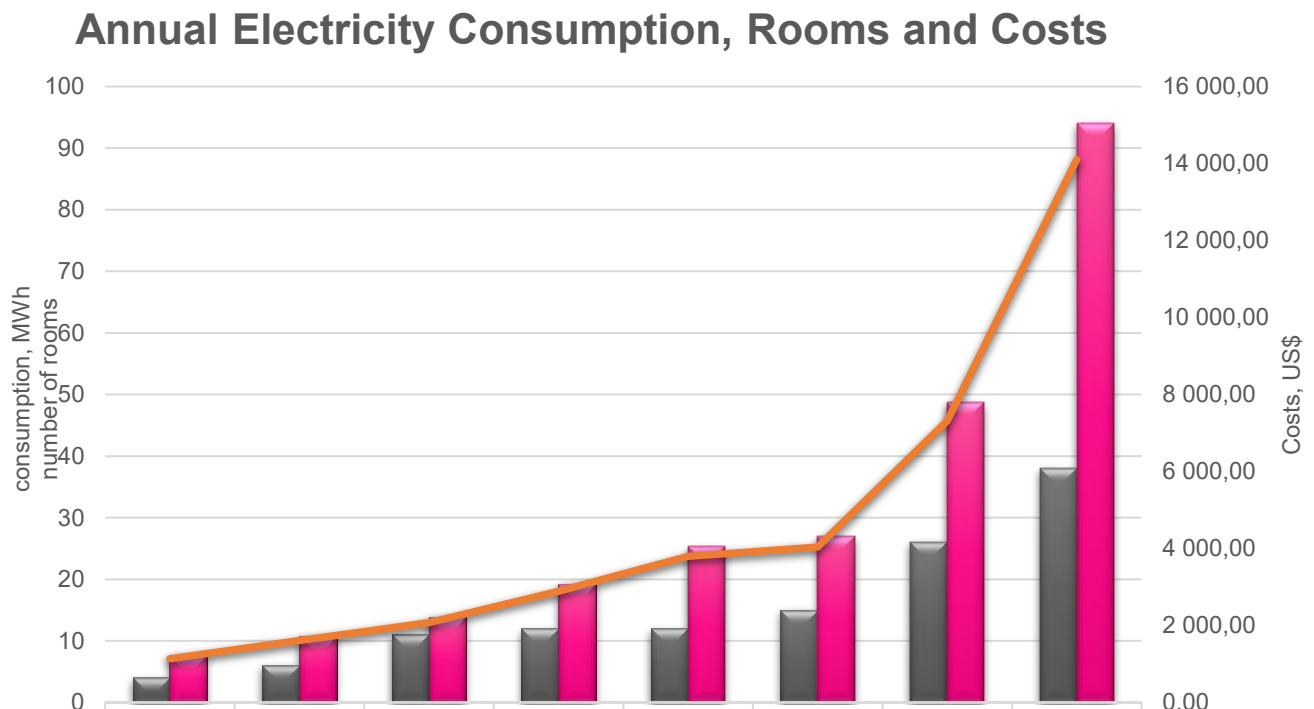
~1,250 - 2,475 kWh/room/year

Electricity tariff

M**2.4**/kWh or US$c **15**/kWh

Annual Energy Costs

US$ **1,000** to US$ **14,000**



	KayTee	Conmilla	Scenery	Grace	Tribute	Molimo-Nthuse	Molengoane	Mmelesi
Rooms	4	6	11	12	12	15	26	38
Consumption	7,57	10,74	13,83	19,25	25,29	26,92	48,73	94,04
Costs	1 135,42	1 610,74	2 074,11	2 887,02	3 794,23	4 037,40	7 309,56	14 105,61

Energy costs place a financial strain on hospitality operators

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Solar Thermal Opportunity

Excellent solar resource across the country

Strong demand match

Mature, low-risk technology

Centralized or distributed solar water heating systems

Systems are modular and scalable

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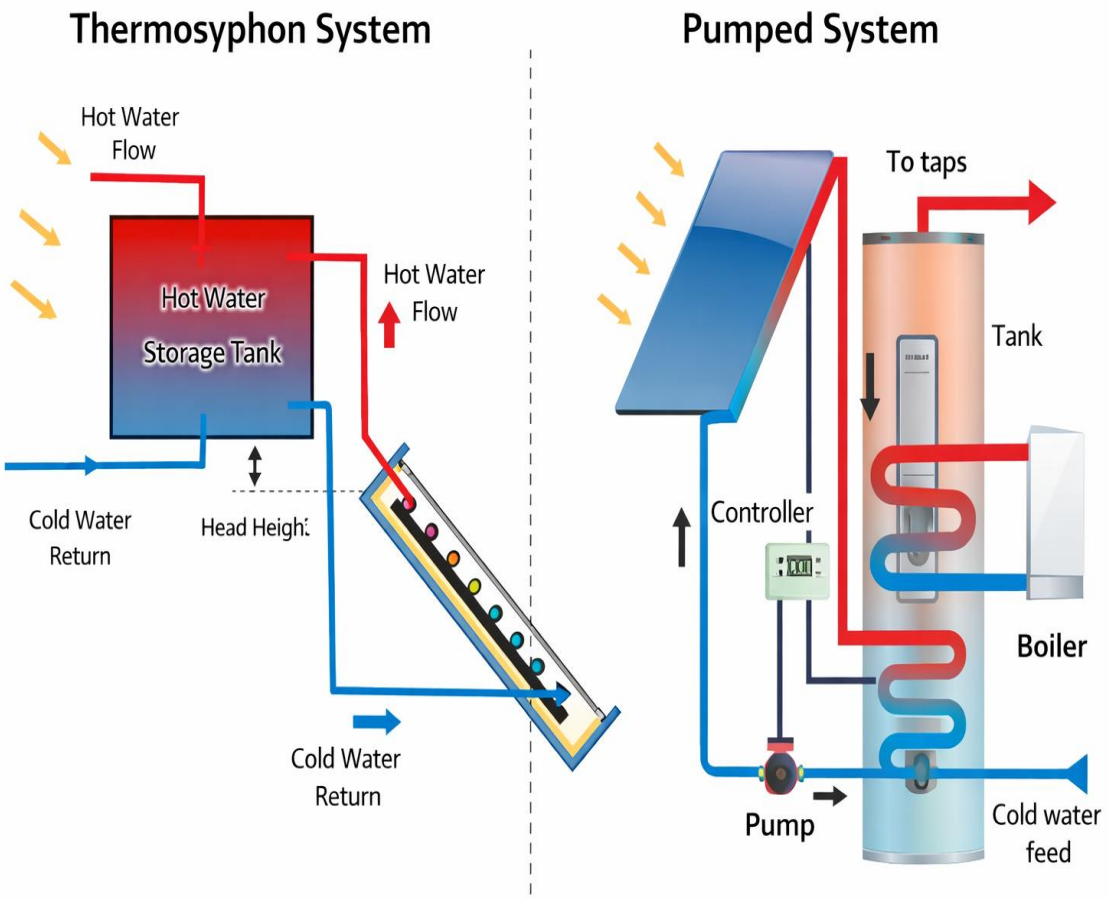

Proposed Solar Thermal Solutions

Daily hot water demand (HWD): average of **30** L / person

Typical configurations: 100 – 700 L systems for rooms – Dedicated systems for rooms only

Pumped systems with electric backup – Collectors + Storage + Backup heater

Assumed average system cost of **US$800/m2** for pumped and **US$500/m2** for thermosiphon

Krawczyk, Dorota & Ruiz de Adana, Manuel & Moreno-Pérez, María Fátima & Bullejos Marín, David & Teleszewski, Tomasz & Teilans, Artis. (2022). Sustainable buildings. Designing and management of cost-effective and eco-friendly systems. 10.24427/978-83-67185-29-5.

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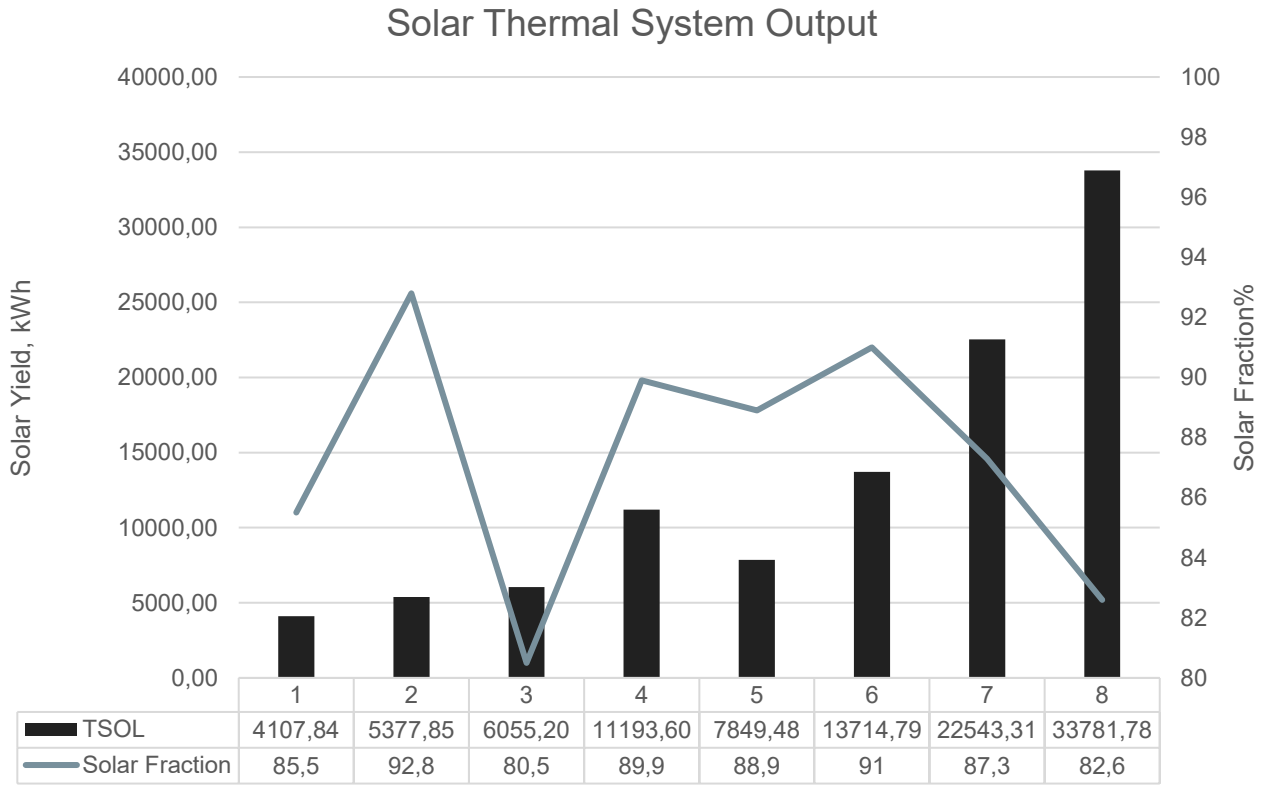
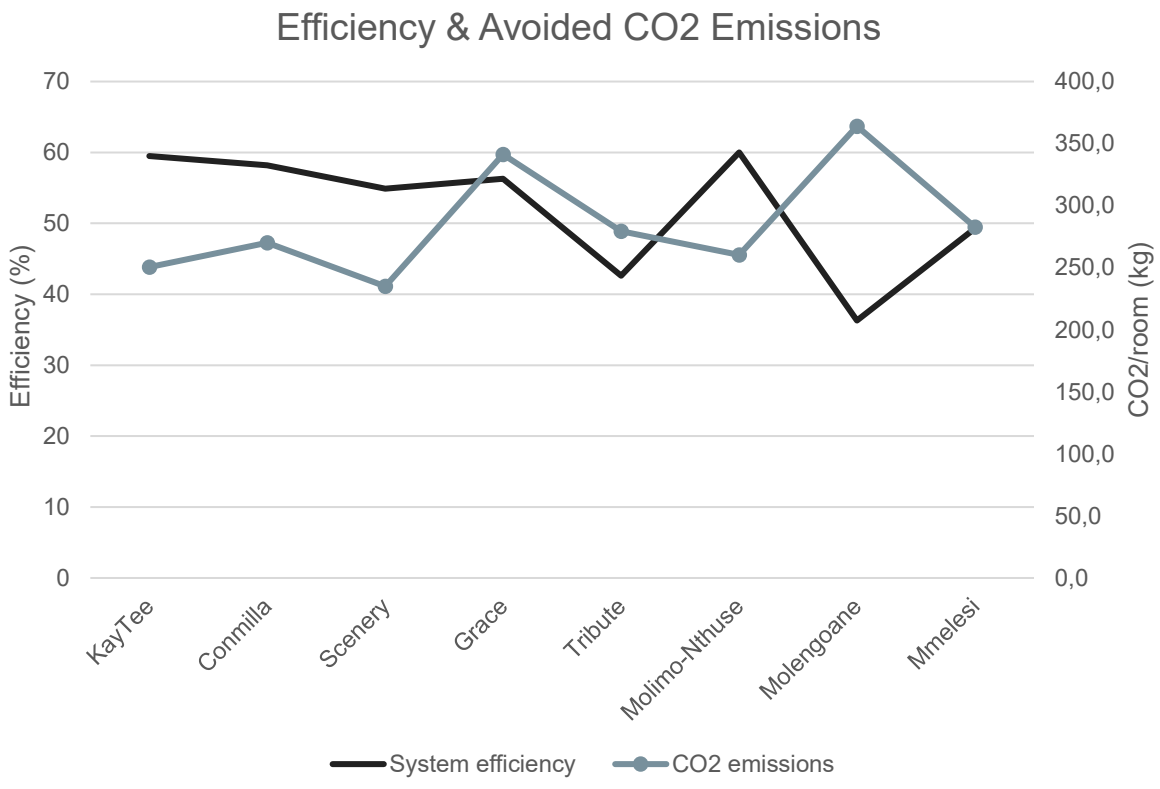
Solar Thermal Performance



	1	2	3	4	5	6	7	8
TSOL	4107,84	5377,85	6055,20	11193,60	7849,48	13714,79	22543,31	33781,78
Solar Fraction	85,5	92,8	80,5	89,9	88,9	91	87,3	82,6



Average Solar Fraction **87.3%**

Average system efficiency: **51.2%**

Average energy yield **1200 kWh/m2**

Average CO_2 emissions avoided **290 kg/room**

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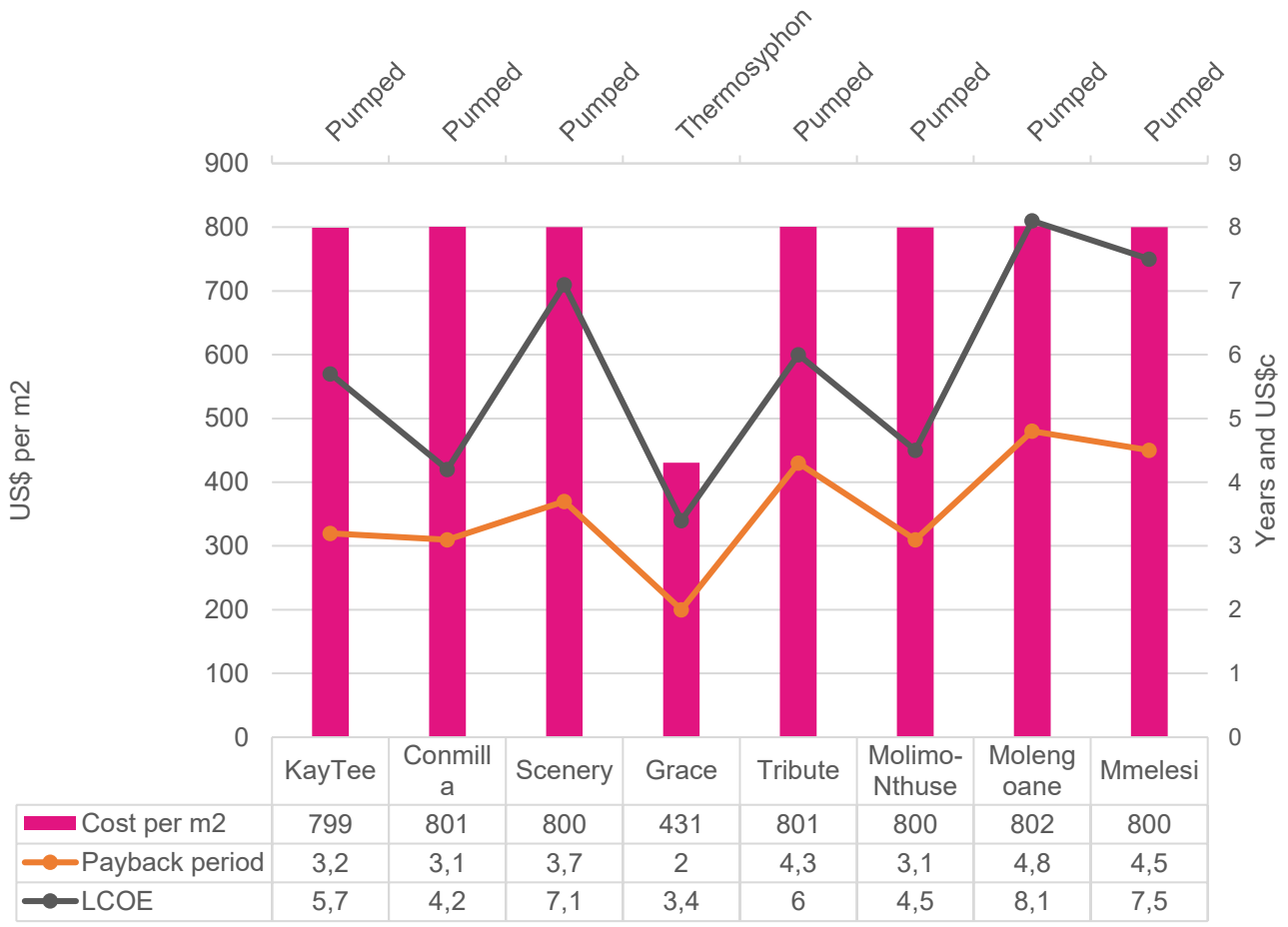
Economic Assessment



	KayTee	Conmilla	Scenery	Grace	Tribute	Molimo-Nthuse	Moleng oane	Mmelesi
Cost per m2	799	801	800	431	801	800	802	800
Payback period	3,2	3,1	3,7	2	4,3	3,1	4,8	4,5
LCOE	5,7	4,2	7,1	3,4	6	4,5	8,1	7,5

Typical investment cost: US$ **431 – 800** per m2

Simple payback period: 2 – 4.8 years

Levelized cost of solar thermal energy lower than grid electricity: US$c **3.4** / kWh – US$c **8.1** / kWh

Solar thermal systems are financially attractive without heavy subsidies.

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Conclusions and Way Forward

Energy audits reveal clear, repeatable patterns across facilities
Strong case for policy support and incentives
Ready / replicable model for national scale-up
NUL aims to expand audits to 40 facilities nationwide
Targeted support for solar water heating—through awareness, financing mechanisms, and installer capacity— can deliver immediate economic benefits, reduce pressure on the electricity grid, and support Lesotho's green tourism ambitions.

Thank You!