

Large-scale Solar Water Heating in — South Africa

STERG Symposium 2016

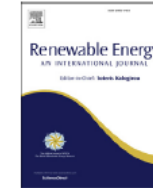
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Large-scale solar water heating in South Africa: Status, barriers and recommendations

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ABSTRACT

This work evaluates large-scale solar thermal systems in South Africa. A database of 89 systems has been generated and analysed with regards to cost, applications and beneficiary industries. Since 2007 the average total annual commissioned collector area was only 1544 m². Most systems are used for domestic hot water preparation. The average system cost is currently 603 EUR/m², which is higher than the costs achieved in other countries. A brewery solar process heat case study compares 10 proposals for a tender. Proposed system installation costs varied by a factor of 2.5, suggesting low maturity in this market. The winning proposal has a 120.7 m² gross collector area, LCOH = 7.9 EURc/kWh, IRR = 16.7% and payback = 9.3 years. A key barrier is the low cost of coal of 2 Eurocent/kWh, which is the dominating fuel. Current systems can already well compete with heat sources like paraffin, diesel, petrol and gas, which is shown by a detailed financial analysis. Besides the low coal price, other key barriers for increased market diffusion are long payback times, the technical complexity of the technology, as well as the lack of awareness and trust in the technology.

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Agenda



1. Large-scale Systems Database
2. Analysis CBC
3. Barriers and Recommendations

Large-scale ST System Database



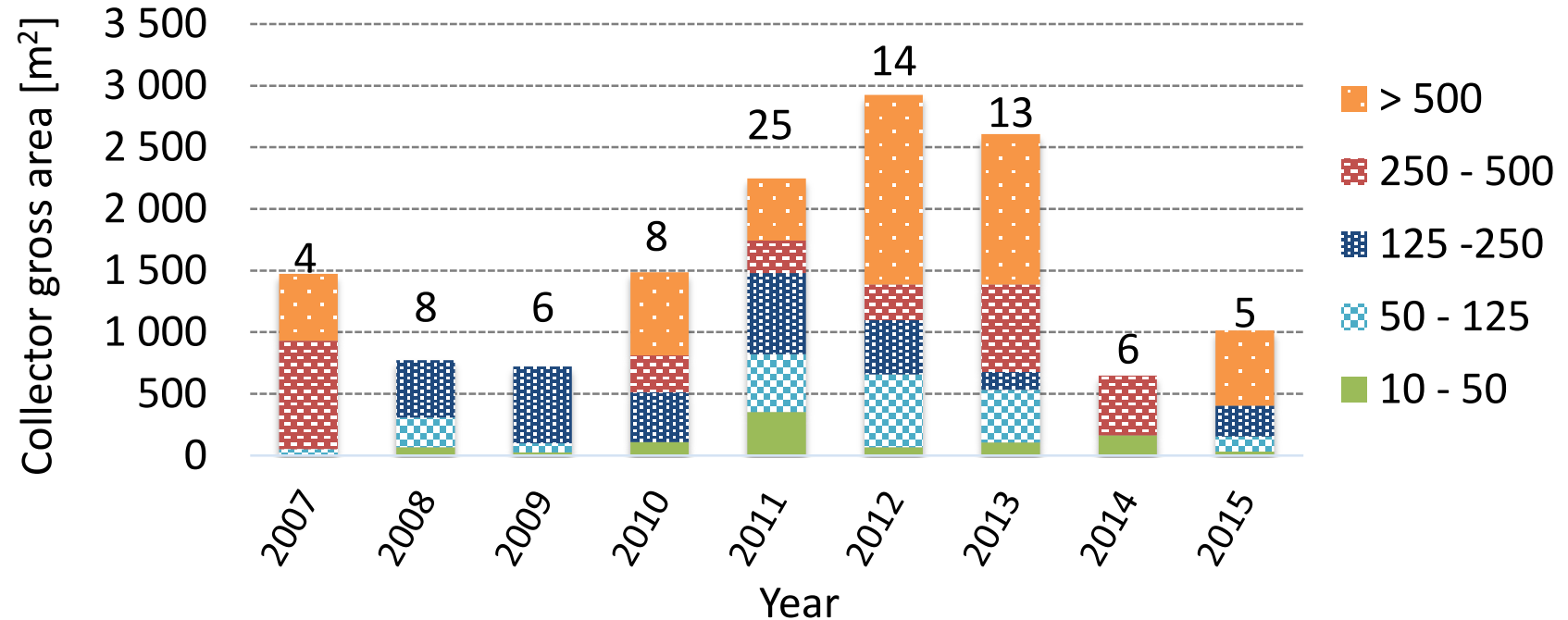
Database:

- Only stationary systems $> 10 \text{ m}^2$
- Whole SA, installed between 2007 and 2015
- Sources: Blackdot Energy, Soltrain 1&2, installers, past projects

Currently:

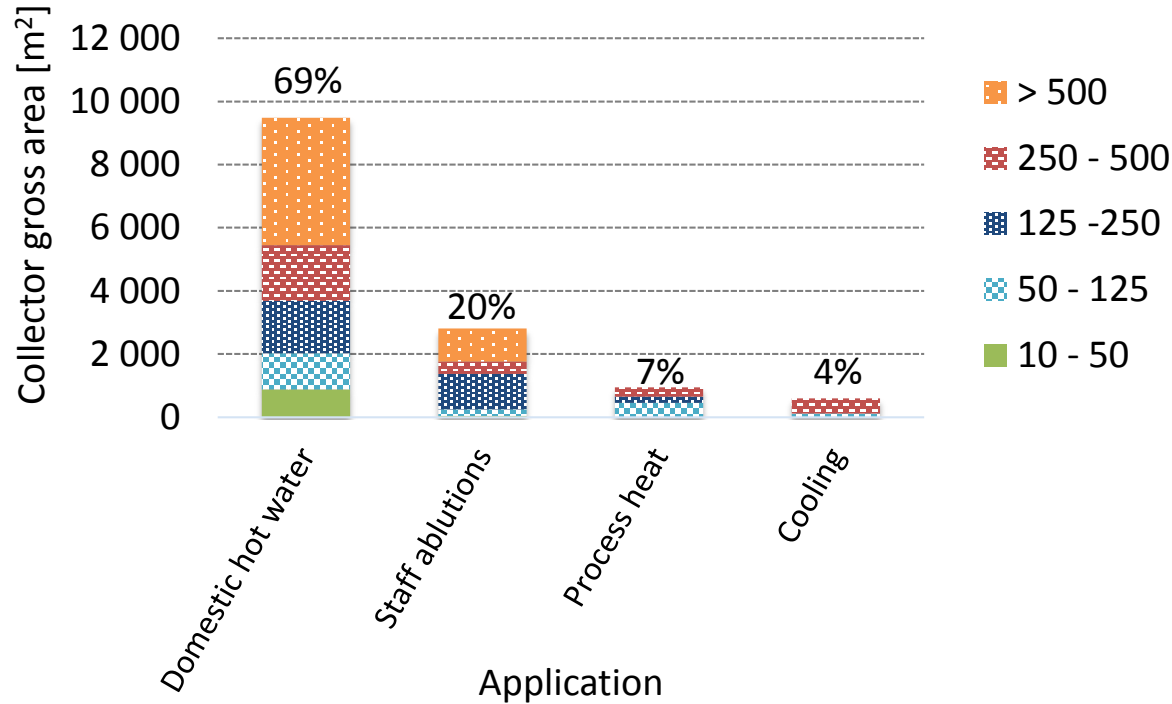
- 89 systems $> 10 \text{ m}^2$
- Total gross area $13\,894 \text{ m}^2$
- Confidence: high $> 50 \text{ m}^2$, low $< 50 \text{ m}^2$

Annual Installations



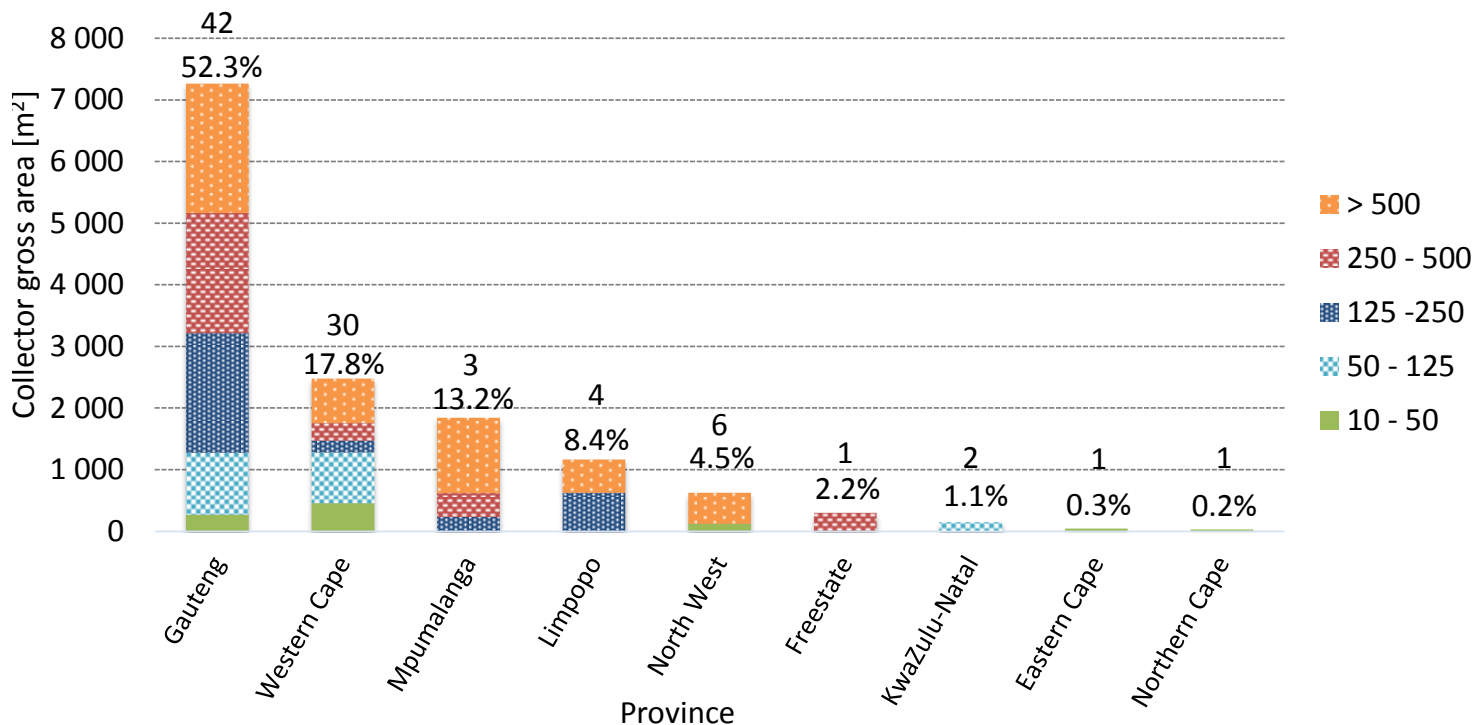
ST collector gross area (> 10 m²) newly installed in SA in recent years. Total number of installations per year indicated above bars. Legend units are m².

Applications



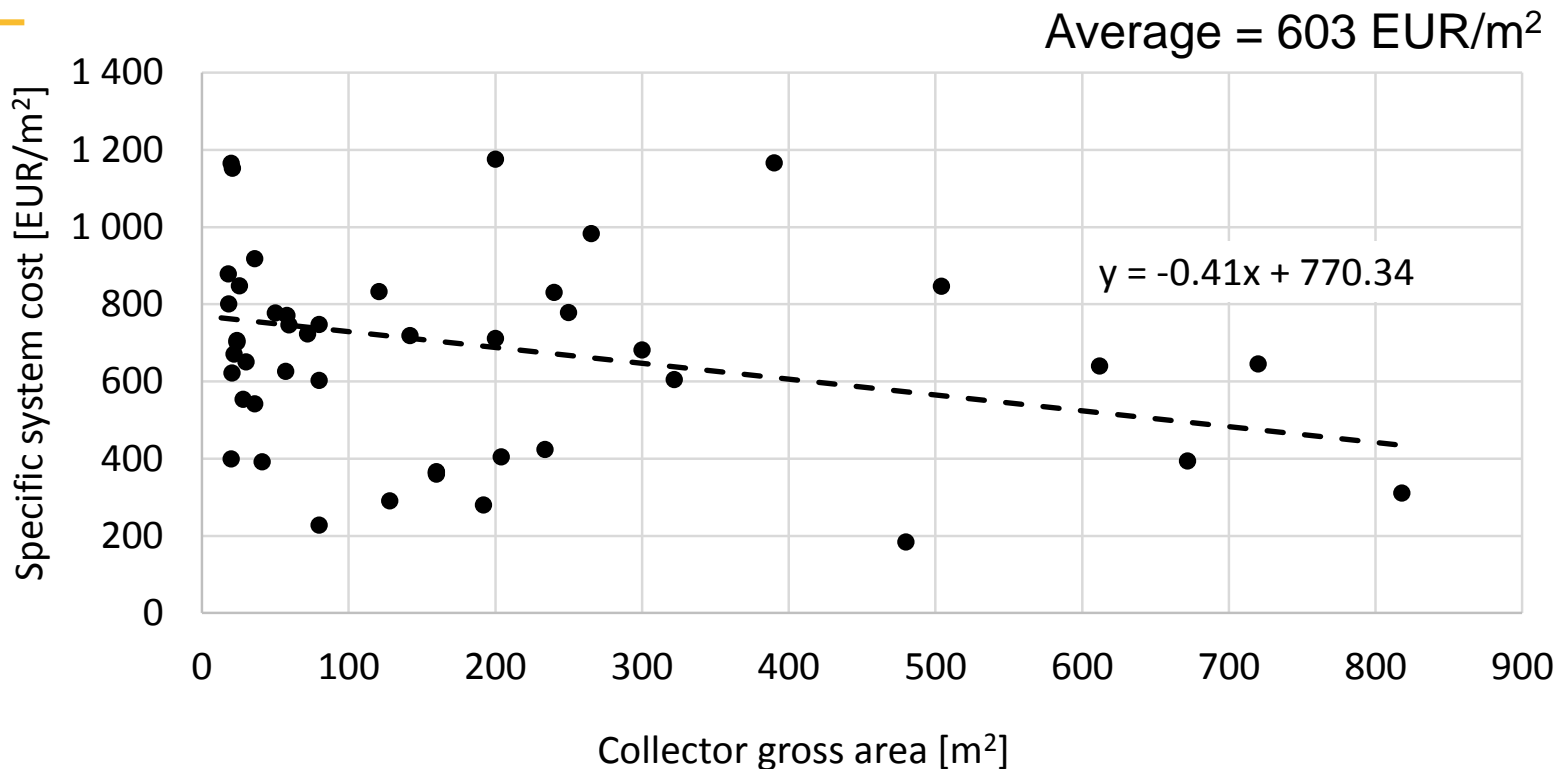
Large-scale SWH systems in SA per type of application (gross collector area > 10 m²). Domestic hot water 66 systems, staff ablutions 14 systems, process heat 7 systems, solar cooling 2 systems. Legend units are m².

Installations per Province



Large-scale SWH systems in SA per province (gross collector area > 10 m²).
Number of systems and percentage contribution above bars. Legend in m².

System Costs



Costs relative to collector area (data from Blackdot Energy, AEE Intec and personal communication with installers during 2014 - 2015). Exchange rate at date of installation was used ($9.66 < \text{ZAR/EUR} < 15.3$ from 2007 to 2015).

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CBC Brewery, Paarl

<http://www.soltrain.co.za/>



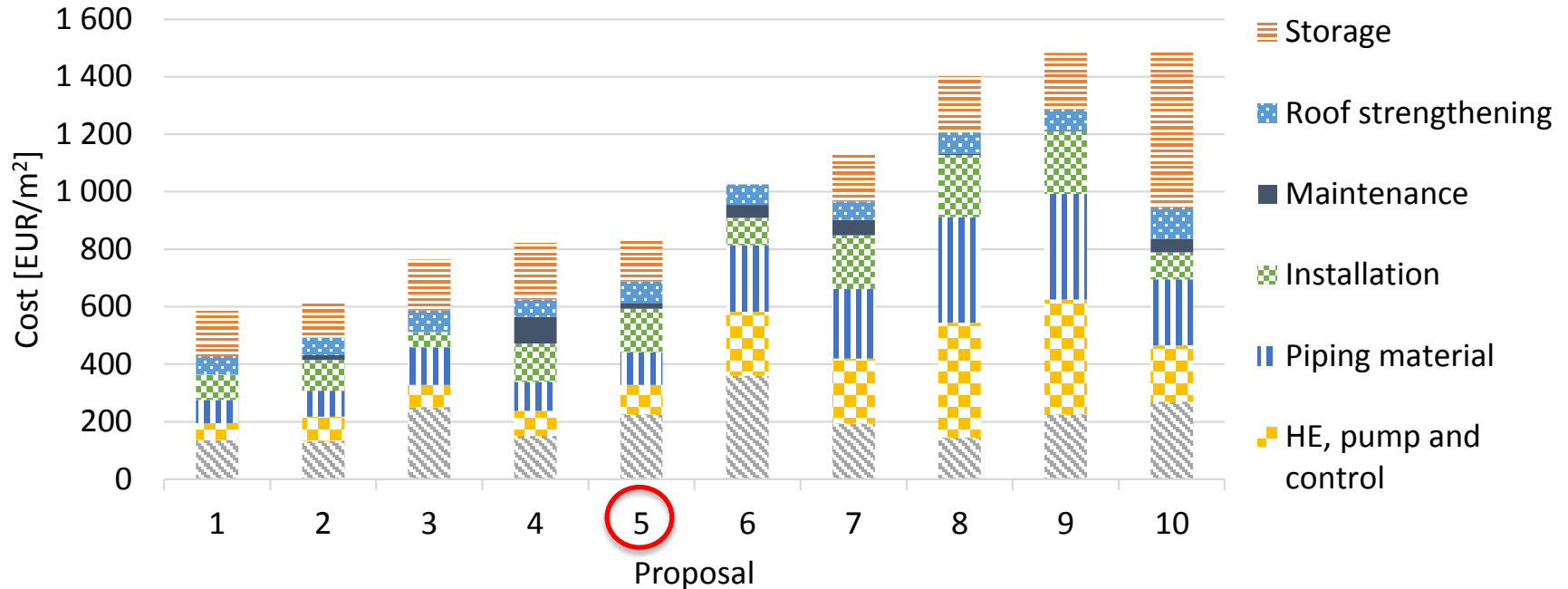
120 m² flat-plates, 10 m³ storage, SF = 60 %
<https://www.youtube.com/watch?v=JXANpox482k>



Pre-heating storage
with stratified charging

CBC Brewery, Paarl

Tender evaluation

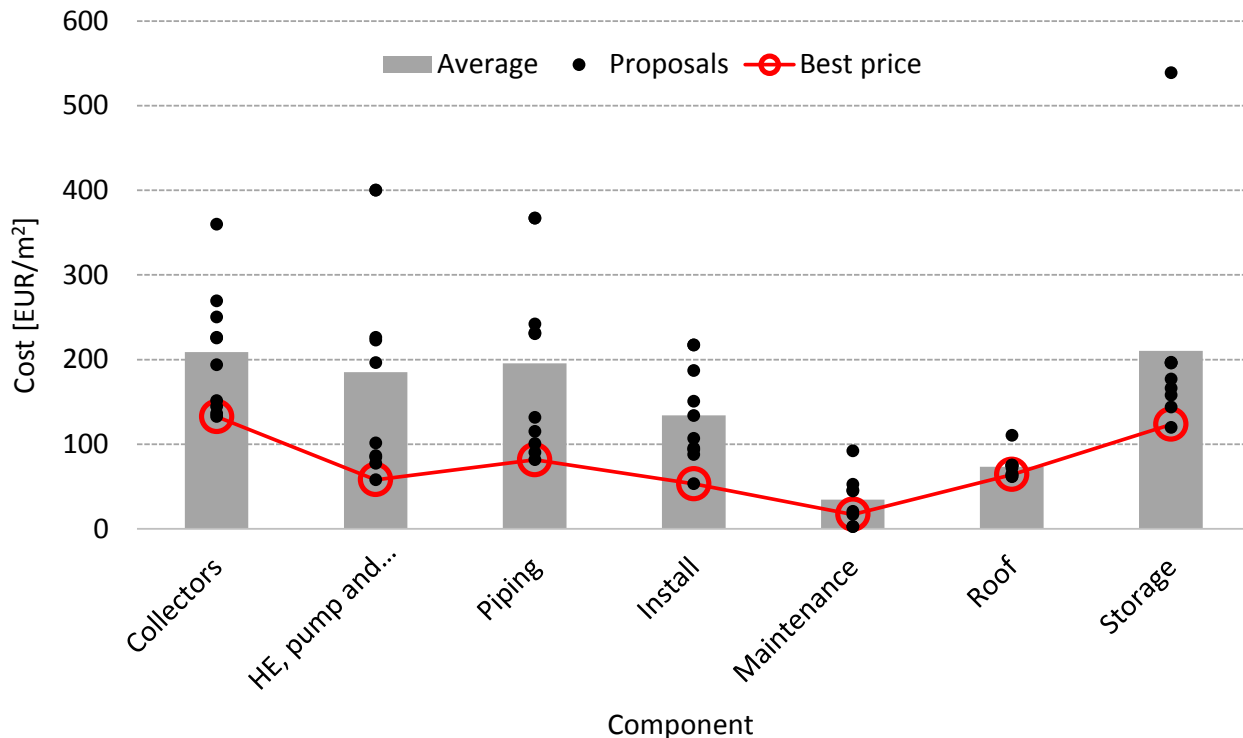


Proposal comparisons and component breakdown from the CBC tender (using September 2015 exchange rate of ZAR/EUR = 15.3)

CBC Brewery, Paarl



Theoretical best price = 503 EUR/m²



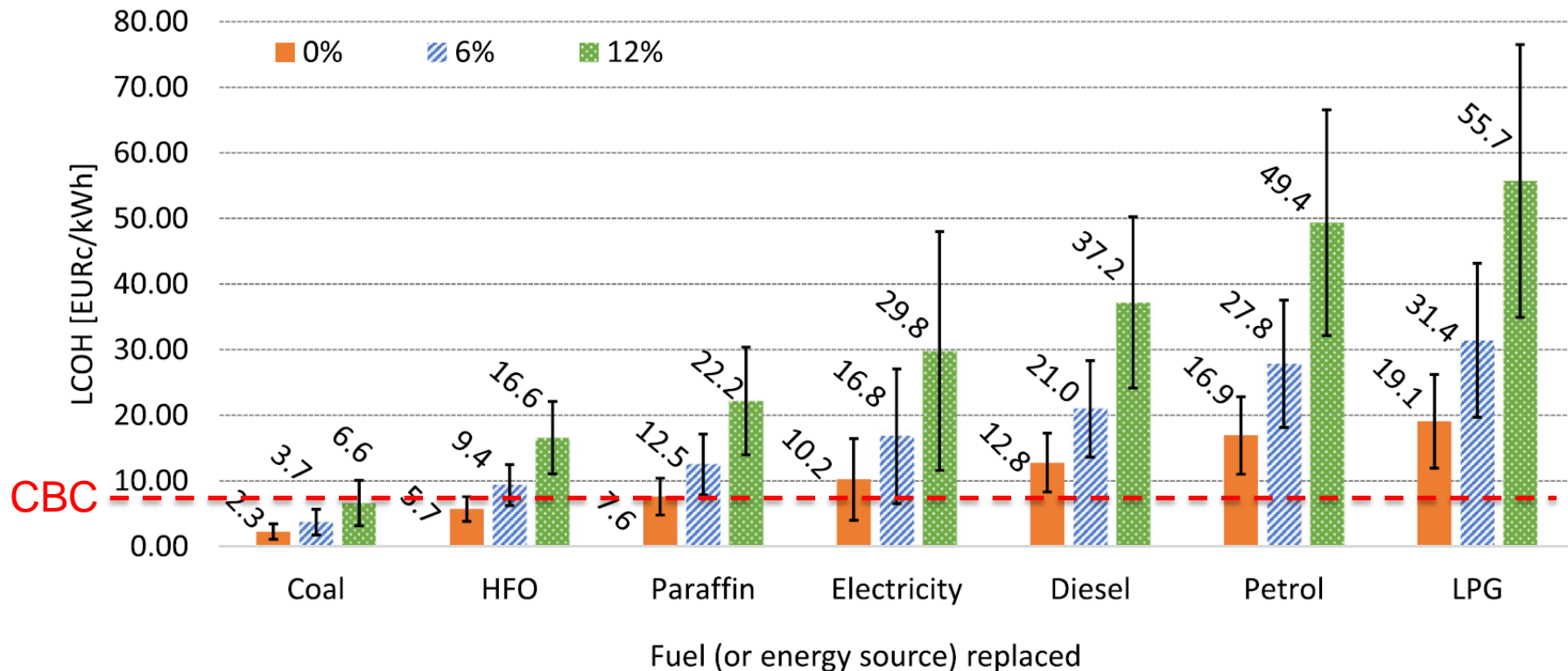
Average costs and variance per cost category between all ten proposals of the CBC tender. Not all offers included costs for future maintenance and storage.

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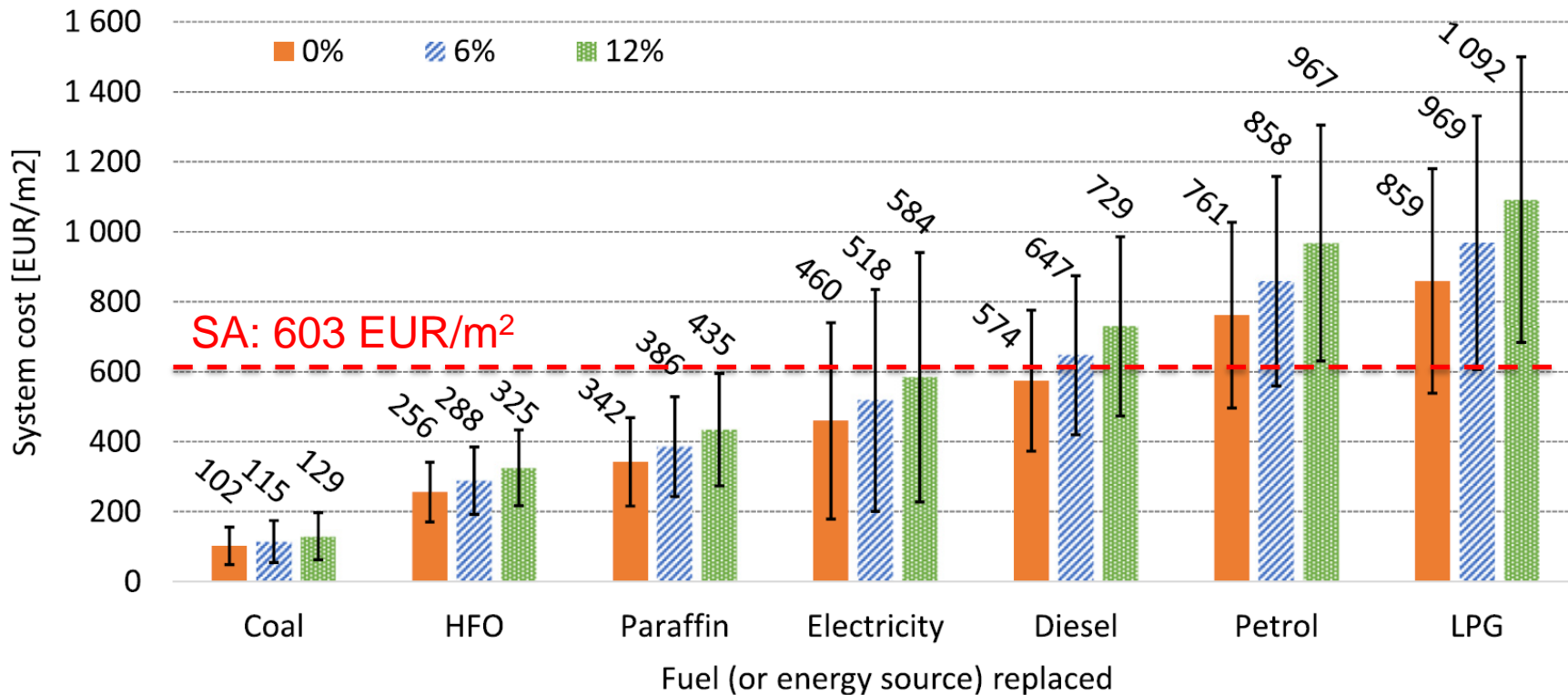
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Levelized Costs of Heat (LCOH)



Current and future heat generation **costs from conventional fuels** in SA. LCOH values over 20 years with and price increase 0%, 6 % and 12 % respectively. Values in EUR/kWh.

Specific System Costs



Required specific ST system costs to **break even after 5 years** in SA

Recommendations / Next Steps



Overcome long payback:

- Reduce system costs: Local components, 1 Master Ind. Eng.
- Implement contracting: Collaboration with SolarCollective

Increase competence of solar planners:

- Training seminars: Soltrain (3 / 4 November, after SASEC)
- Tools: SolGain (Master Corvin Ilchmann)

Push market diffusion:

- Sector projects: STEP-Bio (Master Willem Krog)
- Approach potential Clients: Tendering Klein Karoo (500 m²)

Thank you!

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visit us: concentrating.sun.ac.za

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Joubert, EC, Hess, S & van Niekerk, JL 2016. Large-scale solar water heating in South Africa: Status, barriers and recommendations. *Renewable Energy* 97: 809-822.

SATIM 2013. *Assumptions and Methodologies of the South African TIMES Energy Model*. Energy Research Centre. University of Cape Town. Available from: <http://www.erc.uct.ac.za/groups/esap/satim>. [21 August 2015].

Soltrain, n.d., *About Soltrain*. Available from: <http://sessa.org.za/about-sessa/affiliates/soltrain>. [5 January 2016].

Local Central Receiver Technology



Stellenbosch University spin-off for medium to high SPH:
90 % SA content, Low-cost, 200 m² pilot plant of 100 Heliostats



 **HELIO100**

<http://helio100.sun.ac.za/>