69TH AMEU CONVENTION

1 – 4 October 2023

CSIR International Convention Centre

Confronting South Africa's Electricity Crisis in the context of a 'Balanced Just Energy Transition' (BJET) and the need for a reliable and resilient national electricity grid

The Potential for Intelligent Geyser Management: Five Lessons Learned from Project Smart Geyser

Presented by:

Zanele Hakamela, Advisor, GIZ

Jon Kornik, CEO, Plentify

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project smart geyser

Project partners

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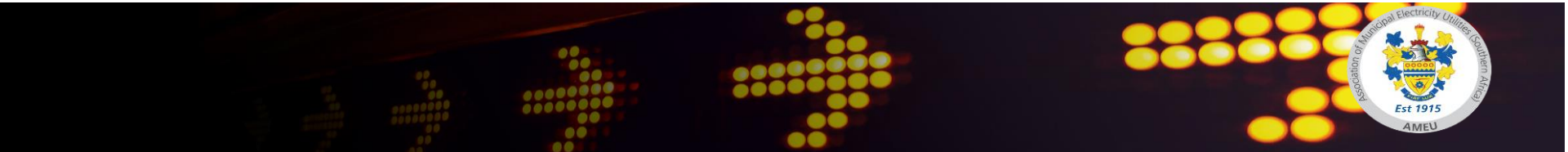

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Project objectives

Can intelligent geyser management enable a cheaper, cleaner, more reliable electrical grid through the provision of three services:

1. **Load Reduction:** shifting energy use out of either Peak TOU or Rotational hours

2. **Maximum Demand Management:** coordinating fleets of geysers to eliminate spikes in energy use.

3. **Solar Load Building:** shifting energy use to solar hours, and coordinating geysers to match energy use with solar generation.

All while promoting **Energy Efficiency** and protecting **Hot Water Satisfaction.**

HotBot provided the intelligent geyser control services

plentify

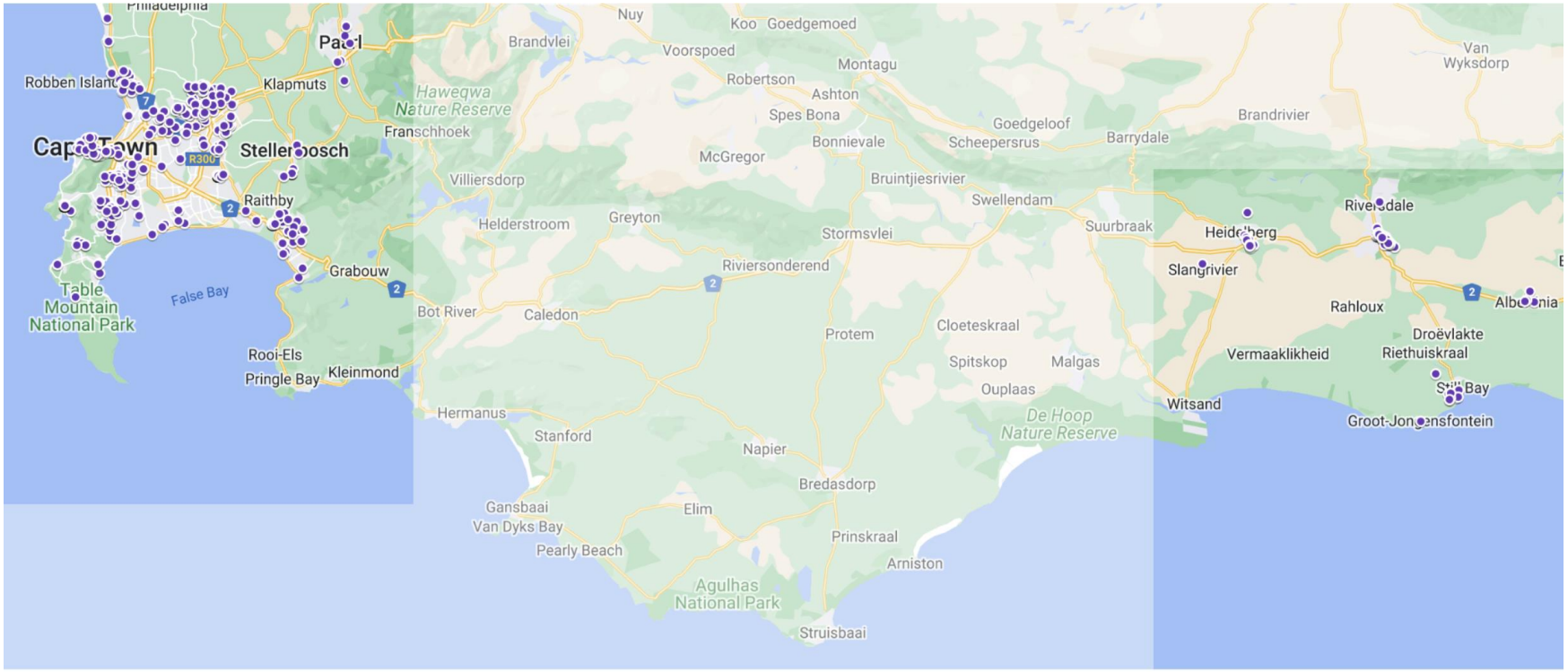
Internet of Things controller

Connected to each geyser

Intelligence engine

Made control decisions based on geyser characteristics, user behaviour and preferences, and service objectives.

500 HotBots deployed across City of Cape Town and surrounds and Hessequa Municipality



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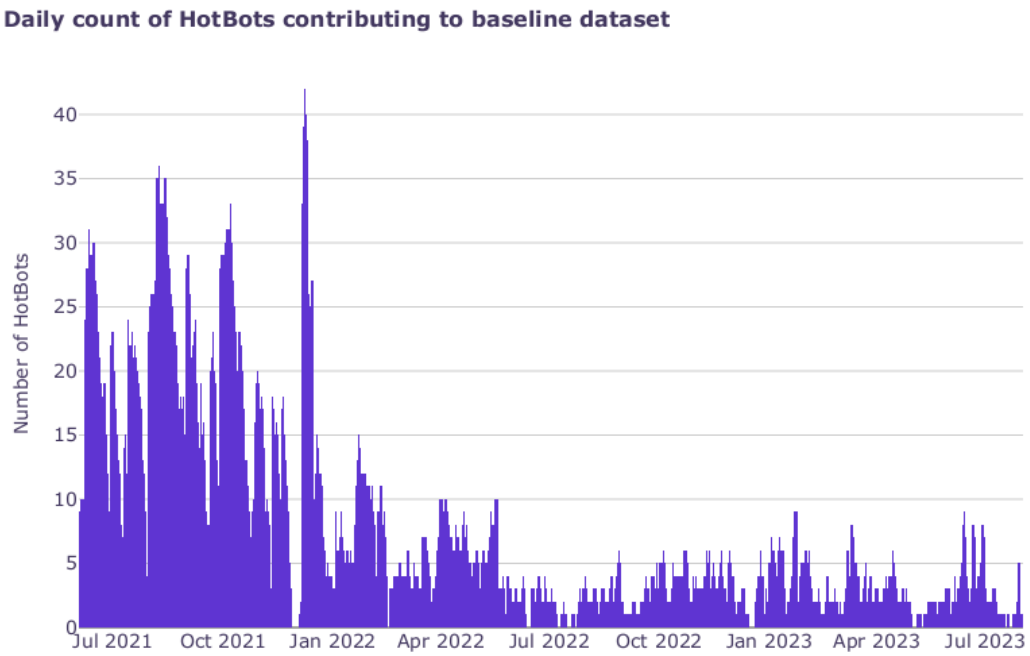
Collected 3,811 days of diverse baseline data over a period of more than 2 years

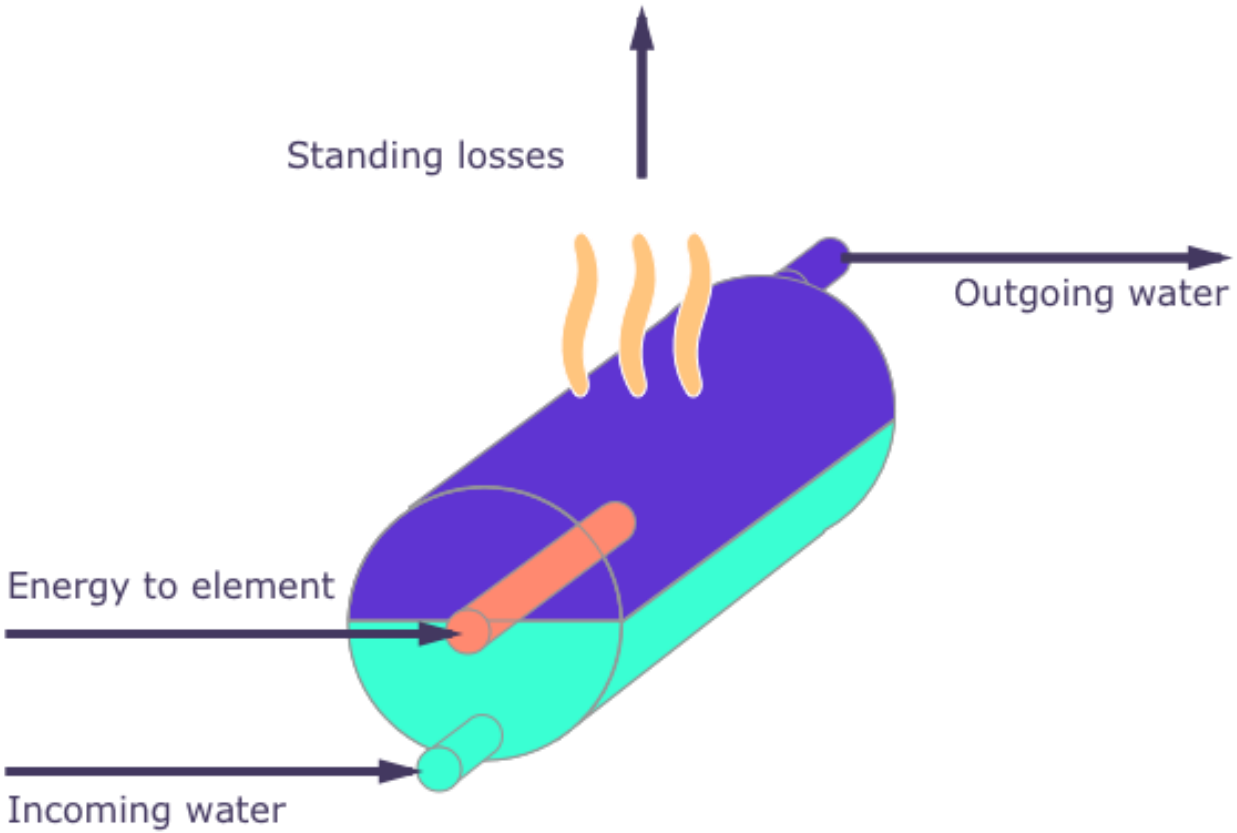


Data includes periods of thermostatic control for:

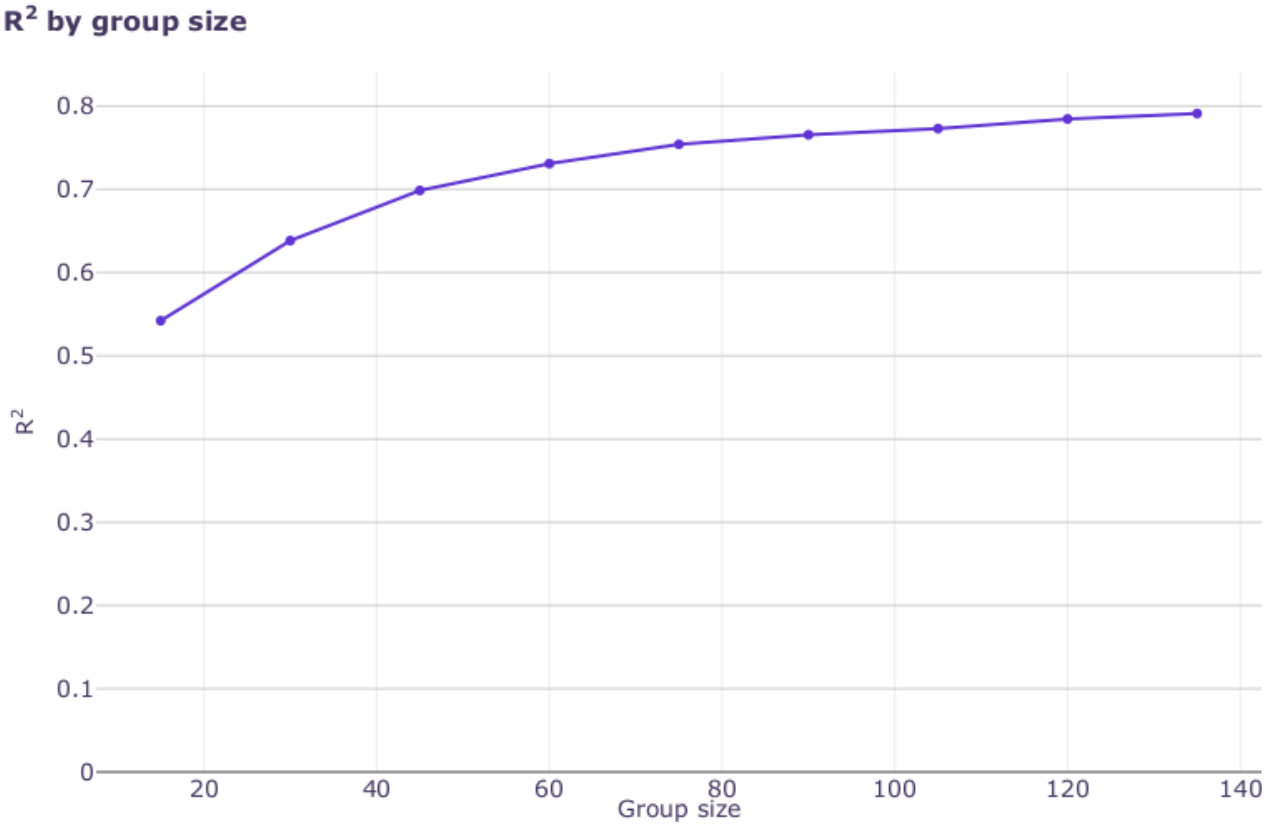
- **All seasons**
- **122 geysers**
- 100l, **150l, 200l** and 250l capacity
- 2kW, 2.5kW, **3kW**, 3.5kW and 4kW elements
- **Horizontal** and vertical

Bold = most common

Baseline data used to calibrate a thermodynamic simulation model



Simulation model found to have an R^2 of >0.7 for fleet sizes of 50+



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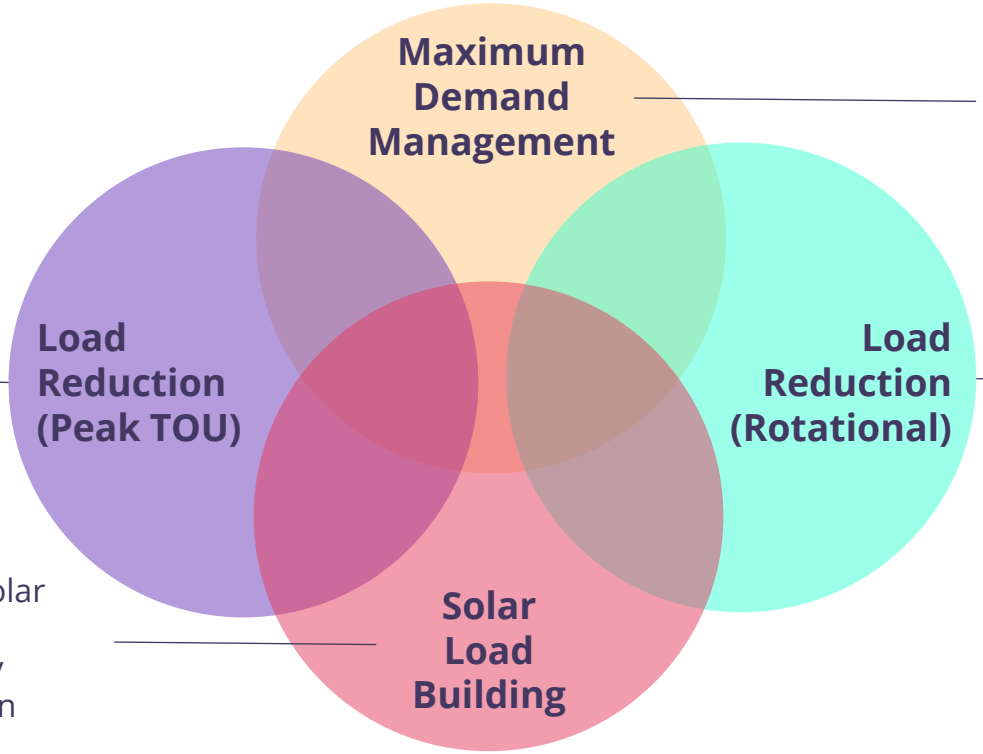
We tested compatible combinations of four load management services



Coordinating fleets of geysers to eliminate spikes in energy use

Shifting energy use out of Peak TOU hours

Shifting energy use out of Rotational hours

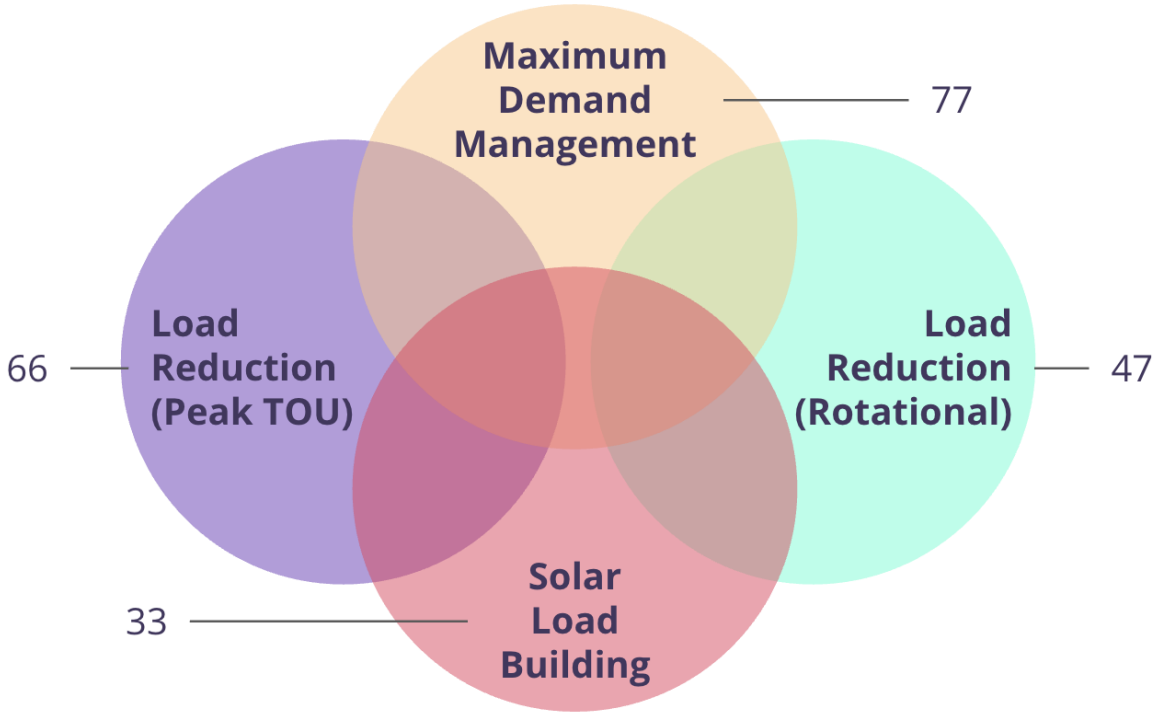
Shifting energy use to solar hours, and coordinating geysers to match energy use with solar generation

Rotated through experiments every 2 weeks, creating 113 experiments spanning services, fleets and seasons

Experiment approach

- Experiments split into 24x 2-week periods (from 29 Aug 2022 - 3 Aug 2023)
- Across the five fleets, this created 113 experiments
- Rotated through different combinations of services every 2 weeks to ensure that each service was well tested across fleets and seasons.

Number of experiments by load management service



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5 lessons learned from Project Smart Geyser

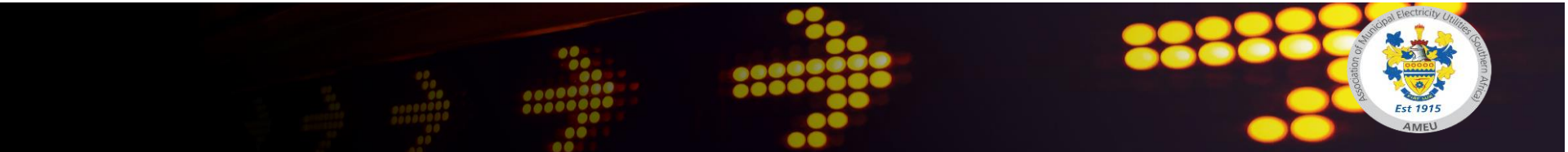
1. **Geysers can reduce Peak TOU energy by up to 80% without compromising on hot showers.**

2. Load shedding causes geysers to create spikes in energy use, which inflate electricity bills and damage grid infrastructure. Geysers can flatten the curve.

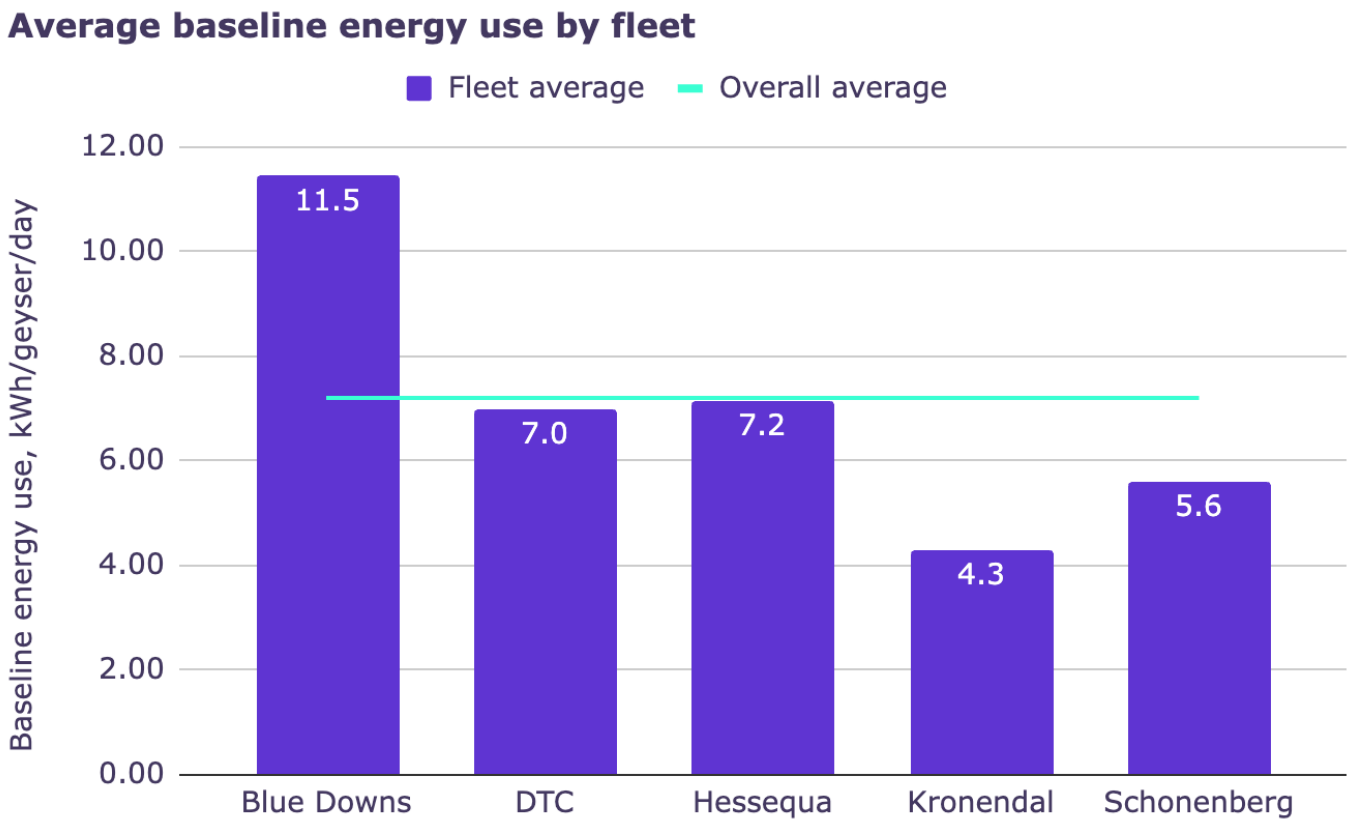
3. Geysers can help fight the Duck Curve and enable 2x more solar.

4. Citizens need not pay a penalty for geyser load management. Services provided while delivering efficiency savings of up to 24% and hot water when needed.

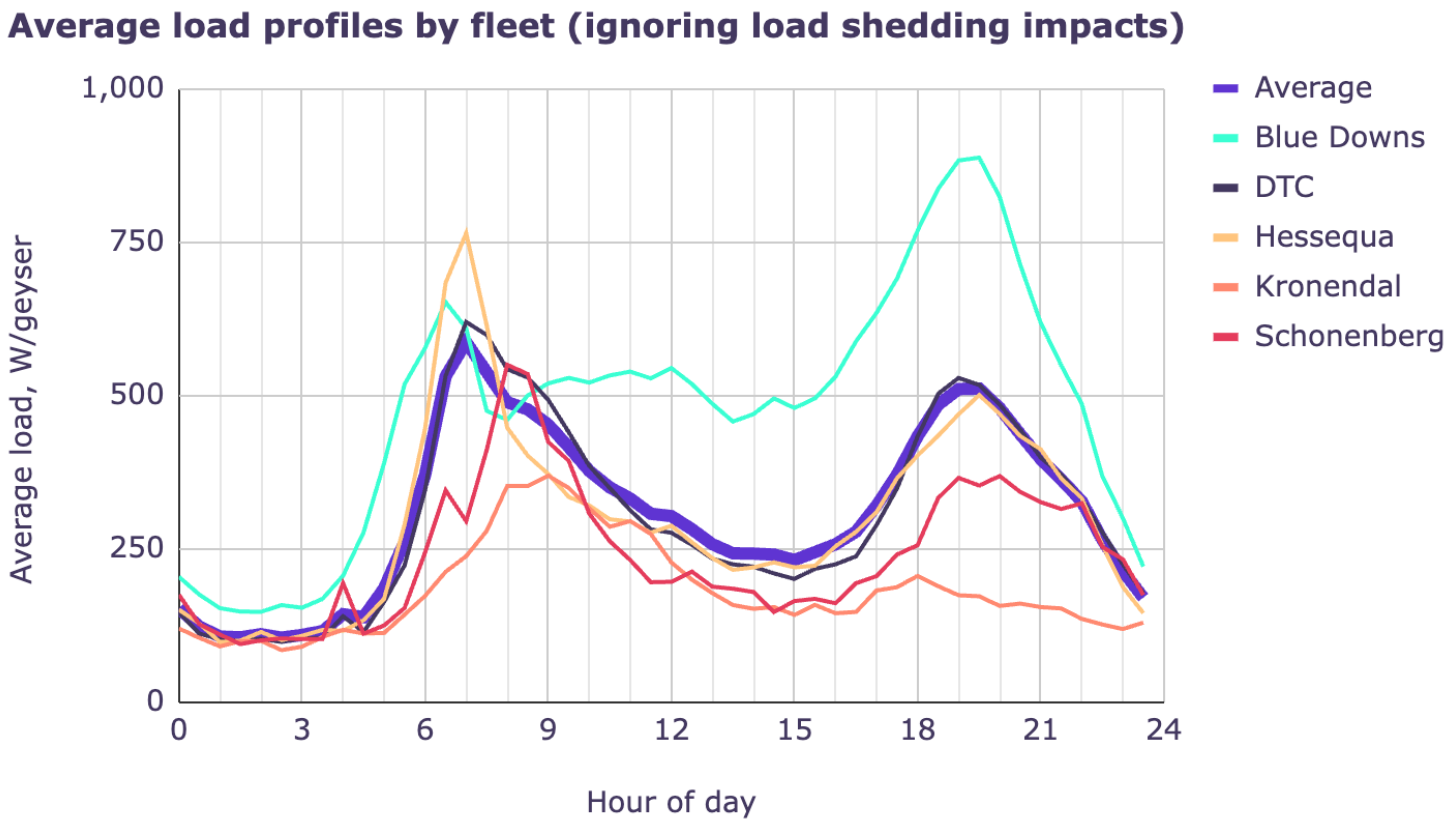
5. Geyser load management is not just a way to shed load on demand. It is also a critical tool to enable a more reliable, affordable and clean electricity system.



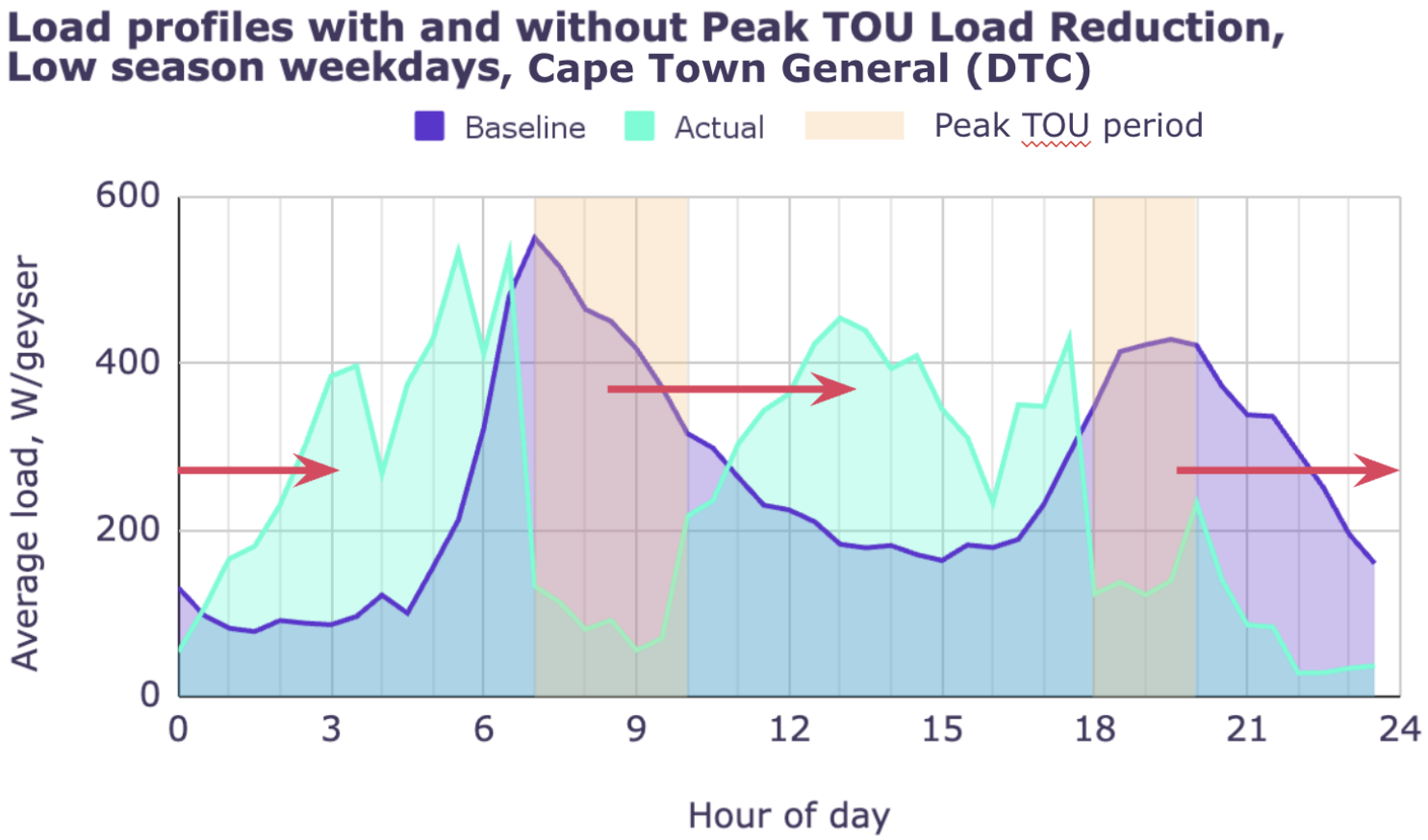
Geyser energy use averaged 7.2kWh/day, ranging widely across fleets



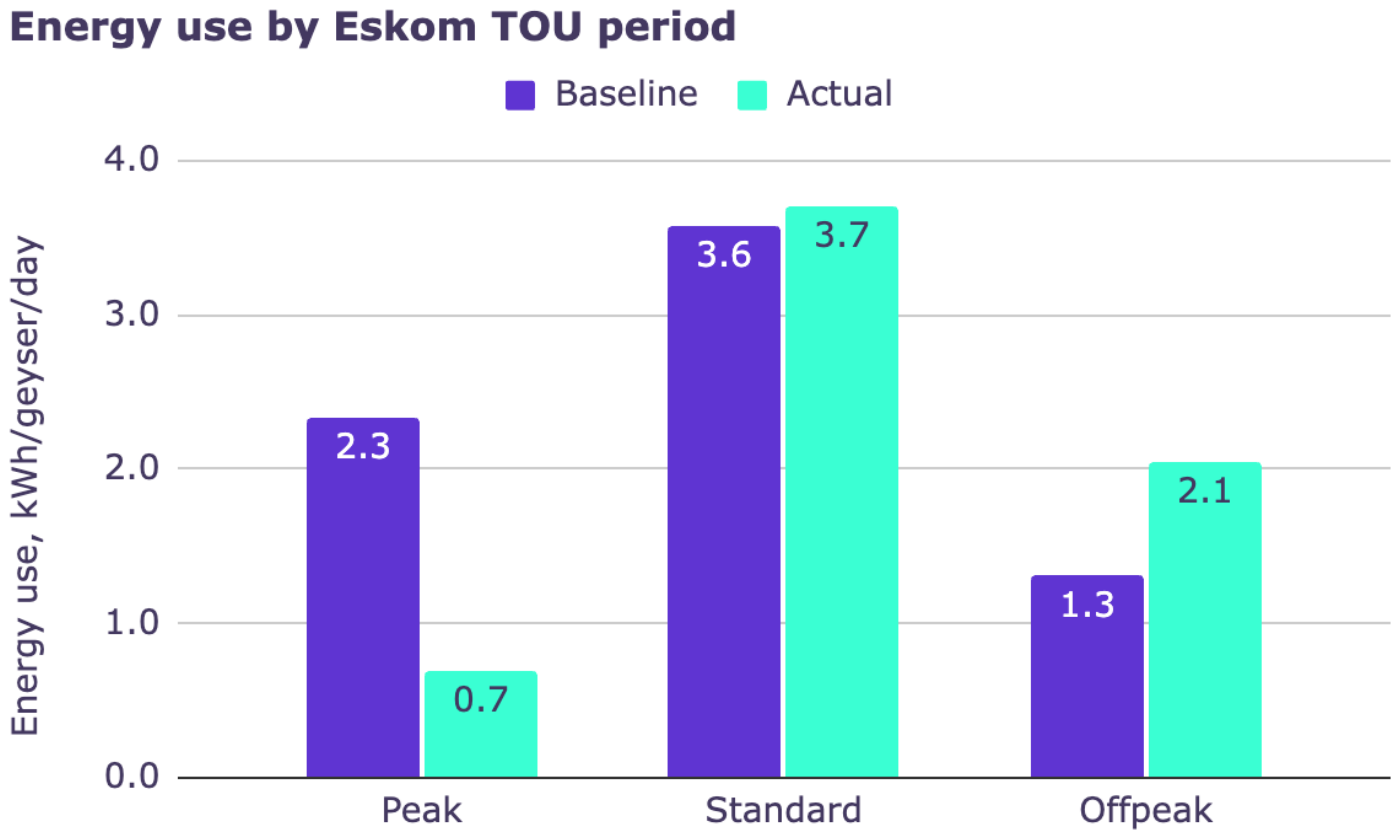
Most fleets displayed largest energy use during morning Peak TOU periods



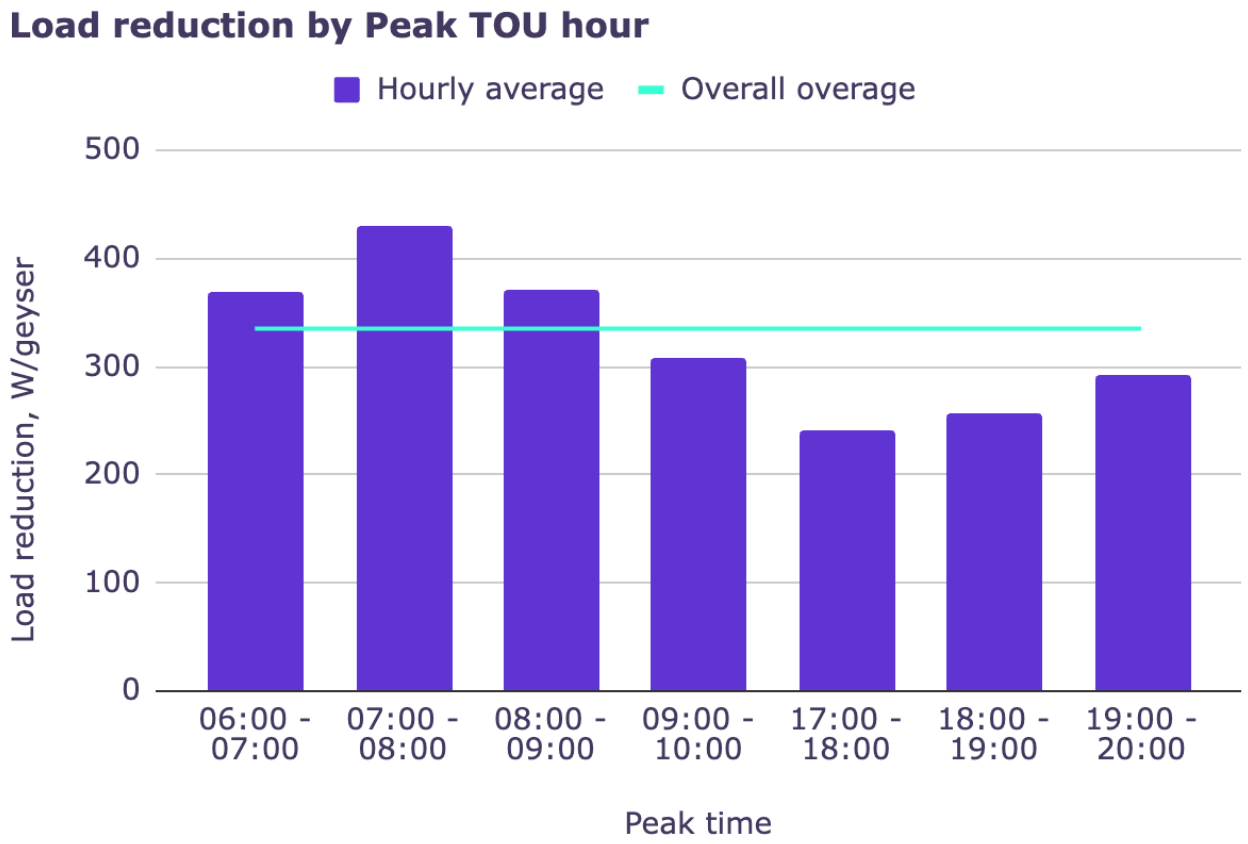
Load Reduction (Peak TOU) reduced energy use during Peak TOU periods



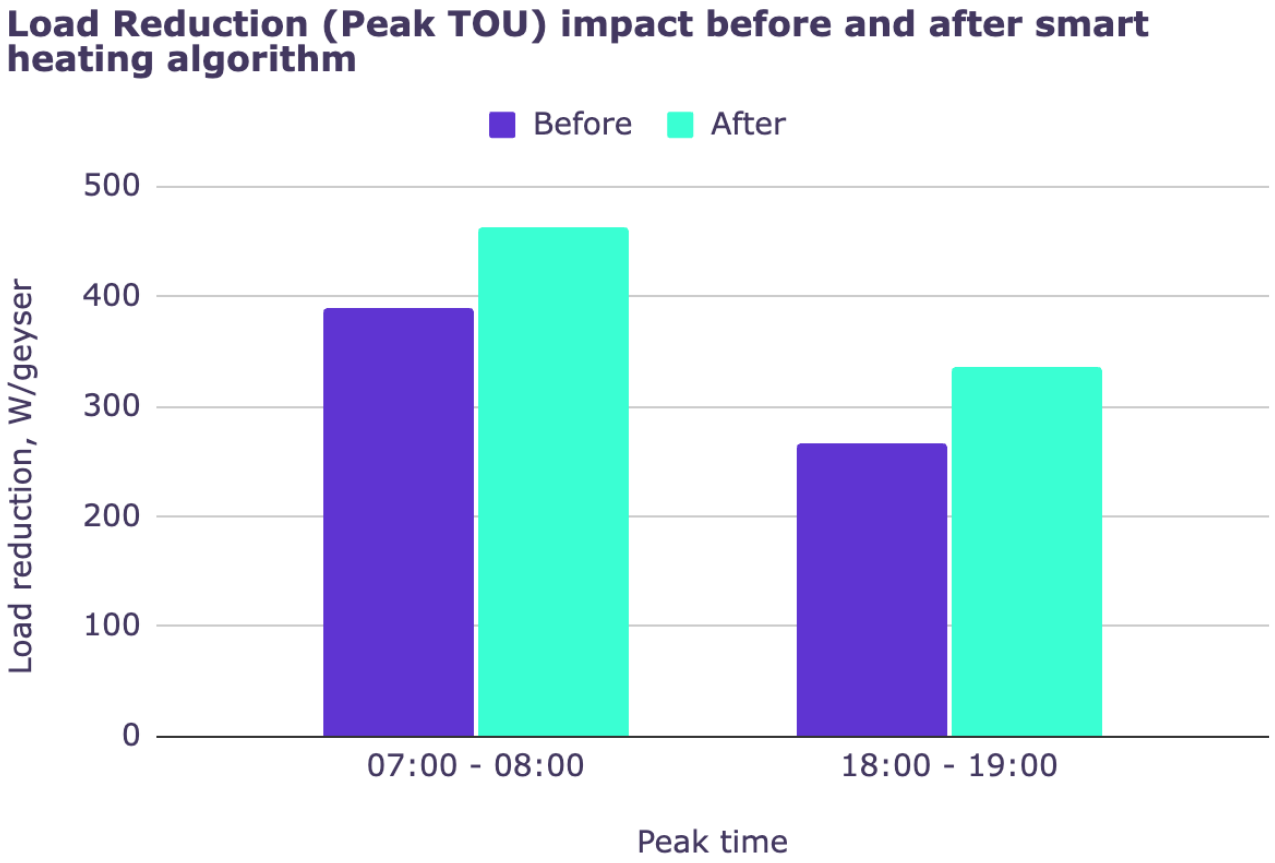
Peak TOU energy fell by an average of 1.6kWh/geyser/day and up to 80%



Peak TOU load fell by an average of 335W/geyser, with most impact in morning hours



Plentify's latest heating algorithm improved load reduction performance further while protecting hot water delivery



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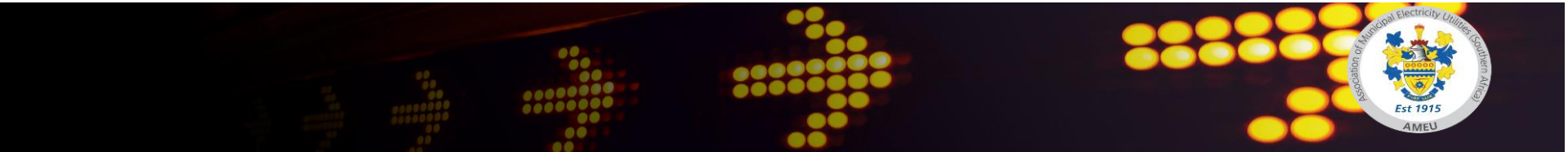
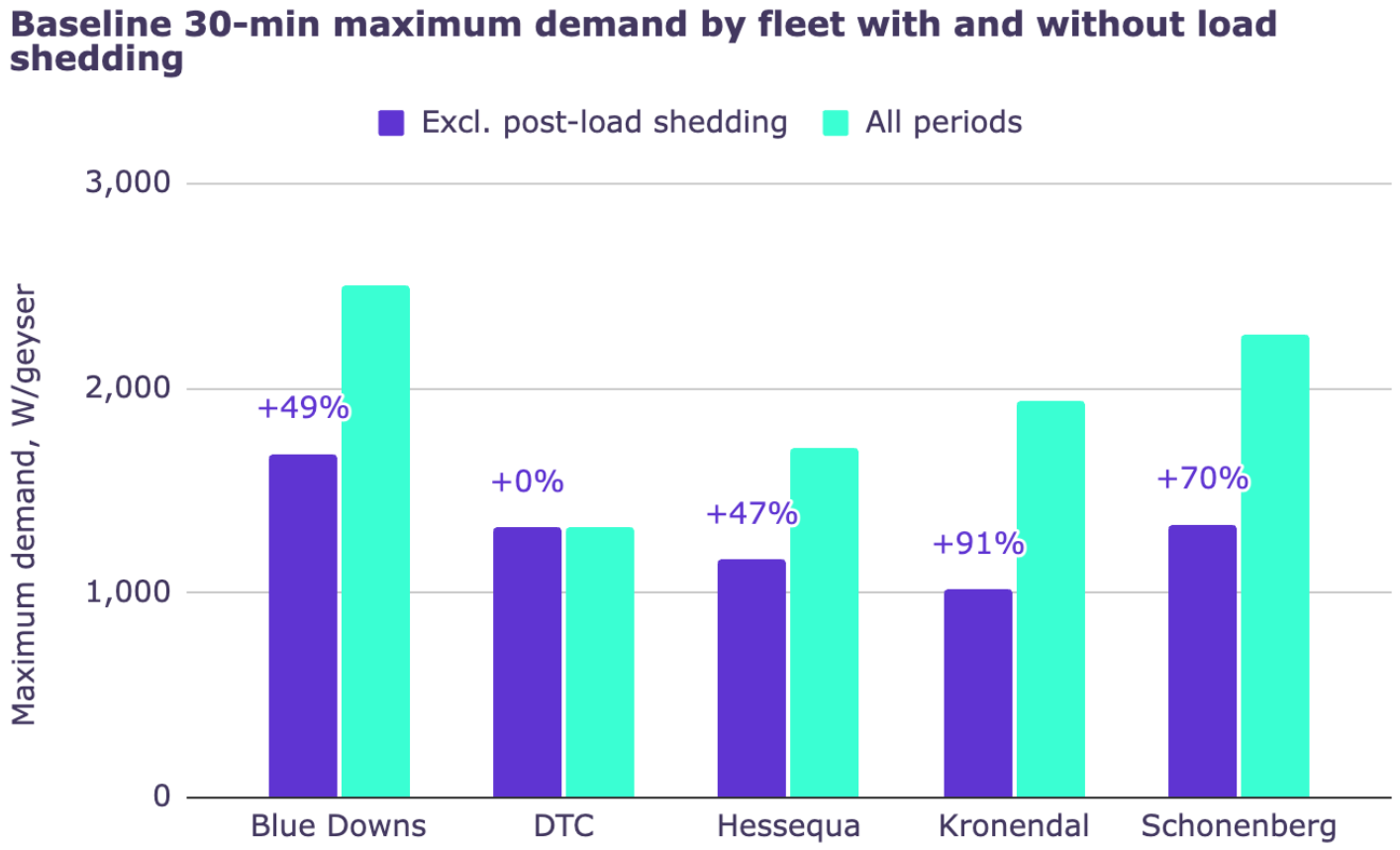
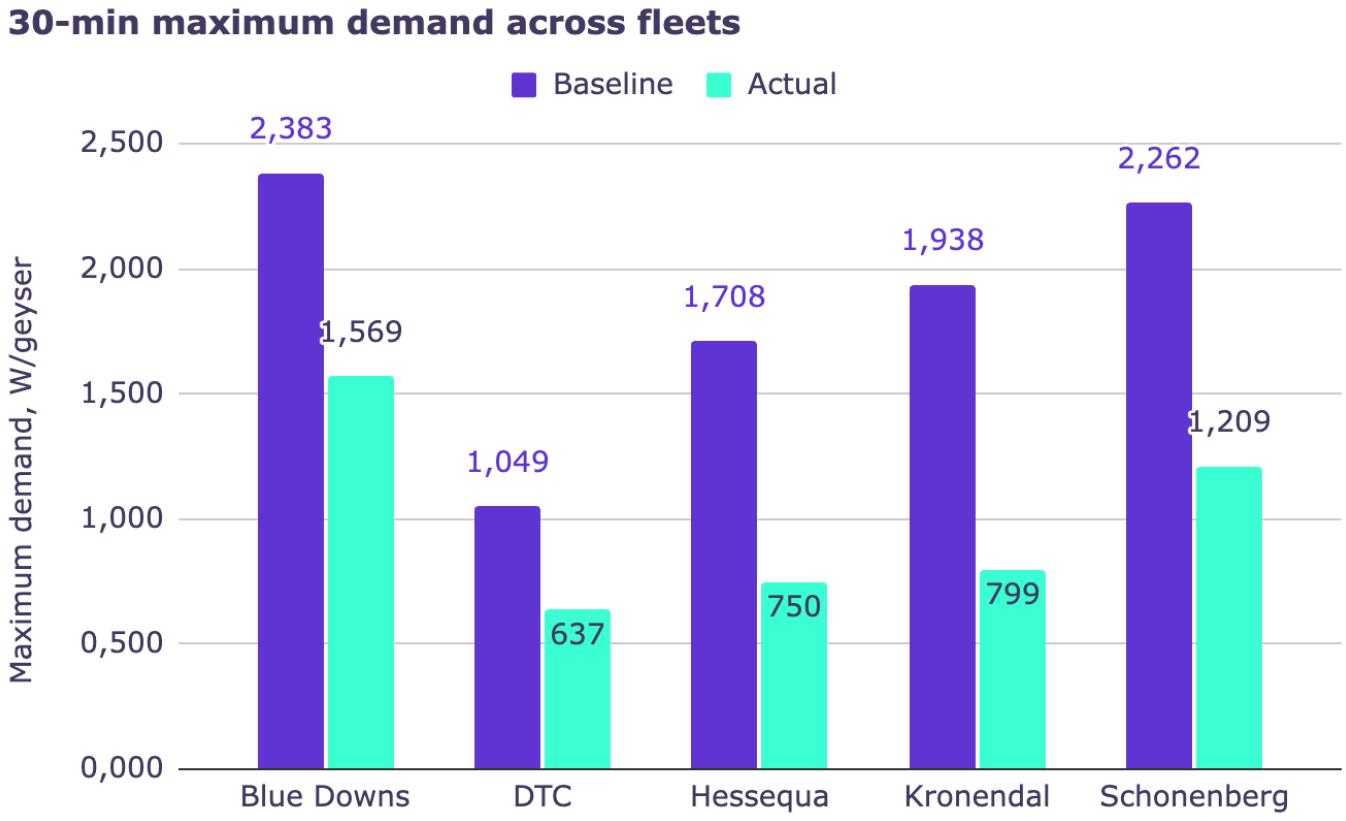


Load shedding caused Maximum Demand to spike up to 91%

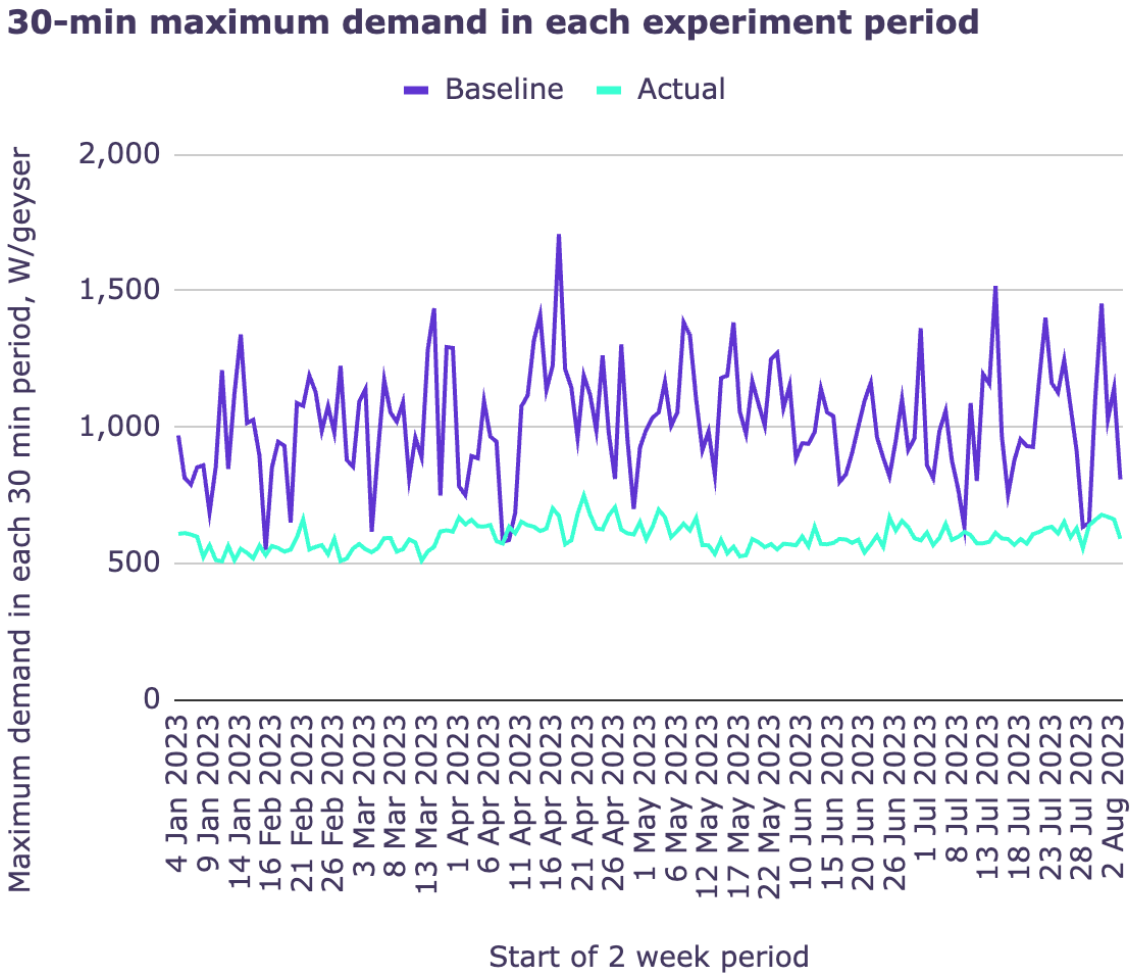


Major reductions in Maximum Demand across fleets, of up to 59% at Kronendal

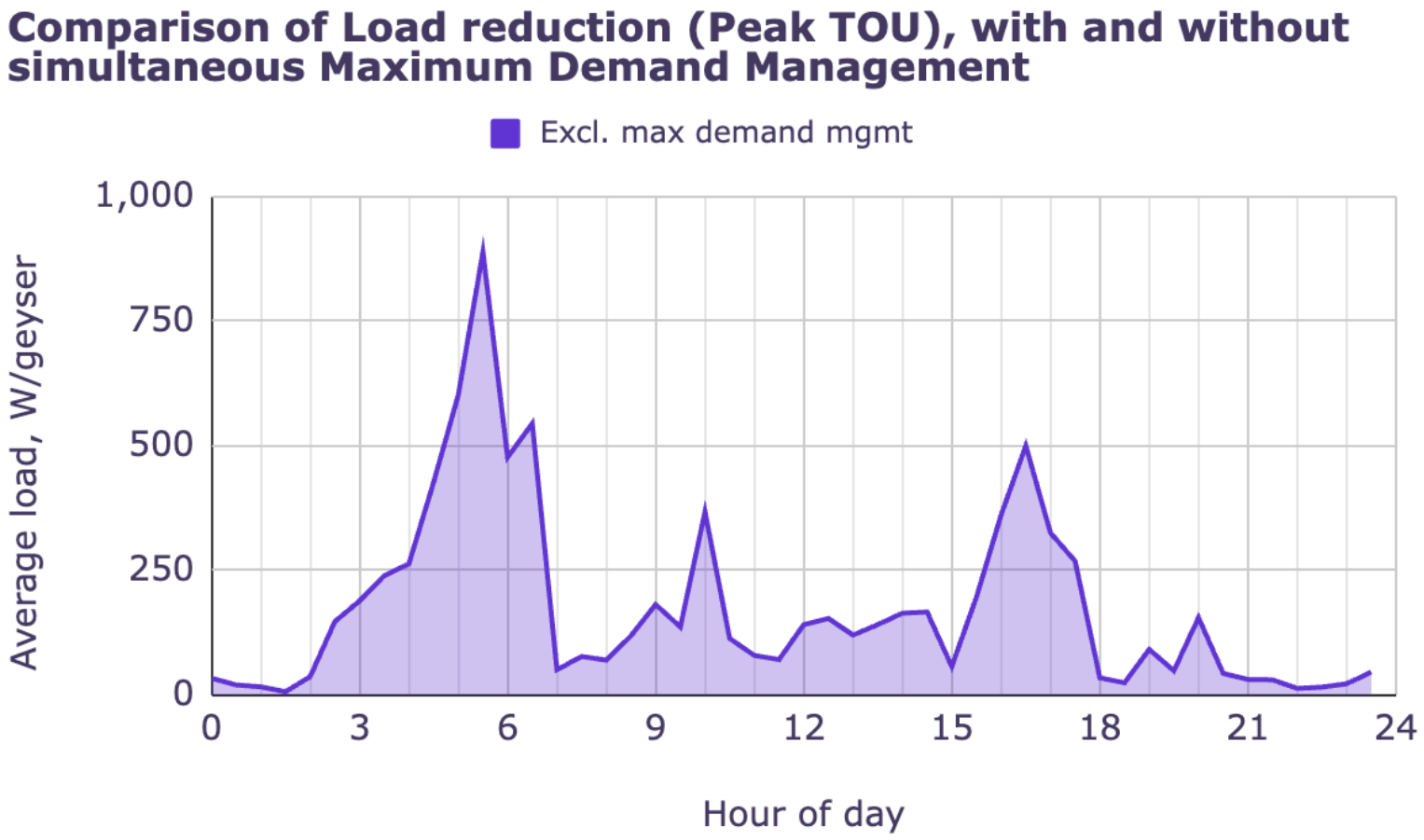


Reduction:	**34%**	**39%**	**56%**	**59%**	**47%**

Maximum Demand completely flattened, eliminating the impact of comeback load after load shedding



Maximum Demand also eliminated spikes in energy demand caused by Load Reduction



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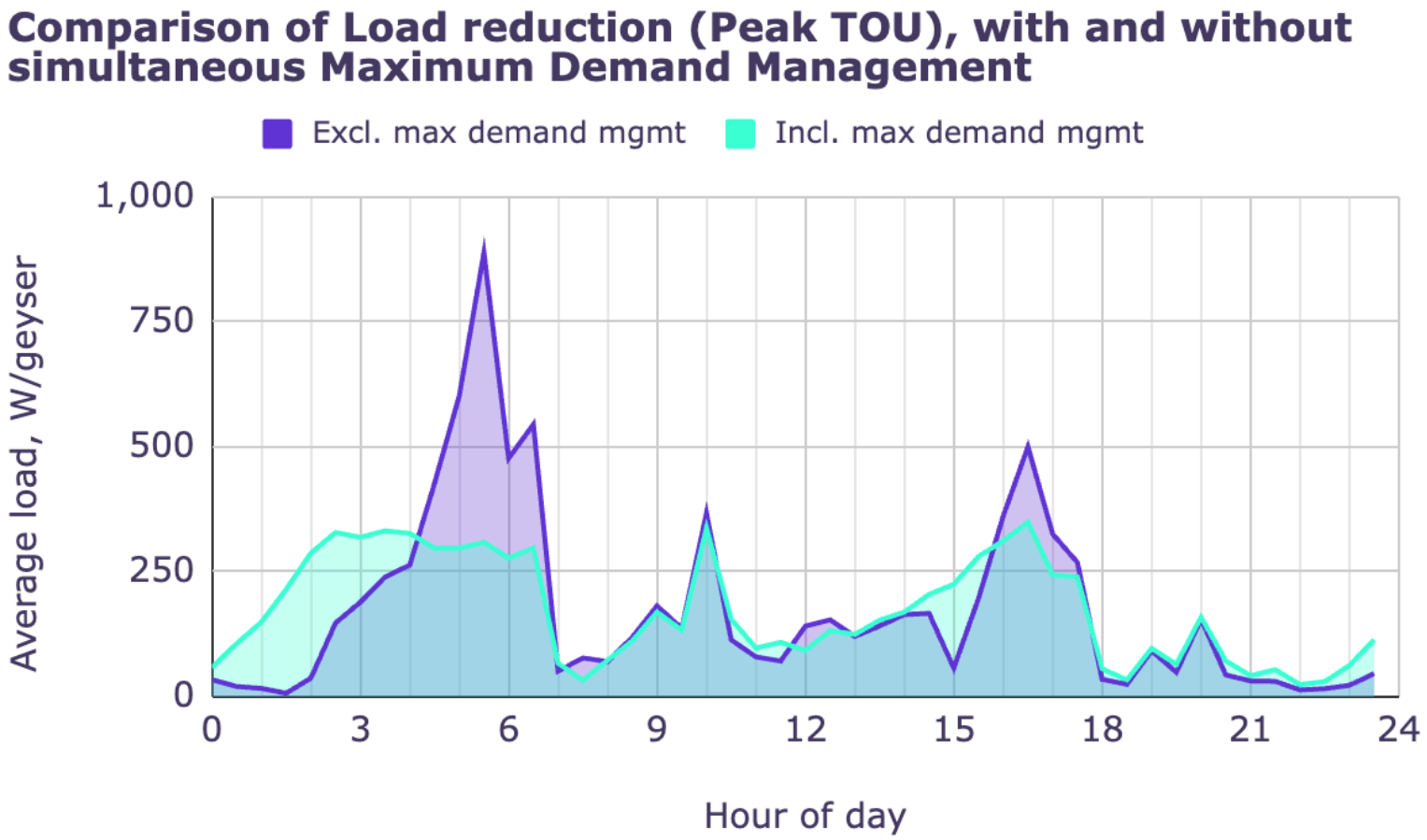

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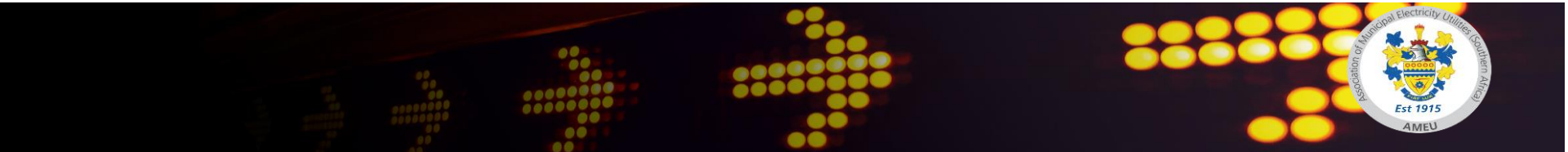
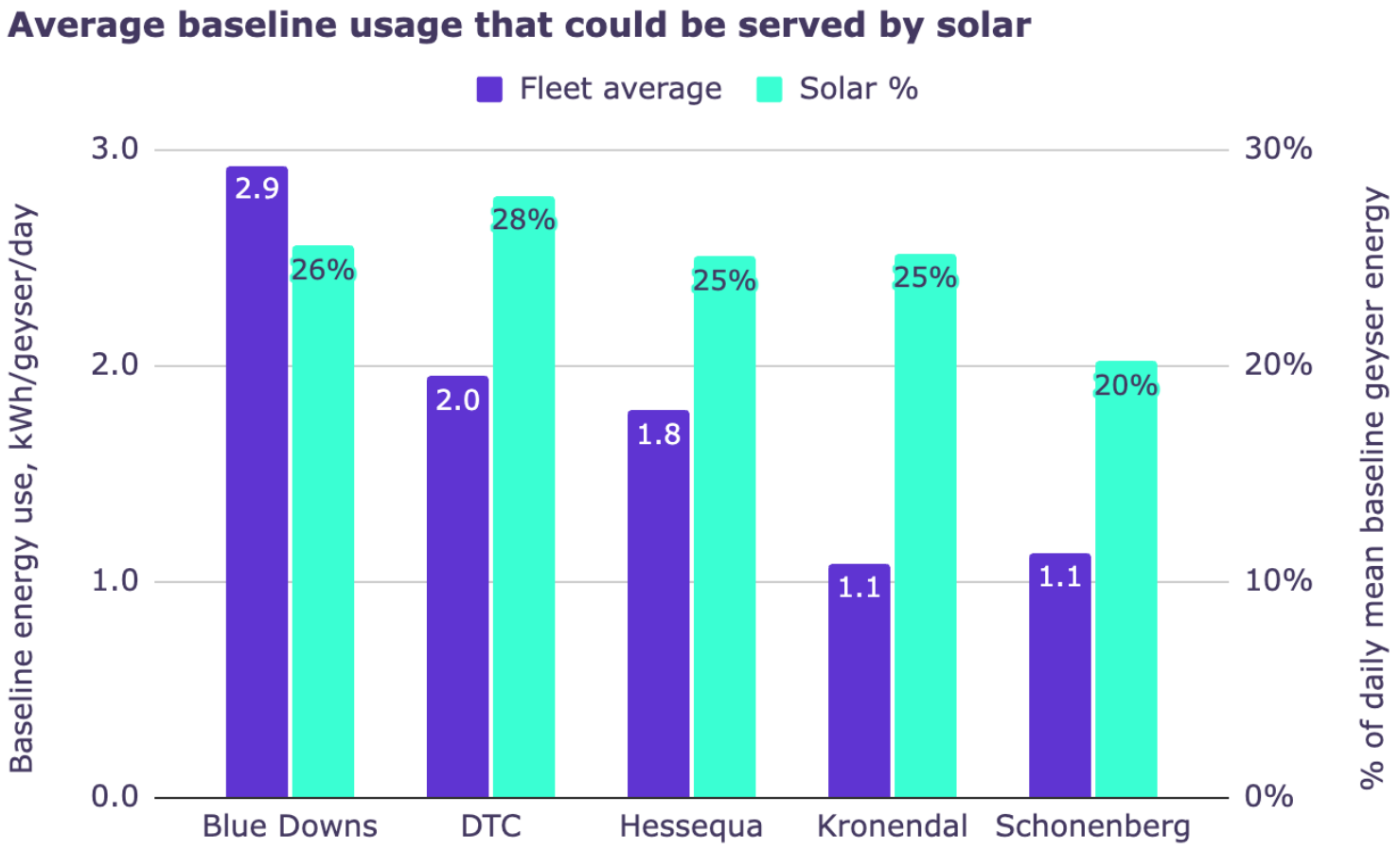
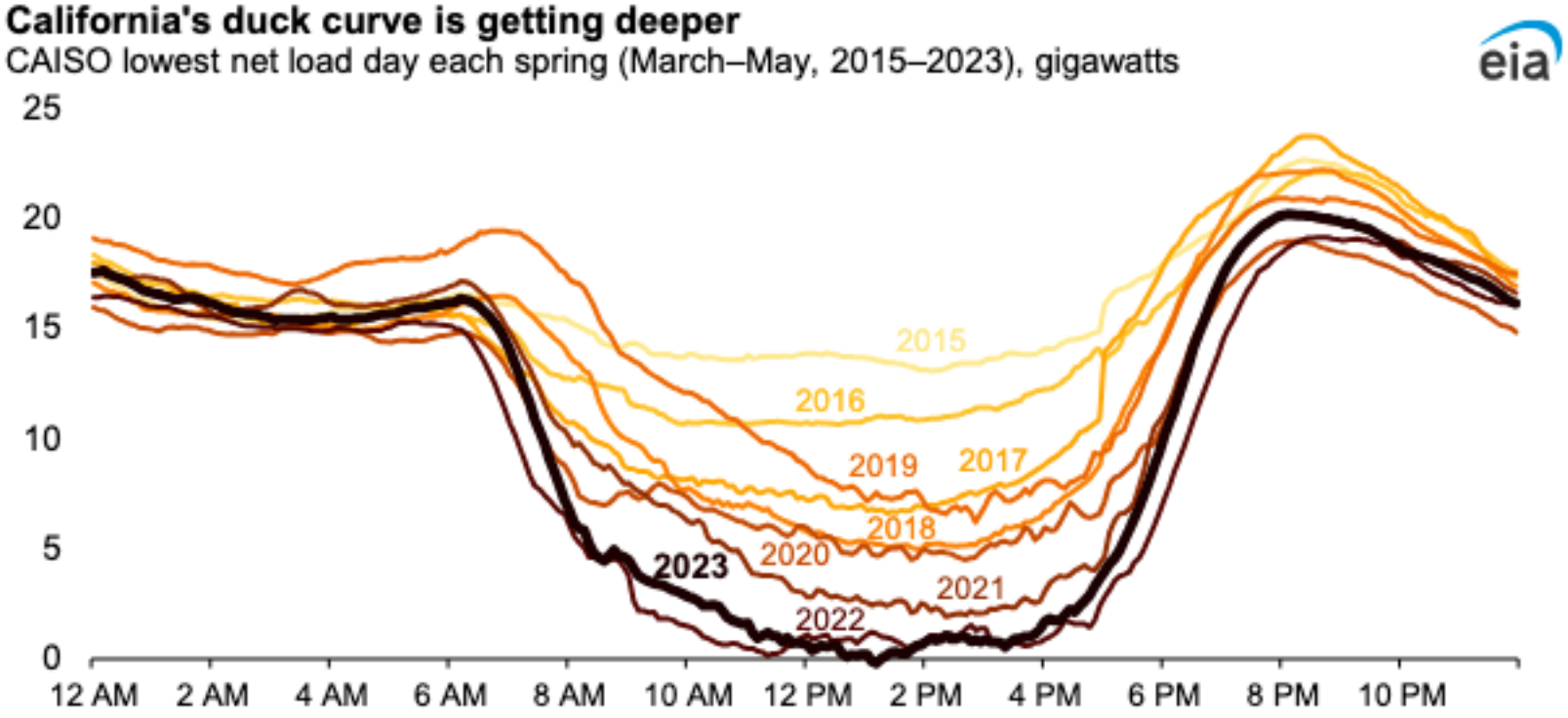


In the baseline, only 20-28% of geyser energy could be served by solar across fleets

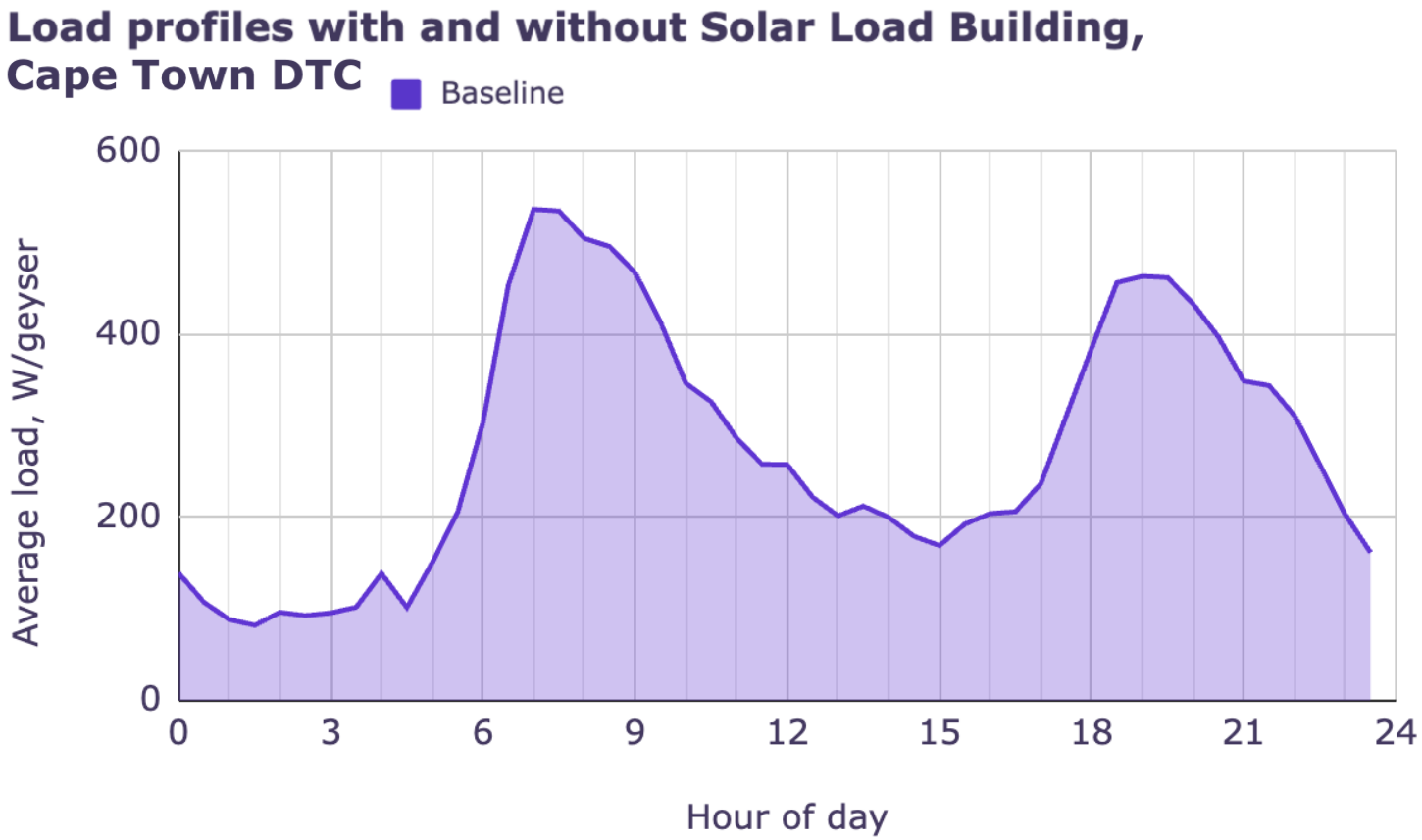


More daytime load is needed to fight the Duck Curve and support municipality-owned solar

California provides a case study of what is to come



Solar Load Building shifted energy use to match solar generation, reduce Peak TOU usage, and drive efficiency



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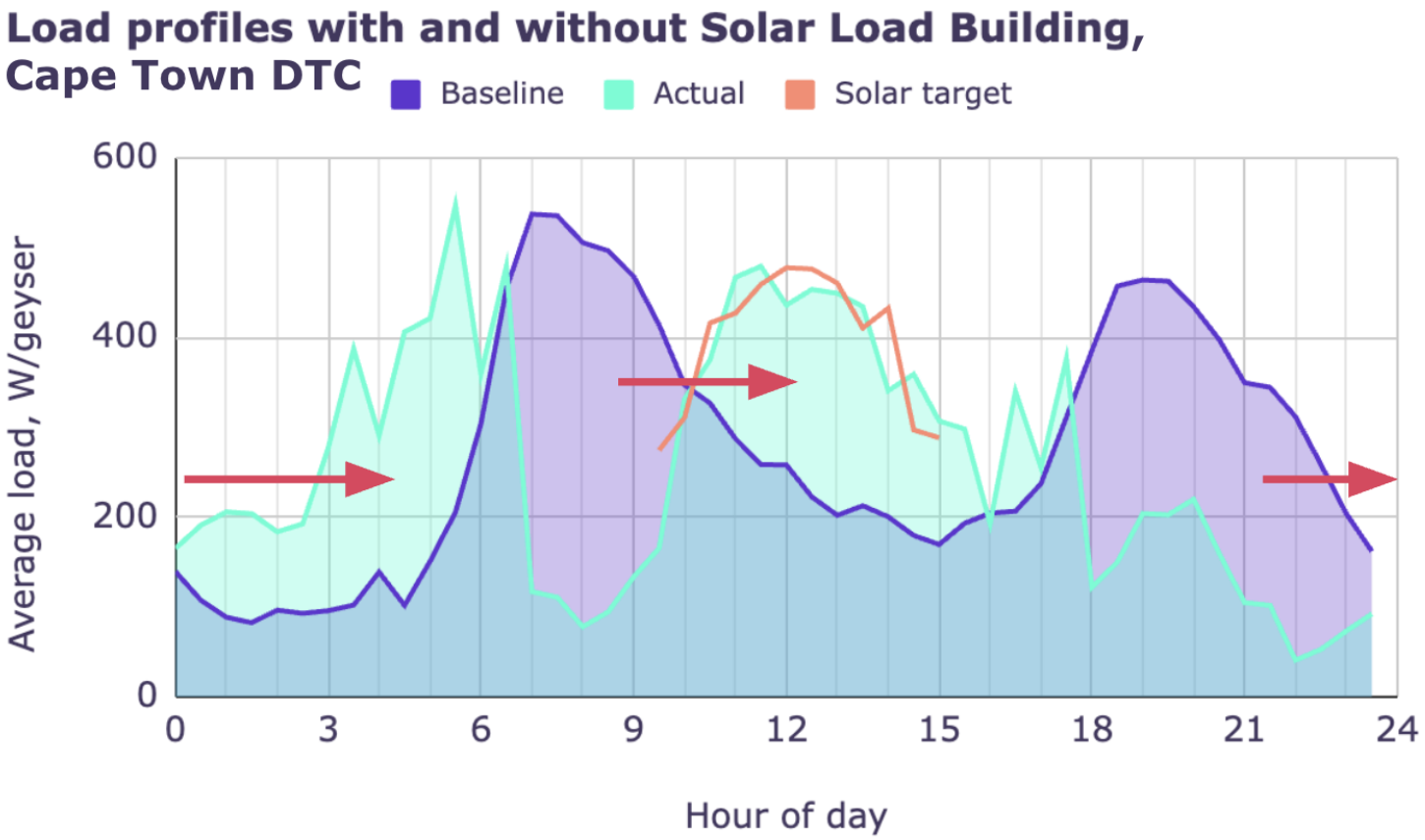
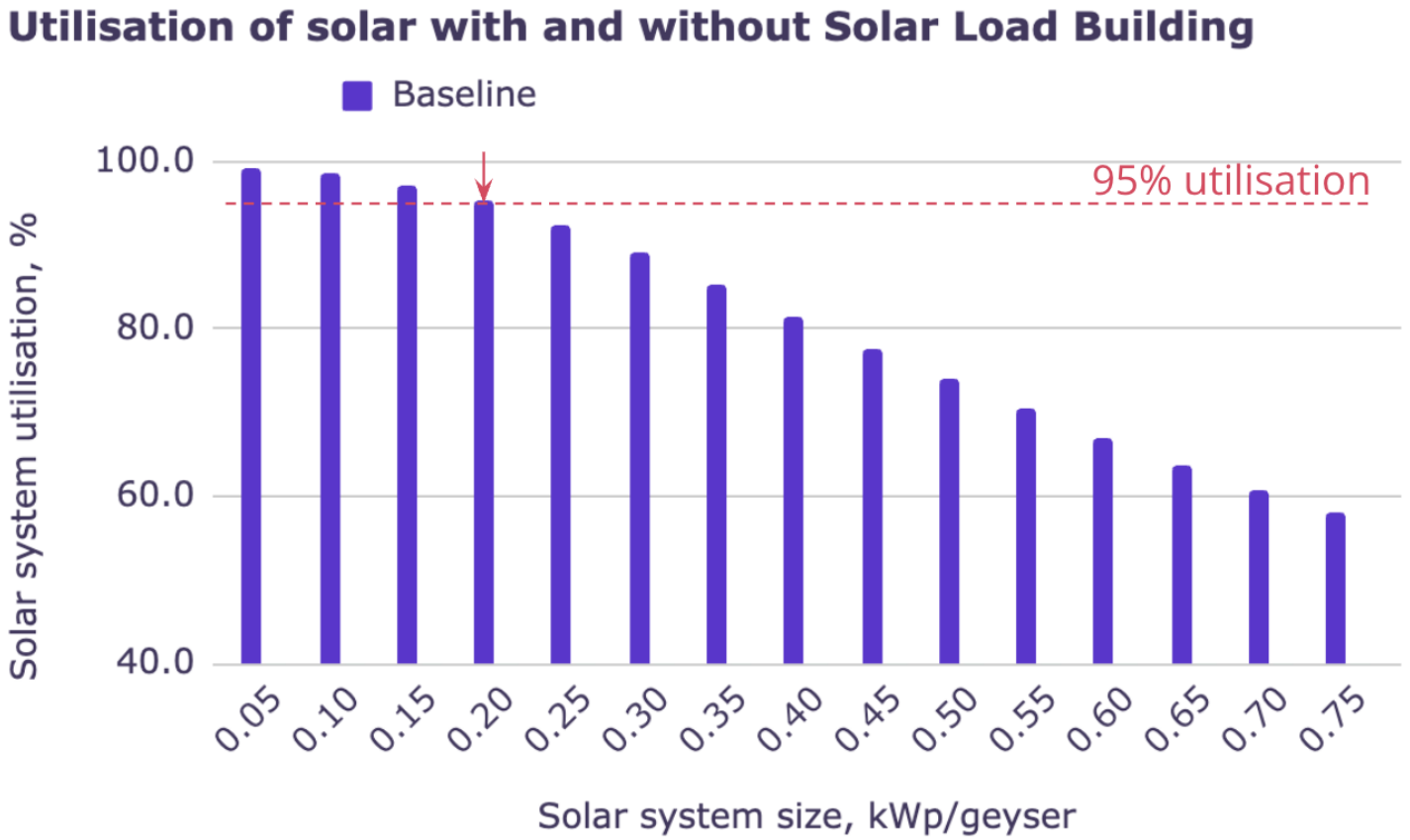


Solar Load Building can enable solar plants twice as large, with the same utilisation rate



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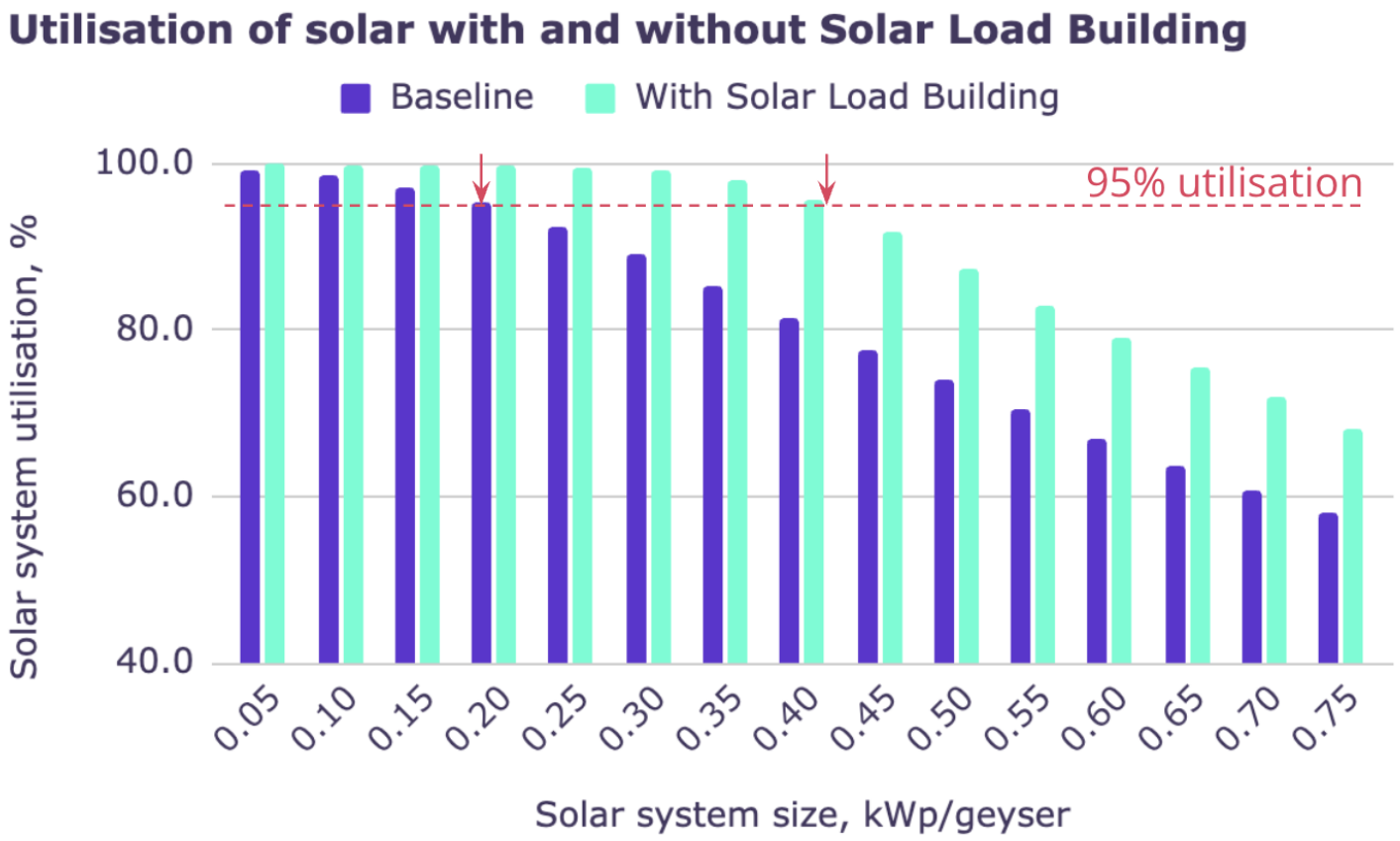

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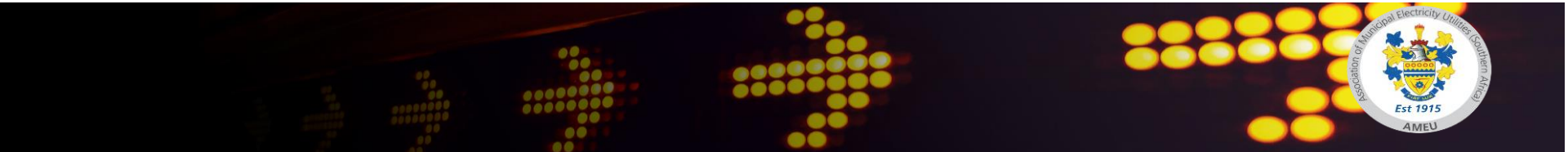
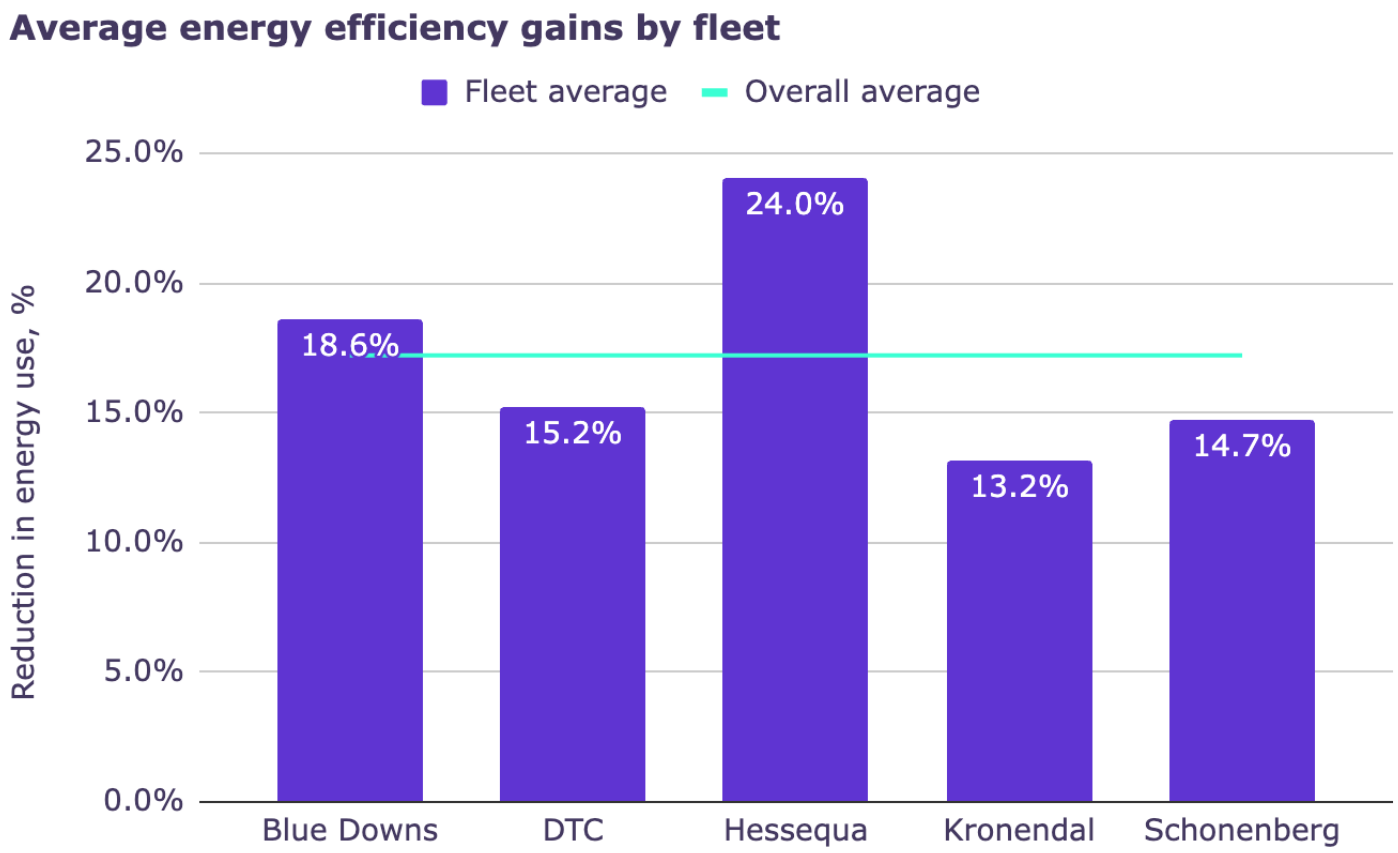
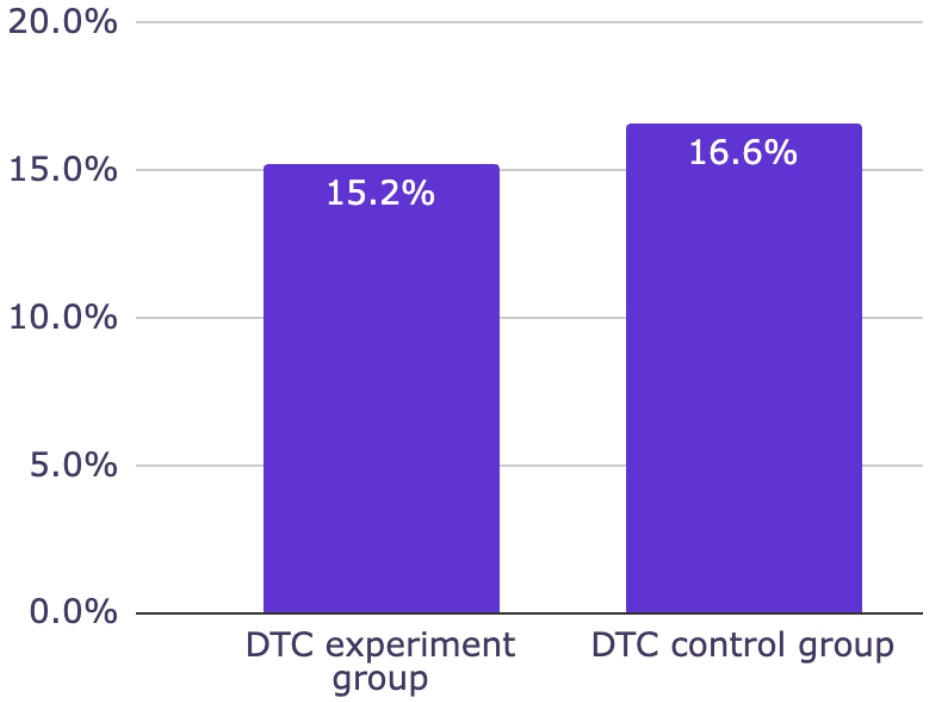


Despite load management services running, geysers conservatively used an average of 18% less energy



The efficiency cost of load management in Cape Town was about R10/geyser/month

Energy efficiency gains in Cape Town with and without load management services



DTC control group:

- Acquired through the **same channel** as the Cape Town DTC experiment group
- BUT only efficiency services were run, with **no load management services**.
- **Saved 0.1kWh/geyser/day more**, worth **R10/month** in Cape Town.

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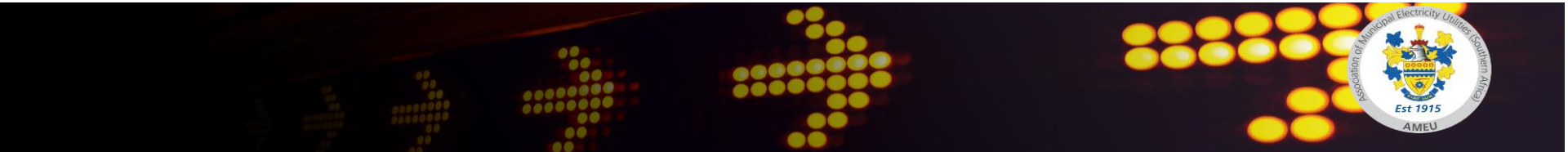

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Confronting South Africa's Electricity Crisis in the context of a 'Balanced Just Energy Transition' (BJET) and the need for a reliable and resilient national electricity grid

Thank you!

Jon Kornik

jon@plentify.co.za

060 876 8308

Association of Municipal Electricity Utilities (Southern Africa) Est 1915 AMEU

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