



CITY OF CAPE TOWN  
ISIXEKO SASEKAPA  
STAD KAAPSTAD



# STATE OF ENERGY AND CARBON 2025

Supplemental report: A baseline assessment of Cape Town's energy system through the lens of the 2050 Energy Strategy

Making progress possible. Together.



# Acknowledgements

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# Foreword by the Executive Mayor

One of the most compelling things about municipal government is scale. Cities organically grow very large systems of infrastructure, and in the developing South, they are getting bigger fast. The State of Energy and Carbon report focuses on Cape Town's energy system at a detailed level, linking it to an overview of carbon accounting of greenhouse gases.

Carbon accounting touches on many of the other fascinating systems in the city, including water, wastewater, solid waste, green spaces, agriculture and even air conditioners and transformer switchgear. This systems view, with energy in the foreground, provides an important planning resource for illustrating the links and trade-offs between systems in the city metabolism.



Within the energy system, the electricity supply industry has gone through tumultuous upheavals since the last Cape Town State of Energy and Carbon (SOEC) report in 2021. The severe load-shedding of 2022 and 2023 has altered the landscape of the sector irrevocably and has thrust many new challenges and changes upon the City's electricity utility. The 2050 Energy Strategy, which we adopted in 2023, captures our strategic objectives for the coming decades, and the SOEC 2025 report now assesses the data on the state of play as the strategy rolls out.

The SOEC report matters because Cape Town's electricity utility is facing profound financial, operational, and structural changes that demand a detailed and credible understanding of the city's energy system.

The State of Energy section of the report provides this evidence base. It analyses how declining electricity sales, efficiency gains and small-scale embedded generation (SSEG) uptake are reshaping a capital-intensive wires business, weakening traditional cost recovery, complicating cross-subsidy models, and accelerating the need to adapt to new customers, new services such as wheeling, and diversified supply options, including an imminent wholesale market for electricity.

The State of Carbon section, in turn, applies a consistent, cross-sectoral carbon accounting framework to inform our transition to decentralised, carbon-neutral energy. To this end, it tracks our progress on mitigating emissions within Cape Town's broader energy, infrastructure, and natural systems.

Together, these perspectives support sound decisions on utility reform, climate mitigation and investment, and demonstrate the City's commitment to transparent, high-quality reporting.

**Geordin Hill-Lewis**

*Executive Mayor, City of Cape Town*

# Executive Summary

Cities are energy-intensive engines of modern economies. Globally, cities account for 78% of energy use and more than 60% of greenhouse gas (GHG) emissions (UN, 2020). Cape Town is no exception: The city's energy system underpins its economic activity, mobility, and quality of life, while also exposing residents and businesses to affordability challenges, reliability risks, and carbon emissions.

In 2023, the City of Cape Town (hereafter 'the City') approved its [2050 Energy Strategy](#) (City of Cape Town, 2023d), which sets out a bold vision of "a resilient energy system where all residents and businesses have access to reliable, affordable, and carbon-neutral energy". To deliver on this vision, we need to track the rapidly changing energy landscape and assessing whether trends are moving towards or away from the Energy Strategy's vision.

The 2025 SOEC report presents a data-rich overview of Cape Town's energy supply and demand as well as the city's GHG emissions, focusing on the period 2014–2023. Drawing on the best available data, analysis was undertaken at both a macro and detailed level to promote a systems understanding and offer insight into progress against strategic goals. Sector-specific supply and demand trends for electricity, fuels and GHG emissions are documented in detail in the **2025 SOEC main report**.

This supplemental report synthesises this material into key system trends (**section 2**) as well as an energy security analysis (**section 3**). This provides a thematic and contextual framework that supports an informed assessment of energy security (**section 3.5**) and the key SOEC takeaways to feed into the Energy Strategy (**section 4**). It is hoped that by making the data freely available, both internal and external stakeholders and partners will contribute their own expertise to enrich and expand on the information. The following are the headlines of the key takeaways from the SOEC supplemental report analysis for the period in review (full descriptions in **section 4**):

1. Despite rapid population growth, energy demand is not increasing, but has been increasingly volatile.
2. Petroleum fuels continue to dominate, despite growth in renewables
3. Load-shedding changed the structure of Cape Town's energy system
4. The local liquid fuels supply chain rode out severe supply-and-demand shocks while buffering load-shedding, but affordability remains a concern.
5. Transport dominates the energy mix and fossil fuel dependence but the 'electron economy' electrification challenge is imminent.
6. Electricity consumption patterns are changing unevenly across sectors and incomes.
7. The City's electricity business faces growing financial and system complexity.
8. After 20 years of progress, providing sufficient electrification and subsidised electricity is becoming more challenging.
9. Citywide GHG emissions are declining along the voluntary target line, but remain structurally concentrated, with a major driver being low economic growth.
10. In a global age of data science, access to and the quality of energy and activity data in South Africa is a mixed bag.
11. There are critical knowledge gaps in understanding the persistent drop in per capita demand for all forms of energy.
12. Overall, energy security in Cape Town has declined since 2008, and particularly from 2019 to 2023.
13. The 'end' of load-shedding and rail restoration represent green shoots.

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# A guide to the Cape Town State of Energy and Carbon 2025 supplemental report

The SOEC report provides a data-rich overview of the energy and GHG emissions systems in Cape Town from the perspective of a metropolitan municipality, drawing on a wide range of national, provincial, industry and municipal sources. The City has produced a SOEC report every five years since 2003.

This is a **supplemental report** to the 2025 SOEC main report. It focuses specifically on using the data collected and analysed to assess baseline progress towards the vision of the 2050 Energy Strategy, which the City adopted in 2023. The supplemental report is one of a suite of products that can be accessed at the links below:

The 2025 SOEC report is available in the City's online document centre:

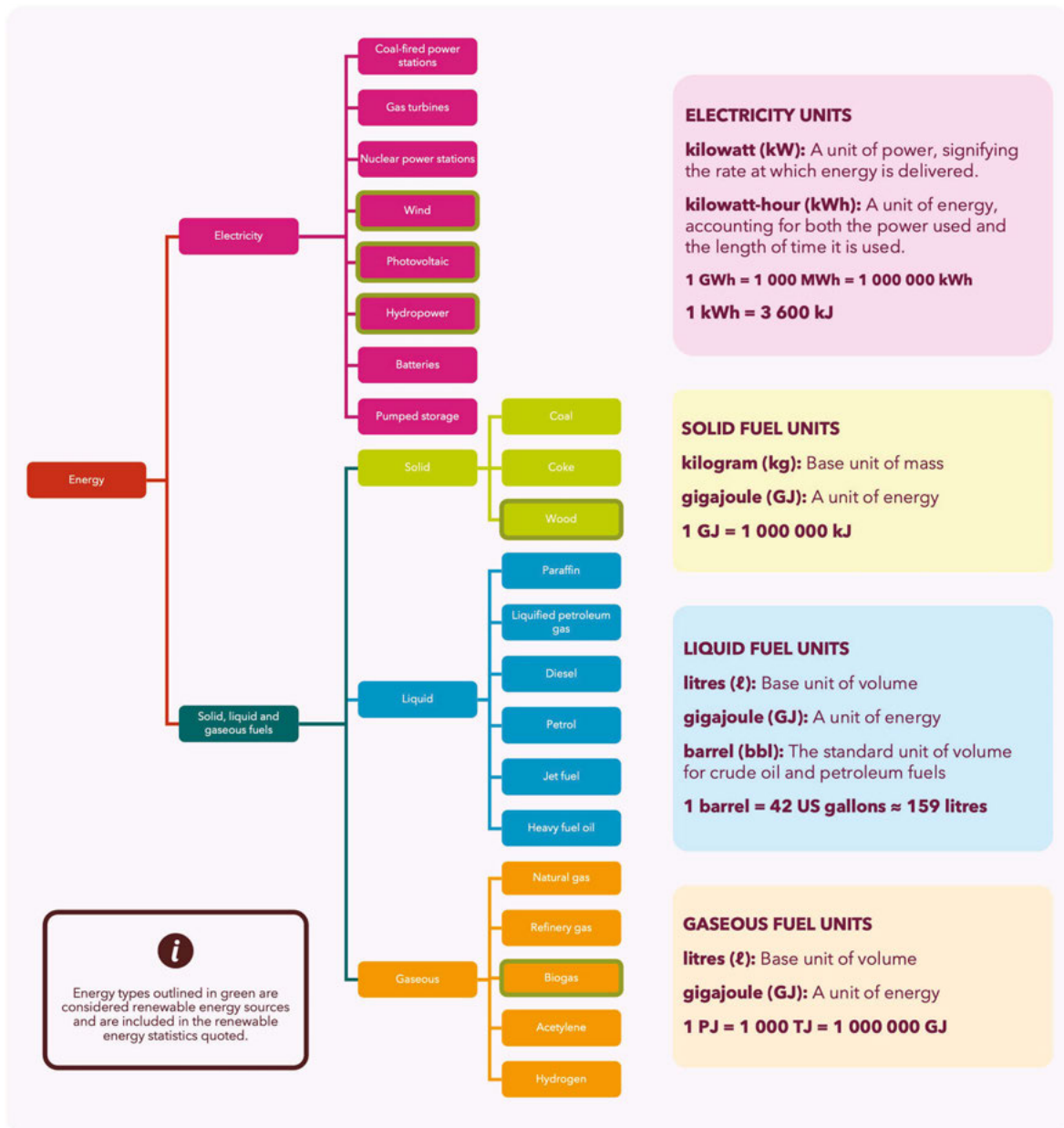
[www.capetown.gov.za/SOEC](http://www.capetown.gov.za/SOEC)

The electronic data accompanying this report along with detailed methodology notes are available on the City's Open Data Portal:

<https://odp-cctegjs.opendata.arcgis.com/>

The data reporting period is 2014–2023, but analyses also draw on older data where relevant. There is a particular emphasis on the period 2019–2023, which was marked by significant disruption, including the Covid-19 pandemic and an escalation of national load-shedding. Since classifications and units for energy can vary significantly, those used in this publication are outlined in Figure 1.

**Figure 1: Energy classifications and units across Cape Town's energy sectors**



### Box 1: A note on Eskom data and the City's reporting

Electricity data from both the City and Eskom Distribution is required and are included to produce a complete SOEC report. While the City supplies around 70% of customers and 78% of total electricity in Cape Town, Eskom supplies the remainder. While the City has full access to its own electricity sales data, updated Eskom customer sales data within Cape Town's boundaries was not available for this report. Therefore, older Eskom data (2017–2020) had to be scaled to estimate current consumption – a limitation flagged in the data quality assessment. Importantly, this challenge applies only to **Eskom sales data within Cape Town's municipal boundaries**. Other Eskom datasets, including those on national generation and plant performance, are publicly available and unaffected. This highlights the need for improved, standardised data-sharing between government entities to support accurate municipal and national energy and climate reporting.



# 1 Introduction

The City's vision of becoming a city of hope for all, as set out in the Integrated Development Plan (2022–2027), depends in part on how effectively energy and other resources are managed. Reliable, affordable and sustainable energy underpins inclusive economic growth and quality of life. Yet energy use also generates GHG emissions and waste, which could undermine long-term progress if not managed properly.

In 2023, the City approved its long-term 2050 Energy Strategy, Our Shared Energy Future, which defines energy security where all residents and businesses have access to reliable, affordable and carbon-neutral energy". To achieve this vision, the City needs to

continuously track changes in the energy system, understand emerging risks and opportunities, and assess whether Cape Town is moving towards or away from the Energy Strategy's desired outcomes.

The SOEC report applies the four principles of the Energy Strategy – reliability, affordability, carbon neutrality and resilience – as a lens through which energy system performance is assessed. These principles represent the long-term outcomes that the City aims to achieve, and provide a coherent framework for understanding the condition of the energy system today, and the pressures and patterns shaping its evolution.

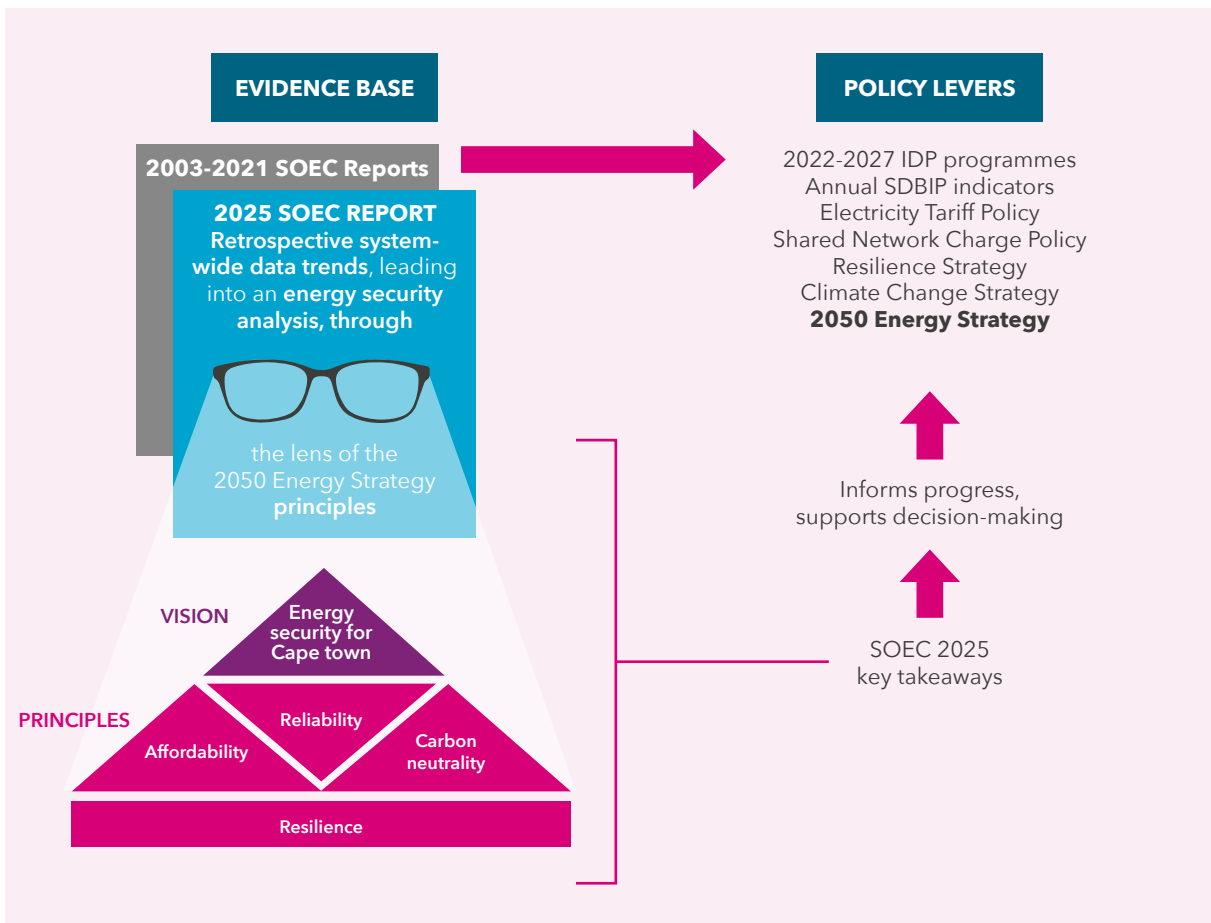
The SOEC report is retrospective and data-based. Its purpose is not to forecast or recommend policy, but rather to present as large a sample of evidence, as could be accessed, highlighting patterns and offering interpretations where this was possible within the time and scope of the analysis. The City’s unique access to the greater part of the local grid and its customers, as well as its mandate to report more broadly, allowed a fairly complete, integrated view of how the energy system is changing.

Sector-specific supply and demand trends for electricity, fuels and GHG emissions are documented in detail in the 2025 SOEC main report. This supplemental report synthesises that information

into key system trends (section 2) and an energy security analysis (section 3) to provide a thematic and contextual framework that supports an informed assessment of energy security (section 3.5) and the key SOEC takeaways to feed into the Energy Strategy (section 4). Ultimately, these insights serve as a basis for assessing Cape Town’s progress towards its 2050 energy vision.

By distilling the key system-level trends from the full SOEC report and interpreting them directly through the lens of the Energy Strategy, this supplemental report provides a bridge between the data-rich main report and the City’s strategic choices.

**Figure 2: SOEC structure, with the Energy Strategy lens, and linkage to policy levels**





## 2 Cape Town key energy system trends

The key system trends reflect observable patterns in the collected data, and consideration of the dynamics that materially shape system-wide outcomes. However, rigorous quantitative attribution of outcomes to factors such as technology, national policy, global markets and behavioural responses was beyond the scope of the analysis.

Importantly, Cape Town's energy trends must be understood against a low-growth, low-income backdrop: Weak expansion suppresses demand and increases price sensitivity, while also constraining system investment and pushing resilience into privately financed, often fuel-intensive, coping pathways. Therefore, signs of stable or declining consumption and GHG emissions should not, on their own, be seen as evidence of a successful energy transition.

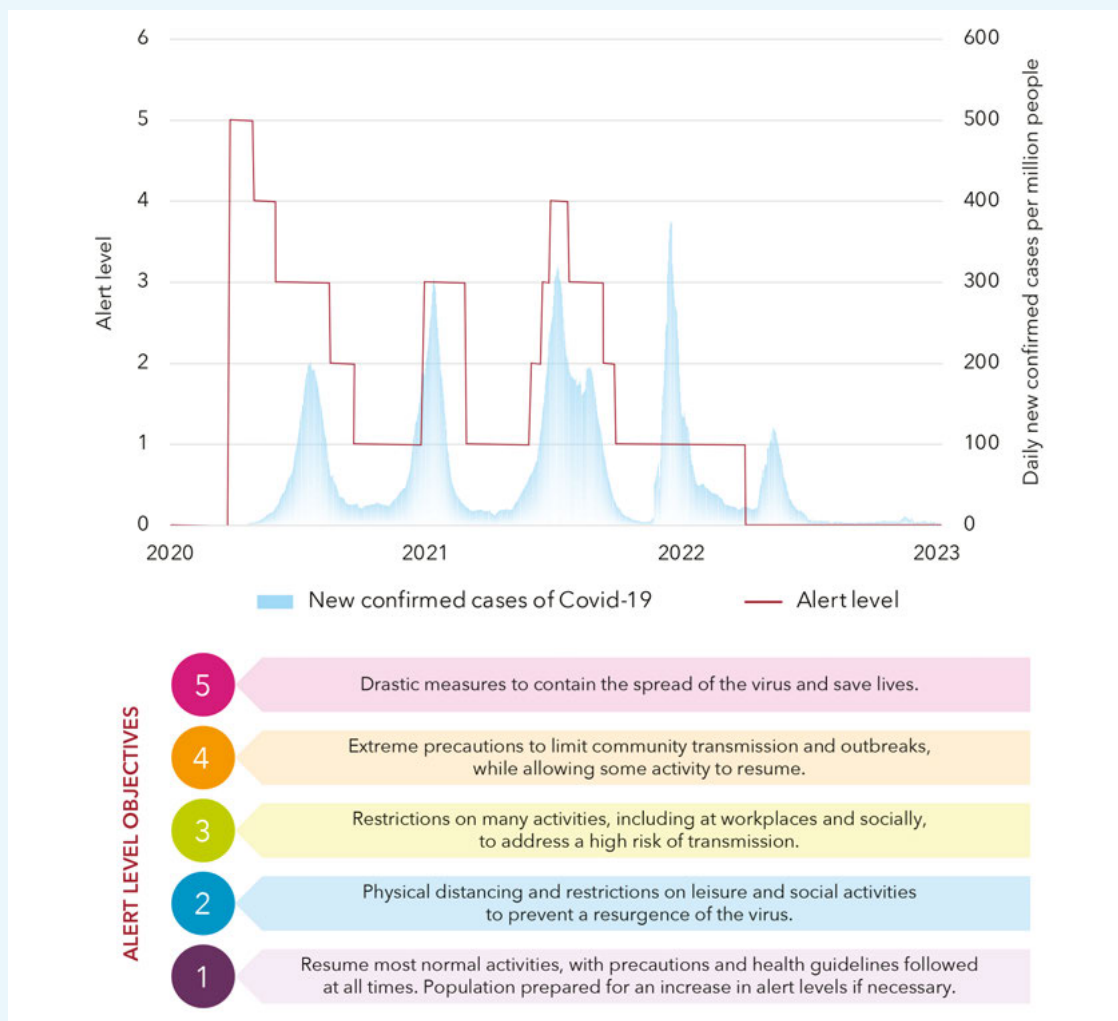
**Box 2: System shocks and stressors that have reshaped the system (2019-2023)**

The period 2019-2023 was a turbulent time for South Africa, including both the Covid-19 pandemic (2020-2022) and the load-shedding crisis (mainly 2022-2023). These two phenomena significantly affected the national state of energy and carbon, including reductions in economic activity, with subsequent reductions in energy use, while accelerating the adoption of new energy technologies. For the City and other municipalities, the two events increased the vulnerability of service delivery systems, and particularly electricity supply. Where the impacts are evident in the data, the report highlights them as anomalies to the overall trend. Additionally, Cape Town saw the extended shutdown of the Astron refinery and experienced a range of system stressors.

**SHOCK: COVID-19 PANDEMIC**

The Covid-19 pandemic (2020-2022) temporarily suppressed economic activity and mobility, reducing both electricity demand and transport fuel use, while accelerating behavioural shifts that persisted beyond the acute crisis.

**Figure 3: National state-of-disaster alert levels over time, overlaid on daily new confirmed Covid-19 cases per million persons**

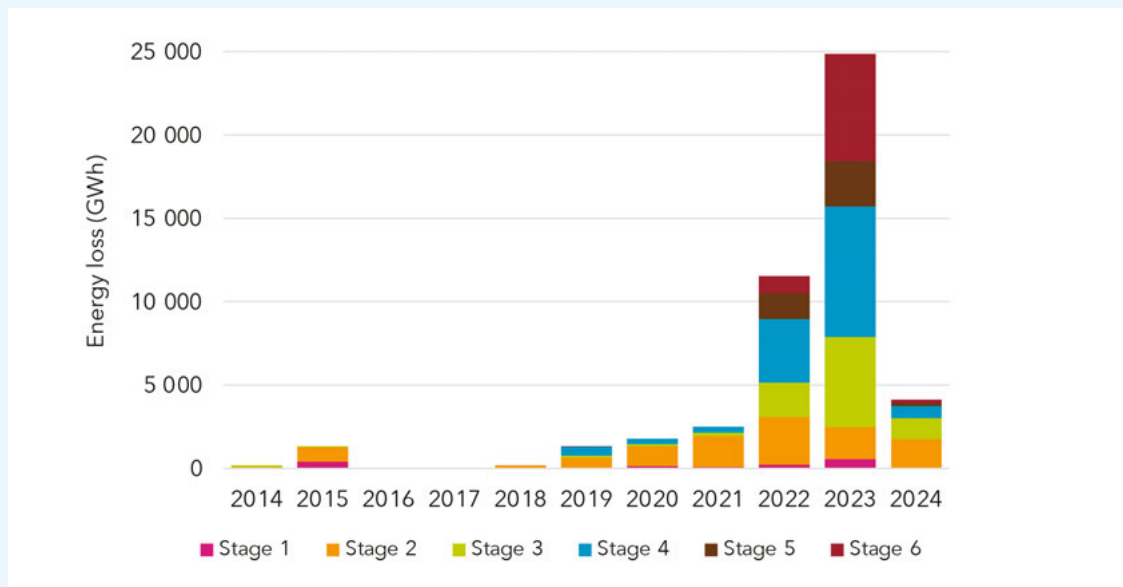


Sources: South African Government; World Health Organisation (2021)

### SHOCK: LOAD-SHEDDING AND THE NATIONAL ENERGY CRISIS

Load-shedding took place on 157 days in 2022, and 290 days in 2023. This resulted in an estimated unmet energy demand of 11,5 TWh and 24,9 TWh respectively, equivalent to 5% and 10% of 2018 annual national demand (CSIR, 2024), and reduced an already low gross domestic product (GDP) by 0,5-2%, with some estimates twice that (SARB, 2023; OECD, 2025). Load-shedding also created an environment and opportunity for vandalism and theft to escalate beyond usual levels as a result of the regular and publicly advertised outage periods, further compounding operational and reliability challenges.

Figure 4: National load-shedding by stage over time



Source: (CSIR, 2024)

Note: While the 2024 data covers the year up until June only, minimal load-shedding was experienced after April 2024

### SHOCK: ASTRON REFINERY SHUTDOWN

In parallel, Cape Town’s energy system suffered a fuel supply disruption that revealed its heavy reliance on fuel logistics for resilience. An incident at the Astron refinery in February 2020 caused the plant to shut down until March 2023, forcing the city to rely on petroleum fuels imported solely through the Burgan Cape (white products such as petrol and diesel) and Sunrise terminals (LPG) just as the electricity crisis was worsening. Although fuel storage capacity and import terminal capacity prevented shortages, the episode exposed a deeper vulnerability: When the system leans more heavily on especially diesel for resilience, critical energy risks expand from grid supply reliability to include supply chain reliability, port performance, storage capacity, and oil price volatility.

### SYSTEM STRESSORS: PRICE VOLATILITY, RAPID POPULATION GROWTH, INFORMALITY

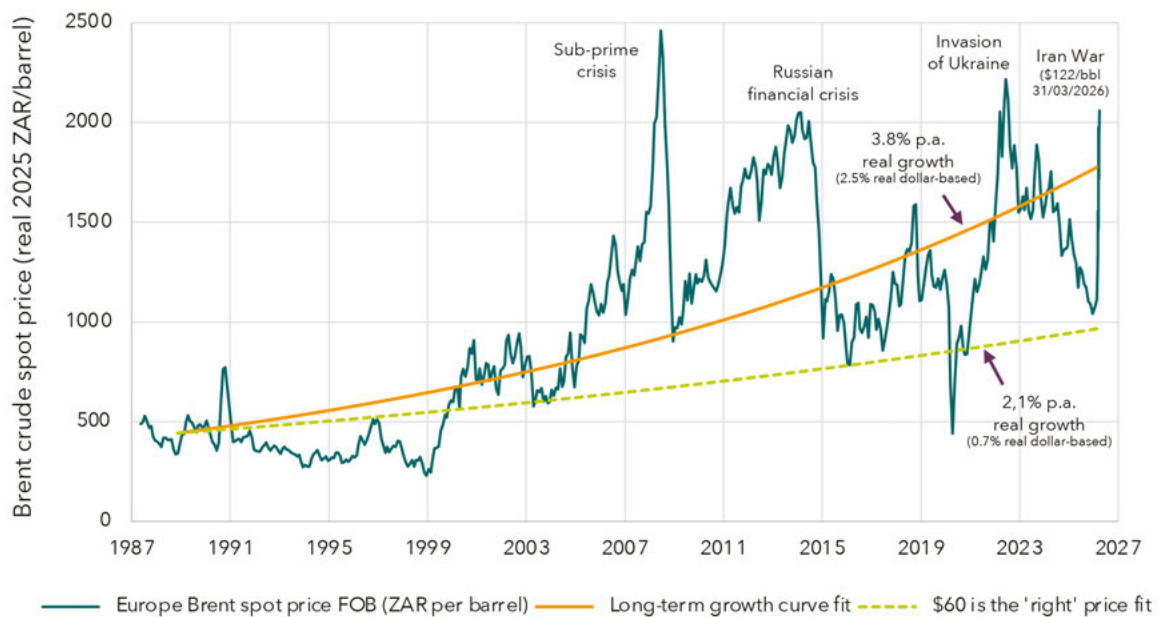
Across both electricity and fuels, escalating price pressures acted as a cross-cutting stressor, shaping how households, businesses and public services experienced and managed the shocks described above. Structural inequality and rapid household growth, especially in the informal sector, further affected system outcomes by determining who could adapt quickly and who remained constrained by unaffordability and a lack of access.

## 2.1 Turbulence and disruption has profoundly affected energy demand patterns

Energy is a key input to the economy, and value creation and energy consumption together reveal a lot about the wellbeing of an economy and a society. The past 18 years have seen a series of global economic

disruptions that completely changed the stability of energy prices enjoyed in the late 1980s and 1990s, as shown below based on the long-term history of the oil price (inflation-adjusted).

**Figure 5: Oil price in real 2025 rands, accounting for exchange rate, 1987-2025**

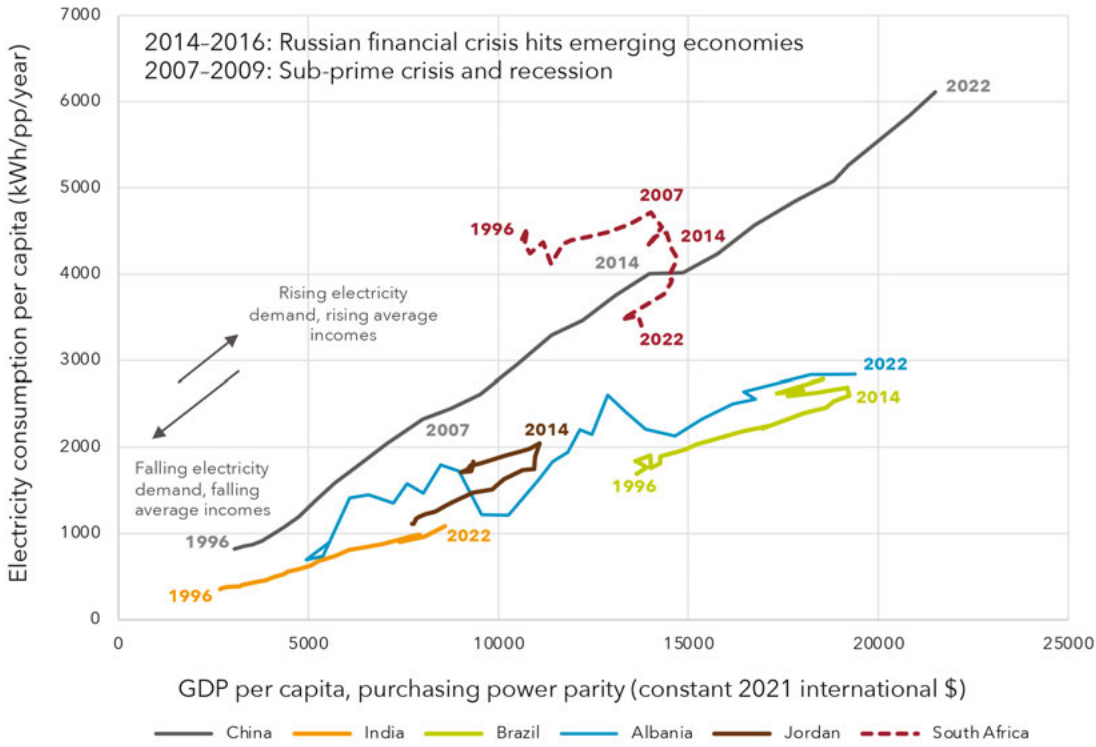


Sources: Oil price from U.S. Energy Information Administration (2026); ZAR/\$ exchange rate from Federal Reserve Bank of St. Louis (2026); CPI from Stats SA (2025b)

Each one of the giant price spikes had an almost immediate effect on the world's poor through direct cost escalations, and also triggered or was triggered by cascading economic impacts. As shown below, South Africa was particularly hard hit compared with

other emerging economies. The country found itself in a situation of sustained contraction of average incomes and electricity demand, with the two feeding into each other due to constrained supply.

**Figure 6: The relationship between per capita electricity consumption and per capita GDP for South Africa and five other emerging economies (1996-2022)**

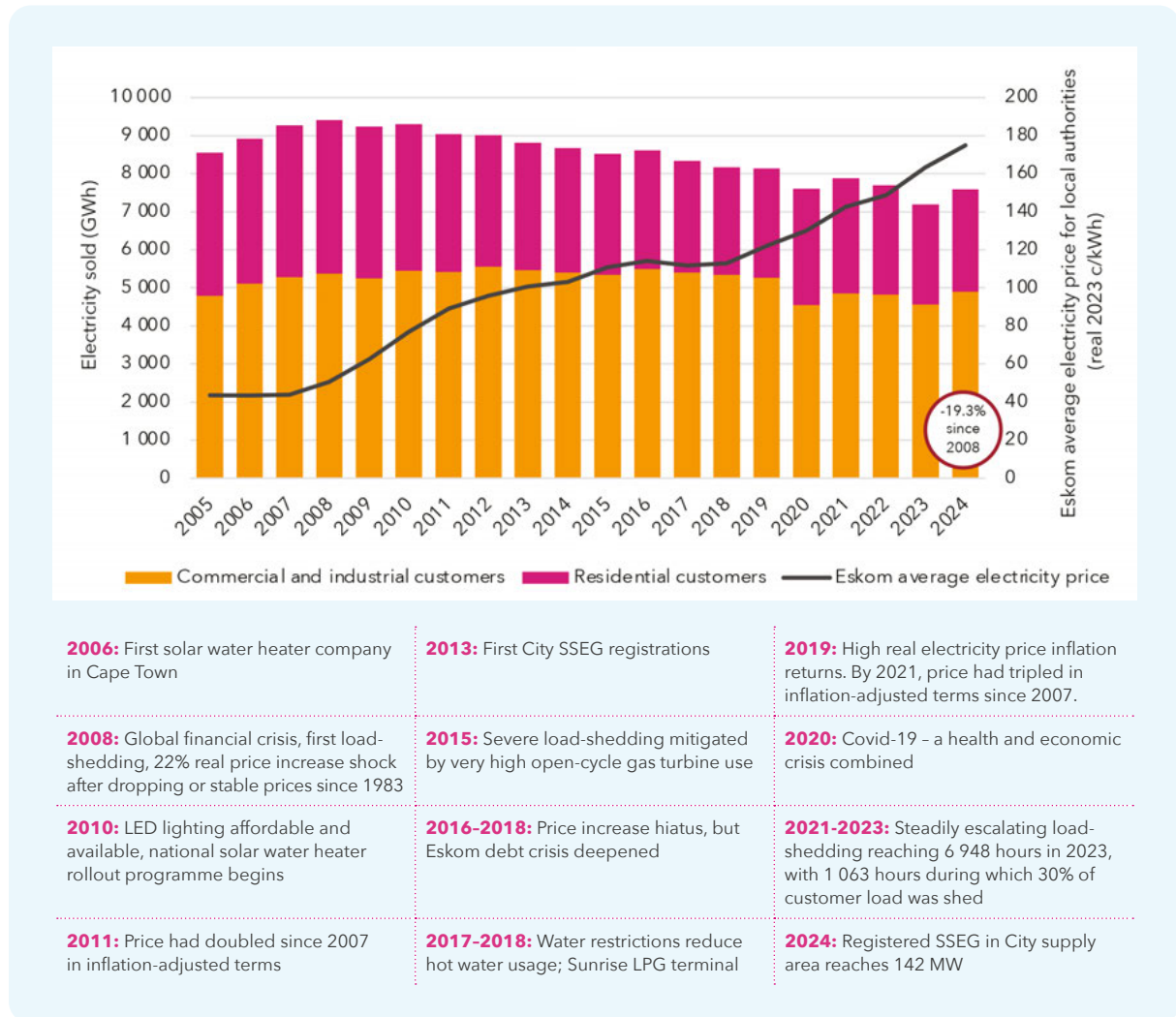


Source: World Bank World Development Indicators

For the City electricity supply area, a consistent drop in electricity sales has been evident since 2008. As seen in the figure below, global economic crises have combined with several other, interlinked system

disruptions, including energy efficiency, SSEG, long-term real electricity price escalations, fuel-switching away from grid electricity, and load-shedding.

**Figure 7: Grid electricity sales for City supply area vs Eskom bulk electricity price, against a backdrop of disruption**



Sources: City of Cape Town (2025c); Eskom (2025a)

Note: Metered customer sales. Residential consumption excludes estates on commercial tariffs reselling to households.

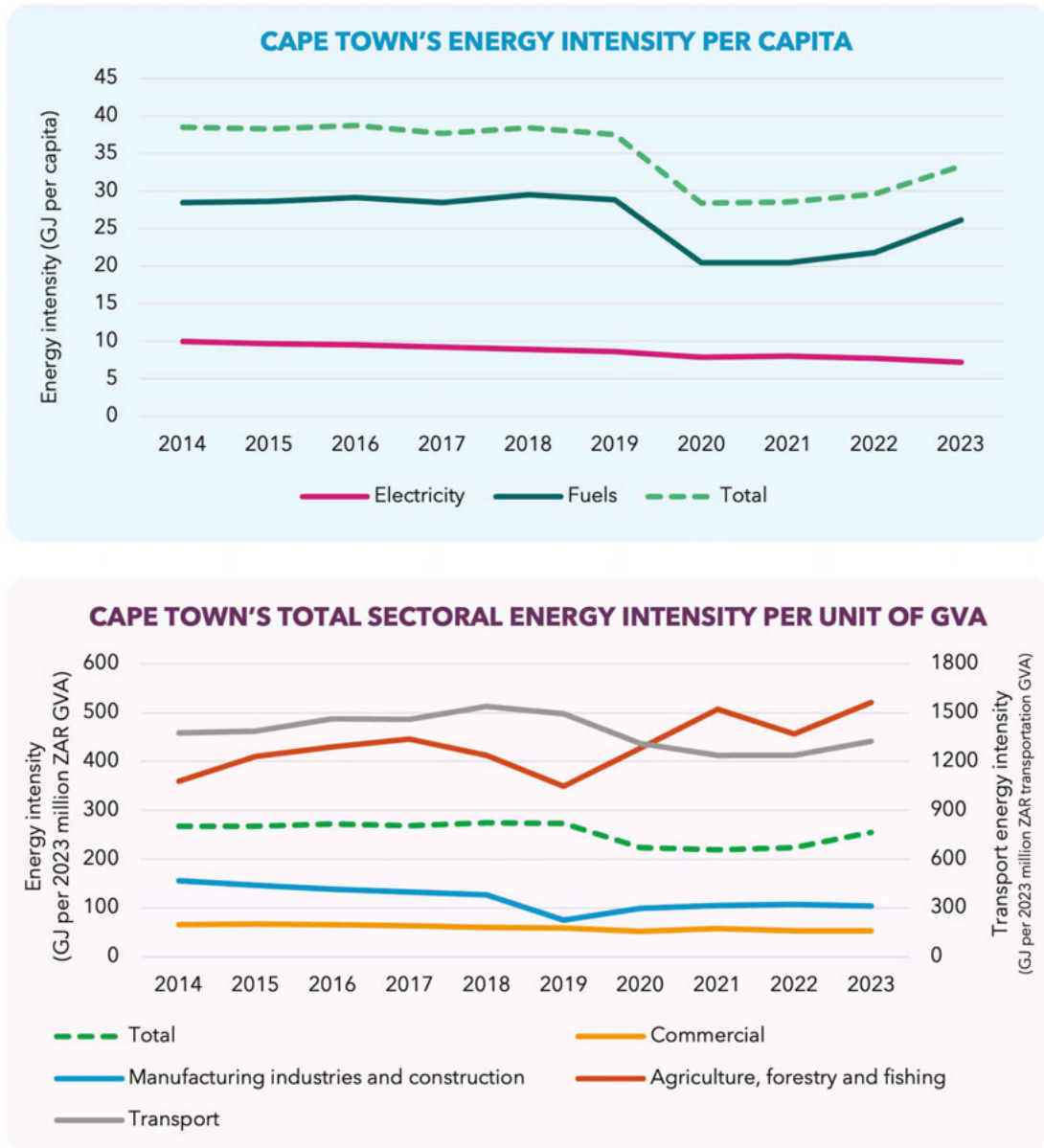
These disruptions and their consequences are touched on from different angles in the sections below, with economic aspects specifically addressed in sections 3.2 and 3.3. The following is a summary of the data highlights and context:

## Energy

- Total energy consumption per capita declined from around 37 GJ per capita in 2014 to 33 GJ per capita in 2023 (see Figure 8 below), heavily affected by the impact of Covid-19 on all forms of transport.

- Prior to the pandemic, transport services' increasing energy intensity per unit of gross value added (GVA) tended to cancel out the dropping energy intensity of commerce and manufacturing (Figure 8). However, the overall energy intensity of the economy appears to have dropped over the reporting period. See section 3.2 for supporting data on the shift of the local economy to the tertiary sector.

**Figure 8: Overall energy intensity trends**



Sources: ACSA (2025); City of Cape Town (2025c); DEE (2023); Eskom (2025a); LEAP model; DFFE (n.d); Stats SA (2025b); Transnet (2025); S&P Global (2025)

## Electricity

- Grid electricity consumption has declined by 14% over the decade (from 11 426 GWh in 2014 to 9 794 GWh in 2023, estimated for both City and Eskom supply areas). Electricity sales in City supply areas reflect this general trend, as seen in Figure 7.



For further insights, consult section 2.4.1 in the 2025 SOEC main report

- During 2020-2021, residential demand temporarily increased as a result of the Covid-19 lockdown/work-from-home arrangements for all rate categories. Overall, however, average customer consumption for all rate categories dropped from 2018/19 to 2023/24. The drivers of this shift are interrogated in more detail in section 2.2 below.
- Unsurprisingly, given dropping sales and an increasing population, electricity intensity per capita has declined steadily since 2014, as shown in Figure 8.

- Electricity demand in the commercial and manufacturing sectors declined sharply after 2019 and remains below 2014 levels, as reflected in Figure 7, while electricity intensity per unit GVA has dropped markedly (see section 3.3 for structural changes to the economy). In the City supply area, the number of commercial customers has dropped.

## Fuels

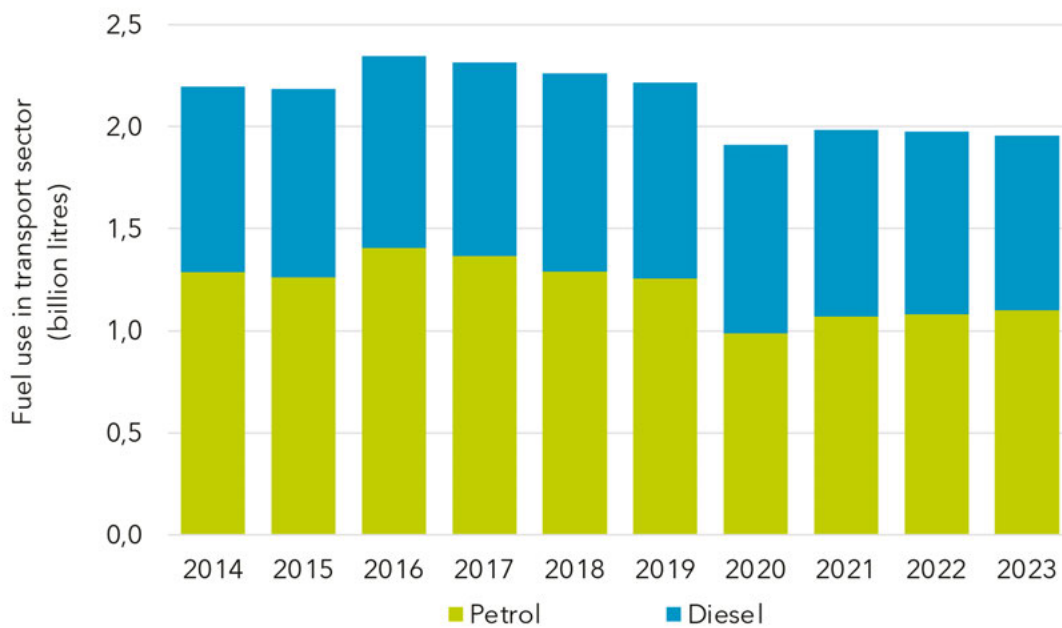
- Liquid fuel demand shows a much sharper Covid-era contraction than electricity, followed by an apparently faster recovery. In 2023, however, load-shedding was suppressing electricity use, while driving higher diesel use for electricity backup.

- Nevertheless, transport fuel use appears to have dropped, notwithstanding the challenges in allocating diesel in the 2023 data, given extreme load-shedding. As touched on in section 3.2, the data shows that this can be attributed to improved efficiency and potentially reduced travel.
- Aviation fuel experienced a 60% decline during Covid 19, with recovery closely linked to recovering passenger volumes. The marine bunkering fuel oil trade was resurgent in the reporting period. Recently, it was more likely suppressed by the Astron refinery shutdown than by Covid, but has since rebounded.



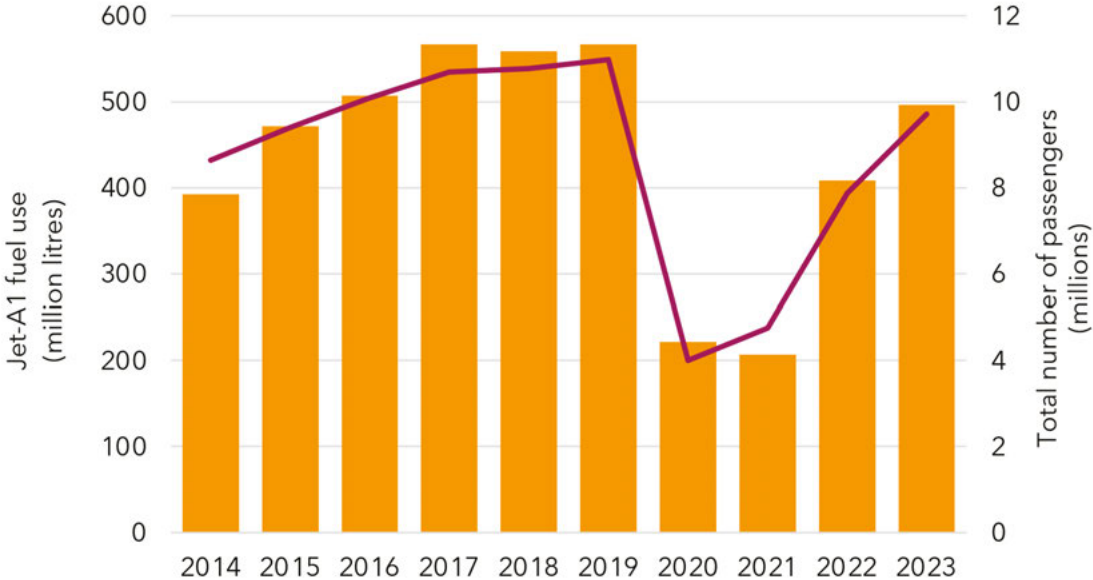
For further insights, consult section 2.5.1 in the 2025 SOEC main report

**Figure 9: Trends for petrol and diesel fuel use in road transport**



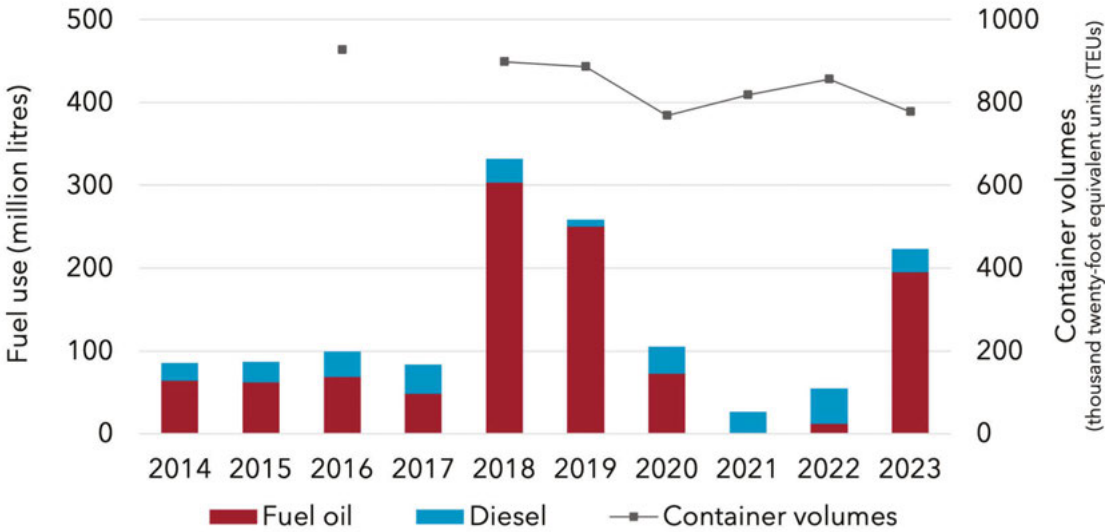
Sources:  
 Diesel 2019 onwards: Calculated from DMRE; Eskom; City of Cape Town (2025c); DFFE (n.d)  
 Diesel pre-2019: Scaled from 2019 based on transport sector GVA  
 Transport diesel includes residential diesel demand for generators, which could not be accurately quantified.  
 Petrol all years: DMRE; City of Cape Town (petrol sales not for City operations)

**Figure 10: Aviation fuel use (scope 1 and 3) and air travel passenger count**



Source: ACSA (2025)

**Figure 11: Waterborne navigation fuel use**



Sources: Fuel oil and diesel local use: DFFE (n.d)  
 Fuel oil (bunkering): Transnet

Disruption has become the norm for the energy industry and has particularly reduced per capita consumption of electricity and petroleum fuels for the residential sector (electricity) and the transport sector (fuels). By contrast, diesel for power backup spiked during load-shedding, while aviation and marine fuels are linked to more global drivers. Energy trends are increasingly shaped by efficiency, affordability, behavioural change, infrastructure constraints and sector specific dynamics rather than growing uniformly with the population and the economy, as was the case prior to 2008.

## 2.2 Key system trend 2:

**Decentralised energy responses are reshaping how energy services are delivered, but this shift is occurring unevenly across the system**

Decentralised energy responses are increasingly shaping how Cape Town's electricity services are delivered, with the rapid uptake of SSEG across households, businesses and City facilities. While the national grid remains the primary source of supply, rising installation of rooftop solar and changes in consumption behaviour signal a gradual, albeit uneven, transition towards more distributed and self-generated electricity in Cape Town alongside the traditional grid-based model. Figure 12 below provides an overview of the city's electricity system. Figures 13 and 14 explore the growth of SSEG and shifts in customer behaviour. The following is a summary of the data highlights and context:



**For further insights, consult section 2.4.1 in the 2025 SOEC main report**

- Rooftop solar photovoltaic (PV) installations (over 99% of SSEG) have expanded exponentially since 2013. By 2024, registered systems in the City supply area stood at 691 commercial and industrial customers (100 MW), including 100 City buildings (2,6 MW), and more than 5 600 residential customers (42 MW). Geospatial imaging confirms significant additional unregistered capacity. Figure 13 suggests that Cape Town has a disproportionately high share (25%) of residential (<30 kW) SSEG capacity nationally (6% registered with the City, and 19% unregistered or in Eskom areas). However, there are three data sources for the <30 kW group, and given the very high rates of growth at the time, even a few months' difference between them would skew proportions appreciably. Nevertheless, the proportions are broadly supported by an independent analysis of the same data, which estimated Cape Town's share of total residential installations in the five metros at 30% at the end of the first quarter of 2023 (GreenCape, 2025).
- Section 2.1 discusses the impact of disruptions, including SSEG, on declining grid electricity sales. Figure 14 compares residential consumption between 2019 and 2024 at a granular level, using billing data to reduce the confounding effects of Covid and load-shedding. Over this period, the entire distribution of residential consumption shifted lower, indicating that the observed average residential consumption drop is caused by decreases across the whole customer base.
- Households with higher property valuations (>R2 million) showed reduced grid purchases between 2019 and 2024, but slightly increased

total consumption once SSEG is added back. SSEG supplied approximately 8,5% of total electricity use for these households in 2024, with estimated total residential SSEG self-generated increasing twenty-fold from 3 000 MWh to 62 000 MWh between 2019 and 2024.

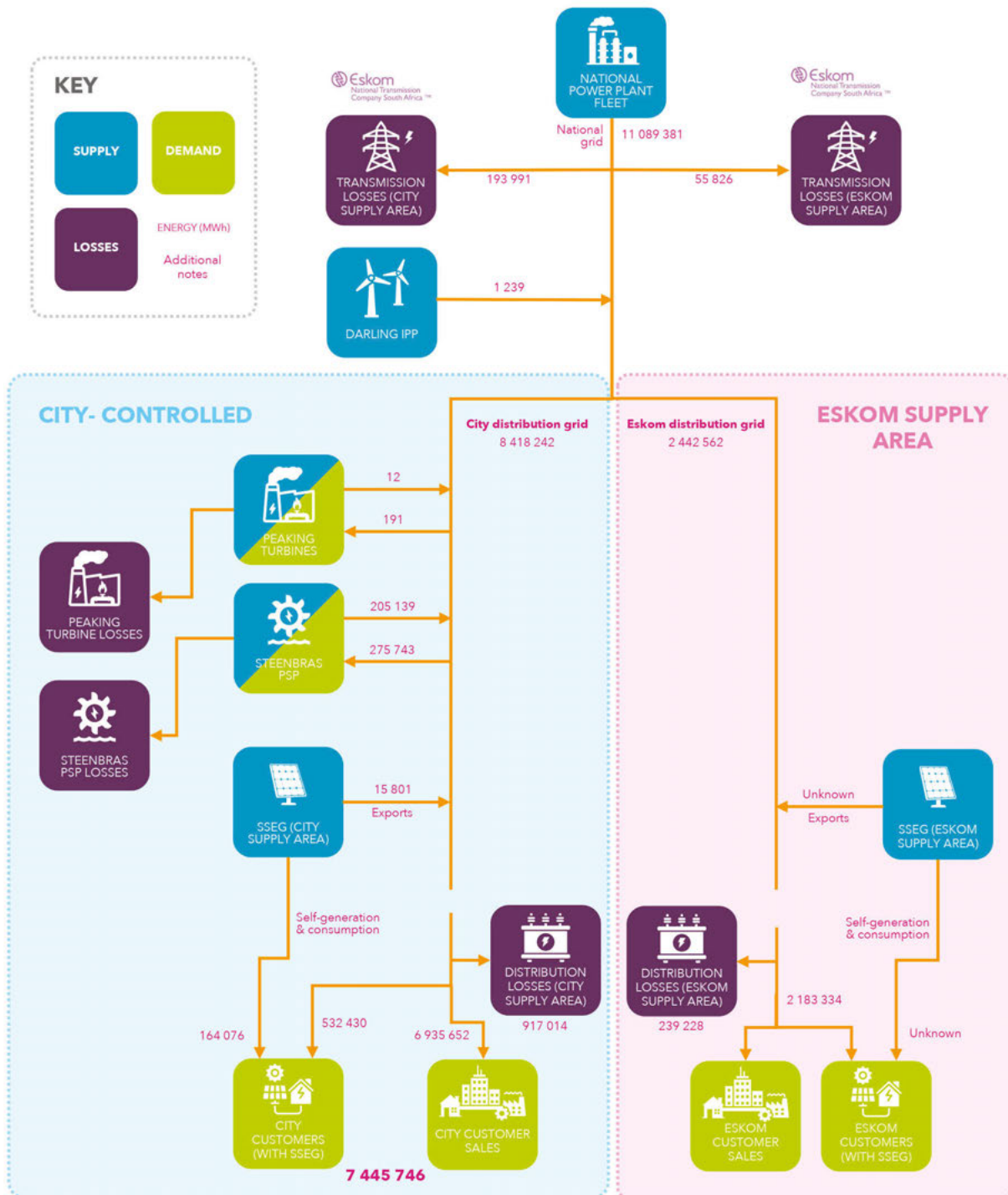
- While LPG data is far less certain, adding estimated additional LPG use over the period suggests a 3–4% higher household energy demand in 2024, which is consistent with a continued rebound in hot-water use after the drought. Figure 14 also compares average customer consumption for 2019 and 2024 in valuation deciles (unpaired), as a proxy for wealth. The results show the drops in consumption of the two poorest deciles to be similar to the two wealthiest deciles (6–11%) on a percentage basis, with little change in middle-income consumption. However, customers without valuations – mostly non-ratepaying low-income households – comprised a third of the sample and showed the largest proportional drop (13%).
- Therefore, the data points to a continued decline in grid electricity sales as a result of affordability

constraints at the lower end of income, and because of substitution with SSEG at the upper end. The 2021 SOEC report (City of Cape Town, 2021a) already suggested that while energy efficiency and behaviour drove rapid reductions in consumption among higher-income groups from 2008 to 2018, total consumption, including SSEG, had rebounded by 2019. This analysis now confirms that residential energy efficiency has indeed slowed down since 2018.

Households and businesses with the resources to invest in SSEG were able to secure viable, reliable, self-generated electricity and reduce their dependence on the grid while those facing affordability barriers were exposed to severe load-shedding in 2022 and 2023. As a result, similar trends in grid consumption mask vastly different lived experiences in terms of energy across Cape Town. These patterns highlight both the growing importance of decentralised generation in improving resilience, and the need for inclusive approaches that ensure that all households can access dependable and affordable energy services.

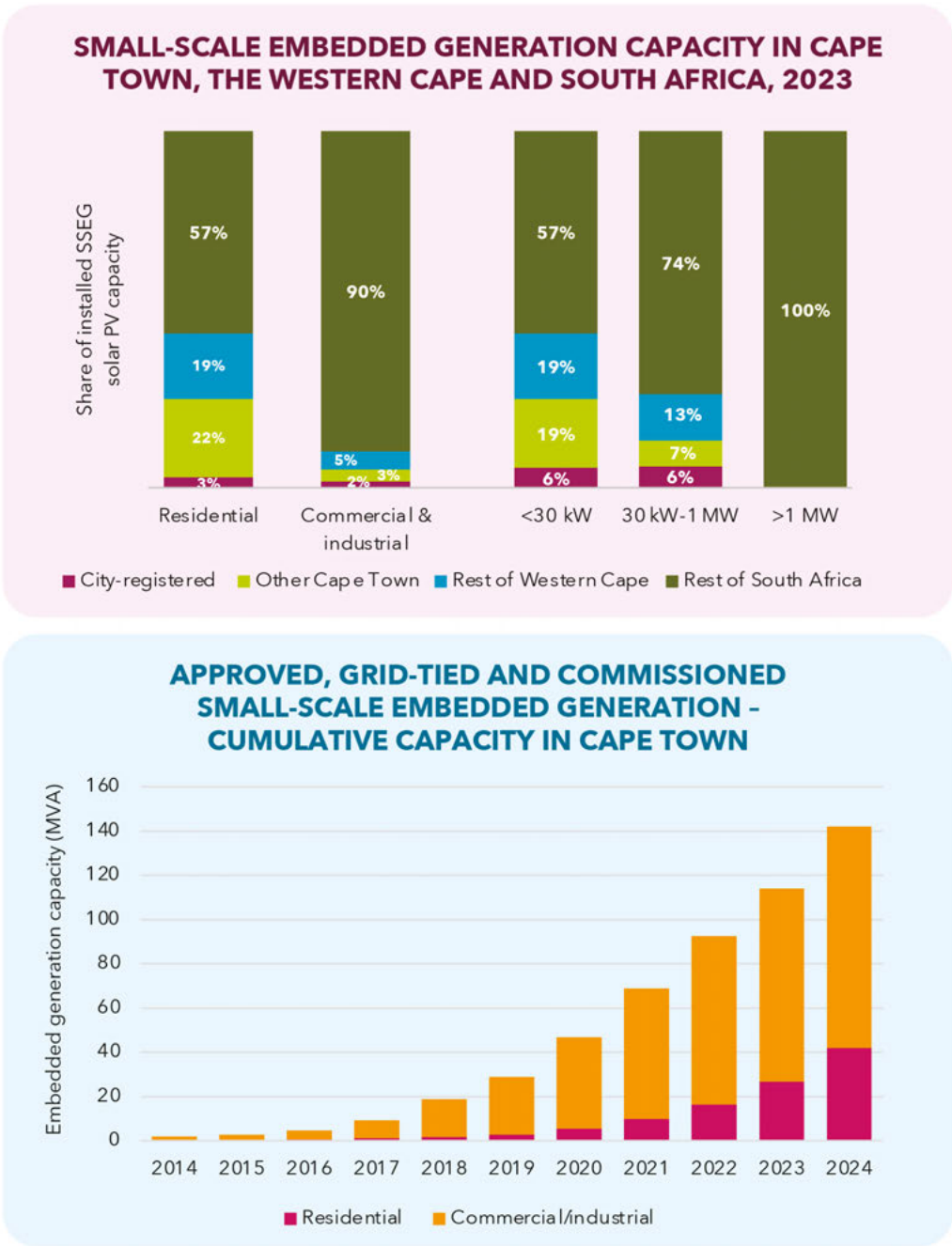


**Figure 12: The electricity supply system from generation to final consumption across City and Eskom networks, 2023**



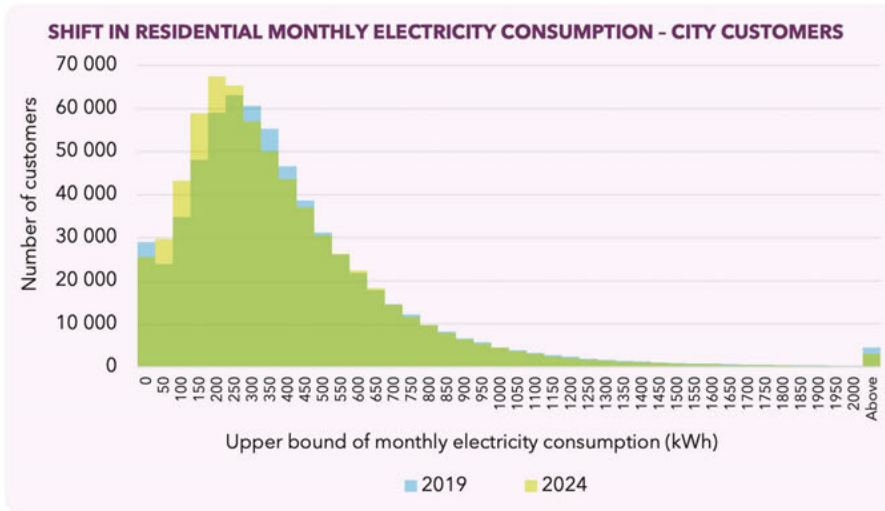
Sources: City of Cape Town (2025c); Eskom (2025a)

**Figure 13: SSEG capacity in Cape Town, the Western Cape and South Africa, 2023**



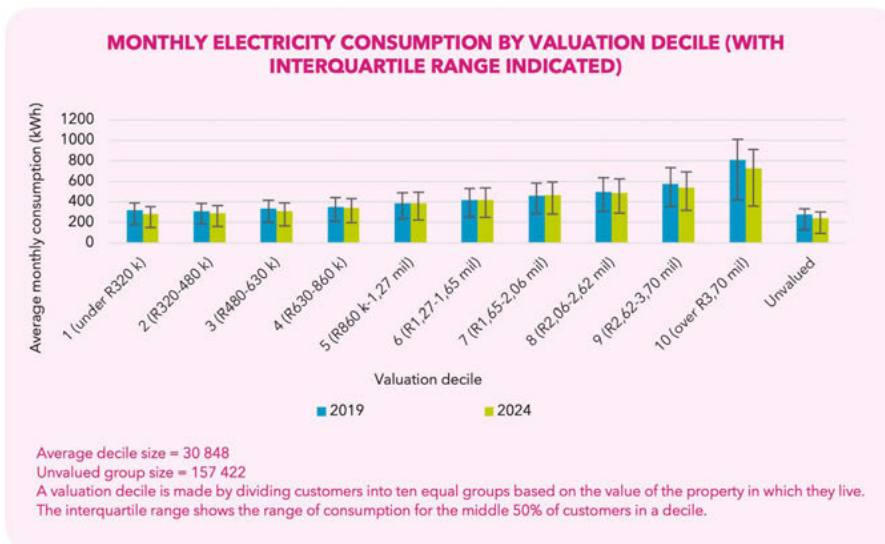
Sources: Eskom (2024a); IPP Office (2023); GeoTerra Image & SAPVIA (2024); City of Cape Town (2025c); WCG (2025a)  
 Note: "Rest of Cape Town" is the Western Cape Government's Energy Dashboard figure for Cape Town, less SSEG registered with the City. There are three sources for the <30 kW group: Western Cape Government SAPVIA data, SAPVIA public data, and the City of Cape Town. Given the high rates of growth at the time, even a few months' difference between them would skew proportions appreciably.

**Figure 14: Has City customers' residential energy consumption really declined in high-income households? Adding back SSEG self-consumption, 2019 vs 2024**



**i**

In this infographic, residential sales in 2019 and 2024 are compared to strip out the impacts of both Covid-19 and load-shedding as far as possible. The key question it aims to answer is whether households have increased or decreased their grid electricity usage over this period.



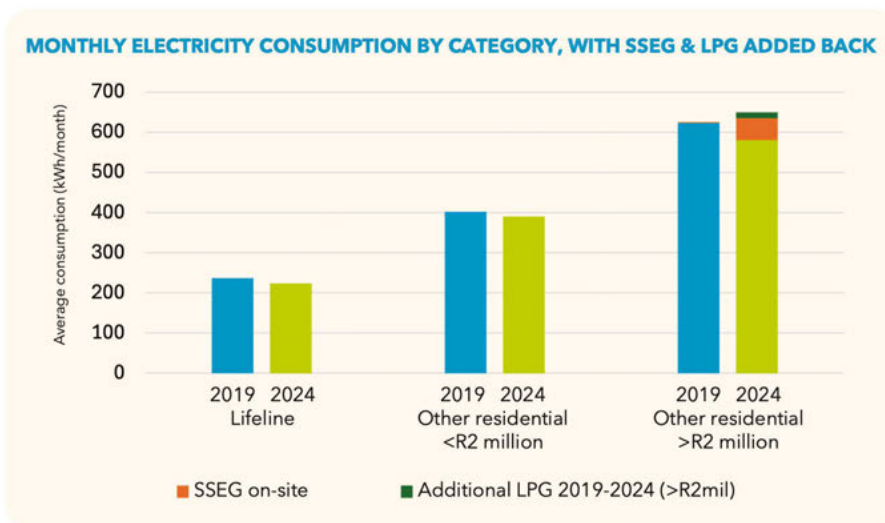
### NUMBER OF CONTRACT ACCOUNTS

	PREPAID	CREDIT
2019	529 873	88 603
2024	571 796	63 255

### SSEG IN 2019 VS 2024

	2019	2024
Total SSEG self-generation & consumption in City-supplied areas (MWh)	3 107	61 913
Average monthly self-generation & consumption (kWh/month/customer)*	3	54
SSEG as % of average monthly consumption per customer*	0,4%	8,5%

\*Total SSEG self-generation & consumption allocated across all contract accounts for properties valued over R2 million.



### WHAT IS A DECILE?

Deciles break up a set of data into ten equal parts. Here, for each year, customers are broken into ten equal parts according to property valuation (a proxy for income) in that year. From 2019 to 2024, the average monthly consumption decreased for both the lower and upper-income ends. However, a third of the sample had no property valuations.

Source: City of Cape Town (2025c)

## 2.3 Key system trend 3:

Fuels supply diverse niches, but transport is a giant demand that will eventually electrify, challenging grid infrastructure and supply adequacy

Cape Town's energy system is dominated by liquid fossil fuels in terms of 'final' energy consumed within the municipal boundaries. This does not translate into the same dominance of energy services because of the large amount of energy lost to heat in direct combustion processes. Nevertheless, fuel volumes are important in light of the extreme oil price shocks since 2005 and the long-term underlying real escalation in the oil price (see section 2.1). The Sankey diagram in Figure 15 below illustrates how petroleum fuels are distributed across a diversity of niches, but are concentrated in transport. Key features of the transport system are explored in Figure 16, with an overview of local electric vehicle (EV) numbers and supporting infrastructure following in Figure 17. The following is a summary of the data highlights and context:



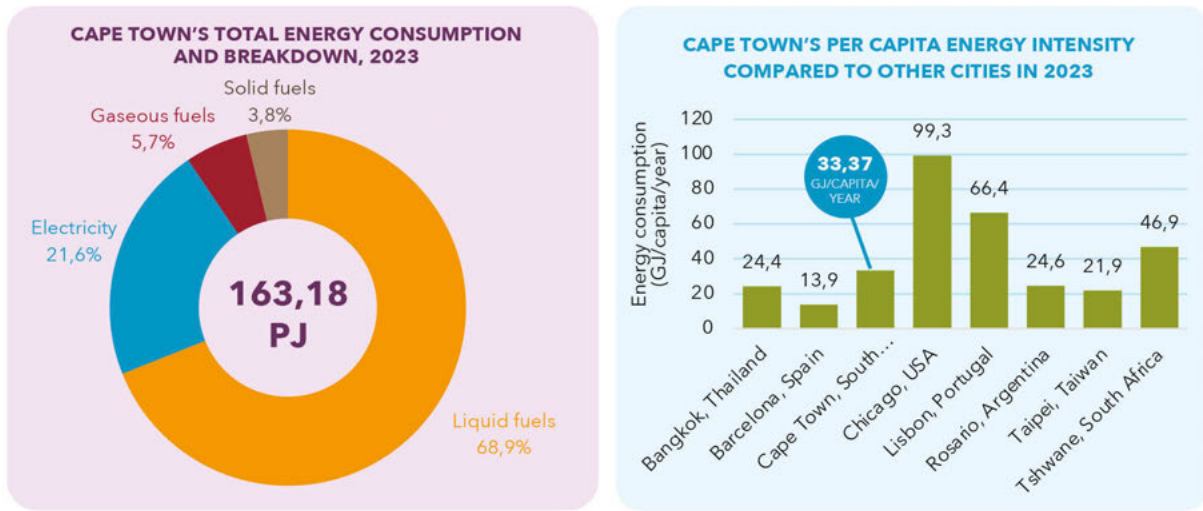
For further insights, consult section 2.5.1.2 in the 2025 SOEC main report

- Typical for a region without a concentration of heavy industries, transport in Cape Town dominates fuel energy demand. However, the difficulties of diesel allocation in 2023 notwithstanding, per capita consumption of liquid

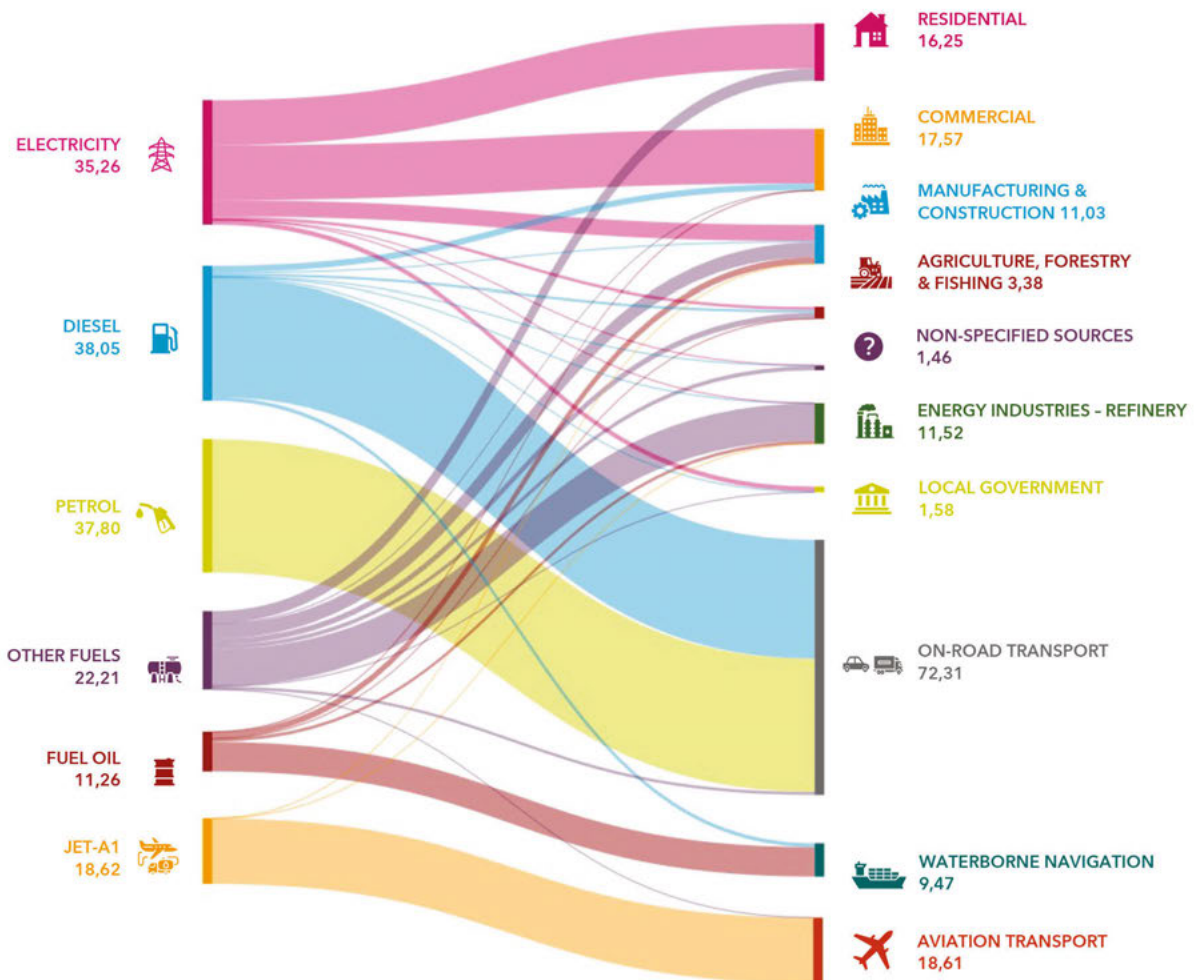
fuel use for mobile applications is estimated to have decreased by 24% since 2017. A quarter to half is likely due to greater energy efficiency, implying less personal travel for both work and leisure purposes (see also section 3.2).

- EV uptake in the private car segment is emerging: Some 4,5% of new passenger vehicle sales in 2024 were battery-electric vehicles (BEV) or plug-in hybrid models (double the 2023 share). Crucially, Chinese entrants to the market have significantly lowered prices for BEV recently (Taylor, 2025). While public charger infrastructure compares well to global norms for the current small vehicle numbers, rapid growth could challenge, or be constrained by, distribution networks, particularly for fast chargers.
- While EV uptake is still too small to shift the city's fuel mix, faster growth - supported by falling EV prices - could place substantial demands on local grid infrastructure and electricity supply capacity. Energy from road transport was around 11,1 PJ in 2023. As shown in Figure 16, the energy intensity of EVs is typically just under a third of that of internal combustion vehicles. Assuming that 50% of demand could be substituted, this translates into a potential of over 3,4 TWh of electricity sales. The localised demand on the power network from fast charging at this scale could be very high.
- Rail (Eskom supply area) is recovering at a high rate, albeit from a low base (see also section 3.2), with the potential to cause a significant rise in transport's electricity demands.

**Figure 15: Overview of Cape Town's energy system, 2023**



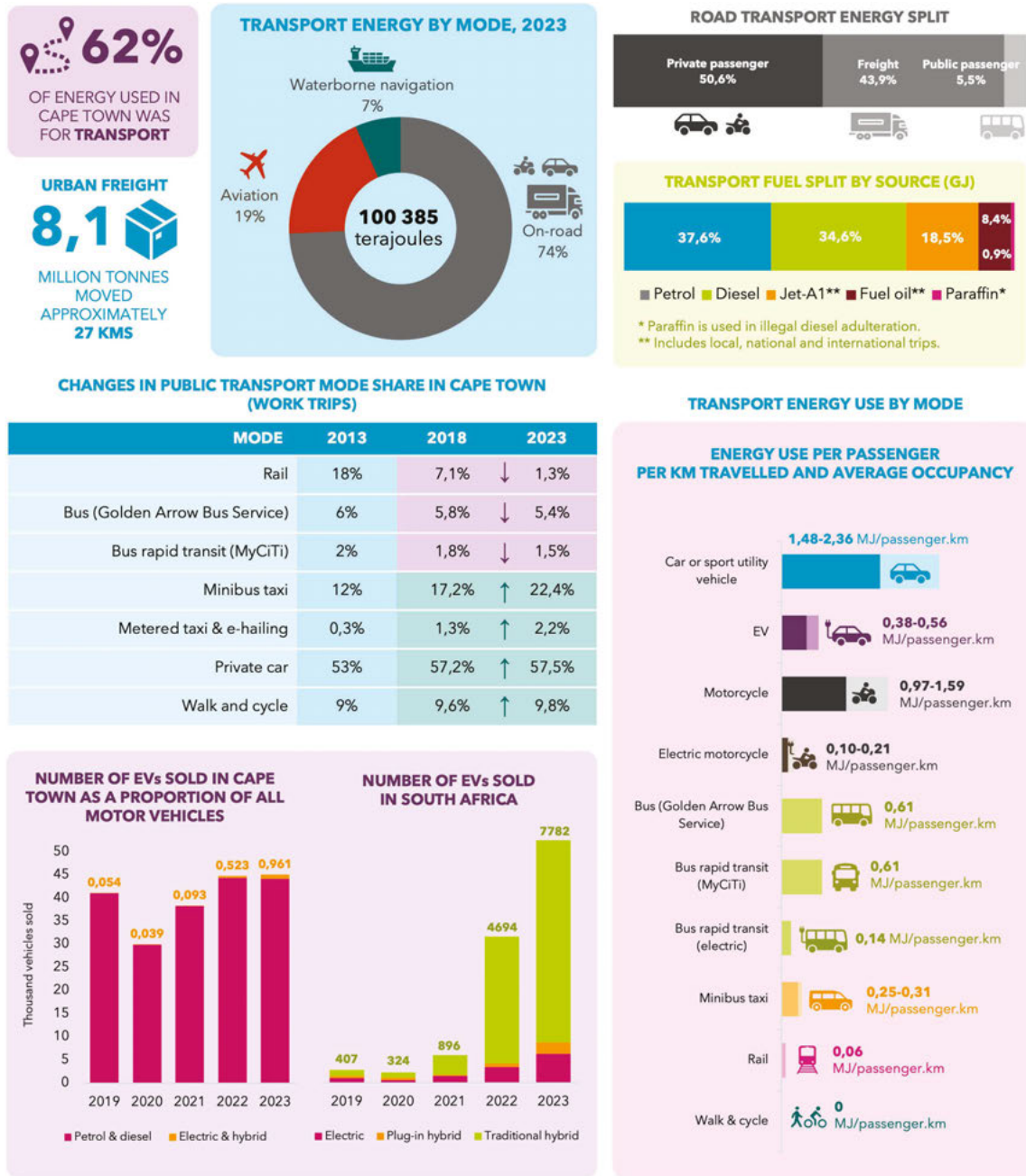
**OVERALL ENERGY SANKEY FOR CAPE TOWN BY SOURCE AND SECTOR, 2023 (PJ)**



Notes: Electricity generation industries (Ankerlig and Acacia) are on both the supply and demand side, as diesel is used to generate electricity. Therefore, diesel for electricity generation is excluded from the final diesel count, as it is already accounted for under energy industries. Includes scope 1, 2 and 3 as well as territorial energy from electricity generation supplied to the grid. Transmission and distribution losses, while included in the Sankey diagram above, are not included in the City's overall energy balance.

Sources: ACSA (2025); City of Cape Town (2025c); DEE (2023); Eskom (2025a); LEAP model; U.S. Energy Information Administration (2024); DFFE (n.d); Transnet (2025); CDP (2024)

Figure 16: Transport energy use in Cape Town, 2023

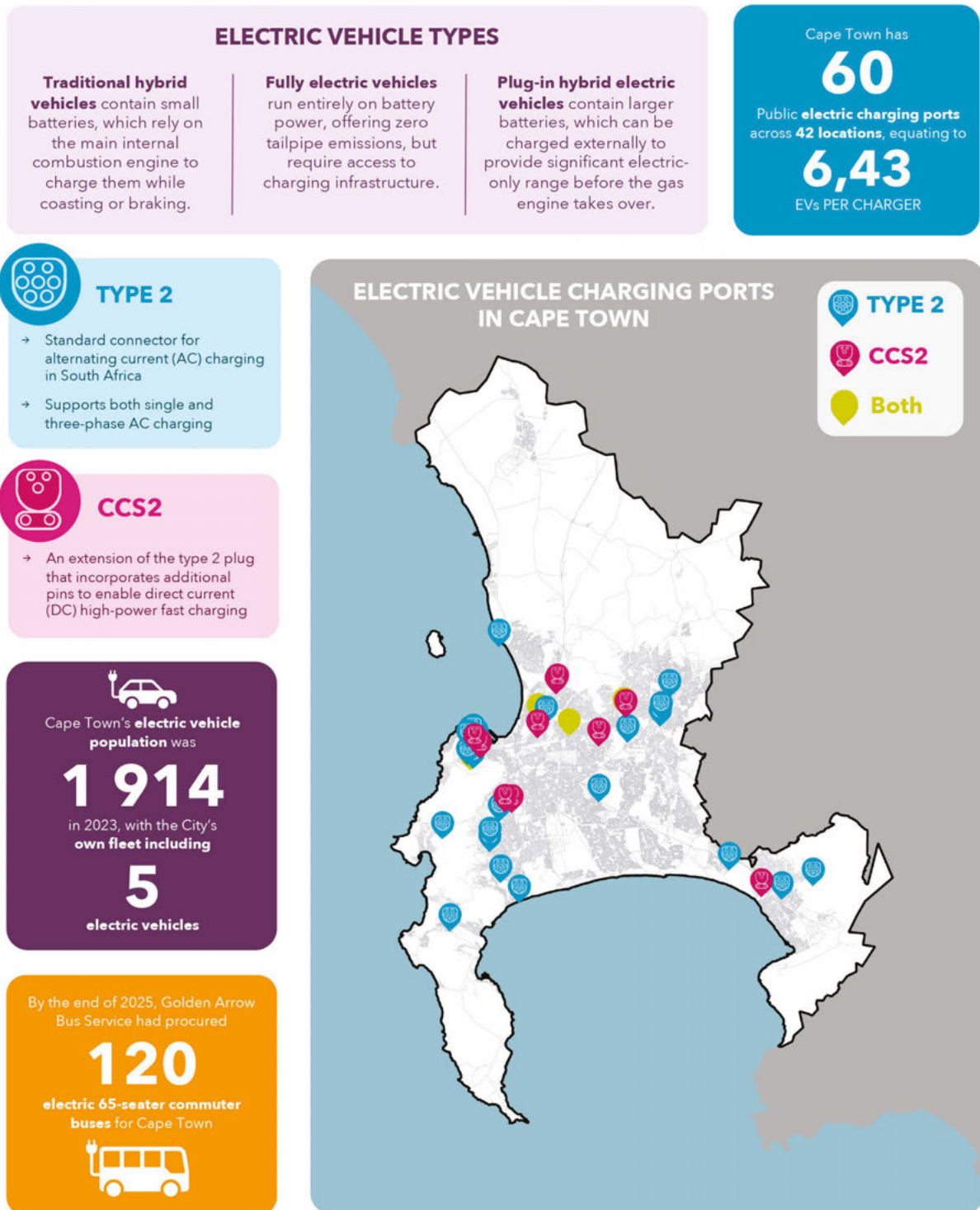


DIRECT TRANSPORT EXPENDITURE BY INCOME GROUP, 2018

Income group	Income stratification	Percentage of employed population	Average monthly income	Average direct cost expenditure vs monthly income (%)		
				Public transport	Private transport	Both
Low-income	<R4 640	47%	R2 400	17%	35%	26%
Medium-income	R4 640- R37 100	45%	R14 100	3%	23%	14%
High-income	>R37 100	8%	R70 800	1%	9%	7%

Sources: ACSA (2025); City of Cape Town (2025c); DEE (2023); UCT, SEA (2011); Eskom (2025a); GreenCape (2023); Lightstone; Merven (2012); Transnet (2025); WCG (2024b)  
Note: In this section, the terms 'energy' and 'fuel' are used interchangeably, as the analysis is based primarily on liquid fuel use. Electricity consumption for transport - such as rail and EV charging - has not been quantified due to data limitations.

**Figure 17: Electric vehicle recharging infrastructure in Cape Town**



Sources: Plugshare (April 2025); GreenCape (2021); Lightstone; City of Cape Town (2025c)

## 2.4 Key system trend 4:

### Fuel-electricity interactions under system stress

Fuel consumption patterns provide important insight into how system stress is absorbed across different energy carriers when electricity becomes less available, accessible and affordable. Load-shedding intensified reliance on fuel-based buffering across the energy system, with a particularly notable increase in diesel consumption to stabilise electricity supply. In Cape Town, this dynamic is especially evident from both the national utility's operations (Figure 18) and the responses of businesses seeking to maintain essential services during load-shedding (Figure 19). The electricity access and affordability pressures that drive residential fuel-buffering are touched on in section 3.2, and residential fuel use trends are presented in Figure 20. The following is a summary of the data highlights and context:



**For further insights, consult section 2.5.1.3 in the 2025 SOEC main report**

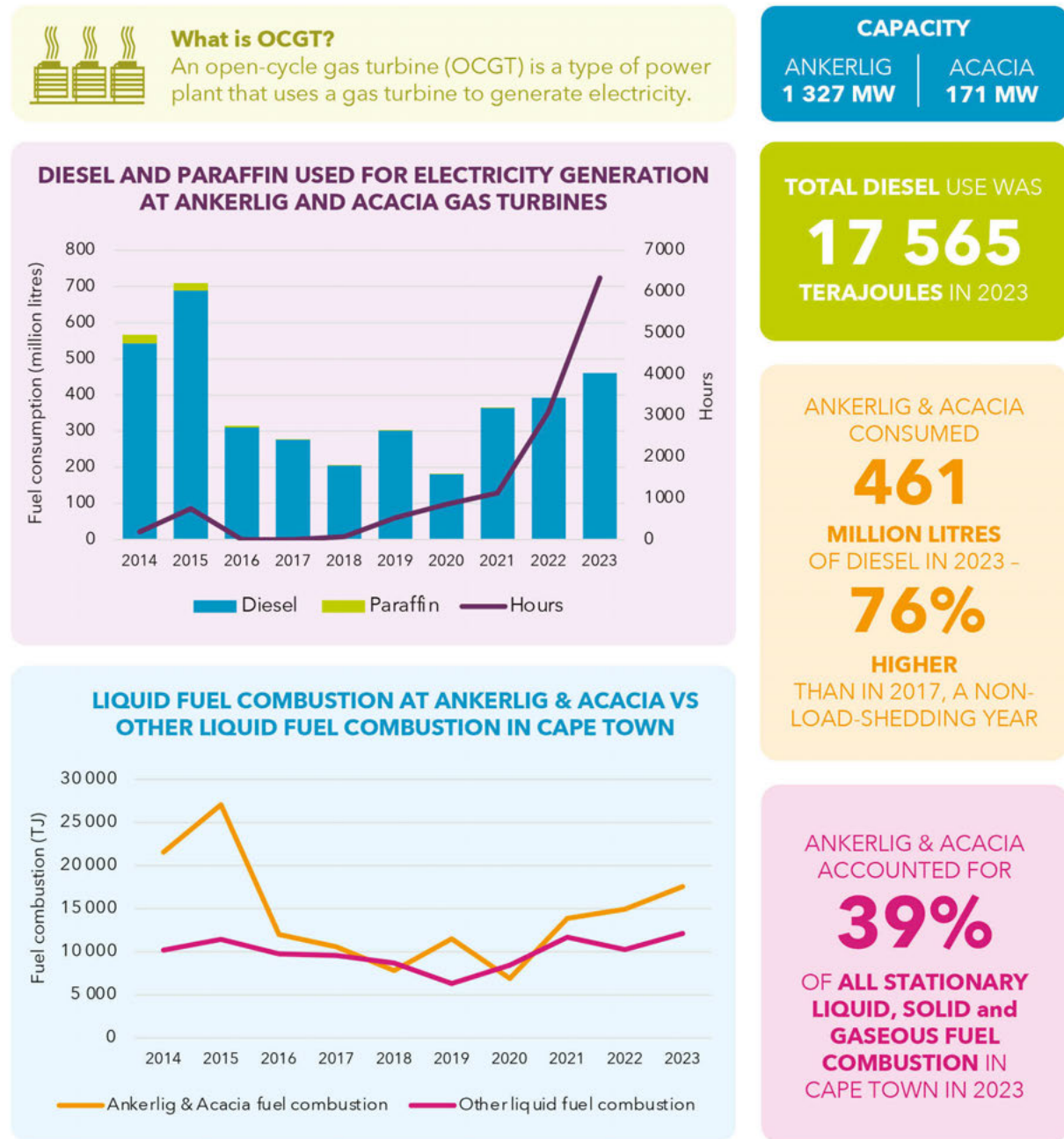
- Eskom's diesel-fired open-cycle gas turbines (OCGTs) in Cape Town (Ankerlig and Acacia), which serve as key emergency and peaking resources, consumed 461 million litres of diesel in 2023 (39% of all stationary fuel combustion in the city) – representing a 76% increase from 2017. This made them the single largest contributors to stationary fuel use in Cape Town.
- Commercial-sector diesel use shows clear alignment with major electricity system disruptions, with a peak in 2015, a general decline up until

2018, and a significant increase in 2022 and 2023, coinciding with increased load-shedding hours.

- Residential fuel use trends (Figure 20) are based on survey data spaced more than a decade apart (City of Cape Town, 2024d, 2023c). As a result, short-term shocks such as Covid-19 and load-shedding are not visible, but longer-term shifts such as a continuous rise in LPG use and a long-term decline in paraffin use among households are evident (see also Figure 26 in section 3.2).
- Survey-based estimates indicate that LPG – the preferred cooking fuel for between 21% and 34% of all households – made up roughly two thirds of residential fuel consumption by 2023, with most use occurring in electrified formal dwellings across income groups (Figure 20). Fuel-stacking, including paraffin and small total volumes of coal and wood, occurs in both formal and informal electrified and unelectrified households, but with informal low-income dominating paraffin use.
- A 2023 survey of unelectrified households (City of Cape Town, 2024f) confirms extensive fuel-stacking behaviour: LPG was widely used and preferred; paraffin remained an important secondary fuel; and while households typically had a dominant preference, they alternated between LPG, informal electricity, and paraffin.

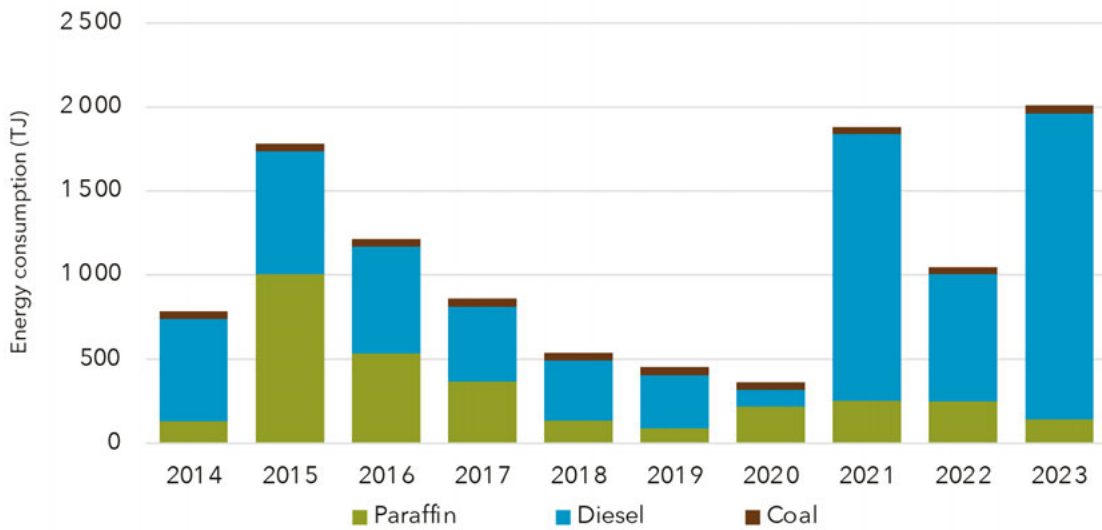
The evidence demonstrates that fuel-based buffering by utilities and commercial entities was a central feature of Cape Town's energy landscape under conditions of electricity system stress. Households chose fuels as an alternative to electricity in response to rising costs and the decline in electricity access and reliability.

**Figure 18: Diesel usage at Ankerlig and Acacia to safeguard the national electricity grid**



Sources:  
Diesel and paraffin (2014-2023): Eskom AEL  
Load-shedding hours: CSIR (2025)

**Figure 19: Commercial fuel use for stationary energy**



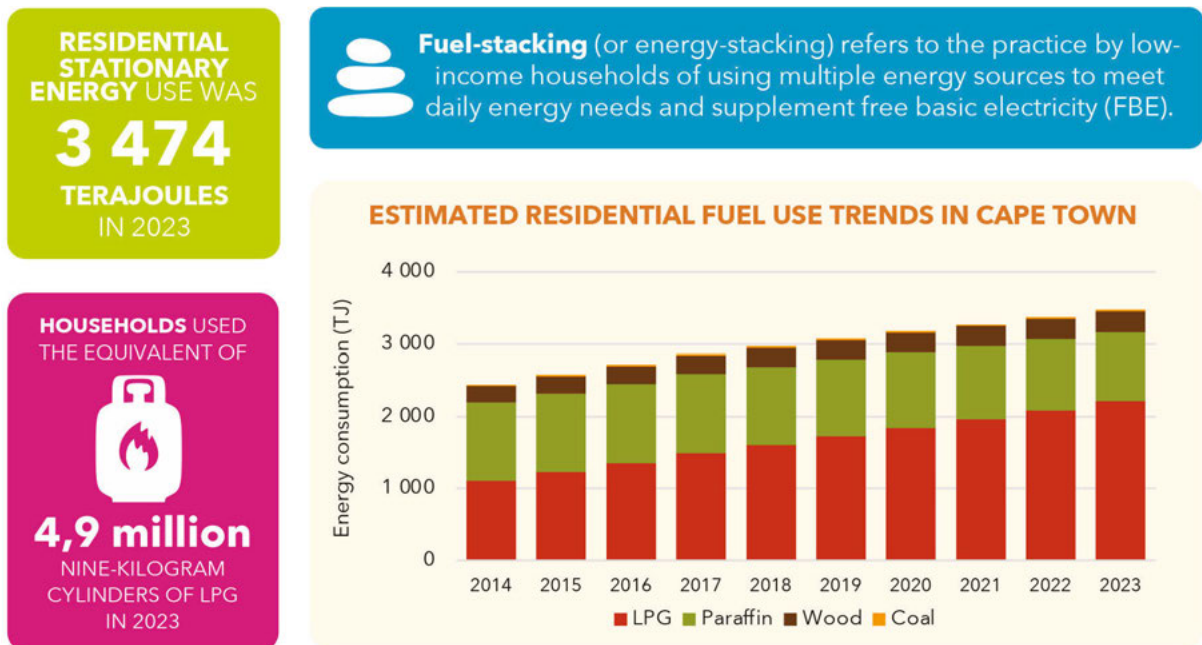
Sources:

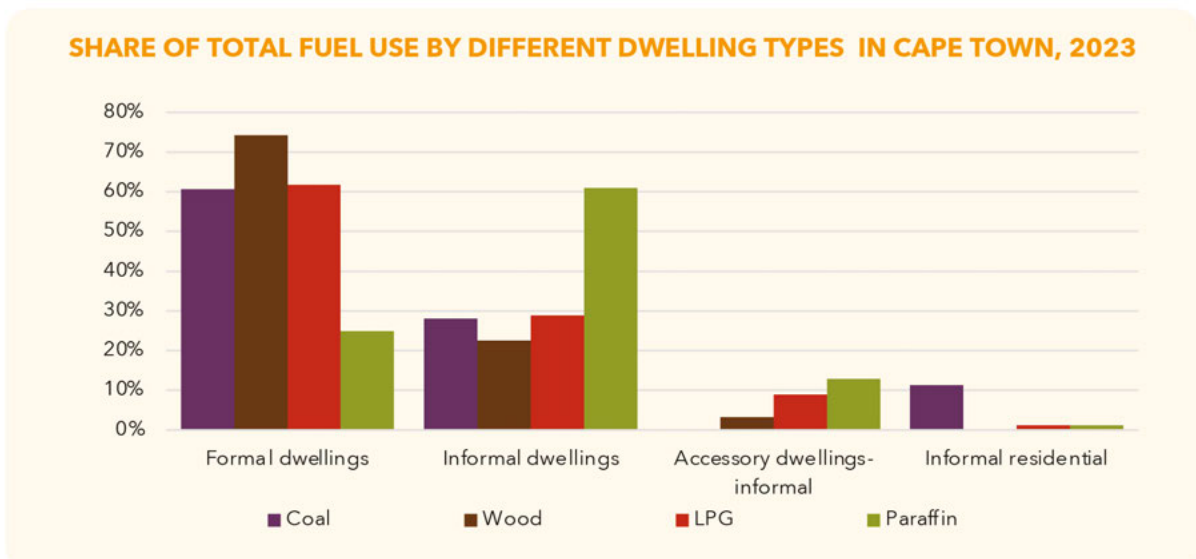
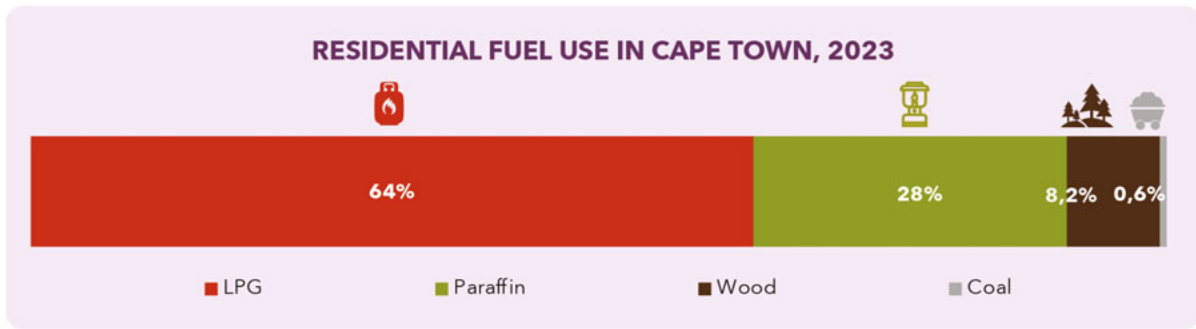
Diesel and coal (2019-2023): DFFE (n.d), adjusted to account for Cape Town-based head-office reporting

Diesel and coal (2014-2018): Modelled using total commercial sales from DEE and ratio of stationary use to total sales (2019-2023)

Paraffin (2014-2023): DEE (2023)

**Figure 20: Residential fuel use in Cape Town, 2023**





Sources: City of Cape Town (2023a, 2025c); LEAP model; Stats SA (2012, 2023)

## 2.5 Key system trend 5:

Decarbonisation against targets is affected by economic structure, stagnation and transition



For more details, consult sections 2.4.4, 2.5.4 and chapter 3 in the 2025 SOEC main report

As well as being required to implement the relevant requirements of the Climate Change Act, the City has made a voluntary carbon-neutral commitment under C40's Deadline 2020 framework (C40, 2016). This resulted in the municipality's [Climate Change Strategy](#) (City of Cape Town, 2021c) and [Climate Change Action Plan](#) (City of Cape Town, 2021b). Cape Town's GHG emissions system is detailed in Figure 22 below. Emissions are concentrated in the energy and, to a lesser degree, waste system. The fossil-fuel-intensive electricity supply and transport systems that dominate energy emissions are large, capital-intensive and

nationally linked, which means they are inherently slow to change. Electricity (stationary energy) contributes just over half of total emissions; transport - primarily on-road - accounts for approximately one third. Yet the chain of shocks and events highlighted in section 2.1 have changed these systems and significantly reduced emissions.

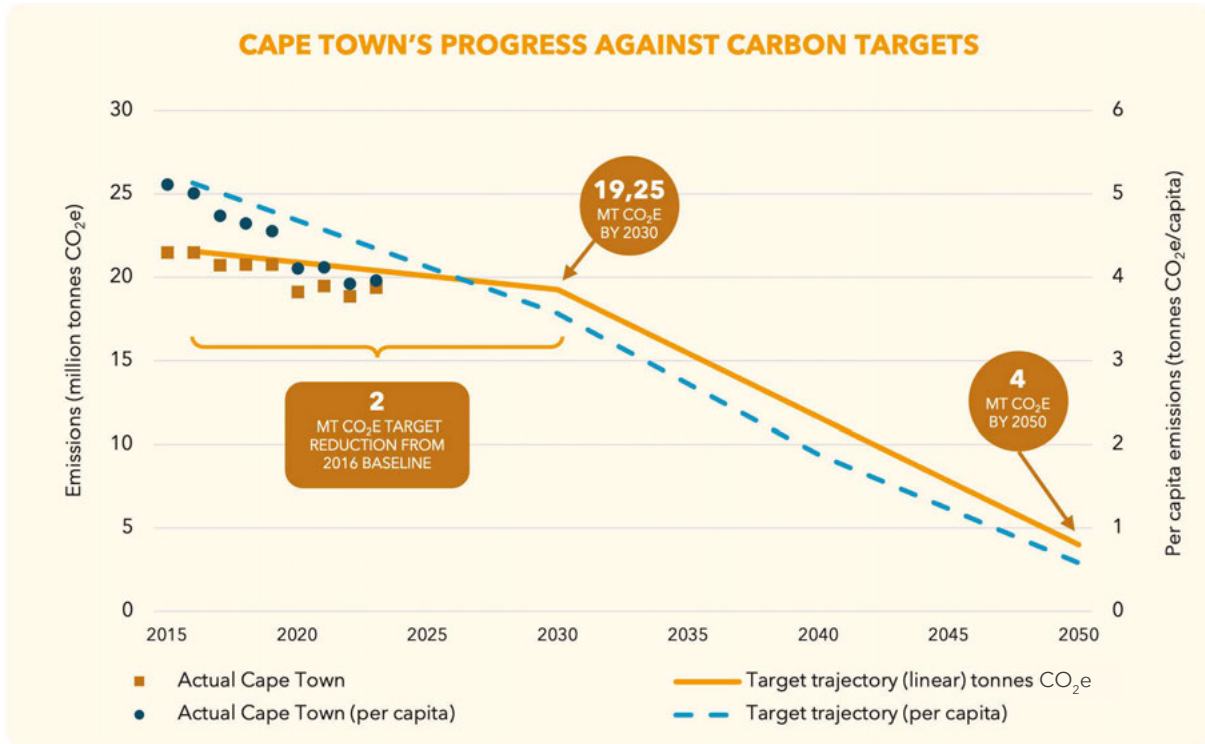
The following is a summary of the main features of local decarbonisation:

- The City has committed to a 9,4% absolute emissions reduction by 2030 (from a 2016 baseline) and an 81% reduction by 2050 (Figure 21 below), aligned with its carbon neutrality commitment.
- Target frameworks such as C40's Horizon 2020 prioritise developing-country welfare with lower initial required rates of change, recognising that these economies require a 'carbon budget' to grow their economies and social welfare.

For additional data and context, see the discussion on the effect of affordability on energy demand and, therefore, emissions in section 3.2, and the analysis

of trends and drivers in energy system emissions in section 3.3, Figure 28.

**Figure 21: Progress towards Cape Town’s voluntary citywide carbon targets**

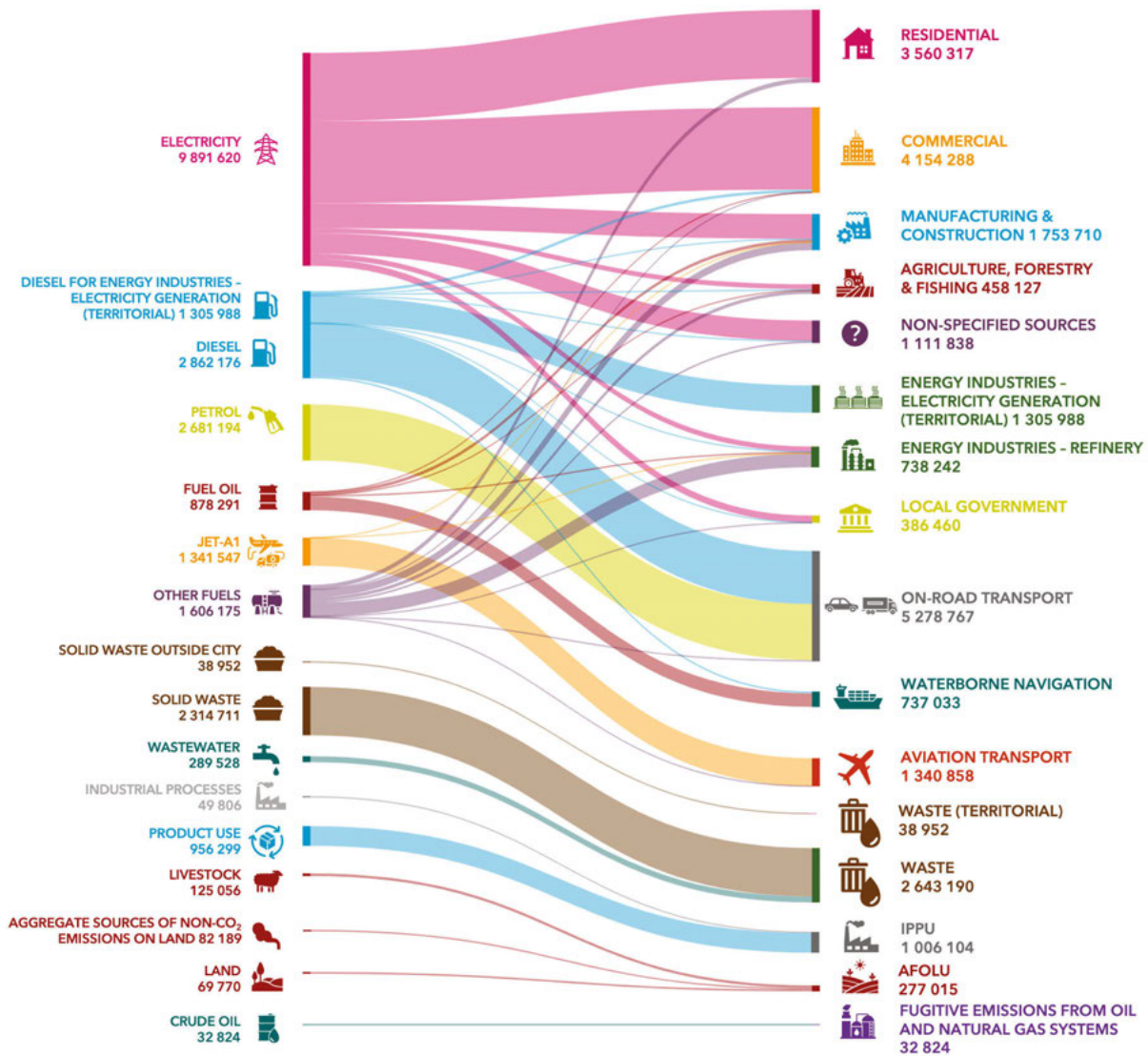


\*Note: Only BASIC emissions are included.

Sources: City of Cape Town (2024a, 2025c); LEAP model

- Importantly, the seemingly modest absolute decline to 2030 is projected to require a large 30% per capita drop in emissions because Cape Town’s population will likely continue to grow fast due to urbanisation.
- BASIC emissions have declined on a path close to the trajectory line, with 2023 emissions estimated at 19,39 MtCO<sub>2</sub>e, down from 2016 emissions of around 21 MtCO<sub>2</sub>e. This does not mean that the target has been met, however, given the high rate of population growth and, potentially, the rate of economic growth in certain sectors.
- As discussed in section 3.3 below, while emissions are reducing due to efficiency and technology change, declining per capita incomes reflect a stagnation in overall economic activity, which causes energy emissions growth to stagnate as well. Additionally, it is not clear whether the structural shifts in the local economy have had an equitable benefit.
- As a result, emissions trends may appear ‘favourable’, even though neither broad-based economic development nor extensive decarbonisation has occurred. This creates a risk that regions such as Cape Town will enter the post-2030 period without the financial or institutional capacity needed to transition rapidly, even if low-carbon technologies have matured elsewhere, or wealthier households and corporations have already transitioned significantly.
- More positively, pragmatic technology change could provide South African cities with the opportunity for ‘green growth’ leading up to 2030 and beyond, and therefore, the theory of change underpinning the City’s climate change and energy planning is to harness these opportunities as they arise.

**Figure 22: Cape Town’s emissions sources and emitting sectors, 2023**



\*Note: Scope 1, 2 and 3 territorial total includes electricity generation dispatched by the national grid system operator, as well as solid and biological waste generated outside the city's boundaries.

Source: City of Cape Town (2025c)



# 3 The state of energy security in Cape Town - a review of system performance

In this section Cape Town's energy security is analysed through the lens of the Energy Strategy principles (reliability, affordability, carbon neutrality, and resilience), linking to the key system trends above.

## 3.1 The state of reliability in Cape Town's energy system

Reliability, in the context of Cape Town's energy system, refers to the availability of sufficient energy

of a suitable quality when and where it is needed. For electricity, reliability depends on the performance of the national generation fleet, the stability of transmission and distribution networks, and the ability to limit disruptions such as unplanned outages or load-shedding. For fuels, reliability encompasses the secure and consistent supply of petrol, diesel, jet fuel, LPG, liquified natural gas (LNG) and coal, supported by stable refining capacity, adequate storage infrastructure, and dependable international imports.

Overall, Cape Town's local systems performed reliably, but outcomes were driven mainly by national and global factors beyond municipal control. Data reflecting the state of reliability in the energy system based on Cape Town and national trends are presented in Figures 26 to 28. The following is a summary of the data highlights and context:

## Electricity reliability



**For further insights, consult section 2.4.2 in the 2025 SOEC main report**

- Inadequate national generation has been the primary cause of reduced reliability of electricity supply (see Box 2 for load-shedding data). In addition to delayed national expansion programmes and projects, Eskom's generation fleets' energy availability factor (EAF) fell from 65% in 2020 to 55% in 2023, rising again to 60% in 2024 (Eskom, 2024b) and 65% by early 2026 (Eskom, 2026). While this is still below the 70% target estimated to provide a safe margin against load shedding, by early February 2026, load-shedding had not been implemented for 320 days.
- Under conditions of electricity scarcity, system resilience increasingly depended on fuel-based buffering from diesel-fired peaking plants and decentralised generators. These improved short-term reliability, but shifted costs, emissions and exposure to price volatility elsewhere in the system.
- In response to load-shedding, the City initiated a programme of targeted measures to reduce the severity and frequency of load-shedding for customers within its own supply areas. These measures included strategically deploying its pumped storage capacity, SSEG incentives, industrial load curtailment, demand-side management (DSM), own builds, and IPP procurement. While the latter three involve complex procurement and are being implemented in the current load-shedding hiatus, they can achieve significant bulk energy cost savings while improving system reliability under future constraints.<sup>1</sup>
- The Steenbras pumped storage scheme was the main means of load-shedding mitigation, allowing the City to mitigate load shedding by up to two stages. As a result, some 91% of customers' energy needs in City supplied areas were met versus 89% in Eskom-supplied areas.
- The City's distribution network remained stable, with approximately 4% of revenue (R800 m in 2023/24) invested in repairs and maintenance.<sup>2</sup> This is reflected in the average system interruption frequency index (ASIFI) that has stayed below the maximum allowable limit of 1,3 since 2014, indicating strong distribution reliability. While the City continues to maintain a strong and resilient distribution network, national-level energy challenges constrain overall reliability.
- Severe load-shedding accelerated long term shifts towards decentralised backup solutions, widening reliability differences between users who can self-supply and those who rely solely on the grid.
- Reliability of public lighting has declined below the City's 90% performance target due to theft, vandalism, cable damage, load-shedding stress, and safety risks for maintenance teams. While targeted technical interventions have been implemented, sustained improvements depend on broader cross-departmental and law enforcement support.
- Most respondents to the City's Customer Satisfaction Survey rate the City's electrical fault repair and streetlight service as 'good' to 'excellent'.<sup>3</sup> The quality rating for streetlighting

<sup>1</sup> The City's ability to mitigate load-shedding outside of its supply areas is limited; however, any mitigation efforts undertaken have also had a broader benefit by reducing strain on the national energy supply system.

<sup>2</sup> This investment needs to be responsive. The grid grows with the city, growing the maintenance burden and spread of component vintage. Lumpy investment can be required when cohorts of older infrastructure reach the end of their useful life. This can compete for resources with the need to expand capacity in parts of the network. Delays in response can cause overloading, compounding the maintenance problem.

<sup>3</sup> Under electricity provision, residents assessed whether the electricity provider (Eskom or the City) attended to electrical faults or infrastructure failures in their areas within a reasonable time. Under streetlighting, residents assessed whether the electricity provider had installed streetlighting that provides enough light for roads and pathways in residents' areas and fixed faulty streetlights within a reasonable time.

has not strongly correlated with burn rate challenges, but the lowest score in 2020/21 may be the result of the movement restrictions imposed on City maintenance staff during Covid. For 2024/25, responses for City (N = 1 624 for faults)<sup>4</sup> and Eskom supply areas (N = 1 153 for faults) were disaggregated,<sup>5</sup> and showed a statistically significant 12% (of scale) higher satisfaction level among City customers for fault repairs. Streetlighting quality was similarly perceived to be better in City supply areas (15% of scale), although the municipality is responsible for this service in Eskom areas also, indicating possible co-variance of respondents' perceptions.

## Fuel reliability



**For further insights, consult section 2.5.2 in the 2025 SOEC main report**

- Critically, the reliability of petroleum fuels depends on global markets and logistics. Petrol

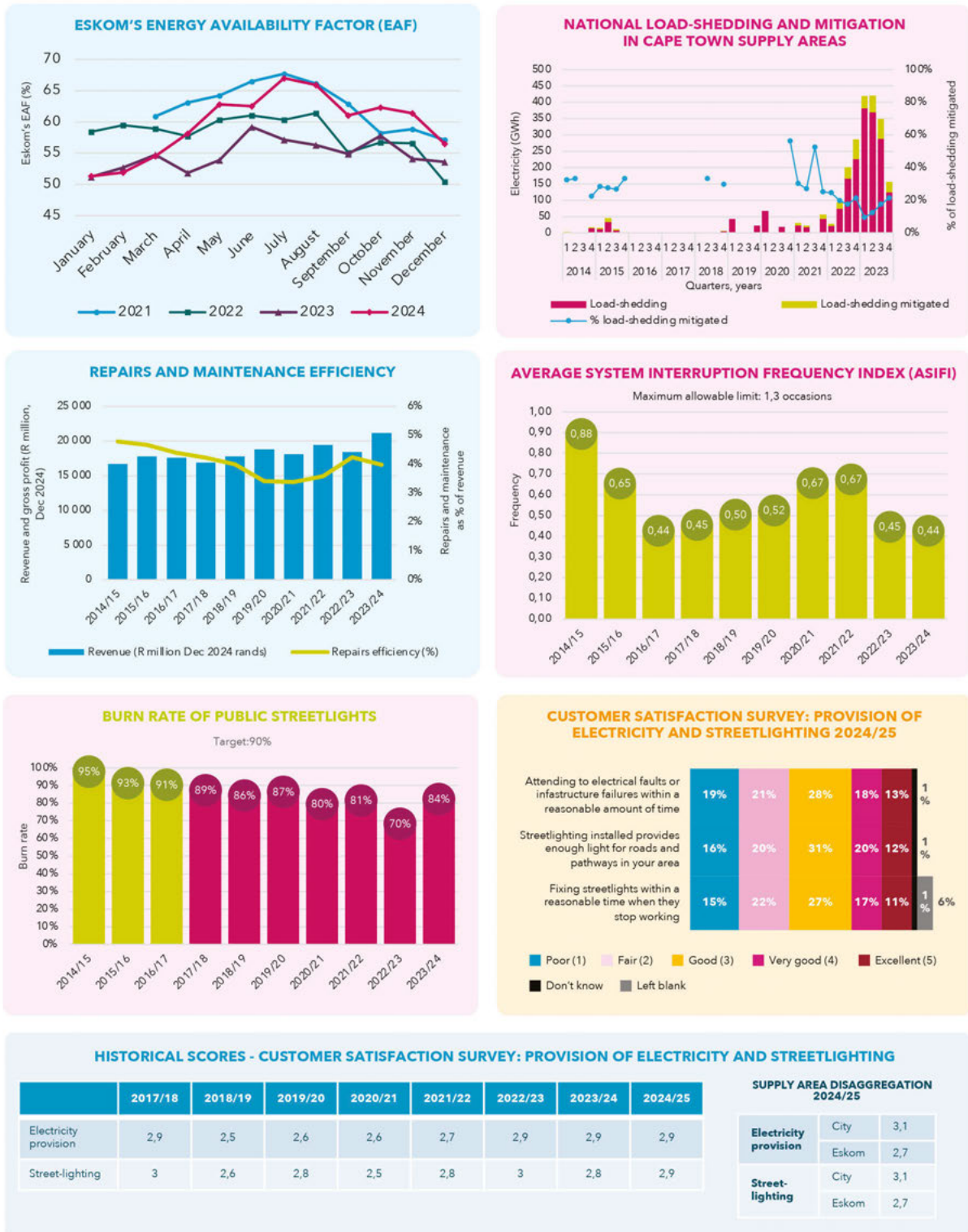
and diesel supply remained reliable despite national refinery closures, a local refinery outage, and a surge in diesel demand due to load-shedding. Import terminal and storage capacity ensured continuity, as seen in Figure 24.

- During the reporting period, there were no recorded incidents of fuel shortages, market restrictions or widespread quality issues in Cape Town, indicating that the city's fuel supply has remained reliable.
- Vulnerabilities persist in specific petroleum segments:
  - Fuel oil has small stock reserves and tighter supply chains.
  - Port delays from high winds occasionally affect offloading.
  - Natural gas remains a small, less reliable component due to single-source dependence and long-distance road transport.
  - Coal supply for industrial use is vulnerable due to logistics challenges, as volumes have declined and are now trucked rather than railed.

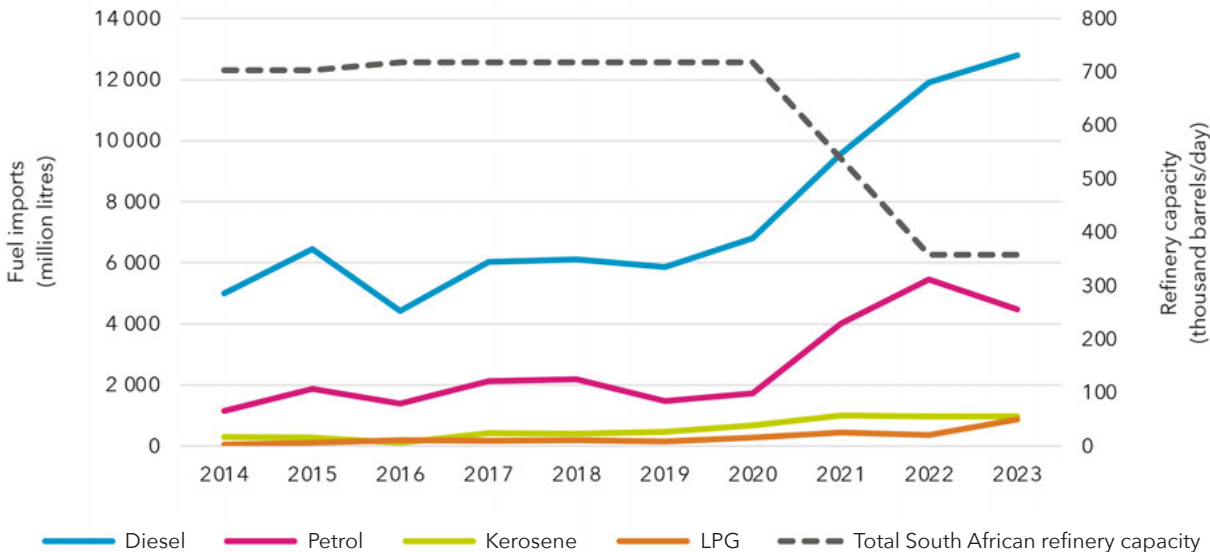
<sup>4</sup> N = Sample size with valid responses.

<sup>5</sup> While this cannot be seen as an independent survey of City and Eskom supply areas, it was executed by a third-party service provider.

**Figure 23: Overview of the reliability of the electricity system in Cape Town**

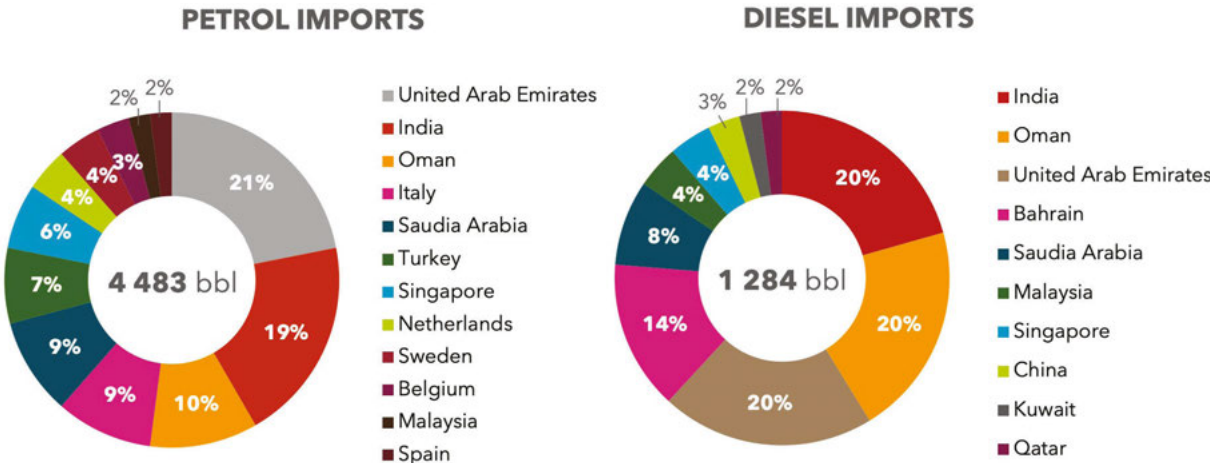


**Figure 24: Decline in refinery capacity and rise in fuel imports, 2014-2023**



Source: SAPIA (2023)

**Figure 25: South African imports of petrol and diesel, 2023**



Source: SAPIA (2023)

## 3.2 The state of affordability in Cape Town's energy system

Affordability refers to the extent to which households and businesses can secure the energy services they need without compromising essential needs or economic viability. Affordability reflects not only energy costs, but also users' capacity to absorb, manage or adapt to those costs. In considering the affordability principle, there are three important factors when viewed through a data lens:

- Trends in fuel costs relative to inflation, which can be referred to as the 'real energy cost'
- Whether fuel and electricity affordability interacts, and whether real energy price rises are compounded by real escalation in the prices of other essential goods and services and/or shrinking incomes
- The extent to which costs are being mitigated by policy, efficiency or consumption avoidance
- Data reflecting the state of affordability in the energy system in Cape Town is presented in Figures 29 and 30. The following is a summary of the data highlights and context:

### Economy-wide factors affecting energy affordability

- The period 2014–2023 saw an 11% real contraction in industry GVA, and a 14% expansion in the tertiary economy (trade, finance and community services), with finance, real estate and business services specifically recording a significant 25% expansion.<sup>6</sup>
- Overall, however there was an estimated drop of 10,6% in local real GDP/capita between 2014 and 2023, reflecting a likely proportional drop in average real incomes.
- For the Western Cape, between June 2014 and June 2025, water supply cost inflation was 24% higher, food cost inflation 16% higher and rental

inflation 4% higher than general national inflation (Stats SA, 2025b). The accelerating decline in rail services from 2013, repeated fuel price shocks and increasing informal urbanisation have contributed to low-income households on the urban periphery spending an estimated 17% of their income on transport – well in excess of the 10% affordability benchmark (City of Cape Town, 2025d).

- The PRASA-led rail system restoration programme saw monthly ridership increase by 62% year on year by June 2025.<sup>7</sup> This holds out the prospect again of an integrated public transport system that reduces growing service affordability pressures.

### Electricity affordability



For further insights, consult section 2.4.3 in the 2025 SOEC main report

- Electricity tariffs have increased at more than double the rate of consumer inflation over the past decade (a 70% real rise). Rising Eskom bulk supply costs and declining sales have pushed up per-unit costs for consumers, as utilities such as the City and Eskom are left to recover fixed network costs from a shrinking sales base.
- While electrification is near universal, low-income households in particular struggle to afford sufficient grid electricity, even with FBE (either 60 or 25 kWh per month, depending on average consumption) and subsidised tariffs (City of Cape Town, 2024f). Due to price increases relative to oil, consumers have likely been progressively pushed towards alternatives, particularly for cooking and space heating. The data shows that this switch has mostly been to LPG. Fuel-stacking with paraffin also persists despite significant reductions recorded since 2001 (City of Cape Town, 2023c), as paraffin is price-regulated with low tax.
- Rapid population growth, particularly in low-income and informal settlements, puts pressure

<sup>6</sup> S&P Global Market Intelligence, 2025.

<sup>7</sup> Since operations resumed in 2022, passenger numbers have steadily increased from a low base. Between April 2024 and March 2025, the network carried over 25,5 million trips, followed by 13,8 million trips in the first four months of 2025/26 alone, representing an increase in monthly ridership of about 2,1–3,4 million trips, or 62% (PRASA, 2025).

on electrification programmes as well as subsidised services. Areas of informality on compromised<sup>8</sup> land have grown by 49% since 2018 (City of Cape Town, 2025g) – a rate much greater than the City’s annual 1 500 household electrification target. Therefore, households without a formal electricity connection are increasing, and will likely continue to do so.

- The falling costs of solar PV and batteries, supported by the City’s feed in tariff and incentive, have improved affordability for those able to invest in these alternatives. For those without access to capital, however, these technologies have further deepened affordability inequality.

## Fuel affordability



**For further insights, consult section 2.5.3 in the 2025 SOEC main report**

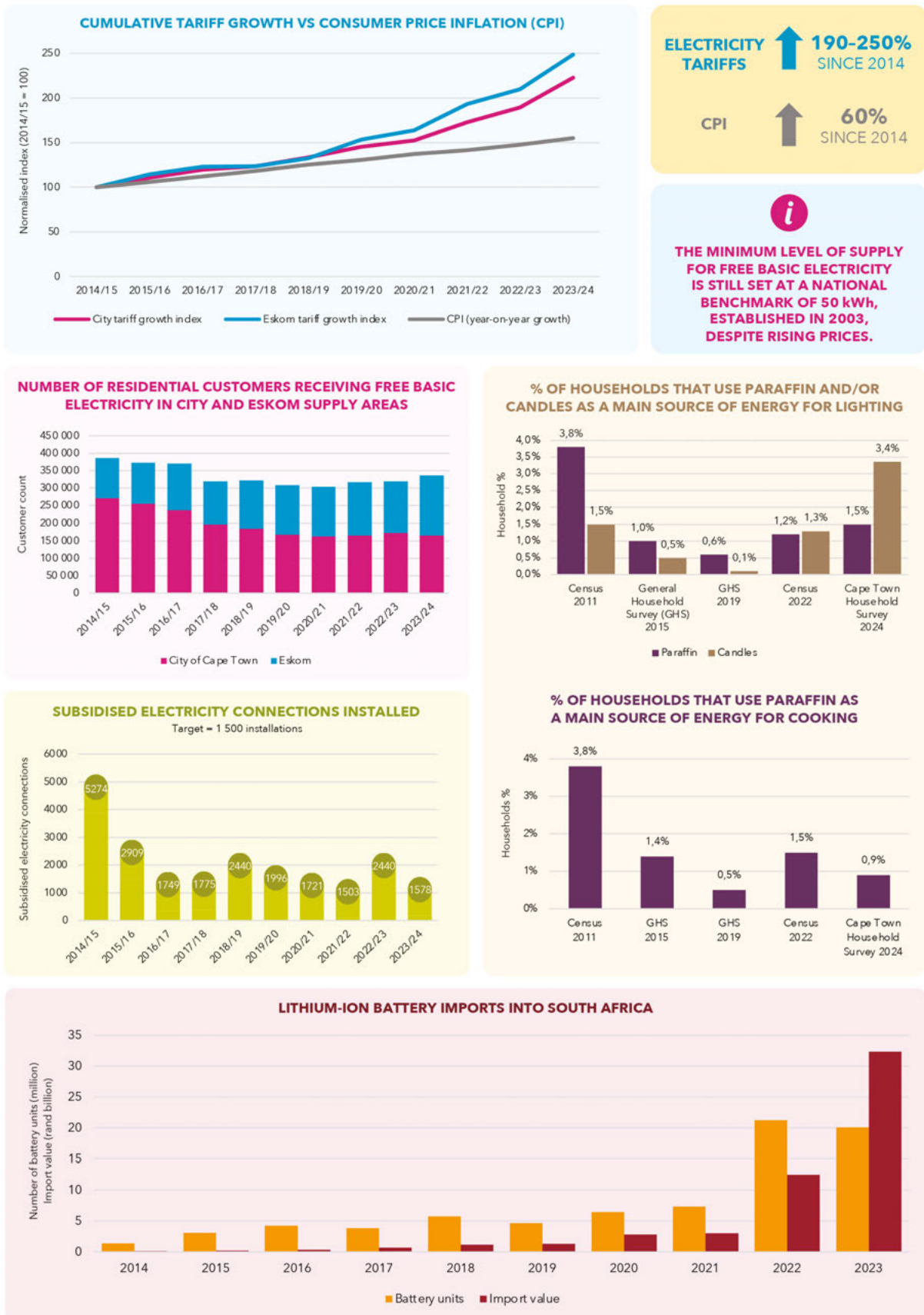
- Petrol, diesel and LPG prices are driven by global oil markets and national tax structures, creating volatility beyond municipal control, with an upward trend in oil prices between 2020 and 2023 raising transport and industrial operating costs.
- Per capita petrol and diesel consumption fell by 24% from 516 L/person/year in 2017 to 394 L/person/year in 2023. Based on historical data on fleet fuel economy globally, a 1-2% per annum improvement has been typical of the past 20 years, which implies that 6-13% of the per capita change above can be attributed to improved efficiency (GFEI, 2023; IEA, 2019).

- Coal prices have risen faster than inflation, but slower than electricity tariffs, creating mixed signals for fuel-switching. This picture changes once carbon pricing is considered.
- Scheduled reductions in carbon tax allowances will raise effective fuel costs, particularly for coal and fuel oil, tightening links between affordability and decarbonisation.
- Rising fuel and carbon related costs strengthen incentives for efficiency and fuel-switching (to renewable electricity, LPG, natural gas or biogas). However, for energy-intensive sectors with limited transition options, rising costs may constrain or close operations.
- At an individual level, rising fuel prices, compounded by the collapse of the rail system in Cape Town between 2013 and 2023, escalated transport costs significantly, especially for households on the urban periphery.

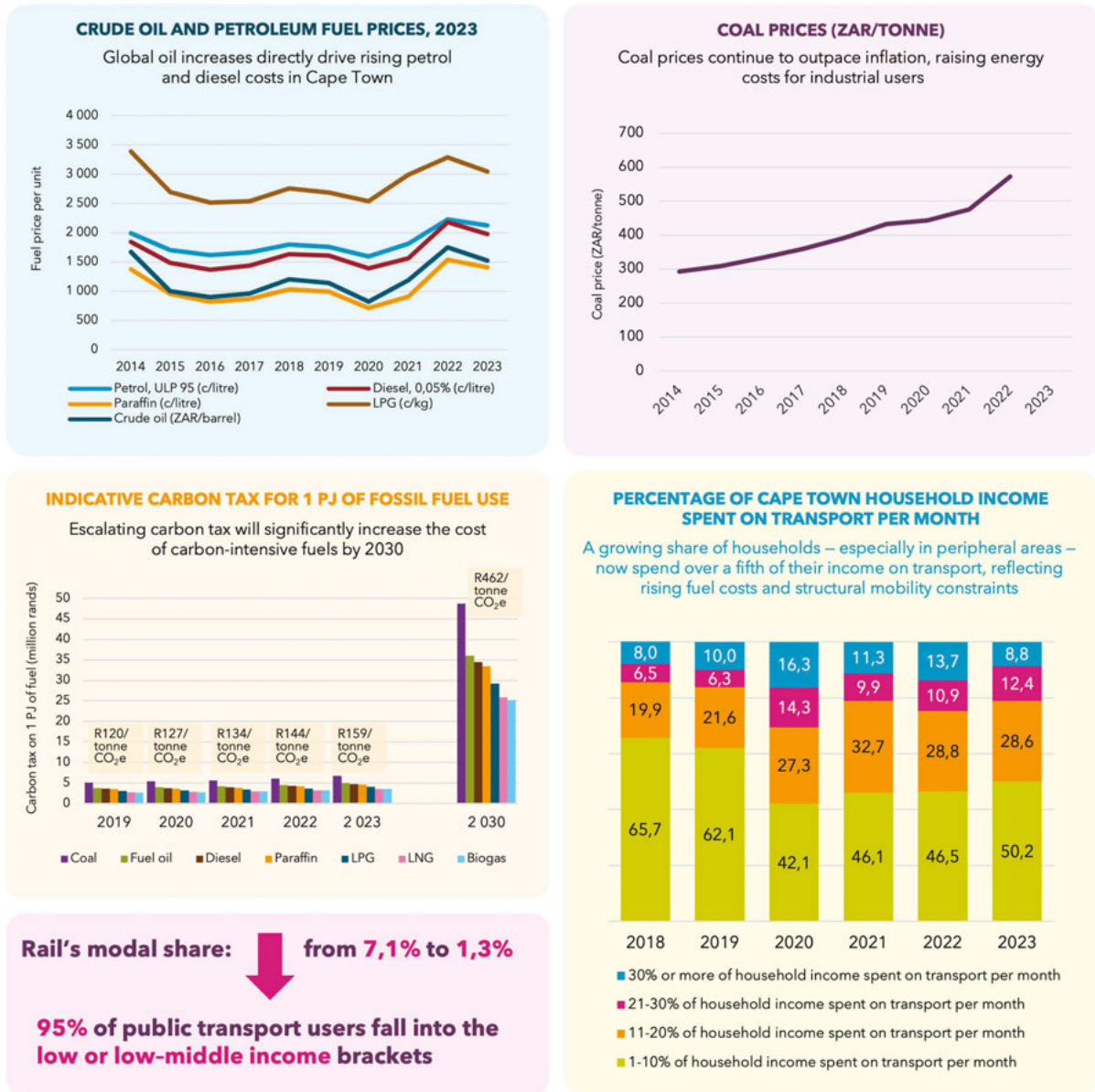
Energy affordability in Cape Town has weakened significantly across both electricity and fuels, driven by above-inflation electricity tariff increases, global fuel price volatility and stagnant household incomes. These pressures suggest that falling energy consumption increasingly reflects financial constraints rather than just increased efficiency and substitution, with the cost of alternatives such as solar PV and batteries merely widening affordability gaps across income groups. The data shows that rapid urbanisation, pressure on subsidies as well as rising energy prices will make it difficult to maintain the current electricity access rate, with growing energy poverty also a potential outcome.

<sup>8</sup> Portions of land that are reserved for infrastructure expansion, are on unsuitable or unsafe terrain, or are subject to legal or ownership disputes.

**Figure 26: Affordability dynamics in Cape Town's energy system**



**Figure 27: Fuel and transport affordability trends in Cape Town**



### 3.3 The state of carbon neutrality in Cape Town's energy system

Section 2.5 above touched on the fact that Cape Town's emissions sources being concentrated in the energy sector, and also showed the city's decarbonisation trajectory relative to its voluntary targets. This section, and particularly also Figure 28, offers a deeper dive into the GHG emissions trends in the energy sector.



For further insights, consult sections 2.4.4, 2.5.4 and chapter 3 in the 2025 SOEC main report

The following is a summary of the data highlights and context:

#### Economy (see section 3.2 for data)

- Cape Town is decarbonising, especially on a per capita basis. However, since low-emitting, low-income urbanisation combined with high-income 'semigration' appears to be driving tertiary rather than primary-sector growth, the drop in overall emissions intensity per unit GVA of the entire economy is expected.
- Per capita emissions per person declined from more than 5 tCO<sub>2</sub>e in 2014 to approximately 4 tCO<sub>2</sub>e in 2023, reflecting lower electricity intensity and a gradually improving grid emission factor, but also demographic change and suppressed demand linked to affordability and reliability pressures.

#### Electricity

- By the end of 2024, the City had approved more than 6 000 grid-connected SSEG installations, totalling over 140 MW. With the onset of severe load-shedding, most installations included

storage, potentially reducing demand during the evening peak, although their aggregate effect remains incremental. Coal still dominates national supply, and grid electricity meets most demand (especially during peaks).

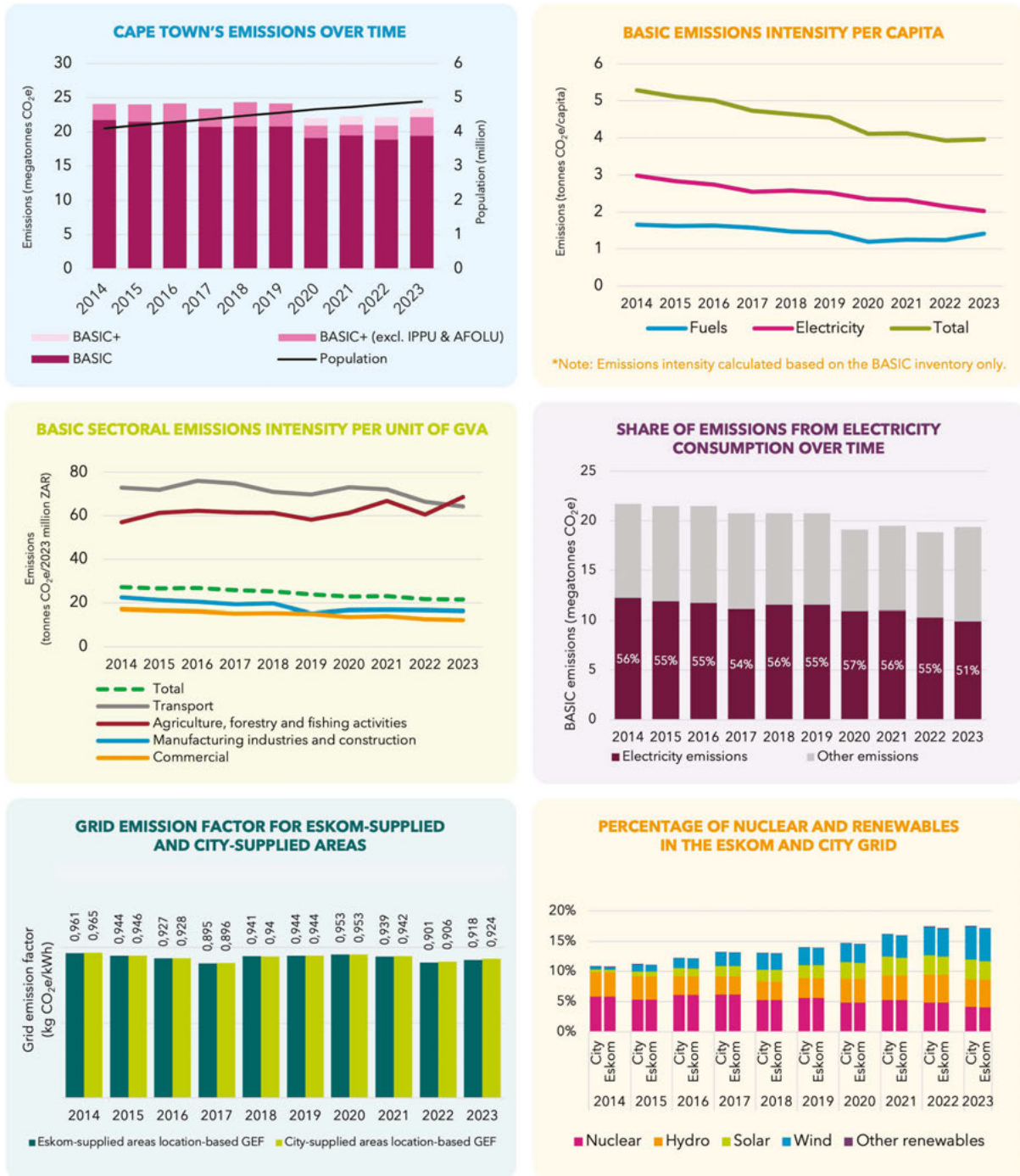
- Year-to-year electricity-related emissions are driven predominantly by national generation performance (coal plant availability, dispatch, use of peaking turbines), which can offset local efficiency and renewable gains.
- With regard to reliability trade-offs during stress periods, maintaining service during supply constraints has at times required diesel OCGTs and decentralised backup, increasing short-term emissions. Additionally, Steenbras pumped storage improves reliability, but consumes more electricity during pumping (often when coal is on the margin), slightly raising the effective emissions intensity of City-supplied electricity.

#### Fuels

- Despite a Covid-era dip and rebound, transport emissions remain high relative to the economic output of the sector. In 2024, hybrid vehicles/EVs represented some 4,5% of new vehicle sales - constrained by affordability, urban form, and the structural reliance on road transport.
- Manufacturing shows a gradual decline in emissions intensity (efficiency, reduced coal/heavy fuel oil). Biogas remains niche (scale, infrastructure, siting), and hydrogen is at a pilot stage, with no material impact at present.

Overall, local actions such as efficiency gains, SSEG and gradual supply diversification are reducing emissions intensity. Nevertheless, absolute emissions remain largely shaped by upstream national supply, transport fuel dependence, reliability-driven trade-offs and economic factors.

**Figure 28: Cape Town's progress towards a carbon-neutral energy system**



Sources: ACSA (2025); City of Cape Town; (2023b, 2025c); DEE (2023); Eskom (2025a); LEAP model; NASA EarthData (2025); DFFE (n.d); SARS; SAWIC; Stats SA (2024, 2025); Transnet (2025)

## 3.4 The state of resilience in Cape Town's energy system

Energy resilience is the capability of Cape Town's multi-carrier energy system – across electricity and petroleum fuels – to maintain, restore and adapt its functionality during and after shocks or stresses, while reducing overall exposure to such disruptions. Interpreting resilience, therefore, requires consideration of how the system responds under pressure, how risks are redistributed across energy carriers, and how short-term coping strategies shape longer-term system outcomes.

Cape Town's energy system has shown strong adaptive capacity during the reporting period, maintaining functionality despite electricity supply constraints, global fuel disruptions and financial pressures.

Municipal actions strengthened distribution network performance and expanded local generation, while fuels infrastructure absorbed shocks such as refinery outages. However, the system remains structurally exposed: Resilience gains often rely on shifting the risk to fuels, which increases costs or emissions and exposes residents and businesses to national and global conditions outside the City's control. Overall, Cape Town's energy resilience has improved, but is increasingly dependent on trade-offs across affordability, reliability and carbon neutrality. Data reflecting the state of electricity and fuel resilience for Cape Town is presented in Figure 29. The following is a summary of the data highlights and context:

### Electricity system performance



For further insights, consult section 2.4.5 in the 2025 SOEC main report

- The distribution network remained robust over the reporting period, despite external stresses. Electricity losses declined from a peak of approximately 13% to below the City's 12% target, signifying improved operational controls such as revenue protection and meter replacement, as well as strengthened technical and commercial performance.

- Average System Interruption Frequency Index (ASIFI) and Average System Interruption Duration Index (ASIDI) stayed below the City's target threshold during periods of heightened disruption, indicating the network's strong service restoration capability.
- Intensive load-shedding increased diesel reliance at both national utility and household/business levels. While this achieved resilience by shifting – not removing – risk across energy carriers, it also exposed households and businesses to global fuel prices and raised their operating costs.

### Local generation and supply diversity

- City-owned assets such as Steenbras pumped storage and Roggebaai gas turbines contributed to operational stability through enabling system balancing, peak-shaving and load shedding mitigation.
- Darling Wind IPP and a small but growing capacity of SSEG consumed on-site and fed into the grid met an estimated 2,3% of demand by 2023, signalling early diversification supported by both public and private investment.

### Financial resilience of the electricity utility

- Fixed costs such as network maintenance and expansion, metering as well as administrative support account for roughly a third of the electricity utility's total expenditure, while only around 7–8% of revenue is recovered through fixed charges. This has increased financial vulnerability as consumption decreases because of energy efficiency, embedded generation and a stagnant, de-industrialising economy.
- Since financial resilience is essential for electrification rollout, network maintenance, and support to vulnerable households, it is imperative to ensure sustainable and cost-reflective tariffs.

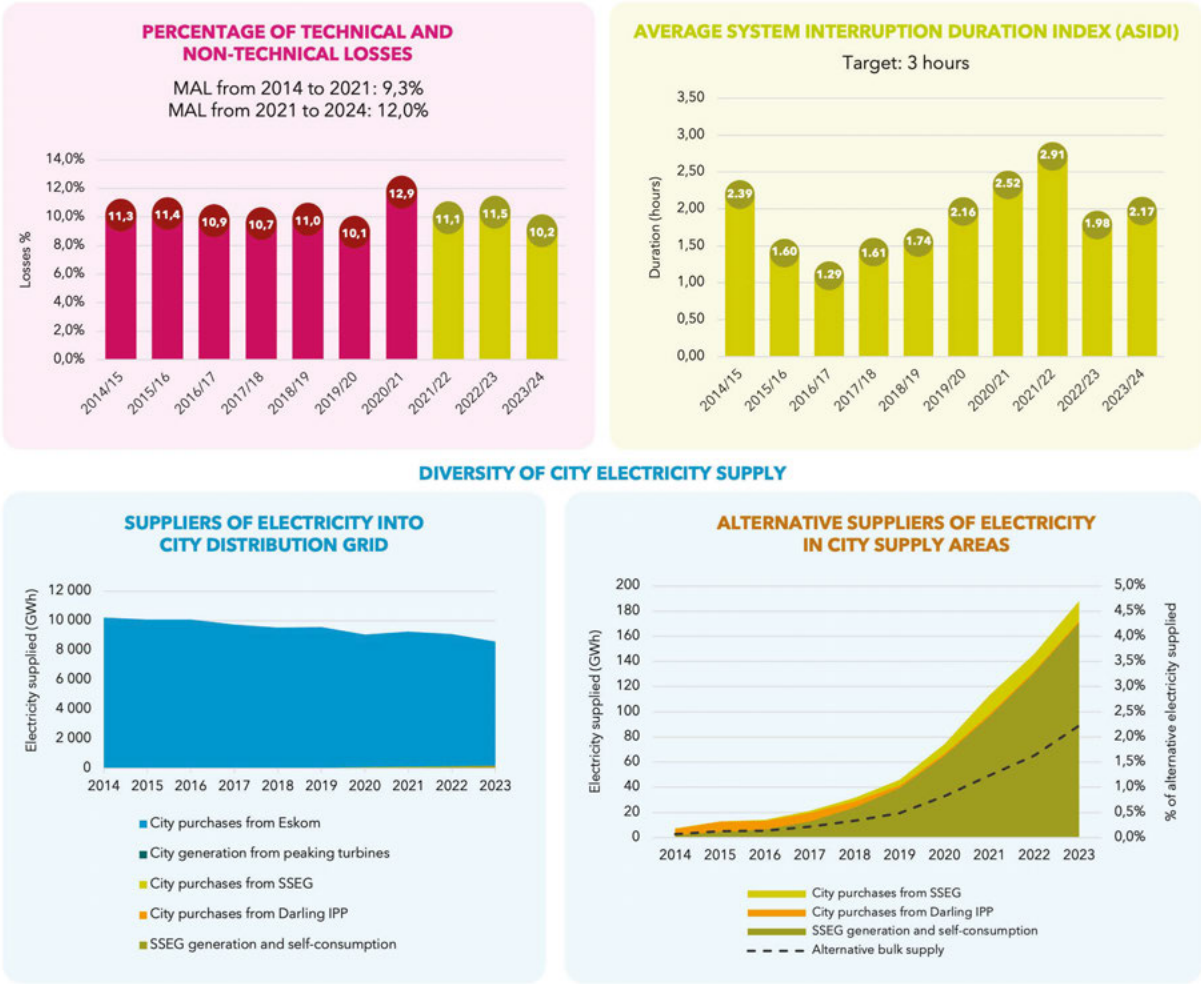
### Fuel system resilience

- Cape Town's fuel supply chain stability supported resilience during electricity outages.
- Despite the Astron refinery shutdown and Covid-19 disruptions, Cape Town avoided significant fuel shortages as a result of storage capacity and the diversification of supply routes.

Collectively, the evidence points to an energy system that has adapted to repeated shocks without systemic failure, but whose resilience is increasingly contingent on trade-offs. Local investment has strengthened the City's capacity to manage disruptions, yet national electricity performance and global fuel dynamics continue to shape outcomes. An energy-resilient system maintains secure supply, limits the impact of external shocks, and adapts to long-term structural changes in demand, infrastructure stress and market conditions.

This highlights a central insight of the 2025 SOEC report, with important implications for Cape Town's energy transition: Resilience cannot be assessed in isolation. It is closely linked to reliability, affordability and carbon neutrality, with progress in one dimension often affecting the others. Therefore, building a resilient, low-carbon and inclusive energy system will depend not only on absorbing shocks, but on gradually reducing the structural dependencies that make those shocks so consequential.

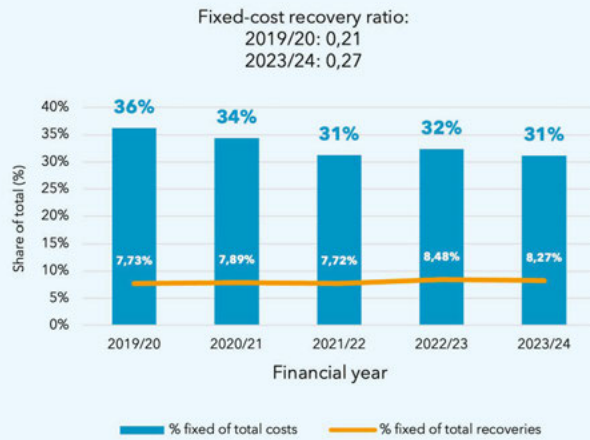
**Figure 29: Resilience of the electricity system: performance, supply diversity and financial sustainability**



**CITY-OWNED GENERATION AND STORAGE FACILITIES CONTRIBUTING TO RESILIENCE**

Source	Date commissioned	Capacity (MW)
Steenbras hydro pumped storage scheme	1979	172
Athlone gas turbine (mothballed)	1972	36
Roggebaai gas turbine	2007	42
Atlantis solar PV plant	Under construction	7
Paardevelei solar PV plant	Development phase	70

**FINANCIAL RESILIENCE: COMPARISON OF FIXED COSTS AND FIXED REVENUE SHARES**



### 3.5 Assessment of Cape Town’s energy security

The 2050 Energy Strategy defines energy security through four interlinked principles: reliability, affordability, carbon neutrality, and resilience.

This section synthesises the insights from sections 2 and 3 into an assessment of Cape Town’s state of energy security. Figure 30 below summarises the key trends affecting the energy system and economic sectors. These trends have had a direct impact on the four principles of energy security.

**Figure 30: Key trends affecting the electricity and fuels systems and sectors**

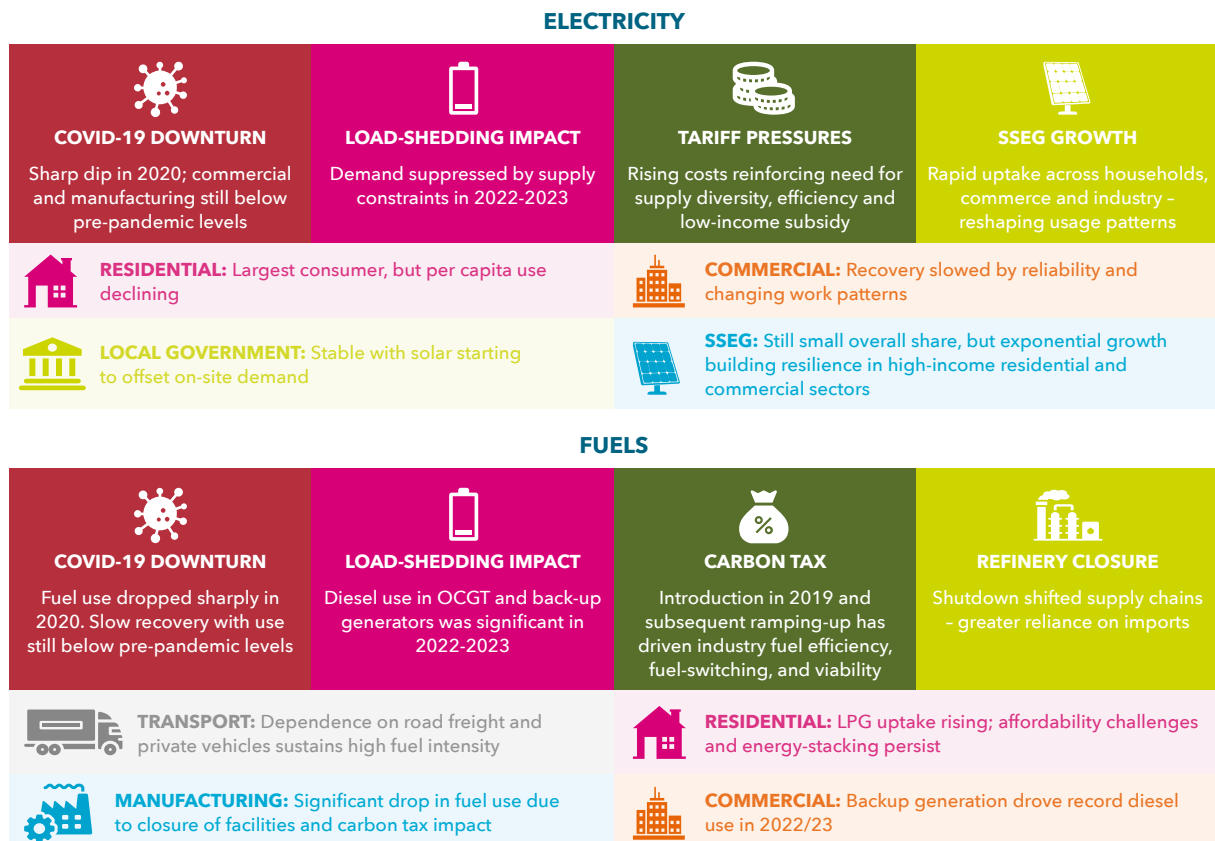


Figure 31 below summarises the state of energy security in Cape Town by energy subsystem based on the insights gleaned from the analysis of the key system trends and energy security principles.

**Figure 31: Summary of the state of energy security in Cape Town by energy subsystem**

	RELIABILITY	AFFORDABILITY	CARBON NEUTRALITY	RESILIENCE
<b>ELECTRICITY CITY SUPPLY AREAS</b>	<p><b>Stable</b></p> <p>Steenbras pumped storage reduces the severity of load-shedding by up to two stages.</p> <p>System interruption frequency index (ASIFI) consistently below thresholds.</p> <p>Increased spend on replacement of obsolete equipment.</p> <p>However, reliance on Eskom bulk supply still creates vulnerability.</p>	<p><b>Stable/declining</b></p> <p>Tariffs rising faster than CPI, though City smooths Eskom increases.</p> <p>Expanded Lifeline tariff to protect low-income households.</p> <p>Affordability remains a challenge for many customers.</p>	<p><b>Improving</b></p> <p>Growth of SSEG and municipal solar projects.</p> <p>Grid emission factor slowly declining, with more renewables.</p>	<p><b>Stable</b></p> <p>Increasing share of prepaid customers reduces non-technical losses.</p> <p>Active revenue protection and metering replacement.</p> <p>Consistent annual allocation of revenue towards repairs and maintenance.</p> <p>Small diversification beyond Eskom, though overall share remains low.</p>
<b>ELECTRICITY Eskom SUPPLY AREAS</b>	<p><b>Declining</b></p> <p>Eskom EAF fell from 65% (2020) to 55% (2023), only partly recovering in 2024.</p> <p>Load-shedding risks remain high.</p>	<p><b>Declining</b></p> <p>Above-inflation tariff increases (250% since 2014 vs 60% CPI).</p> <p>Costs passed through to municipalities and end-users.</p>	<p><b>Stable/improving</b></p> <p>Renewable IPPs increasing, but coal dependence keeps emission factor high.</p>	<p><b>Declining</b></p> <p>Heavy reliance on ageing coal fleet.</p> <p>Limited flexibility or redundancy in supply.</p>
<b>LIQUID FUELS TRANSPORT</b>	<p><b>Stable</b></p> <p>Supply secured via imports and refinery.</p> <p>Global market shocks can disrupt prices and availability.</p> <p>Recent investment in refinery.</p>	<p><b>Declining</b></p> <p>Linked to volatile global oil prices and exchange rates.</p> <p>Rising costs affect freight and private mobility.</p> <p>Transport making up a larger proportion of expenditure.</p>	<p><b>Declining</b></p> <p>Small increase in public transport and EV uptake.</p> <p>Transport sector remains highly carbon-intensive.</p>	<p><b>Stable</b></p> <p>Mature supply chain, but highly exposed to global shocks.</p> <p>Limited national refining capacity increases vulnerability.</p>
<b>LIQUID AND GASEOUS FUELS STATIONARY ENERGY</b>	<p><b>Stable</b></p> <p>Used mainly in industry and households for heating/cooking.</p> <p>Supply relatively consistent through imports.</p>	<p><b>Stable</b></p> <p>Prices sensitive to international markets, but less volatile than transport fuels.</p>	<p><b>Declining</b></p> <p>Use of LPG, paraffin and diesel remains carbon-intensive.</p> <p>Some substitution with cleaner fuels, but limited.</p> <p>Use of liquid fuels in stationary applications is linked to load-shedding.</p>	<p><b>Stable</b></p> <p>Availability generally secure, though affordability constrains access for poorer households.</p>
<b>SOLID FUELS</b>	<p><b>Stable</b></p> <p>Supply for industrial users remains reliable via national logistics.</p>	<p><b>Declining</b></p> <p>Relatively low-cost energy source, but subject to carbon tax.</p>	<p><b>Declining</b></p> <p>Highly emissions-intensive, incompatible with carbon-neutrality goals.</p> <p>Significant fuel-switching appears to have taken place.</p>	<p><b>Declining</b></p> <p>Dependence on coal exposes industry to regulatory risks, and possible future supply constraints.</p>
<b>EMERGING FUELS: HYDROGEN</b>	<p><b>Stable (emerging)</b></p> <p>Still in pilot phase (HyTra, Sasol MVP).</p> <p>Potential to support industrial resilience in the future.</p>	<p><b>Stable (expensive)</b></p> <p>Green hydrogen remains approximately 3x the cost of grey hydrogen.</p> <p>High transport and infrastructure costs slow uptake.</p>	<p><b>Improving (future)</b></p> <p>Key to decarbonising hard-to-abate sectors (steel, chemicals, heavy transport).</p>	<p><b>Stable (emerging)</b></p> <p>Strategic investment and Western Cape Roadmap set foundations.</p> <p>Risk of slow market development and stranded assets.</p>

Key: ■ Stable ■ Improving ■ Declining

The high-level findings from the energy security analysis follow below and have been integrated into the key takeaways from the SOEC analysis, which are presented in section 4:

### **Reliability**

Load-shedding in 2022-2023 was unprecedented and has had a lasting impact on households and businesses. Reliability challenges remain a defining feature of the energy system, shaping economic performance, service delivery and quality of life.

### **Affordability**

Rising electricity tariffs and volatile fuel prices have deepened affordability pressures. High-income households are increasingly insulated through efficiency and self-generation, while lower-income households remain exposed, with limited options to manage costs.

### **Carbon Neutrality**

Technology and regulation have slowed electricity emissions growth, while renewable electricity generation is increasing, albeit still representing only a modest share. Petroleum still dominates energy, and EVs are a coming major transition test, especially for distribution utilities. Drops in per capita GHG emissions

are partly the result of national economic stagnation, yet pragmatic choices in technology and business models offer cities a low-emissions growth pathway.

### **Resilience**

The energy system has demonstrated resilience in responding to refinery closures and supply disruptions, supported by storage, imports and decentralised generation. Rapid growth in SSEG signals a structural shift towards more distributed and resilient energy supply, though access remains uneven.

### **Overall Energy Security**

Overall, energy security in Cape Town has declined since 2008, and particularly from 2019 to 2023, with most subsystems assessed as declining or stable against the 2050 Energy Strategy principles. At a system level, this was driven by a significant decline in electricity reliability, and decreasing affordability across fuel types. Improvements in energy security were only evident at the individual level, where customers were able to access capital to shield themselves from declining energy security in the system.

Together, these insights provide a baseline for future interventions and investments that will help Cape Town transition to a more energy-secure future.



# 4 Key State of Energy and Carbon takeaways to feed into the Energy Strategy

The following are the key SOEC takeaways for the period in review:

- 1. Despite rapid population growth, energy demand is not increasing, but has been increasingly volatile:** In contrast to the ongoing growth seen in industrialising economies, total energy consumption remains below the 2019 peak, though has displayed volatility in response to economic shocks and supply disruptions. Commercial and industrial electricity demand declined sharply during Covid-19 and remained depressed under load-shedding, while per capita electricity use has fallen by around 30% over the past decade.
- 2. Petroleum fuels continue to dominate, despite growth in renewables:** Renewable electricity and small-scale embedded generation (SSEG) are increasing, yet 78% of total energy consumption within the metro's boundaries is from the direct combustion of fossil fuels, mostly for mobility, underscoring the scale of the decarbonisation challenge.

**3. Load-shedding changed the structure of Cape Town's energy system:** The 2022–2023 period saw supply interruptions of unprecedented duration and severity, with load-shedding in 2023 occurring over 75% of the time at some level, and 30% of the load (stage 6) disconnected for nearly one in every eight hours. This had long-lasting effects on electricity demand, economic output and confidence, the regulatory and trading landscape, energy behaviour across households and businesses, and the lifespan of distribution infrastructure, including due to vandalism. The data shows the interconnection between the City's Energy Directorate and general national financial wellbeing, emphasising the importance of identifying and mitigating/leveraging potential future system shocks to provide a sustainable service.

**4. The local liquid fuels supply chain rode out severe supply-and-demand shocks while buffering load-shedding, but affordability remains a concern:** The Astron refinery closure (2020–2022) and elevated demand for diesel during load-shedding (2021–2023) were shocks that could have led to fuel shortages. However, the system coped thanks to local import and storage capacity and an industry adept at scaling up to target opportunities. This system resilience comes at a cost, though, and long-term underlying price increases, extremely volatile fuel prices and the carbon tax have intensified affordability pressures.

**5. Transport dominates the energy mix and fossil fuel dependence but the 'electron economy' electrification challenge is imminent:** Typical of cities without concentrated heavy industry, Cape Town's transport sector dominates total energy consumption (62% in 2023), made up almost entirely of petrol and diesel. This embeds exposure to global oil markets, but also makes the sector resilient. Even partial electrification of this substantial block of energy, which seems more likely with dropping electric vehicle prices, will require large-scale change to provide the necessary local grid infrastructure and electricity supply capacity. Data centre growth, the restoration of the rail system, the substitution of fossil fuel processes as well as the use of heat

pumps for space heating are additional likely local growth loads from the 'electron' economy.

**6. Electricity consumption patterns are changing unevenly across sectors and incomes:** Some commercial customers and high-income households are increasingly offsetting grid electricity through efficiency measures, liquified petroleum gas (LPG) and SSEG, which expanded rapidly between 2019 and 2024. Load-shedding particularly redefined SSEG from a simple business decision to reduce grid electricity costs, to contributing to system resilience and customer self-sufficiency. The City extended its additional feed-in incentive on the tariff schedule and introduced a Cash for Power programme to compensate feed-in beyond just offsetting grid electricity bills. Low-income households, on the other hand, remain largely grid-dependent, constrained by affordability and limited access to resilience options.

**7. The City's electricity business faces growing financial and system complexity:** Declining electricity sales – driven by price response, efficiency gains and SSEG uptake – are reducing the capacity for cross-subsidisation and for cost recovery by the capital-intensive wires business. This, combined with rapid regulatory and market change, means that the City's electricity utility must, within a short space of time, adapt to a changing customer base, restructure its business lines, and accommodate new services, such as wheeling, at scale. Moreover, the utility has to diversify its supply options to hedge against price and supply risk through own builds, power purchase agreements (PPAs) with independent power producers (IPPs) and licensed traders, and trade in the imminent South African Wholesale Electricity Market.

**8. After 20 years of progress, providing sufficient electrification and subsidised electricity is becoming more challenging:** The high rate of urbanisation of low-income households, particularly in expanding informal settlements on contested land, presents an electrification challenge. Balancing the rate of in-migration with sustained support for the vulnerable through free basic electricity (FBE) and subsidised tariffs

in an increasingly constrained economic climate is proving difficult. This challenge is exacerbated by declining electricity sales, as it implies that the share of the customer base receiving subsidies is likely to grow with continued low-income urbanisation. This highlights both the need for cross-subsidisation for the poor to remain a policy priority, and for a review of the systems through which National Government provides financial support to local governments.

- 9. Citywide GHG emissions are declining along the voluntary target line, but remain structurally concentrated, with a major driver being low economic growth:** Citywide GHG emissions<sup>9</sup> fell from approximately 20,8 MtCO<sub>2</sub>e in 2019 to 19,4 MtCO<sub>2</sub>e in 2023 (a 6,5% absolute drop, but a 12,8% per capita drop), with stationary energy and transport combined accounting for the majority of emissions. The City is on track towards its voluntary emissions target for 2030. However, dampened activity due to economic shocks and structural economic challenges seems to be a significant driver, raising questions about the real capacity of South African cities, including Cape Town, to cope with the accelerated ‘burden sharing’ of decarbonisation required after 2030.
- 10. In a global age of data science, access to and the quality of energy and activity data in South Africa is a mixed bag:** The City’s internal and open data, Eskom’s national data and the Department of Forestry, Fisheries and the Environment’s scheduled emitters data (SAIGE, formerly known as SAGERS) all greatly improved since the last publication, although Eskom data at the local distribution level was not directly accessible. Important datasets such as liquid fuel sales and local vehicle registrations, while accessible, are increasingly self-regulated and/or less publicly available, less transparent and/or less relevant, reducing their practical value. With some exceptions, local data providers overall fall short

of international standards for openness, usability, data quality, and especially metadata availability.

- 11. Critical knowledge gaps in understanding demand:** The demand for all forms of energy dropped fast and steadily on a per capita basis over the reporting period. While it is relatively easy to infer drivers such as energy efficiency and price increases, explicitly and quantitatively attributing change to different drivers presents a challenging gap.
- 12. Overall energy security assessment:** Overall, energy security in Cape Town has declined since 2008, and particularly from 2019 to 2023, with most subsystems assessed as declining or stable against the Energy Strategy principles of reliability, affordability, carbon neutrality, and resilience. At a system level, this was driven by a significant decline in reliability, and decreasing affordability across fuel types. Improvements in energy security were only evident at the individual level, where customers were able to access capital to shield themselves from declining energy security in the system.
- 13. The ‘end’ of load-shedding and rail restoration represent green shoots:** Two major crises affecting the energy system turned around in the reporting period. While still severe in 2023, load-shedding occurred far less in 2024 and was marginal in 2025, primarily as a result of an improvement in the energy availability factors of Eskom’s generation fleet. Restoration of the rail system by state rail provider PRASA (Passenger Rail Agency of South Africa), including the provision of new train sets, saw system functioning resume in 2022, with a rapid and sustained growth in ridership. These green shoots emphasise that solutions to the difficult problems of providing reliable, affordable and carbon-neutral energy services are possible if all stakeholders across the complex systems of supply collaborate.

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<sup>9</sup> BASIC inventory as per the Global Protocol for Community-Scale Greenhouse Gas Emissions.

## Abbreviations

<b>BEV</b>	battery-electric vehicle	<b>MtCO<sub>2</sub>e</b>	million tonnes carbon dioxide equivalent
<b>CO<sub>2</sub></b>	carbon dioxide	<b>MW</b>	megawatt
<b>CO<sub>2</sub>e</b>	carbon dioxide equivalent	<b>MWh</b>	megawatt-hours
<b>Covid-19</b>	coronavirus disease	<b>OCGT</b>	open-cycle gas turbine
<b>EAF</b>	energy availability factor	<b>PJ</b>	petajoules
<b>EV</b>	electric vehicle	<b>PPA</b>	power purchase agreement
<b>FBE</b>	free basic electricity	<b>PRASA</b>	Passenger Rail Agency of South Africa
<b>GDP</b>	gross domestic product	<b>PV</b>	photovoltaic
<b>GHG</b>	greenhouse gas	<b>SAIGE</b>	System for Administration of Integrated Greenhouse Gas Emissions Reporting System
<b>GJ</b>	gigajoules	<b>SAGERS</b>	South African Greenhouse Gas Emissions Reporting System
<b>GVA</b>	gross value added	<b>SOEC</b>	State of Energy and Carbon
<b>GWh</b>	gigawatt-hours	<b>SSEG</b>	small-scale embedded generation
<b>IPP</b>	independent power producer	<b>tCO<sub>2</sub>e</b>	tonnes of carbon dioxide equivalent
<b>kW</b>	kilowatt	<b>TJ</b>	terajoules
<b>kWh</b>	kilowatt-hours	<b>TWh</b>	terawatt-hours
<b>LPG</b>	liquified petroleum gas		
<b>MAL</b>	maximum allowable limit		

## Glossary



For a full glossary, consult the 2025 SOEC main report

## References



For the full reference list, consult the 2025 SOEC main report



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ISIXEKO SASEKAPA  
STAD KAAPSTAD

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