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Crime in the Dark: Role of Electricity Rationing

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Abstract

In many developing and emerging economies, frequent power outages are often a consequence of electricity rationing, stemming from the insufficient generation capacity to meet peak demand. In an effort to minimize the disruption caused by sudden power outages, utilities often implement scheduled outages to allow consumers to prepare. However, these planned outages may inadvertently influence criminal behavior and planning. This study investigates the causal relationship between planned electricity outages and crime rates, leveraging a geographic discontinuity in outage duration due to differences in electricity suppliers within the City of Cape Town, South Africa. We compare crime trends in areas served by the municipal grid, which benefits from pumped hydro storage to mitigate outages, with those served by the national grid, where outages are more severe. We find that 10 hours per month more outages lead to an increase of 2.6 percent or eight more crime incidents. The analysis reveals that while overall crime rates are affected, specific types of crime, such as robbery, theft, and violent crime, are particularly sensitive to power outages. Outages caused by electricity rationing create opportunities for certain types of criminal activity, particularly at night. The larger the share of areas affected by severe load shedding, the higher the incidence of crime. Conversely, crimes less related to load shedding, such as commercial and drug-related offenses, are not affected by these outages.This research contributes to the growing body of evidence on the socioeconomic consequences of power outages and highlights the importance of reliable electricity access for public safety and development.

Keywords: outages, developing countries, crime, law enforcement
JEL codes: O18, O17, K42

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1 Introduction

Electricity shortages, characterized by frequent and prolonged power outages and electricity rationing, are prevalent in many developing and emerging economies despite improvements in electricity access (Gertler, Lee, and Mobarak 2017; Borenstein, Bushnell, and Mansur 2023). These shortages not only impede industrial productivity and economic growth but also potentially exacerbate social issues, including crime. The link between electricity shortages and crime can be rationalized through several theoretical channels. Electricity outages and rationing may lower the opportunity cost of committing crimes by disabling streetlights and security systems such as electric fences, and surveillance cameras, increasing the duration of crime detection, and lowering the effectiveness of police patrol, thereby creating conducive environments for criminal activities. Other channels, such as income losses, economic hardship, and psychological stress due to job losses resulting from lower firm performance, may also drive individuals towards criminal activities as a means of subsistence. However, the first channel tends to be highly localized to the areas experiencing outages and rationing, while the latter can be more widespread, affecting larger communities or regions as the exposure is dispersed based on where the labor markets are.

We exploit the geographic discontinuity in load shedding occurrences, resulting from differences in electricity suppliers, to capture the localized impact of planned outages. We take advantage of the predetermined electricity suppliers in the City of Cape Town (CCT), South Africa, where some regions are served by a municipal electricity supplier, CCT, while others are served by a national electricity supplier, Eskom. The former notably experiences less severe outages because it can take advantage of pumped hydro storage to mitigate the severity of outages. This setting offers a unique discontinuity in the frequency and duration of outages. The presence of two distinct electricity suppliers within the same municipality leads to variations in load shedding exposure between the two regions, even though they can be right next to each other.

We compiled the load shedding schedules and actual outage records from utility providers and matched them with the locations of police stations obtained from the Research Unit of the South African Police Service (SAPS). Since the schedules for electricity shortages are publicly available, certain types of crimes are more likely to occur during these planned outages, such as robbery. Therefore, we can categorize crimes based on their likelihood of occurrence due to planned outages: (1) those more likely to be influenced by outages, such as violent crime, robbery, and theft, and (2) those less likely to be influenced, such as fraud and drug-related crimes. Particularly at night, power outages significantly undermine visibility, reducing the likelihood of criminals being caught, which is particularly relevant for crimes like robbery and theft (Payne 2022; Lamb 2023).

We employ a standard difference-in-differences (DiD) methodology to infer the causal impact of increased outage duration on crime rates, leveraging variations in outage duration resulting from the presence of different electricity suppliers. The key identifying assumption is that conditional on station and time fixed effects, crime rates recorded by police stations located in regions served by CCT would have followed trends similar to those in Eskom-served regions in the absence of differential load shedding intensity. Indeed, we do not observe differential trends in crime prior to the load shedding period in our sample, reassuring us that the police stations in areas served by CCT provide a plausible counterfactual for police stations in areas served by Eskom in the absence of more severe load shedding incidents. Additionally, we include specifications that account for weather conditions during load shedding hours, along with police station-level controls and their interactions with time trends, to minimize omitted variable bias.

We find that 10 additional hours of outages per month lead to eight more crime incidents (2.6 percent of total monthly crime). Robbery, theft, and violent crimes are most affected by outages, while other crimes such as fraud and burglary show no significant change. This aligns with the potential mechanism that planned outages might lower the cost of conducting specific types of crimes. Other crimes that are less likely to be influenced by outages did not show differential trends. We find that the increase in crime primarily occurred during outages at night, and not during daytime outages, suggesting that crime is fueled by the outage-induced changes in the opportunity cost for criminal activities. Due to electricity rationing, electric utilities announce the schedule of potential outages, possibly changing the dynamics of crime planning and anticipation. This is supported by the fact that we find no changes in burglary, as households may anticipate outages, or may have backup generators, and stay at home, and put measures to guard their property.

This paper contributes to the limited body of research on the relationship between electricity rationing and crime. Most existing studies have focused on short-term outages caused by abrupt interruptions in the electric grid, with mixed results. For instance, Lal, Lee, and Query 2023 found no impact of electricity outages on crime rates during the 2021 rolling blackouts in Texas, which were caused by winter storms. Similarly, Chalfin, Kaplan, and LaForest 2021 found that outdoor nighttime crime did not change significantly on street segments experiencing street light outages, concluding that darkness in outdoor settings alone, especially unexpected sudden darkness, is not enough to trigger a substantial increase in crime incidents. Conversely, a randomized experiment in New York demonstrated that improved street lighting can reduce outdoor nighttime index crimes (Chalfin et al. 2022), and Daylight Saving Time has been shown to reduce firearm homicides (Toro, Tigre, and Sampaio 2024). However, our study focuses on the more frequent and prolonged outages induced by electricity rationing, which potentially have a stronger impact on crime due to their extended duration with a known-in-advance schedule of potential outages.

Our contribution addresses the identification challenges in disentangling the causal impact of electricity shortages on crime, which tend to be confounded by economic shocks and the quality of public safety. Most existing studies on electricity outages and crime focus on developed countries, especially the U.S., where electricity outages tend to be unplanned and brief. There is a lack of empirical evidence in the context of developing countries, where crime rates are generally higher, and public safety and police response are less robust. This increases the severity of the impact of electricity shortages on crime. Using the geographical discontinuity, this paper aims to address this gap by examining the causal relationship between planned electricity shortages and crime rates in a developing country context, leveraging high-frequency data on electricity outages and different types of crime incidents.

The remainder of this paper is structured as follows. Section 2 provides a background and context of load shedding and crime in South Africa. Section 3 describes the data used and the identification strategy, while Section 4 presents the main findings and discussion. Finally, Section 6 concludes.

2 Background

2.1 Crime in South Africa

Crime is one of the most pressing social issues in South Africa. The country has one of the highest levels of violent crimes, such as murder, rape, and robbery. Several studies have shown that inequality is both the result and cause of crime (Becker 1968; Chiu and Madden 1998; Demombynes and Özler 2005; Gramckow et al. 2016; Bhorat et al. 2020). With a Gini Index of around 0.67, South Africa is ranked as the most unequal country globally (Sulla, Zikhali, and Cuevas 2022). Even after accounting for the influence of inequality, South Africa still displays high levels of both violent and property crimes when compared to other countries with similarly high levels of inequality in the region, such as Botswana, Eswatini, Namibia, and Zambia.

In the 2022-2023 period, around 1.1 million households in South Africa experienced an estimated 1.6 million housebreaking incidents, representing 5.7% of all households in the country (Statistics South Africa 2023). At the same time, planned outages have increased substantially and coincide with the increasing trends in crime. This paper attempts to investigate whether some of the increase in crime can be attributed to unreliable access to electricity.

2.2 Planned outages

Eskom is South Africa's primary electricity utility, responsible for generating, transmitting, and distributing over 90% of the country's power. As a vertically integrated company, Eskom manages the entire electricity value chain, from coal mining to power generation, transmission, and distribution to end-users. While historically a monopoly, the company is undergoing significant restructuring to accommodate independent power producers and transition to cleaner energy sources. However, challenges such as aging infrastructure, financial constraints, and increasing demand have led to intermittent power outages, known as load shedding, impacting the nation. Initiated in October 2007, load shedding has since escalated in both frequency and duration. While insufficient generation capacity to match the growing demand was often regarded as the root cause of this energy crisis, other contributing factors include coal supply issues, inadequate maintenance, and management challenges within Eskom.

Load shedding in South Africa has eight stages, each indicating the severity of the power deficit. The system operator sets the stage based on the power needed to balance the grid, and Eskom and municipalities implement it on a rotational basis according to a predetermined schedule. Stage 1 requires shedding up to 1000 megawatts of the national load, while Stage 8 involves shedding up to 8000 megawatts. As the stages increase, both the frequency and duration of power outages escalate. For instance, during Stage 1, customers may experience power cuts up to three times over four days, each lasting about two hours. In contrast, Stage 8 can lead to up to twelve outages within the same period, with each outage lasting up to four hours (Eskom 2024). Stage 6 is the most intense level of load shedding ever implemented by Eskom, initially occurring in 2019. At this stage, outages can last up to six hours daily. In 2023, which was the worst year for load shedding, South Africans faced 44.3 days of stage 6 load shedding (Outlier and EskomSePush 2024).

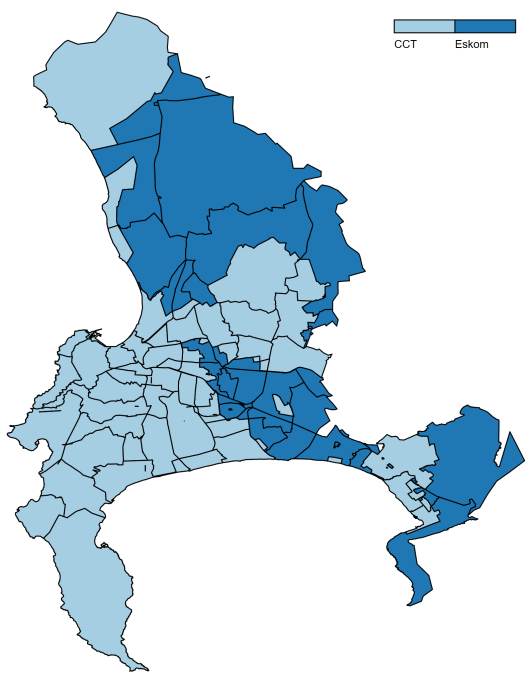
A unique aspect of load shedding in South Africa is that the schedule of power outages is predetermined and announced well in advance, with structured schedules in place as early as 2014.[1] The scheduled outage times for each stage and block vary by day of the month and are designed to rotate equitably across all load shedding blocks. Eskom designs this rotational schedule to ensure an even distribution of power cuts across different regions (Cape Town 2020). However, some blocks may occasionally experience more load shedding than others due to higher stages being in effect during their scheduled times, resulting in a greater impact on those blocks. Consequently, the specific timing and duration of each outage remain highly unpredictable (Lawson 2022). This unpredictability undermines residents' ability to prepare effectively, despite the overarching predictability of the schedule. Moreover, while the structured schedule offers a general framework, it inadvertently provides opportunities for criminal activities to be coordinated around these known blackout periods.

1. New time slots were added later when Eskom introduced higher load shedding stages (https://businesstech.co.za/news/energy/766565/new-load-shedding-stages-for-south-africa-the-big-changes-and-the-big-problems/).

2.3 The case of the City of Cape Town

The City of Cape Town (CCT) relies on the national power utility, Eskom, for electricity supply and was initially subject to Eskom's load shedding schedule. However, since February 1, 2015, CCT has implemented its own load shedding schedule. The CCT has leveraged the Steenbras Hydro Pumped Storage Scheme, Africa's first such facility, which offers a rapid 180 MW power supply (Matthews 2015; Cape Town 2023), allowing them to implement less severe load shedding stages in City-supplied areas compared to the rest of the country.[2] Figure 1 shows the load-shedding zones served by CCT and Eskom. Figure 2 compares the daily average load shedding duration per block between areas served by Eskom and CCT. The data suggest that CCT's served regions generally experience the same or shorter duration of load shedding compared to those under Eskom. In 2022, Eskom shed 2.3 hours more per day than CCT. By 2023, this increased to on average 5 hours more per day, effectively doubling the previous year's difference (see Figure 4).

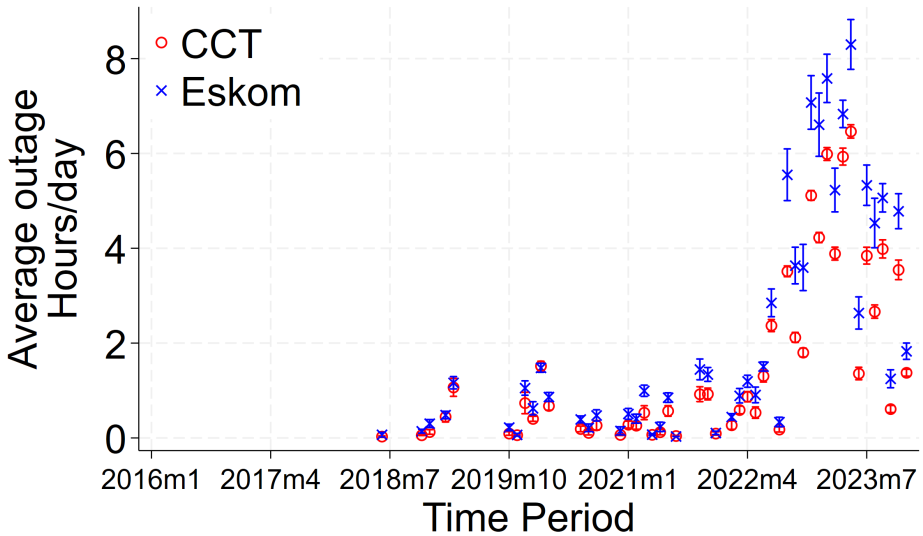
Figure 1: Discontinuity in the electricity providers within CCT



Notes: The background polygons indicated police station boundaries as of 2023, while the color indicates regions served by either CCT or Eskom.

2. This pumped hydro can be started at short notice with 12.5 hours of supply at full load (Cape Town 2023).

Figure 2: Load shedding duration by CCT and Eskom shed area



Notes: The load shedding time refers to the daily average duration of load shedding experienced by police stations in a given month. The period covered is from January 2016 to December 2023. The error bars represent the standard deviation indicating variation across different police stations.

3 Data and Empirical Strategy

3.1 Data

To investigate the role of longer power outages in crime rates, we combine four datasets: crime statistics, load-shedding schedules, weather data, and socioeconomic indicators. First, for our outcome variable, we use monthly crime rates by type from monthly crime statistics published by the Research Unit of the South African Police Service (SAPS) from January 2016 to December 2023. The crime statistics include reported crimes (by either the victims, witnesses, or third parties) and crimes detected by the police at the station level (SAPS 2023). There are 62 police stations in CCT as of 2023. We use the crime categorization created by SAPS and report the summary statistics of the outcome variables in Table 1. We use police station coordinates to determine whether their coverage areas fall within Eskom or CCT service territories. Where a police station's coverage overlaps both regions, its precise location is used to assign it to the appropriate electricity supplier. Given the potential impact of electricity supply on police operations, accurately identifying the utility provider for each station is crucial.[3]

The impact of electricity outages on crime likely varies across different crime categories. We can categorize crime types into two categories: more relevant to outage and less relevant.

3. We also use Eskom share variable which indicate the share of Eskom-served area relative to the total area coverage of the police station (see Section 5.

The more relevant crime indicates that outages are likely to influence the cost of conducting crimes within this category, such as robbery, violent crime, theft, and burglary. Robbery seems to be the most relevant one, as suggested by previous studies and news reports (Chalfin, Kaplan, and LaForest 2021; Lamb 2023). Violent crimes, which have the highest incidence, involve the use of violence or the threat to use violence against a person, murder, attempted murder, sexual offenses, and assault with the intention of inflicting grievous bodily harm. The less relevant category includes commercial crimes, drug-related crimes, driving violations, and illegal possession of firearms. These types of crimes rarely depend on electric reliability and therefore might be less influenced by the severity of load shedding. We conduct the same analysis for these two categories in Table 4 and Table 5.

We obtained the load-shedding data for CCT-served areas from the City of Cape Town's Open Data Portal. The dataset contains the load shedding schedule, including stages, affected areas, and implementation times within the areas load shed by the City from June 2018 to December 2023.[4] The areas supplied by Eskom were obtained from EskomSePush, an application that tracks the timing of Eskom's announcement for load shedding via tweets. This data is then merged with Eskom's static load shedding schedule, which specifies the location, day of the month, times, and load shedding stages. An area experiences load shedding only when its pre-determined outage time intersects with Eskom's announced load shedding period. For example, if Eskom announces that stage 1 load shedding will start at 16:00 on October 3rd, 2023, and last until 5:00 the next day, and area A's schedule shows stage 1 load shedding from 2:00 to 4:30 on the 4th (as shown in Figure 3), while area B's schedule (not shown) indicates stage 1 load shedding from 8:00 to 10:30 on the 3rd, then only area A will experience load shedding. In other words, actual load shedding in a particular region depends on the stage announced for that day and whether the region has a scheduled outage for that specific load shedding stage.

Literature has shown that crime rates are associated with temperature (Ranson 2014). To avoid omitted variable bias, we add a set of control variables that includes weather data from Open-Meteo that includes hourly temperature and precipitation, socioeconomic variables from the 2011 community census that contain small region characteristics such as total number of households, years of education, and income and public infrastructure data such as public lights and public road from Cape Town's Open Data Portal. All of these variables do not differ in time, except the weather data. The result of combining all this dataset, we end up with a panel of 62 police stations observed for 96 months, from January 2016 to December 2023. Table 1 presents the summary statistics for crime incidence by crime type in CCT and Eskom-supplied areas. Table 2 reports descriptive statistics for our primary independent variable—load shedding intensity—alongside the full set of control variables employed in our empirical specifications.

4. There was no load shedding from 2016 to June 2018.

Table 1: Summary Statistics: Crime

(a) Crime in the year 2016-2017

	CCT				Eskom			
	Mean	SD	Min	Max	Mean	SD	Min	Max
All Crimes	305	244	0	1,561	361	164	17	686
Robbery	35	38	0	234	55	36	1	192
Violent Crime	85	87	0	492	150	86	7	375
Theft	96	90	0	634	82	51	3	235
Burglary	42	27	0	151	47	23	3	104
Commercial Crime	12	15	0	115	11	12	0	55
Drug Crime	90	99	0	578	113	84	0	424
Driving Violation	11	11	0	88	16	14	0	102
Illegal firearms	3	5	0	39	6	7	0	37
Observations	1152				336			

(b) Crime in the year 2018-2023

	CCT				Eskom			
	Mean	SD	Min	Max	Mean	SD	Min	Max
All Crimes	241	183	0	1,384	322	160	11	708
Robbery	30	33	0	223	52	34	0	175
Violent Crime	77	72	0	439	152	93	2	420
Theft	67	61	0	501	61	41	2	184
Burglary	27	19	0	125	32	19	0	103
Commercial Crime	16	16	0	120	15	15	0	93
Drug Crime	57	75	0	493	65	64	0	387
Driving Violation	6	8	0	65	10	11	0	78
Illegal firearms	3	4	0	50	5	6	0	43
Observations	3456				1008			

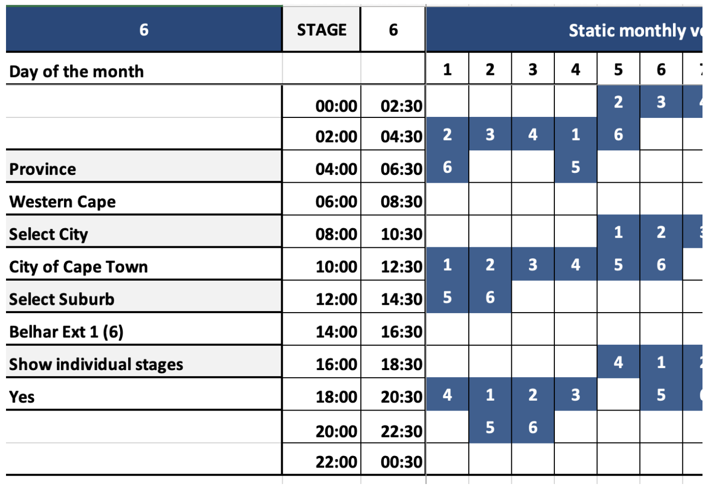
Notes: This table presents summary statistics for monthly crime incidence across crime categories at the police station level in the City of Cape Town, disaggregated by electricity supply jurisdiction (City of Cape Town vs. Eskom). Panel A depicts the period without load shedding (2016-2017), while Panel B covers the years with load shedding (2018-2023).

Table 2: Summary Statistics: Load Shedding and Control Variables

	CCT				Eskom			
	Mean	SD	Min	Max	Mean	SD	Min	Max
Total Outage Hours	32.6	50.4	0.0	209.1	46.6	68.1	0.0	270.0
Outage Fraction	1.1	1.7	0.0	6.7	1.5	2.2	0.0	8.7
Nighttime Outage Hours	18.6	29.2	0.0	123.1	25.2	37.1	0.0	150.4
Nighttime Outage Fraction	0.6	1.0	0.0	4.0	0.8	1.2	0.0	4.9
Max Temperature	29.8	4.7	17.5	40.8	30.0	4.6	18.2	41.2
Max Precipitation	4.2	2.9	0.1	16.6	4.1	2.8	0.2	18.6
Temperature above 35°C	0.1	0.3	0.0	1.0	0.1	0.3	0.0	1.0
Proportion of Informal Settlement	0.2	0.2	0.0	0.7	0.1	0.1	0.0	0.5
Total HH	32.6	24.4	5.2	145.6	44.6	26.7	5.2	119.2
Area (km^2)	36.7	53.5	2.9	264.7	38.4	60.0	5.9	264.7
Median Income 000 ZAR	148.1	80.3	16.9	335.2	110.3	80.0	27.7	335.2
Years of education	10.0	1.2	8.0	12.6	9.3	1.1	8.1	12.6
Income Inequality	0.6	0.1	0.4	0.8	0.6	0.1	0.4	0.7
Public Light Density ($/km^2$)	236.6	161.1	0.2	552.9	185.1	120.2	0.2	482.7
Road (km)	187.8	115.4	19.1	538.7	203.1	109.4	27.3	538.7
Observations	4608				1344			

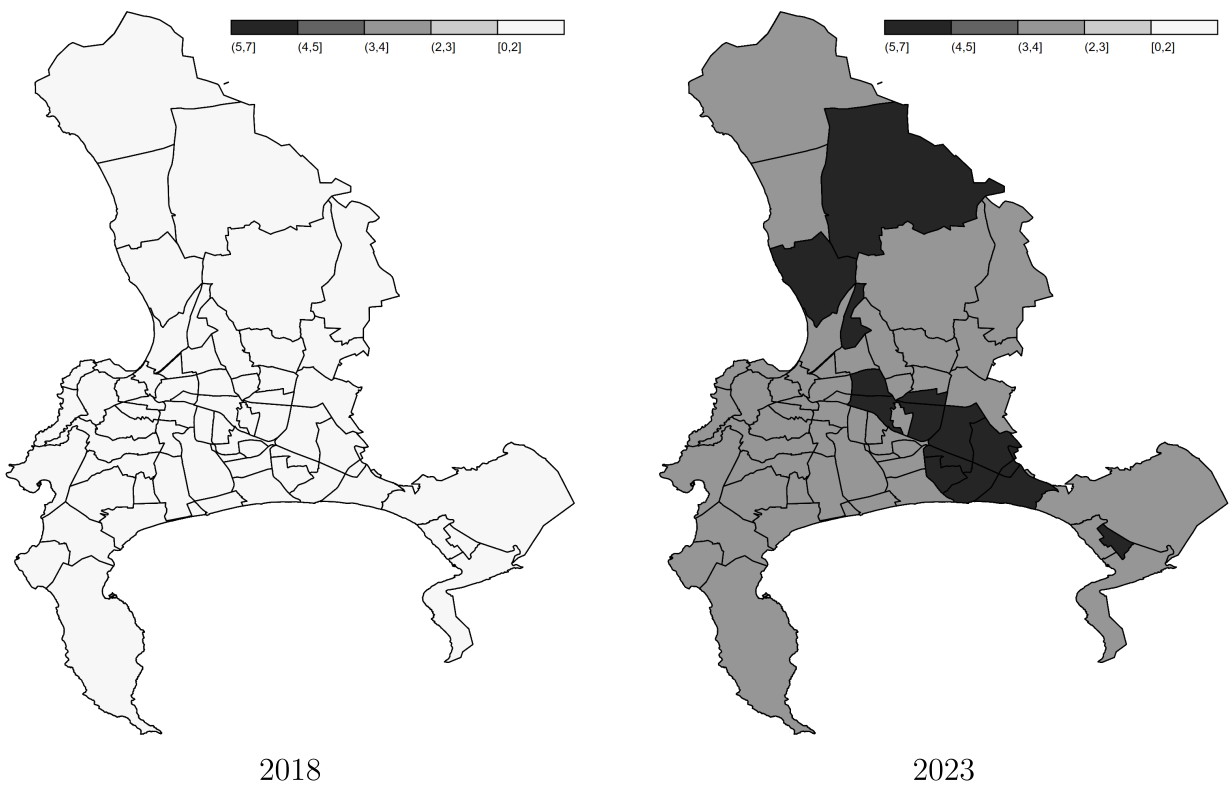
Notes: Total outage hours represent the cumulative monthly load shedding duration per load shedding block. Outage Fraction is the proportion of load shedding hours relative to the total number of hours in a given month. Nighttime Outage is defined as load shedding between 18:00 and 06:00 the following day. Temperature above 35°C indicates the monthly proportion of days exceeding this threshold. The total number of households (in thousands) and median income (annual, in ZAR) are derived from the 2011 census data for each police station boundary. Years of education variable reflects the mean educational attainment, while Income Inequality is measured by the Gini index, both based on 2011 census data at the police station level.

Figure 3: Snapshot of Eskom's load shedding schedule



6	STAGE	6	Static monthly v					
Day of the month			1	2	3	4	5	6
	00:00	02:30					2	3
	02:00	04:30	2	3	4	1	6	
Province	04:00	06:30	6			5		
Western Cape	06:00	08:30						
Select City	08:00	10:30					1	2
City of Cape Town	10:00	12:30	1	2	3	4	5	6
Select Suburb	12:00	14:30	5	6				
Belhar Ext 1 (6)	14:00	16:30						
Show individual stages	16:00	18:30					4	1
Yes	18:00	20:30	4	1	2	3		5
	20:00	22:30		5	6			
	22:00	00:30						

Figure 4: Comparison of average outage hours per day in 2018 and 2023



In the left (right) panel, the graph shows the distribution or average number of hours of power outages per day across different regions or periods within the year 2018 (2023). It shows the geographical variation in the average duration of power outages between the two years. Darker regions experienced a higher frequency of load shedding and it coincides with Eskom serving regions.

3.2 Identification Strategy

We employ a standard difference-in-differences (DiD) methodology to infer the causal impact of increased outage duration on crime rates, focusing on police stations located within the

City of Cape Town (CCT) municipality. Our analysis leverages variations in load shedding duration resulting from the presence of different electricity providers. Regions served by CCT experienced less frequent load shedding compared to those served by Eskom. The key identifying assumption is that conditional on station and time fixed effects, crime rates in police stations located in regions served by CCT would have followed trends similar to those in Eskom-served regions in the absence of differential load shedding intensity. Given that our outcome variables are crime count data, we estimate the following Poisson regression:

$$\text{Crime}_{itm} = \exp(\alpha + \sum_{y=2016}^{2023} \boldsymbol{\beta_y} \text{Eskom}_{im} \times \text{Year}_y + \delta_t + \theta_i) U_{itm} \tag{1}$$

where Crime_{itm} is the crime count for station i in year-month t and region m. Eskom_{im} is a dummy variable equal to 1 if police station i is located in a region served by Eskom and 0 otherwise, while Year_y are dummy variable for each year. $\boldsymbol{\beta_y}$ are a set of coefficients capturing the differences in crime rates between Eskom and CCT regions for each year. Our data spans from 2016 to 2023, with outages started on June 14, 2018. We set 2017 as the reference year, and therefore, the $\boldsymbol{\beta_y}$ coefficients for the years 2018 to 2023 capture the impact of longer outage duration on crime relative to 2017.[5] δ_t represents the month-year fixed effect, and θ_i represents the police station fixed effect. The error term U_{itm} is clustered at the police station level.

To account for potential confounding factors, we include several control variables in our analysis. At the police station level, we incorporate average values for the share of informal settlements, total households, median income, average education, road length, and public light density. We also control for maximum daily temperature, total precipitation, and a temperature exceedance dummy (temperature exceeding 35 degrees Celsius) during load shedding hours. To capture potential time-varying effects, we interact police station-level controls with time trends.

Pre-trends. A crucial assumption for the DiD approach is the parallel trends between the two groups before the onset of load shedding. Table 3 presents the results of our parallel trends test for the baseline years of 2016 and 2017, the two years preceding the implementation of load shedding in June 2018. The statistically insignificant coefficients for Eskom-supplied areas in both years indicate no substantial differences in crime trends between Eskom and CCT supply areas between 2016 and 2017, supporting the parallel trends assumption. This finding reassures us that crime rates in the two regions exhibited similar trends before the implementation of load shedding, making it plausible that they would have continued to trend similarly in the absence of load shedding.

5. Alternatively, we use the continuous variable of monthly aggregated load shedding duration instead of the Eskom dummy. In another specification, we also replace the Eskom dummy with the Eskom share area variable.

Table 3: Parallel test for baseline years (2016-2017)

	(1) All Crimes	(2) Robbery	(3) Violent Crime	(4) Theft	(5) Burglary
Eskom=1 × year=2016	-0.013	0.016	-0.021	0.071	-0.038
	(0.030)	(0.051)	(0.036)	(0.048)	(0.033)
Observations	1,440	1,440	1,440	1,440	1,440

Notes: Parallel trends tested using Poisson regression specified in Equation 1 but for 2016 and 2017 period only, with monthly crime types count as the dependent variable, an Eskom dummy as the key independent variable, and the interaction with year fixed effects, following Equation 1. Standard errors clustered at the police station level.

4 Results

Table 4 presents the DiD model estimation of the impact of planned outages on crime rates. The reference year is 2017. Most relevant crime types experience an increase of around 5% to 16% per month relative to 2017 in Eskom-served areas vs CCT-served areas, assuming other factors remain constant. Table 2 shows the differences in average monthly load shedding between Eskom and CCT served areas, which is around 14 hours per month over the whole sample. Although it is clear that some years were significantly worse than the other according to Figure 5a, showing a marked increase in the disparity starting in 2018, peaking at approximately 150 hours per month in 2023 for all-day load shedding and close to 100 hours for nighttime load shedding. In 2023, when Eskom-served areas experienced 150 more hours of load shedding compared to CCT-served areas, it is estimated that this led to a 14% increase in crime, translating to 41 additional crime incidents from the 295 total crime count in CCT-served areas in 2007.

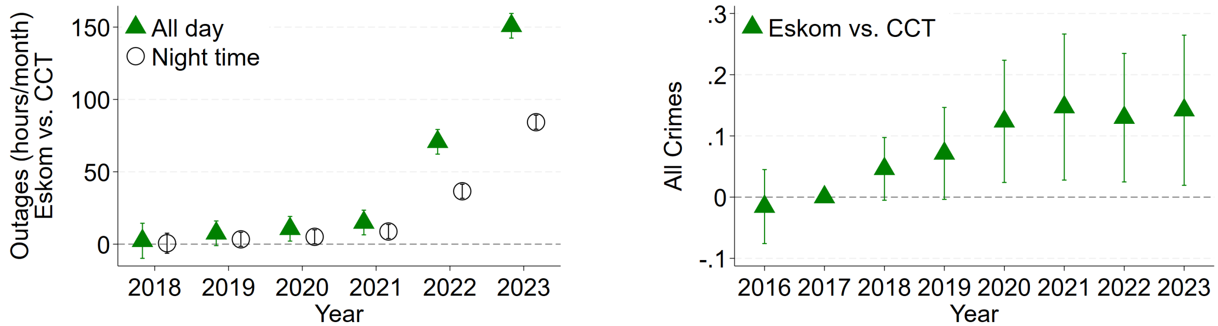
Table 4: DiD results on crime

	(1) All Crimes	(2) Robbery	(3) Violent Crime	(4) Theft	(5) Burglary
Eskom=1 × year=2016	-0.016	0.011	-0.025	0.072	-0.040
	(0.031)	(0.049)	(0.037)	(0.046)	(0.035)
Eskom=1 × year=2018	0.046*	0.043	0.048	0.051	0.019
	(0.026)	(0.039)	(0.038)	(0.040)	(0.041)
Eskom=1 × year=2019	0.072*	0.050	0.072	0.094	0.069
	(0.038)	(0.063)	(0.061)	(0.062)	(0.054)
Eskom=1 × year=2020	0.12**	0.12*	0.12**	0.18**	-0.092
	(0.051)	(0.060)	(0.051)	(0.087)	(0.065)
Eskom=1 × year=2021	0.15**	0.22***	0.16**	0.16*	0.0055
	(0.061)	(0.064)	(0.069)	(0.094)	(0.071)
Eskom=1 × year=2022	0.13**	0.19***	0.15**	0.17**	0.088
	(0.054)	(0.068)	(0.070)	(0.082)	(0.065)
Eskom=1 × year=2023	0.14**	0.21**	0.16**	0.22**	0.098
	(0.063)	(0.086)	(0.082)	(0.097)	(0.080)
CCT Mean Outcome	295.5	35.7	84.2	92.5	39.9
Observations	5,923	5,923	5,923	5,923	5,923

Notes: The outcome variable is indicated on the corresponding column header. To conserve space, we only report the coefficient of the interaction term between Eskom dummy and the year dummies, following Equation 1. The year 2017 is the reference year, thus no coefficient for 2017 is reported. Similar regressions but with different specifications and with more complete coefficients are reported in Table 8 in the Appendix. Standard errors clustered at the police station level.

Electricity rationing leads utilities to announce potential outage schedules, which may alter crime planning and anticipation. Consistent with our hypothesis, Table 4 column 5 shows no change in burglary rates. Households might anticipate outages, use backup generators, stay home, and implement measures to protect their property.

Figure 5: Differences between Eskom and CCT regions



(a) Outages duration

(b) Monthly aggregated crime counts

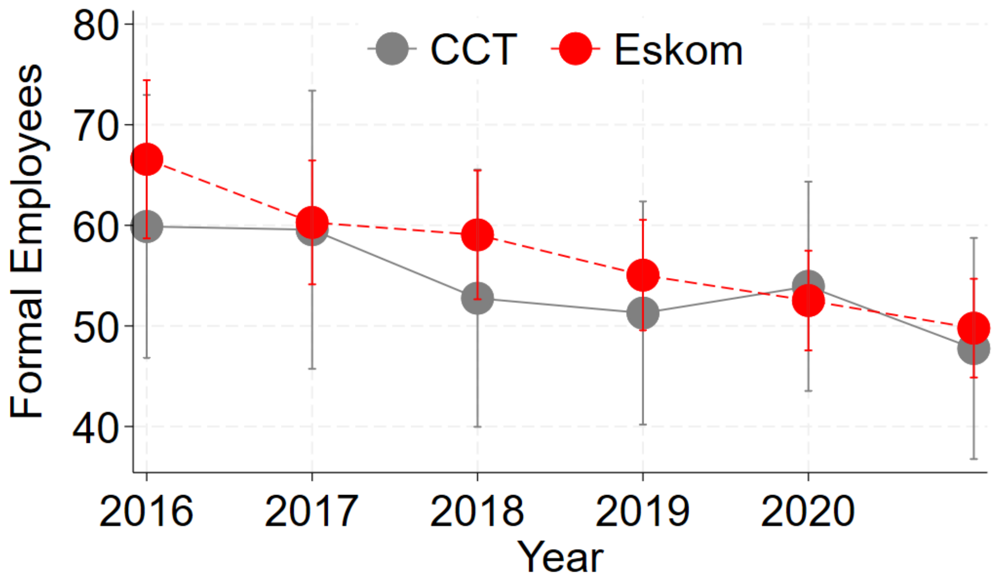
4.1 Threat to identification

Several potential threats could bias the estimated effect of load shedding on crime. First, rising crime trends may be influenced by factors unrelated to load shedding, such as the COVID-19 pandemic, political instability, or widespread job losses, which might have affected the region independently of electricity reliability. However, since both Eskom and CCT-served areas are within the same municipality, it is likely that these macroeconomic factors influenced both regions similarly.[6] For instance, if firms in Eskom-served regions suffer more from load shedding and lay off workers, the impact on the labor market is likely dispersed, as workers can reside in either CCT or Eskom-served regions, regardless of where the firm is located or which load-shedding block it falls under. Figure 6 suggests that trends in the number of formal employees do not significantly differ between CCT and Eskom-served regions, indicating no distinct pattern in formal worker layoffs between these areas. Although this figure does not capture trends among informal employees, if the supply of formal and informal workers is correlated, it is reasonable to expect similar patterns among informal workers.

Another concern is that our analysis might inadvertently capture a general trend of increasing crime in Eskom-served areas, which could be correlated with both observable and unobservable station-specific characteristics. To address this, we include time trends interacted with station-level control variables to account for crime trends explained by station characteristics over time. Additionally, we conduct a placebo test by analyzing other types of crimes less likely to be directly impacted by outages, such as commercial crime, drug crime, driving offenses, and illegal possession of firearms (discussed in Section 3.1). For instance, criminals planning to commit commercial crimes, such as trademark theft, bank fraud, and tax evasion,

6. Even if the COVID-19 pandemic affected the Eskom area more than the CCT area, the direction of this impact on crime is not entirely clear. Data shows that crime incidents decreased during the pandemic in 2020. However, no substantial divergence in crime trends is observed between Eskom and CCT-served regions starting from 2020.

Figure 6: Trends in the number of formal employees



Notes: The figure shows the average number of employees reporting their taxes and disclosing their employer. Based on the employer's location, we identify whether it falls under Eskom or CCT-served regions. There is no clear evidence that Eskom regions behave substantially differently from CCT regions, suggesting that the formal labor market is generally dispersed and not correlated with the division of the electricity provider. Source: Personal Income Tax from South African Revenue Service and National Treasury.

are unlikely to be more active during load shedding, as these crimes require extensive planning, and load shedding does not directly alter the opportunity cost of committing them. Similarly, drug-related crimes, which involve traffickers moving drugs in and out of the country disguised as legitimate cargo, do not depend on electricity reliability, making load shedding incidents less likely to reduce the cost of committing these crimes.[7] While one could argue that load shedding might still affect the cost of conducting these types of crimes, we posit that they are less impacted than crimes like robbery, theft, and violent offenses. Table 5 shows that the impact of outages on these less affected crimes is negligible or even negative, with some coefficients being significantly smaller in magnitude compared to those in Table 4. Although one coefficient related to driving violations was significantly positive in 2018, this effect is not consistent across the years. These findings suggest that the increasing trends in robbery, theft, and violent crimes are more likely attributable to the growing duration of load shedding rather than a general increase in crime.

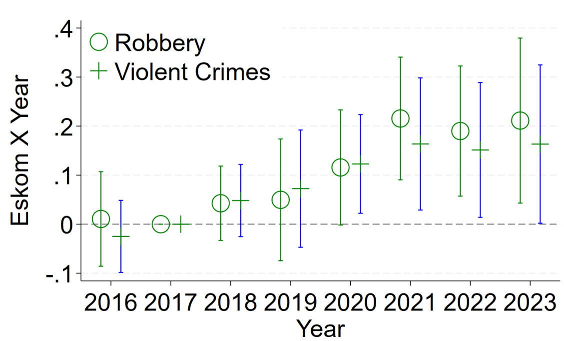
7. https://www.dailymaverick.co.za/article/2024-08-13-watch-south-africas-deep-connection-to-the-global-drug-trafficking-underworld/

Table 5: Outage effects on crimes that are less influenced by load shedding

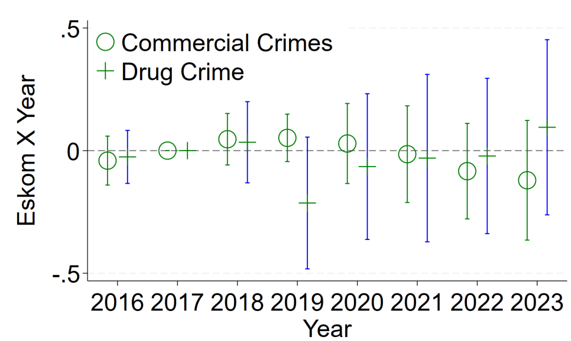
	(1) Commercial Crime	(2) Drug Crime	(3) Driving Violation	(4) Illegal firearms
Eskom=1 × year=2016	-0.041	-0.026	0.13	0.054
	(0.051)	(0.056)	(0.12)	(0.13)
Eskom=1 × year=2018	0.047	0.035	0.15*	0.041
	(0.054)	(0.085)	(0.088)	(0.11)
Eskom=1 × year=2019	0.052	-0.21	-0.085	0.015
	(0.049)	(0.14)	(0.15)	(0.15)
Eskom=1 × year=2020	0.029	-0.066	-0.11	0.046
	(0.083)	(0.15)	(0.13)	(0.13)
Eskom=1 × year=2021	-0.014	-0.031	0.18	0.0038
	(0.10)	(0.17)	(0.18)	(0.18)
Eskom=1 × year=2022	-0.084	-0.023	-0.12	0.029
	(0.099)	(0.16)	(0.19)	(0.14)
Eskom=1 × year=2023	-0.12	0.095	0.16	0.015
	(0.12)	(0.18)	(0.22)	(0.16)
CCT Mean Outcome	11.8	95.5	10.6	3.1
Observations	5,923	5,923	5,923	5,827

Notes: The observation count for illegal possession of firearms is lower due to the exclusion of one police station from the analysis, as this station reported zero incidents of this crime type within the sample period. Standard errors are clustered at the police station level.

Figure 7: The contrast in the impact of load shedding on different types of crimes



(a) Likely to be influenced by load shedding



(b) Less likely to be influenced

Notes: Figure (a) presents the coefficients from Table 4, which focuses on crimes likely to be influenced by load shedding, while Figure (b) presents the coefficients from Table 5, which focuses on crimes less likely to be influenced by load shedding as the outcome variable.

5 Mechanism

Planned power outages, such as load-shedding, can influence crime through several potential channels. We discuss two primary mechanisms: the opportunity cost channel and the economic strain channel.

Opportunity channel. One of the main ways load-shedding might affect crime is by lowering the opportunity cost of committing criminal activities. We show two supporting evidence: load shedding during night time and the density of public street lighting.

During planned outages, the absence of lighting and security systems may create more opportunities for crimes such as burglary, theft, and vandalism. Studies have shown that darker environments are associated with an increase in certain types of crime (Ratcliffe 2015; Chalfin et al. 2022). Moreover, the failure of security systems during power outages could reduce the risk of detection and apprehension, leading to an increase in crime during these periods (Tompson and Bowers 2013). Conversely, load-shedding might decrease crime if potential victims take preventive measures, such as staying at home and securing their properties. Our analysis considers the fact that police stations may be less effective during outages, as officers might be out patrolling and not available at the station, depending on whether the police station is located in a region served by Eskom or CCT.

We test whether changes in crime are primarily driven by outages during the night or daytime and whether crime incidents are more affected by severe load-shedding. Table 6 compares the impact of load shedding occurring during the daytime and nighttime. As expected, the increase in crime is linked to outages during the nighttime. The coefficients for nighttime load shedding duration and frequency are larger than those for day-time load shedding, supporting the argument that nighttime shedding, by reducing visibility, further increases the likelihood of crime incidents. This pattern holds consistently across different types of crime. The findings on theft are in line with existing studies, which show that motor vehicle theft increased the most due to street light outages in Chicago (Chalfin, Kaplan, and LaForest 2021). Similarly, the pattern observed in violent crime aligns with the effect of Daylight Saving Time (DST) on homicides in Brazil, where there was a 9.83% reduction in firearm homicides during DST months (Toro, Tigre, and Sampaio 2024). The high temperature during load shedding also explains some of the increase in crime incidents, consistent with the well-known relationship between crime and heat (Ranson 2014).

To provide some perspective on the magnitude, a one-hour increase in nighttime outages per month led to a 0.26% increase in total crime. Given the mean total crime incidents of 295 in 2017, 0.26% of this is approximately 0.8 incidents. Therefore, a 10-hour increase in nighttime outages per month would lead to an increase of 8 total crime incidents. This increase approximately consists of 2 additional robberies, 3 violent crimes, and 3 theft incidents.

Table 6: Role of time of day when outages occurred

	(1) All Crimes	(2) Robbery	(3) Violent Crime	(4) Theft	(5) Burglary
Nighttime Outage Hours	0.0026***	0.0040*	0.0032**	0.0031**	-0.00017
	(0.00085)	(0.0021)	(0.0013)	(0.0012)	(0.00094)
Daytime Outage Hours	0.00051	-0.00063	-0.00065	0.0013	0.0017
	(0.00095)	(0.0015)	(0.0011)	(0.0016)	(0.0012)
Max Temperature	0.0027	0.012**	0.0032	0.010***	-0.0035
	(0.0026)	(0.0052)	(0.0035)	(0.0036)	(0.0037)
Max Precipitation	0.00073	0.00075	0.0011	0.0014	0.00053
	(0.0015)	(0.0028)	(0.0022)	(0.0022)	(0.0027)
Temperature above 35°	0.013	-0.00091	0.011	-0.0022	0.038*
	(0.0096)	(0.024)	(0.013)	(0.023)	(0.019)
CCT Mean Outcome	295.5	35.7	84.2	92.5	39.9
CCT Outage	13.0	13.0	13.0	13.0	13.0
Eskom Outage	17.3	17.3	17.3	17.3	17.3
Observations	5,923	5,923	5,923	5,923	5,923

Notes: The outcome variable is indicated on the corresponding column header. Following Equation 1, in this table, we replace dummy Eskom and the interaction term with the year dummies with the total outage per month (in hours). We split the outage hours into nighttime vs daytime outages. The standard errors clustered at the police station level.

To confirm that the increase in nighttime crime is driven by Eskom-served regions, we utilize the Eskom share variable. This variable equals one if a police station's coverage area is entirely served by Eskom. If the coverage is split between CCT and Eskom, the value is the ratio of the Eskom-served area to the total coverage area. We then interact the duration of load shedding with the Eskom share variable. Our hypothesis is that as the Eskom share increases, the impact of load shedding on crime should also increase. Table 7 supports this hypothesis. Similarly, we find that daytime outage hours do not significantly explain the increase in crime incidents.

The malfunctioning of street lighting during outages can diminish the deterrent effect against crimes in public spaces, making it easier for such activities to occur without intervention. However, the presence of street lighting often indicates a higher level of public provision, typically found in wealthier areas that may already have measures in place to adapt to outages. In contrast, poorer areas with fewer public amenities are less equipped to handle outages and may therefore become more attractive targets for crime. We conduct a heterogeneous analysis comparing areas with more streetlights to those with fewer streetlights.

Figure 8 illustrates a notable trend: regions with fewer amenities, as indicated by the lower number of public lights, tend to experience higher crime rates during power outages.

Table 7: Role of time of day when outages occurred as share of Eskom region increases

	(1) All Crimes	(2) Robbery	(3) Violent Crime	(4) Theft	(5) Burglary
Eskom Share × Nighttime Outage Hours	0.0048**	0.0100***	0.011***	-0.0022	0.0048**
	(0.0022)	(0.0030)	(0.0027)	(0.0025)	(0.0024)
Eskom Share × Daytime Outage Hours	-0.0013	-0.0023	-0.00067	-0.0013	-0.0025
	(0.0026)	(0.0036)	(0.0033)	(0.0031)	(0.0029)
Max Temperature	0.0097	0.0041	-0.013*	0.022***	0.0023
	(0.0059)	(0.0081)	(0.0073)	(0.0073)	(0.0052)
Max Precipitation	-0.0094	-0.028***	-0.024***	-0.0030	0.0094
	(0.0069)	(0.0097)	(0.0091)	(0.0081)	(0.0071)
Temperature above 35°C	-0.021	-0.097	-0.016	-0.036	0.090*
	(0.051)	(0.070)	(0.063)	(0.060)	(0.051)
CCT Mean Outcome	295.5	35.7	84.2	92.5	39.9
CCT Outage	18.6	18.6	18.6	18.6	18.6
Eskom Outage	25.2	25.2	25.2	25.2	25.2
Observations	4,139	4,139	4,139	4,139	4,139

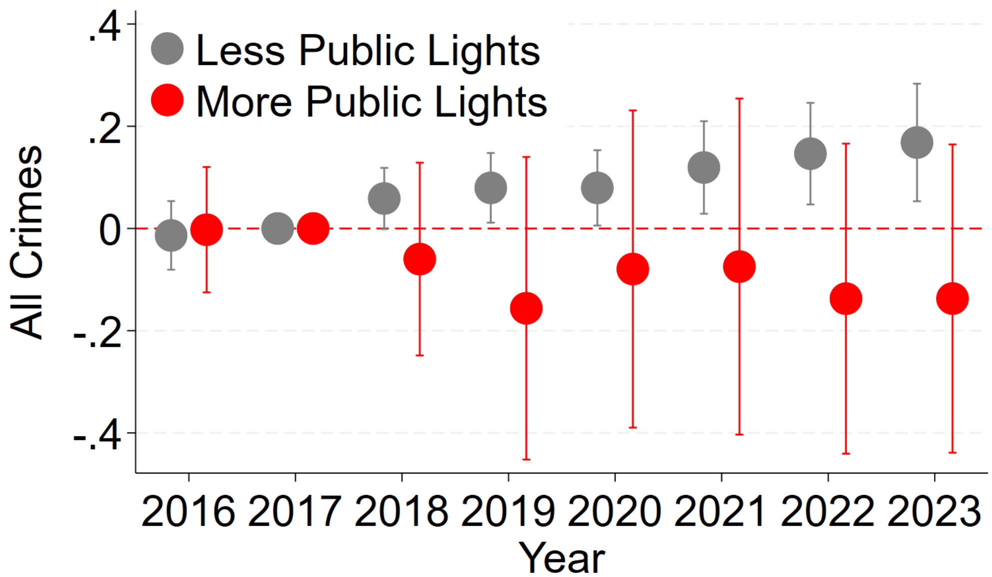
Notes: The outcome variable is indicated on the corresponding column header. Following Equation 1, in this table, we replace dummy Eskom and the interaction term with the year dummies with the total outage per month (in hours) interacted with the share of Eskom-served region within the police station coverage. We exclude station fixed effects due to collinearity. We split the outage hours into nighttime vs daytime outages. The standard errors clustered at the police station level.

This observation supports the hypothesis that the cost of committing crimes in these areas decreases when load shedding is more severe. The lack of amenities often correlates with a reduced likelihood of having backup power sources, making these regions more vulnerable during outages. Consequently, the absence of adequate lighting and security measures during load shedding periods creates an environment where criminal activities can thrive with reduced risk of detection and intervention.

Economic strain channel. Load-shedding can also impose economic strain on individuals and communities, potentially leading to an increase in economically motivated crimes. The economic strain effect posits that the financial stress caused by business disruptions, loss of income, and damage to electrical appliances could push some individuals toward criminal activities as a means of compensating for lost income. For example, load-shedding has been shown to disrupt small businesses and daily wage workers, who may experience significant income losses during outages (Nicholas, Kholopane, and Dlamini 2019). In response, some individuals may turn to illicit activities to mitigate the financial shortfall. To empirically test the economic strain effect, we conduct a heterogeneity analysis comparing areas with larger vs. smaller shares of economically disadvantaged populations, proxied by the share of informal settlements.

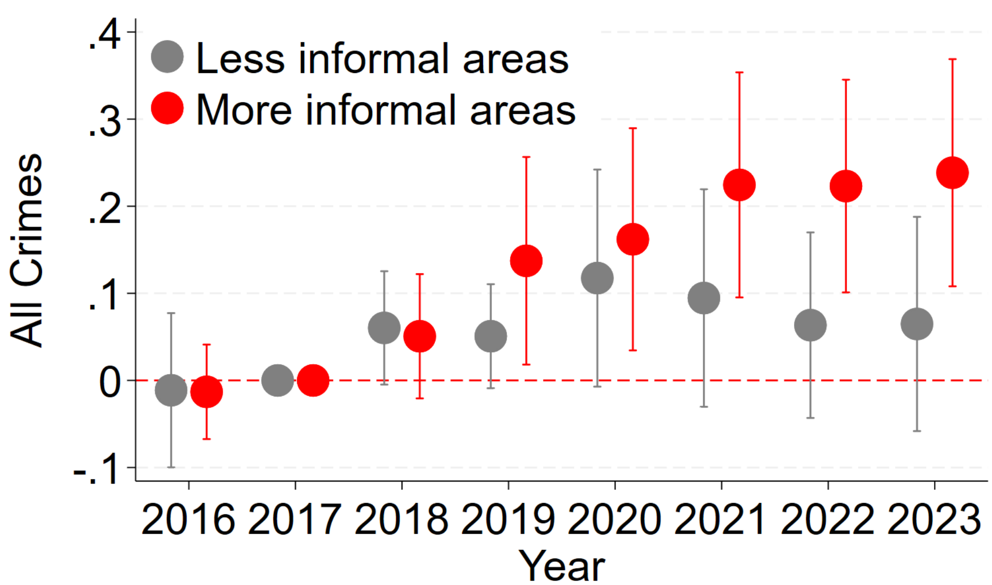
Figure 9 suggests that crime trends increase more significantly in areas with larger informal settlements. In contrast, high-income neighborhoods, which typically have fewer informal

Figure 8: Heterogenous effects by Public Lightings



settlements, can afford to protect themselves from crime by investing in additional security measures or backup generators to mitigate the effects of load shedding. Consequently, crime is more likely to rise in areas with less adaptation to outages and fewer security measures, which are often areas with a larger share of informal settlements. Additionally, the proximity of informal settlements to residential areas can facilitate criminal activities, as shorter distances make it easier for criminals to operate.

Figure 9: Heterogeneous effects by share of informal settlements



6 Conclusion

This study investigates the specific impact of planned electricity outages on crime rates in the City of Cape Town, South Africa, leveraging the unique geographic discontinuity in electricity supply due to different providers. Existing studies, primarily focused on developed countries with brief and unplanned outages, often fail to capture the full extent of the relationship between electricity shortages and crime. Our research fills this gap by providing empirical evidence from a developing country context, where higher crime rates and less robust public safety measures exacerbate the impact of electricity shortages. By using high-frequency data on electricity outages and crime incidents, this study offers a nuanced understanding of the socio-economic consequences of infrastructure deficiencies, particularly in environments with persistent power outages driven primarily by electricity rationing.

Our findings reveal that a 10-hour increase in outages per month leads to an average increase of eight crime incidents, or about a 2.6 percent rise. Robbery, theft, and violent crimes are most sensitive to outages, while other crimes such as fraud and burglary show no significant change. The announcement of potential outage schedules by electric utilities may alter the dynamics of crime planning and anticipation. Households, anticipating outages, may stay at home and implement measures to guard their property, which explains why we do not observe changes in burglary rates. This supports the finding that planned outages might increase the opportunity cost of committing certain types of crimes, while not influencing crime incidents unrelated to outages. Additionally, we find that the increase in crime primarily occurs during nighttime outages, not during daytime outages, indicating that outage-induced changes in the opportunity cost for criminal activities fuel crime particularly at night.

Our findings underscore the importance of a stable electricity supply in mitigating crime and highlight the need for targeted policies to manage and reduce the adverse effects of planned outages. Addressing the underlying infrastructure challenges is crucial to ensuring public safety and economic stability in regions vulnerable to frequent power interruptions.

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7 Appendix

Table 8: Load shedding impact on total crime

	(1)	(2)	(3)	(4)
Eskom=1 × year=2016	-0.015	-0.011	-0.012	-0.013
	(0.068)	(0.031)	(0.031)	(0.031)
Eskom=1 × year=2018	0.043	0.044*	0.044*	0.039
	(0.069)	(0.025)	(0.025)	(0.025)
Eskom=1 × year=2019	0.086	0.086**	0.087**	0.067*
	(0.069)	(0.040)	(0.040)	(0.036)
Eskom=1 × year=2020	0.14**	0.14***	0.14***	0.12**
	(0.070)	(0.052)	(0.053)	(0.048)
Eskom=1 × year=2021	0.16**	0.16***	0.16***	0.14**
	(0.068)	(0.063)	(0.062)	(0.057)
Eskom=1 × year=2022	0.15**	0.15***	0.15***	0.13**
	(0.068)	(0.054)	(0.054)	(0.050)
Eskom=1 × year=2023	0.16**	0.16***	0.16***	0.14**
	(0.069)	(0.060)	(0.060)	(0.058)
Max Temperature	0.0048**		0.0020	0.0026
	(0.0023)		(0.0027)	(0.0025)
Max Precipitation	-0.0028		0.000018	0.00083
	(0.0035)		(0.0015)	(0.0015)
Temperature above 35°C	-0.015		0.014	0.014
	(0.038)		(0.0095)	(0.0090)
Proportion of Informal Settlement				0.23
				(0.15)
Total HH				0.00018
				(0.00088)
Area (km^2)				0.00011
				(0.00038)
Median Income 000 ZAR				0.00089
				(0.00059)
Years of education				-0.076**
				(0.037)
Income Inequality				-0.22
				(0.21)
Public Light Density (/km^2)				0.000078
				(0.00015)
Road (km)				0.0000030
				(0.00017)
Observations	5,952	5,952	5,952	5,923

Notes: The table report results from Equation 1 with different specifications: (1) without station FE and without year-month FE, (2) with station FE and with month of the year fixed effects, (3) with station FE and year-month FE without station controls, (4) with station FE and year-month FE with station controls. The standard errors clustered at the police station level.