Voltage quality and economic activity: On-line Appendix

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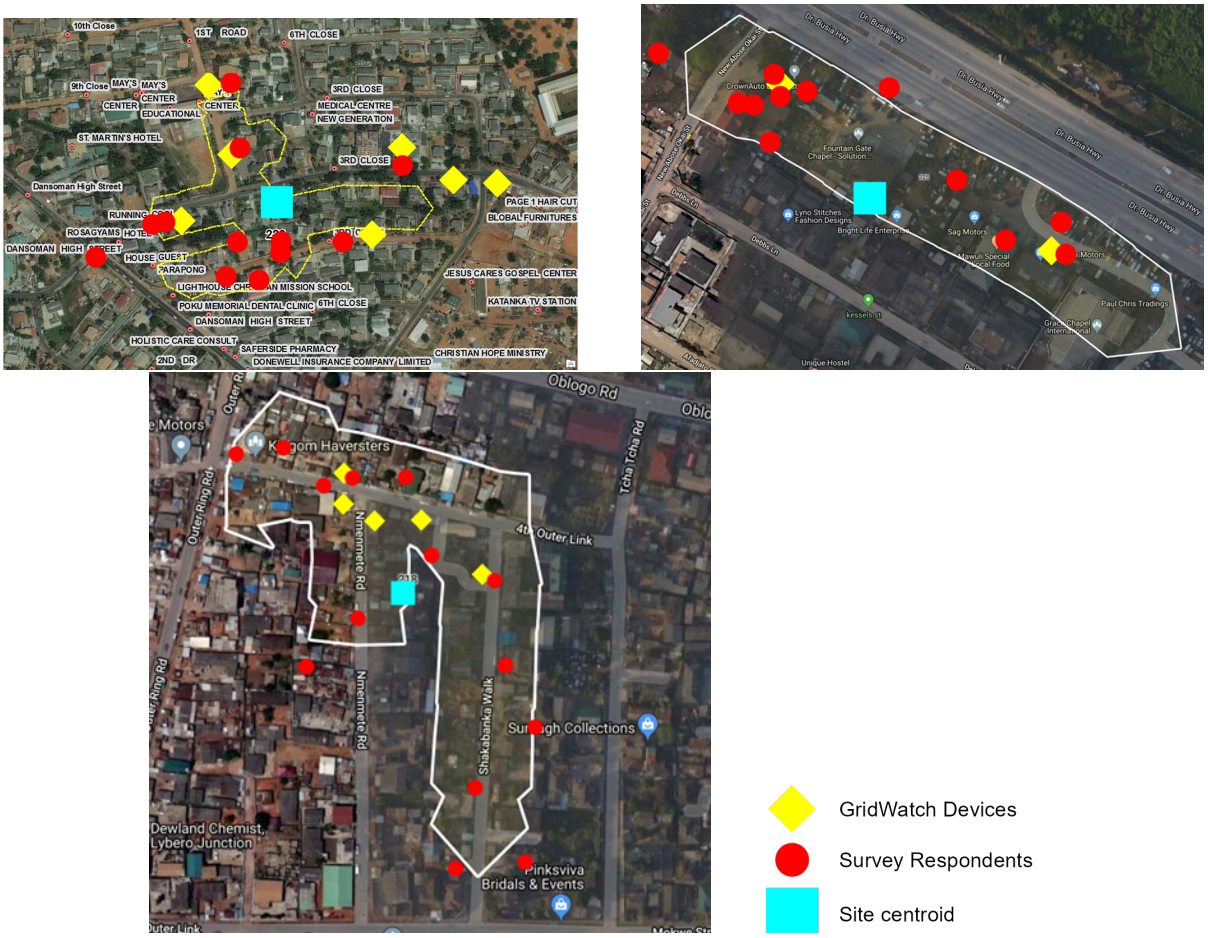
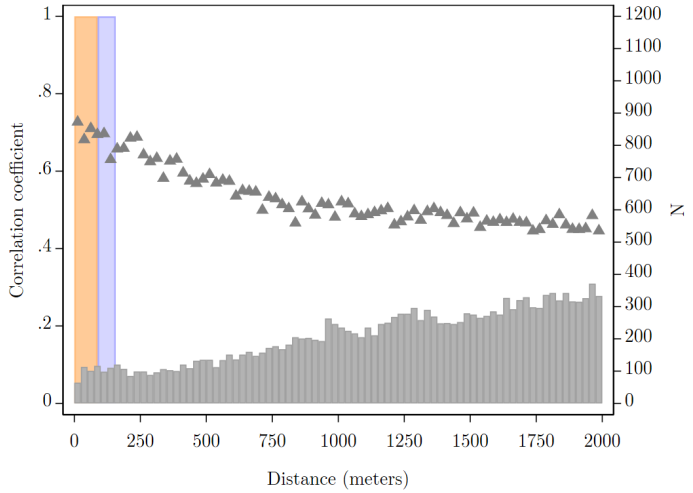
Appendix C: Robustness checks

Figure C1: Examples of other sites



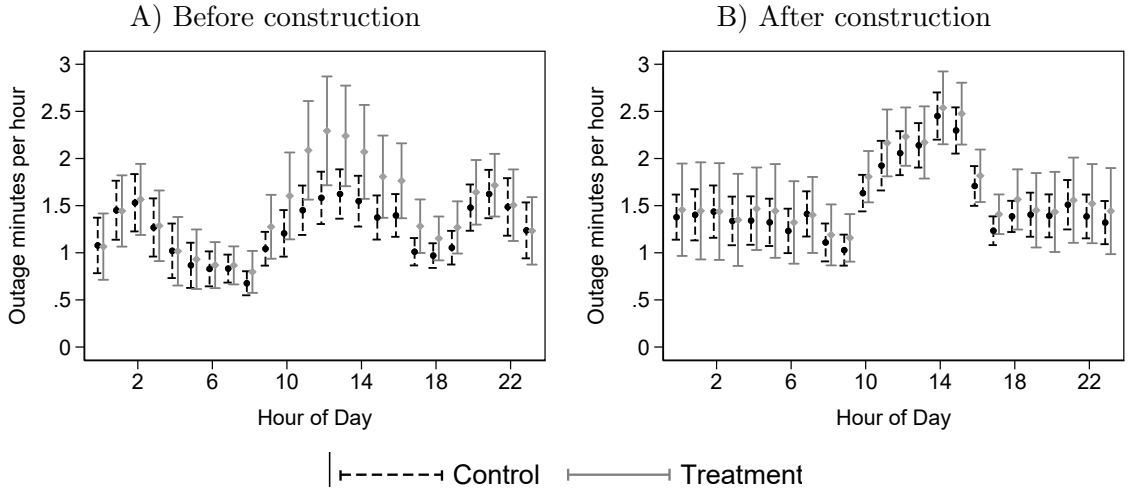
More examples of sites (as discussed in Figure A6).

Figure C2: Power quality is highly correlated within short distances



There are 178,241 pairs of devices with at least one month of overlap. For each pair we calculate distance and the correlation in hourly voltage data. The graph plots the average correlation coefficient and number of pairs in 25m bins. 50% of respondents are ≤88m of a device (in orange); 30% of respondents are between 88–157m (in blue).

Figure C3: Impacts of transformer injection on outages by time of day



The figure shows mean minutes of power outages by hour of day separately for treatment and control sites. 95% confidence intervals around treatment means are clustered at the site level. Panel A shows means for the year prior to the start of the transformer construction period, and Panel B shows means for the year after the end of the construction period. Figure 4 shows impacts on average voltage.

Table C1: Balance between panel and attrited respondents

	Matched		Attrited		
	N	Mean	N	Difference	p-val
Respondent and Location					
Age (years)	1575	39.23	426	2.73	0.000
Respondent is male	1575	0.35	426	0.02	0.547
Completed secondary education	1575	0.50	426	-0.05	0.050
Owns premises	1575	0.38	426	0.12	0.000
Appliances					
Any television (TV) at location	1575	0.71	426	-0.02	0.419
Any fridge at location	1575	0.62	426	0.01	0.835
Count of mobile phones	1575	2.17	426	0.05	0.605
Any electricity protective devices	1575	0.25	426	0.01	0.571
Count of reliability protective devices	1575	0.37	426	0.01	0.785
Electricity and Energy					
Pays someone else for electricity	1575	0.09	426	-0.08	0.000
Count of meter users	1566	1.84	424	-0.44	0.001
Last month electricity spending (USD)	1559	16.68	413	0.46	0.615
Has generator	1575	0.04	426	0.02	0.070
Count of alternative fuels used in past 3 months	1575	0.91	426	-0.07	0.107
Last month spending on alternative fuels (USD)	1575	6.24	426	-0.30	0.497
Reported total outage hours in past month	1575	39.88	426	3.44	0.151
Reported hours of bad voltage in past month	1566	47.49	422	4.29	0.408
Any burnt/broken appliances in past 12 months	1575	0.27	426	0.03	0.141
Amt. spent on burnt/broken apps in past year (USD)	1562	9.30	426	4.10	0.002
Household Characteristics					
Adults	746	2.39	251	0.27	0.002
Children (<18)	746	1.21	251	0.24	0.014
Last month HH income (USD)	714	352.97	234	-34.53	0.502
Share of HH adults with paid jobs in last week	746	0.66	251	-0.04	0.123
Business Characteristics					
Number of workers	829	1.97	175	-0.11	0.579
Last month business revenue (USD)	723	398.22	147	-65.65	0.292
Last month business costs (USD)	829	272.95	175	-29.26	0.449
Last month business profit (USD)	646	98.15	131	-31.02	0.063
Usual business open hours	829	12.07	175	0.20	0.397
Any non-electric business machines at location	829	0.09	175	0.00	0.992
Business engaged in retail activities (=1)	829	0.44	175	-0.07	0.085
Business engaged in manufacturing activities (=1)	829	0.20	175	0.11	0.000
Business engaged in other service activities (=1)	829	0.36	175	-0.03	0.409
Business activity likely using electricity (=1)	829	0.22	175	0.09	0.004

This table shows means in the baseline period for survey respondents, pooling businesses and households, and tests for significance of the differences in means by whether the respondent was also surveyed at the endline. The p-value for the joint F-test for household baseline characteristics is <0.001. The p-value for the joint F-test for business baseline characteristics is 0.024. * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Table C2: Correlation between attrited respondents' characteristics and treatment status

	Mean	LB Treat	N
Age (years)	37.11	-1.20	426
	[12.40]	(1.09)	
Respondent is male	0.37	-0.07	426
	[0.48]	(0.05)	
Completed secondary education	0.54	0.04	426
	[0.50]	(0.05)	
Owns premises	0.31	-0.12***	426
	[0.47]	(0.04)	
Any television (TV) at location	0.69	0.08*	426
	[0.47]	(0.04)	
Any fridge at location	0.60	0.02	426
	[0.49]	(0.05)	
Count of mobile phones	2.22	-0.20	426
	[2.00]	(0.18)	
Any electricity protective devices	0.26	-0.03	426
	[0.44]	(0.04)	
Count of reliability protective devices	0.37	-0.02	426
	[0.70]	(0.07)	
Pays someone else for electricity	0.17	-0.00	426
	[0.38]	(0.04)	
Count of meter users	2.35	-0.13	424
	[2.94]	(0.24)	
Last month electricity spending (USD)	17.12	-1.76	413
	[16.58]	(1.64)	
Has generator	0.02	0.01	426
	[0.14]	(0.02)	
Count of alternative fuels used in past 3 months	0.96	0.05	426
	[0.82]	(0.08)	
Last month spending on alternative fuels (USD)	6.21	0.63	426
	[7.70]	(0.78)	
Reported total outage hours in past month	35.39	2.05	426
	[40.27]	(4.10)	
Reported hours of bad voltage in past month	42.73	0.90	422
	[102.40]	(9.27)	
Any burnt/broken appliances from voltage fluctuations in past 12 months	0.24	-0.01	426
	[0.43]	(0.04)	
Amt. spent on burnt/broken apps in past year (USD)	4.59	1.19	426
	[19.44]	(2.02)	

This table shows the correlation between the attrited respondents' characteristics and treatment status. The sample is restricted to respondents who do not participate in the endline survey. We regress each respondent characteristic at baseline on a dummy variable equals one if the respondent was in a treatment site at baseline. Each row represents an outcome. * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Table C3: Impact of transformer injection intervention on hourly average voltage, robustness to implementation issues

	(1) All sites	(2) Commissioned sites (SMEC)	(3) New tx confirmed sites	(4) All sites, IV new tx with treat	(5) All sites
During construction	0.76	0.79	0.65	0.42	0.79
	(1.09)	(1.09)	(1.18)	(1.22)	(1.55)
Treat X During	2.38	2.55	3.61**		1.95
	(1.60)	(1.63)	(1.70)		(1.93)
Post construction	5.94***	5.95***	5.26***	5.26***	5.95***
	(1.74)	(1.74)	(1.85)	(1.95)	(1.82)
Treat X Post	5.48**	6.06**	8.41***		5.46**
	(2.48)	(2.49)	(2.48)		(2.59)
New transformer X Post				7.13**	
				(3.13)	
New transformer X During				3.24	
				(2.05)	
Observations	9866078	9723260	8815828	9866078	9866078
Pre-constr. ctl. mean	219.18	219.18	220.24	219.18	217.95
Hour of day FE	Y	Y	Y	Y	Y
Week of year FE	Y	Y	Y	Y	Y
Site FE	Y	Y	Y	Y	Y
Revised constr. period	N	N	N	N	Y

This table shows the difference-in-difference results for the impact of the transformer injection treatment on hourly average voltage levels measured by GridWatch devices in each site. Each column is one regression. Column 2 drops two sites where the construction manager SMEC indicated the new transformer was not commissioned successfully. Column 3 drops sites where our own construction monitoring activities indicated no new transformer was built in a treatment site or a new transformer was built in a control site. Column 4 instruments for observing a new transformer during the construction monitoring visits with site treatment assignment. Column 5 defines the construction period as July 1, 2020-December 31, 2020 instead of October 1, 2020-March 31, 2021, based on reported dates of transformer construction activity from the construction manager, SMEC. Standard errors are clustered at the site level. * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$. Table 5 presents the main specification.

Table C4: Impact of transformer injection intervention on hourly outage minutes, robustness to implementation issues

	(1) All sites	(2) Commissioned sites (SMEC)	(3) New tx confirmed sites	(4) All sites, IV new tx with treat	(5) All sites
During construction	0.21***	12.35***	9.80**	12.91***	0.06
	(0.07)	(4.32)	(4.52)	(4.86)	(5.05)
Treat X During	-0.06	-4.21	-2.42		-6.68
	(0.12)	(7.11)	(7.64)		(7.07)
Post construction	-0.08	-4.78	-7.43	-3.21	-2.37
	(0.08)	(4.68)	(4.73)	(5.50)	(4.66)
Treat X Post	-0.21	-14.06*	-13.49		-13.63*
	(0.13)	(8.04)	(8.53)		(8.22)
New Trafo X Post				-16.70	
				(10.37)	
New Trafo X During				-5.39	
				(9.07)	
Observations	10033086	9888612	8962703	10033086	10033086
Pre-constr. ctl. mean	1.39	83.40	84.60	83.40	89.00
Hour of day FE	Y	Y	Y	Y	Y
Week of year FE	Y	Y	Y	Y	Y
Site FE	Y	Y	Y	Y	Y
Revised constr. period		N	N	N	Y

This table shows the difference-in-difference results for the impact of the transformer injection treatment on hourly power outage minutes measured by GridWatch devices in each site. Each column is one regression. Column 2 drops two sites where the construction manager SMEC indicated the new transformer was not commissioned successfully. Column 3 drops sites where our own construction monitoring activities indicated no new transformer was built in a treatment site or a new transformer was built in a control site. Column 4 instruments for observing a new transformer during the construction monitoring visits with site treatment assignment. Column 5 defines the construction period as July 1, 2020-December 31, 2020 instead of October 1, 2020-March 31, 2021, based on reported dates of transformer construction activity from the construction manager, SMEC. Standard errors are clustered at the site level. * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$. Table 5 presents the main specification.

Table C5: Impacts of transformer injection intervention on additional voltage quality measures, hourly data

	N	Control Mean (SD)	Post (SE)	Treat × Post (SE)
Mean voltage during hour	9866078	219.18	5.94***	5.48**
		(22.39)	(1.74)	(2.48)
Absolute deviation from nominal	9866078	16.51	-3.74***	-0.83
		(18.60)	(1.14)	(1.70)
Any voltage >20% below nominal	10033086	0.08	-0.03**	-0.04**
		(0.26)	(0.01)	(0.02)
Minutes voltage >20% above nominal	10033086	0.00	-0.00	-0.00
		(0.31)	(0.00)	(0.01)
Minutes voltage 10-20% below nominal	10033086	9.60	-2.96***	-4.21***
		(19.83)	(0.93)	(1.41)
Minutes voltage >20% below nominal	10033086	2.76	-1.54***	-1.40*
		(11.59)	(0.57)	(0.85)
Minutes with no power (outage)	10033086	1.39	-0.08	-0.21
		(8.59)	(0.08)	(0.13)

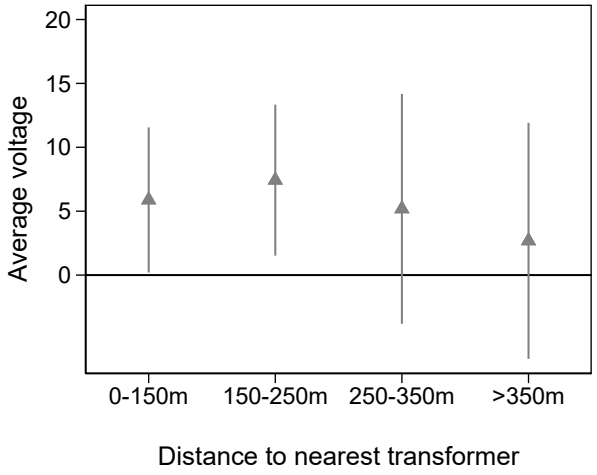
This table shows the difference-in-differences effects of the transformer injection intervention on measures of voltage quality using hourly data at the GridWatch device level. Each row is one regression. The minutes variables indicate the number of minutes in each hourly observation that the electricity had a certain status. "Any voltage >20% below nominal" is a dummy variable for whether voltage fell below this threshold at any point during an hourly observation. All regressions include hour of day, week of year, and site fixed effects. Standard errors are clustered at the site level. * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$. Table 5 presents the main specification.

Table C6: Impacts of transformer injection intervention on voltage quality, monthly data

	N	Control Mean (SD)	Post (SE)	Treat × Post (SE)
Hours with voltage >20% above nominal	14213	0.03 (0.47)	-0.01 (0.01)	-0.05 (0.06)
Hours with voltage 10-20% below nominal	14213	114.27 (152.16)	-33.31*** (11.24)	-52.00*** (17.15)
Hours with voltage >20% below nominal	14213	32.81 (99.40)	-18.18** (7.11)	-16.28 (10.58)
Hours with no power (outages)	14213	13.52 (13.60)	-0.45 (0.73)	-2.12 (1.40)
Number of spells with voltage <207	14213	251.92 (300.46)	-68.51*** (20.10)	-67.83** (31.18)
Number of spells with min voltage >200	14213	212.82 (255.67)	-60.65*** (16.55)	-50.46* (25.88)
Number of spells with min voltage btwn 184-200	14213	29.88 (46.22)	-6.15* (3.67)	-12.80** (5.19)
Number of spells with min voltage <184	14213	9.22 (14.45)	-1.70* (1.02)	-4.57*** (1.67)
Total duration of spells with voltage <207	14213	125.07 (181.45)	-43.46*** (14.11)	-54.68*** (20.80)
Total duration of spells with min voltage >200	14213	15.88 (18.97)	-3.67*** (1.25)	-3.98** (1.89)
Total duration of spells with min voltage btwn 184-200	14213	32.51 (45.81)	-7.76** (3.07)	-8.71** (4.23)
Total duration of spells with min voltage <184	14213	76.69 (154.91)	-32.03*** (11.31)	-41.99** (16.82)
Share of low-voltage time in spells with min voltage <184	11975	0.37 (0.38)	0.03 (0.02)	0.02 (0.04)
Mean spell length (hours)	11975	0.74 (2.19)	-0.29* (0.17)	-0.08 (0.23)
Median spell length (hours)	11975	0.12 (0.58)	-0.05 (0.04)	0.06 (0.05)
Maximum spell length (hours)	11975	11.98 (22.38)	-3.42** (1.72)	-5.90** (2.65)
Mean of mean voltage during a spell	11975	189.84 (35.33)	-8.33*** (2.50)	-15.76*** (4.09)
Median of mean voltage during a spell	11975	191.94 (36.10)	-7.95*** (2.54)	-15.70*** (4.10)
Mean of minimum voltage during a spell	11975	187.41 (36.69)	-8.54*** (2.63)	-15.32*** (4.30)

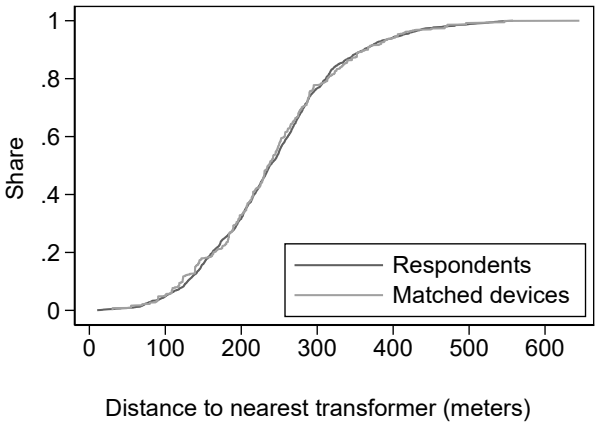
This table shows the difference-in-differences effects of the transformer injection intervention on measures of voltage quality using monthly data at the GridWatch device level. Each row is one regression. Outcomes in all but the first row are measured based on identifying individual low-voltage "spells" during which voltage fell below 207V (10% below nominal) in any 2-minute interval. Individual spells with different characteristics are then aggregated to the month-device level. Months where there were no low-voltage spells for particular devices are assigned a 0 for outcomes that are not conditional on experiencing at least one such spell. Number of spells refers to the number of individual low-voltage spells in a device-month. Total hours of spells take the sum of the duration of individual spells in a device-month. Mean, median, and maximum spell length are statistics calculated over all individual spells in a device-month. Mean and median of mean spell voltage are statistics calculated over the mean voltage level within a spell for all individual spells in a device-month. Mean minimum voltage is calculated similarly. These statistics are conditional on any low-voltage spell being observed in a device-month. All regressions include month and site fixed effects. Standard errors are clustered at the site level. * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$. Table 5 presents the same using hourly data.

Figure C4: Impact of transformer injection intervention by distance to the nearest transformer at baseline



The figure shows coefficients for the differential impacts on average voltage of baseline distance of the GridWatch device from the nearest transformer in treatment sites relative to control sites in the post-construction period. Table 5 presents the pooled specification using hourly data.

Figure C5: Distribution of distances between respondents and devices to the nearest transformer



Distance to the nearest transformer is measured during the baseline period before new transformers were added in treatment sites. The sample of devices includes only those that are matched to respondents as being the closest device.

Table C7: Impact of transformer injection intervention on primary outcomes for businesses

	N	Control Mean (SD)	Post (SE)	Treat (SE)	Post × Treat (SE)
Voltage damage and protection index	1658	-0.15 (0.93)	-0.07 (0.06)	0.13 (0.08)	-0.08 (0.08)
Any voltage-related damage, last 12 months (=1)	1658	0.22 (0.41)	-0.02 (0.03)	0.04 (0.04)	-0.05 (0.04)
Any reliability protective device owned (=1)	1658	0.19 (0.39)	-0.03*** (0.01)	0.04 (0.03)	-0.01 (0.02)
Amt. spent on burnt/broken apps in past year (USD)	1628	7.18 (27.84)	-3.80** (1.62)	-0.28 (2.05)	1.66 (2.21)
Value of protective devices owned (USD)	1426	5.14 (27.95)	-3.10** (1.53)	-0.55 (2.25)	-0.23 (2.22)
Reported hours of bad voltage in past month	1636	40.61 (82.68)	-39.84*** (4.38)	8.28 (7.83)	-10.11 (8.38)
Reported total outage hours in past month	1619	31.99 (31.34)	-29.10*** (2.28)	-0.40 (3.01)	1.31 (3.07)
WTP for perfect reliability and quality (USD)	1658	3.10 (4.35)	-1.07*** (0.25)	-0.26 (0.30)	0.33 (0.35)
WTP for perfect voltage and half outage hours (USD)	1658	1.58 (2.78)	-0.26 (0.19)	-0.27 (0.20)	0.34 (0.25)
WTP for no outages and half bad voltage hours (USD)	440	1.88 (3.46)	0.34 (0.41)	-0.26 (0.43)	0.88 (0.59)
Total no. of appliances owned	1658	7.07 (5.54)	-0.20 (0.12)	-0.02 (0.38)	0.20 (0.18)
Any alt. energy source used in last month (=1)	1658	0.06 (0.24)	-0.01 (0.01)	-0.00 (0.02)	0.00 (0.01)
Last month electricity spending (USD)	1594	17.63 (16.99)	-3.92*** (0.73)	-1.74 (1.22)	0.21 (0.96)

This table shows the difference-in-difference results from Table B5 for businesses only. Each row is one regression. All variables measuring values are in USD. In all the regressions, we control for respondent age, gender, education, whether the meter is paid directly by the user, number of meter users, whether the respondent is part of the household or business sample, whether the location includes both a household and a business, and district fixed effects. The control mean is the mean for control sites in the baseline period. Standard errors are clustered at the site level. * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$. Table D3 shows additional business outcomes.

Table C8: Impact of transformer injection intervention on primary outcomes

	N	Control Mean (SD)	Post (SE)	FDR q-val	Treat (SE)	FDR q-val	Post × Treat (SE)	FDR q-val
Voltage damage and protection index	3150	0.00 (1.00)	-0.11** (0.05)	0.042	0.09 (0.06)	0.678	-0.10* (0.06)	0.331
Any voltage-related damage, last 12 months (=1)	3150	0.25 (0.43)	-0.05* (0.03)	0.122	0.04 (0.03)	0.678	-0.05 (0.04)	0.418
Any reliability protective device owned (=1)	3150	0.25 (0.44)	-0.02** (0.01)	0.030	0.02 (0.02)	0.798	-0.02 (0.01)	0.331
Amt. spent on burnt/broken apps in past year (USD)	3080	9.28 (33.80)	-5.77*** (1.37)	0.001	0.05 (1.77)	0.988	1.23 (1.91)	0.687
Value of protective devices owned (USD)	2668	5.49 (23.16)	-2.32** (0.92)	0.030	0.36 (1.42)	0.975	0.32 (1.63)	0.899
Reported hours of bad voltage in past month	3110	43.18 (87.51)	-42.48*** (4.72)	0.001	7.60 (7.41)	0.678	-9.09 (7.70)	0.453
Reported total outage hours in past month	3081	32.15 (31.08)	-29.32*** (2.05)	0.001	1.69 (2.60)	0.798	-1.18 (2.74)	0.811
WTP for perfect reliability and quality (USD)	3150	3.29 (4.41)	-1.41*** (0.21)	0.001	-0.34 (0.25)	0.678	0.44 (0.28)	0.331
WTP for perfect voltage and half outage hours (USD)	3150	1.58 (2.71)	-0.37** (0.16)	0.042	-0.17 (0.17)	0.678	0.21 (0.21)	0.549
WTP for no outages and half bad voltage hours (USD)	850	1.95 (3.34)	-0.07 (0.30)	0.821	-0.37 (0.32)	0.678	0.99** (0.44)	0.331
Total no. of appliances owned	3150	8.59 (5.98)	-0.04 (0.08)	0.719	-0.05 (0.35)	0.988	0.08 (0.13)	0.687
Any alt. energy source used in last month (=1)	3150	0.05 (0.22)	-0.01 (0.01)	0.416	0.01 (0.01)	0.896	-0.00 (0.01)	0.933
Last month electricity spending (USD)	3050	17.72 (16.95)	-3.92*** (0.60)	0.001	-1.90* (1.02)	0.678	0.53 (0.80)	0.687
Last month business profit (USD)	1104	98.60 (143.83)	-6.77 (10.50)	0.590	-12.44 (11.53)	0.678	3.55 (13.67)	0.899
Last month business revenue (USD)	1280	396.21 (625.91)	84.40* (44.75)	0.095	-0.80 (51.71)	0.988	-92.58 (57.75)	0.331
Last month business costs (USD)	1206	276.34 (358.93)	82.04** (36.68)	0.046	25.30 (37.84)	0.798	-98.48** (49.45)	0.331
Last month HH income (USD)	1358	332.33 (473.05)	-34.24 (36.83)	0.430	16.93 (41.60)	0.896	-75.43 (49.79)	0.331

This table shows Table B5 with sharpened FDR q-values following Anderson (2008). Each row is one regression. All variables measuring values are in USD. Results are qualitatively unchanged when using logged versions of continuous outcomes. Sample sizes vary for some questions because of missing data, particularly when respondents were unable to estimate monetary values with a high degree of confidence, or because some questions were only asked to a subset of respondents. In all the regressions, we control for respondent age, gender, education, whether the meter is paid directly by the user, number of meter users, whether the respondent is a household or a business, and district fixed effects. The control mean is the mean for control sites in the baseline period. Standard errors are clustered at the site level. * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.

Table C9: Impact of transformer injection intervention on primary outcomes, accounting for implementation issues and construction timing

	All sites	Commissioned sites (SMEC)	New transformer confirmed sites	All sites, IV new tx with treat	No movers	All sites, except close sites
Voltage damage and protection index	-0.10*	-0.11*	-0.13**	-0.14*	-0.11*	-0.16**
	(0.06)	(0.06)	(0.07)	(0.08)	(0.06)	(0.08)
Any voltage-related damage, last 12 months (=1)	-0.05	-0.06	-0.07*	-0.06	-0.06	-0.08*
	(0.04)	(0.04)	(0.04)	(0.05)	(0.04)	(0.05)
Any reliability protective device owned (=1)	-0.02	-0.01	-0.01	-0.02	-0.01	-0.02
	(0.01)	(0.01)	(0.01)	(0.02)	(0.01)	(0.02)
Amt. spent on burnt/broken apps in past year (USD)	1.23	1.09	0.21	1.63	0.88	1.49
	(1.90)	(1.93)	(2.04)	(2.53)	(1.89)	(2.64)
Value of protective devices owned (USD)	0.32	0.25	1.05	0.43	0.41	-0.85
	(1.62)	(1.65)	(1.82)	(2.16)	(1.72)	(1.65)
Reported hours of bad voltage in past month	-9.09	-10.19	-12.79	-12.01	-13.26*	-4.85
	(7.69)	(7.80)	(7.92)	(10.08)	(7.16)	(8.42)
Reported total outage hours in past month	-1.22	-1.32	-2.01	-1.62	-1.16	1.84
	(2.73)	(2.76)	(2.87)	(3.59)	(2.84)	(3.41)
WTP for perfect reliability and quality (USD)	0.44	0.46	0.54*	0.58	0.36	0.23
	(0.28)	(0.29)	(0.31)	(0.37)	(0.30)	(0.35)
WTP for perfect voltage and half outage hours (USD)	0.21	0.20	0.26	0.27	0.14	-0.00
	(0.21)	(0.21)	(0.23)	(0.27)	(0.21)	(0.28)
WTP for no outages and half bad voltage hours (USD)	0.99**	1.07**	1.14**	1.31**	0.89**	0.70
	(0.44)	(0.44)	(0.48)	(0.58)	(0.43)	(0.62)
Total no. of appliances owned	0.08	0.09	0.14	0.11	0.11	0.14
	(0.13)	(0.13)	(0.14)	(0.17)	(0.13)	(0.15)
Any alt. energy source used in last month (=1)	-0.00	-0.00	0.00	-0.00	0.00	0.02
	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.02)
Last month electricity spending (USD)	0.53	0.51	0.49	0.70	0.63	0.72
	(0.80)	(0.81)	(0.87)	(1.06)	(0.83)	(1.00)
Last month business profit (USD)	3.67	4.16	10.11	4.97	5.20	6.28
	(13.59)	(13.74)	(14.69)	(18.20)	(14.44)	(18.27)
Last month business revenue (USD)	-91.60	-90.49	-23.30	-125.79	-110.70*	-103.81
	(57.48)	(58.28)	(57.11)	(82.61)	(60.84)	(70.22)
Last month business costs (USD)	-97.46**	-99.05**	-54.44	-129.75*	-105.28**	-140.71**
	(49.15)	(49.64)	(49.75)	(68.16)	(51.70)	(59.55)
Last month HH income (USD)	-75.62	-82.31	-85.61	-102.29	-71.11	-53.05
	(49.63)	(50.19)	(53.64)	(66.69)	(52.38)	(57.50)

This table shows the same difference-in-difference analyses presented in Table B5. Each cell is one regression. Column 1 replicates the "Post × Treat" column from Table B5. Column 2 drops two sites in Kaneshie where the construction manager SMEC indicated the new transformer was not commissioned successfully. Column 3 drops sites where our own construction monitoring activities indicated no new transformer was built in a treatment site or a new transformer was built in a control site. Column 4 instruments for observing a new transformer during the construction monitoring visits with site treatment assignment. Column 5 drops respondents who moved between the baseline and endline survey. Column 6 drops control sites that are within 1.3 km from a treatment site (the median distance). Standard errors are clustered at the site level. * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Table C10: Correlations between raw voltage quality and primary outcomes

	Full N	Mean (SD)	Average voltage	Hours voltage 20% below nominal
Reported hours of bad voltage in past month	3111	22.72	-0.744***	0.162***
		(60.01)	(0.201)	(0.052)
Reported total outage hours in past month	3120	20.52	-0.315***	0.046***
		(33.93)	(0.095)	(0.017)
WTP for perfect reliability and quality (USD)	3131	2.51	-0.019***	0.003***
		(3.48)	(0.005)	(0.001)
WTP for perfect voltage and half outage hours (USD)	3131	1.32	-0.009***	0.002**
		(2.15)	(0.003)	(0.001)
WTP for no outages and half bad voltage hours (USD)	847	1.89	-0.005	0.002
		(3.13)	(0.007)	(0.002)
Voltage damage and protection index	3131	-0.02	-0.003*	0.001**
		(0.97)	(0.002)	(0.001)
Any voltage-related damage, last 12 months (=1)	3131	0.24	-0.002**	0.001**
		(0.42)	(0.001)	(0.000)
Amt. spent on burnt/broken apps in past year (USD)	3063	6.48	-0.087***	0.018**
		(22.79)	(0.028)	(0.008)
Amt. spent on burnt/broken apps (if damage = 1)	710	29.95	-0.111	0.006
		(47.35)	(0.130)	(0.024)
Any reliability protective device owned (=1)	3131	0.25	-0.000	0.000
		(0.43)	(0.001)	(0.000)
Value of protective devices owned (USD)	2649	4.08	-0.031	0.013*
		(14.50)	(0.022)	(0.007)
Any alt. energy source used in last month (=1)	3131	0.05	0.000	0.000
		(0.21)	(0.000)	(0.000)
Total no. of appliances owned	3131	8.52	0.003	0.000
		(5.42)	(0.007)	(0.002)
Last month electricity spending (USD)	3031	14.94	0.011	-0.003
		(12.92)	(0.017)	(0.003)
Last month business profit (USD)	1103	89.36	0.100	0.019
		(127.40)	(0.224)	(0.045)
Last month business revenue (USD)	1273	401.94	2.415***	-0.405*
		(598.45)	(0.914)	(0.217)
Last month business costs (USD)	1201	294.79	1.496**	-0.187
		(390.65)	(0.661)	(0.149)
Last month HH income (USD)	1348	301.69	-0.774	0.188
		(426.69)	(0.782)	(0.160)

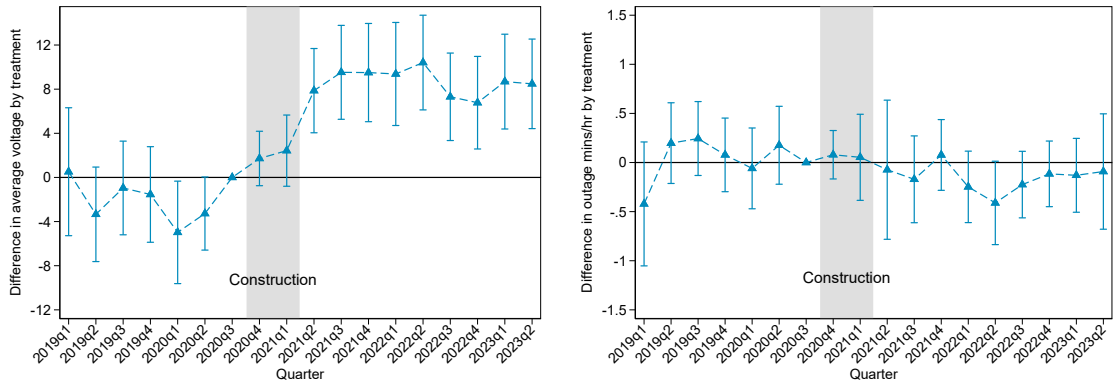
Each cell is one regression. This table shows the results from separate regressions of primary outcomes on measures of voltage quality. This table shows estimates from independent regressions with two voltage measurements as the explanatory variables and each row a different outcome variables, Each row represents a different outcome pooling business and household respondents. Profit is measured by directly asking the respondent, rather than by subtracting costs from revenues. Total reported costs are the sum of costs for specific items/activities and are not comprehensive. The columns indicate measures of voltage quality—the independent variables. Voltage is measured by assigning each respondent GridWatch data based on the nearest devices for the year before the survey date. Mean voltage in control sites is 219.5V at baseline and 224.6V at endline. In all the regressions, we also control for respondent age, gender, education, whether the meter is paid directly by the user, number of meter users, whether the location includes both a household and a business, and district fixed effects. Standard errors are clustered at the site level. Table B3 shows the same using data adjusted for the device and the respondents' distances to transformer. * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Table C11: Baseline balance by site status – Dropping control sites with high voltage improvement

	Control N	Mean	Treat N	Difference	p-value
Respondent and Location					
Age (years)	619	39.01	803	-0.63	0.305
Respondent is male	619	0.36	803	0.01	0.597
Completed secondary education	619	0.50	803	-0.00	0.931
Owns premises	619	0.36	803	-0.03	0.296
Appliances					
Any television (TV) at location	619	0.68	803	-0.05	0.051
Any fridge at location	619	0.62	803	0.01	0.638
Count of mobiles	619	2.27	803	0.17	0.056
Any reliability protective device owned (=1)	619	0.24	803	-0.03	0.260
Count of reliability protective devices	619	0.34	803	0.00	0.922
Electricity and Energy					
Pays someone else for electricity	619	0.09	803	0.01	0.613
Count of meter users	619	1.77	803	-0.10	0.213
Last month electricity spending (USD)	611	17.96	796	2.15	0.013
Has generator	619	0.05	803	0.01	0.584
Count of alternative fuels used in past 3 months	619	0.89	803	-0.02	0.687
Last month spending on alternative fuels (USD)	619	8.05	803	1.40	0.288
Reliability					
Reported number of outages in past month	619	7.25	803	0.62	0.017
Reported total outage hours in past month	619	41.61	803	1.53	0.562
Reported avg. hours per day with bad voltage	616	1.38	797	-0.34	0.033
Any voltage-related damage, last 12 months (=1)	619	0.25	803	-0.04	0.059
Amt. spent on burnt/broken apps in past year (USD)	616	9.66	794	0.24	0.895
Household Characteristics					
Adult members	284	2.37	383	-0.04	0.691
Child members (<18)	284	1.19	383	-0.04	0.728
Last month HH income (USD)	275	308.62	367	-29.06	0.421
Share of HH adults (18+) with paid jobs in last 7 days	284	0.65	383	-0.03	0.331
Business Characteristics					
Number of workers	335	1.99	420	0.04	0.774
Last month business revenue (USD)	276	388.46	380	-10.01	0.825
Total measured business costs in past month	266	278.14	366	-30.99	0.286
Last month business profit (USD)	250	99.19	336	4.96	0.670
Total hours typically open	335	12.17	420	0.20	0.265
Any non-electric business machines at location	335	0.08	420	-0.01	0.655
Business engaged in retail activities	335	0.44	420	0.00	0.919
Business engaged in manufacturing activities	335	0.21	420	0.02	0.530
Business engaged in other service activities	335	0.35	420	-0.02	0.529
Business activity likely using electricity	335	0.22	420	-0.00	0.970

This table shows means in the baseline period for survey respondents, pooling businesses and households, and tests for significance of the differences in means by line bifurcation treatment status. The control group is restricted to control sites that experienced less than a 10 V improvement in voltage after line-bifurcation, which is the 75th percentile of voltage improvement in control sites. The p-value for the joint F-test for household baseline characteristics is 0.111. The p-value for the joint F-test for business baseline characteristics is 0.136. * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Figure C6: Treatment effect on voltage and outages – Dropping control sites with high voltage improvements



The figure shows the impact of injection transformer intervention on average voltage over time. We report the coefficient estimate in addition to the 95% confidence interval. The control group is restricted to control sites that experienced less than a 10 V improvement in voltage after line-bifurcation, which is the 75th percentile of voltage improvement in control sites. Figure 6 shows the version with the full sample.

Table C12: Impact of transformer injection intervention on outages and voltage – Dropping control sites with high voltage improvements

	(1) Minutes power out	(2) Average voltage	(3) Absolute voltage deviation	(4) Standard deviation voltage	(5) Hours of spells >10% below nominal	(6) Hours of spells >20% below nominal
During construction	0.16*	-1.30	0.89	0.15***	16.00	11.43
	(0.08)	(1.00)	(0.91)	(0.05)	(11.97)	(10.38)
Treat X During	0.01	4.32***	-3.01**	-0.33***	-52.93***	-44.28***
	(0.12)	(1.54)	(1.29)	(0.10)	(18.37)	(15.61)
Post	-0.07	0.61	-0.60	0.06	2.39	2.12
	(0.09)	(0.89)	(0.65)	(0.06)	(9.61)	(7.44)
Treat X Post	-0.21	10.76***	-3.96***	-0.75***	-100.42***	-76.00***
	(0.14)	(1.99)	(1.42)	(0.10)	(18.09)	(14.52)
Observations	8581627	8435976	8435976	8406529	12183	12183
Pre-constr. ctl. mean	1.39	222.28	14.07	2.29	93.30	50.89
Hour of day FE	Y	Y	Y	Y	N	N
Week of year FE	Y	Y	Y	Y	N	N
Month of year FE	N	N	N	N	Y	Y
Site FE	Y	Y	Y	Y	Y	Y
Hourly/monthly data	Hourly	Hourly	Hourly	Hourly	Monthly	Monthly

Difference-in-difference results for the impact of treatment on power quality measured by GridWatch devices, with each column a different outcome variable. The control group is restricted to control sites that experienced less than a 10 V improvement in voltage after line-bifurcation, which is the 75th percentile of voltage improvement in control sites. Columns (1)-(4) use hourly data while Columns (5)-(6) use monthly data. Standard errors are clustered at the site level. *$p < 0.1$, **$p < 0.05$, ***$p < 0.01$

Table C13: Impact of transformer injection intervention on customer electricity experience – Dropping control sites with high voltage improvements

	N	Control Mean (SD)	Post (SE)	Treat (SE)	Post × Treat (SE)
Voltage damage and protection index	3150	0.00 (1.00)	-0.11** (0.05)	0.09 (0.06)	-0.10* (0.06)
Any voltage-related damage, last 12 months (=1)	3150	0.25 (0.43)	-0.05* (0.03)	0.04 (0.03)	-0.05 (0.04)
Any reliability protective device owned (=1)	3150	0.25 (0.44)	-0.02** (0.01)	0.02 (0.02)	-0.02 (0.01)
Amt. spent on burnt/broken apps in past year (USD)	3080	9.28 (33.80)	-5.77*** (1.37)	0.05 (1.77)	1.23 (1.91)
Value of protective devices owned (USD)	2668	5.49 (23.16)	-2.32** (0.92)	0.36 (1.42)	0.32 (1.63)
Reported hours of bad voltage in past month	3110	43.18 (87.51)	-42.48*** (4.72)	7.60 (7.41)	-9.09 (7.70)
Reported total outage hours in past month	3081	32.15 (31.08)	-29.32*** (2.05)	1.69 (2.60)	-1.18 (2.74)
WTP for perfect reliability and quality (USD)	3150	3.29 (4.41)	-1.41*** (0.21)	-0.34 (0.25)	0.44 (0.28)
WTP for perfect voltage and half outage hours (USD)	3150	1.58 (2.71)	-0.37** (0.16)	-0.17 (0.17)	0.21 (0.21)
WTP for no outages and half bad voltage hours (USD)	850	1.95 (3.34)	-0.07 (0.30)	-0.37 (0.32)	0.99** (0.44)
Total no. of appliances owned	3150	8.59 (5.98)	-0.04 (0.08)	-0.05 (0.35)	0.08 (0.13)
Any alt. energy source used in last month (=1)	3150	0.05 (0.22)	-0.01 (0.01)	0.01 (0.01)	-0.00 (0.01)
Last month electricity spending (USD)	3050	17.72 (16.95)	-3.92*** (0.60)	-1.90* (1.02)	0.53 (0.80)
Last month business profit (USD)	1104	98.60 (143.83)	-6.77 (10.50)	-12.44 (11.53)	3.55 (13.67)
Last month business revenue (USD)	1280	396.21 (625.91)	84.40* (44.75)	-0.80 (51.71)	-92.58 (57.75)
Last month business costs (USD)	1206	276.34 (358.93)	82.04** (36.68)	25.30 (37.84)	-98.48** (49.45)
Last month HH income (USD)	1358	332.33 (473.05)	-34.24 (36.83)	16.93 (41.60)	-75.43 (49.79)

This table shows the difference-in-difference results from the Equation 2 pooling businesses and households. Each row presents results from one regression with a different socio-economic variable as the outcome. The control group is restricted to control sites that experienced less than a 10 V improvement in voltage after line-bifurcation, which is the 75th percentile of voltage improvement in control sites. All outcomes pre-specified in the pre-analysis plan (Berkouwer et al., 2019), except for voltage improvements as these were unanticipated.. All variables measuring values are in USD. Results are qualitatively unchanged when using logged versions of continuous outcomes. Sample sizes vary for some questions because of missing data, particularly when respondents were unable to estimate monetary values with a high degree of confidence, or because some questions were only asked to a subset of respondents. Reliability outcomes are measured using respondent self-reports based on the 30 days prior to the survey date at both baseline and endline. In all the regressions, we control for respondent age, gender, education, whether the meter is paid directly by the user, number of meter users, whether the respondent is a household or a business, and district fixed effects. The control mean is the mean for control sites in the baseline period. Standard errors are clustered at the site level. * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.

Table C14: Impact of transformer injection intervention on main business outcomes – Dropping control sites with high voltage improvements

	N	Control Mean (SD)	Post (SE)	Treat (SE)	Post × Treat (SE)
Last month business profit (USD)	1104	98.60	-6.77	-12.44	3.55
		(143.83)	(10.50)	(11.53)	(13.67)
Last month business costs (USD)	1206	276.34	82.04**	25.30	-98.48**
		(358.93)	(36.68)	(37.84)	(49.45)
Last month wage and benefits costs (USD)	1330	54.03	14.97*	-5.78	-5.75
		(135.87)	(8.18)	(10.38)	(11.16)
Last month materials costs (USD)	1266	187.49	72.19**	47.78*	-93.21**
		(297.45)	(29.95)	(27.96)	(40.69)
Last month electricity spending (USD)	1594	17.63	-3.92***	-1.74	0.21
		(16.99)	(0.73)	(1.22)	(0.96)
Last month spending on alternative fuels (USD)	1658	5.14	-0.95	-1.38	1.17
		(37.42)	(1.75)	(2.05)	(1.90)
Last month business revenue (USD)	1280	396.21	84.40*	-0.80	-92.58
		(625.91)	(44.75)	(51.71)	(57.75)
Estimated increase in revenue w/ perfect electricity (USD)	1044	545.75	-355.67***	-125.66	30.66
		(2038.28)	(137.04)	(149.10)	(156.00)
Number of workers	1658	1.99	0.11*	-0.06	0.07
		(1.90)	(0.06)	(0.14)	(0.09)
Share of men employees	1646	0.31	-0.01	-0.00	-0.00
		(0.42)	(0.01)	(0.01)	(0.02)
Share of full-time employees	1628	0.91	-0.05***	0.01	0.00
		(0.21)	(0.02)	(0.02)	(0.02)
Business open during any "dark" hours	1658	0.77	-0.08***	-0.01	-0.02
		(0.42)	(0.03)	(0.03)	(0.04)
Total hours typically open	1658	12.16	-0.58***	-0.14	-0.16
		(2.46)	(0.13)	(0.19)	(0.22)
Applied for loans in past 12 months	1658	0.17	-0.01	0.05	-0.01
		(0.38)	(0.03)	(0.03)	(0.04)
Total value of outstanding loans (USD)	1596	350.34	-11.06	98.83	-183.34*
		(1174.33)	(76.81)	(90.68)	(110.30)

This table shows the difference-in-difference results from the main equation. Each row presents results from one regression with a different socio-economic variable as the outcome. All variables measuring values are in USD. Profit is measured by directly asking the respondent, rather than by subtracting costs from revenues. Total reported costs are the sum of costs for specific items/activities and are not comprehensive. The control group is restricted to control sites that experienced less than a 10 V improvement in voltage after line-bifurcation, which is the 75th percentile of voltage improvement in control sites. In all the regressions, we control for respondent age, gender, education, whether the meter is paid directly by the user, number of meter users, whether the respondent is the business owner or a manager, whether the location includes both a household and a business, and district fixed effects. The control mean is the mean for control sites in the baseline period. Standard errors are clustered at the site level. * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Appendix D: Pre-specified analyses of socioeconomic outcomes

Table D1: Impact of transformer injection intervention on willingness to pay outcomes

	N	Control Mean (SD)	Post (SE)	Treat (SE)	Post x Treat (SE)
WTP for perfect reliability and quality (USD)	3150	3.29 [4.41]	-1.41*** (0.21)	-0.34 (0.25)	0.44 (0.28)
WTP for perfect voltage and half outage hours (USD)	3150	1.58 [2.71]	-0.37** (0.16)	-0.17 (0.17)	0.21 (0.21)
Max monthly WTP for 1 unnan. 8hr outage	240	0.97 [1.72]	-0.51* (0.27)	-0.07 (0.30)	-0.17 (0.35)
Max monthly WTP for 1 announ. 8hr outage	262	1.27 [2.08]	-0.77*** (0.28)	0.10 (0.44)	0.12 (0.48)
Max monthly WTP for 4 unnan. 2hr outages	244	1.38 [2.20]	-0.84** (0.34)	-0.39 (0.40)	0.25 (0.43)
WTP for no outages and half bad voltage hours (USD)	850	1.95 [3.34]	-0.07 (0.30)	-0.37 (0.32)	0.99** (0.44)
Max WTP for generator	2724	317.00 [403.13]	-14.43 (24.44)	33.76 (23.80)	-38.35 (31.95)

Additional results from Equation 2. All variables measuring values are in USD. Results are qualitatively unchanged when using logs. Sample sizes are lower for reliability scenarios that were only presented to a random subset of respondents. In all the regressions, we control for respondent age, gender, education, whether the meter is paid directly by the user, number of meter users, whether the respondent is part of the household or business sample, whether the location includes both a household and a business, and district fixed effects. The control mean is the mean for control sites in the baseline period. Standard errors are clustered at the site level. *$p < 0.1$, **$p < 0.05$, ***$p < 0.01$

Table D2: Impact of transformer injection intervention on electricity-related indices

	N	Control Mean (SD)	Post (SE)	Treat (SE)	Post x Treat (SE)
Outage backup power index	3150	0.00	-0.06	0.02	-0.01
		[1.00]	(0.04)	(0.06)	(0.04)
Freq. of wetcell batt./generator	3150	0.06	-0.06	-0.00	0.02
use during outage (normalized)		[1.26]	(0.04)	(0.07)	(0.05)
Share of apps. using	3114	0.10	-0.10	0.04	-0.04
solar/generator during outage (normalized)		[1.41]	(0.06)	(0.09)	(0.08)
Alternative energy/fuel sources	3150	-0.00	-0.02	0.03	-0.03
index		[1.00]	(0.05)	(0.07)	(0.07)
Any alt. energy source used in	3150	0.05	-0.01	0.00	-0.00
last month (=1)		[0.22]	(0.01)	(0.01)	(0.01)
Count of alt. light sources	3150	0.10	-0.10	0.05	-0.05
(normalized)		[1.10]	(0.06)	(0.09)	(0.09)
Count of alt. fuel sources	3150	-0.08	0.08**	-0.00	0.01
(normalized)		[0.96]	(0.03)	(0.05)	(0.05)
Appliance protection index	3150	-0.00	-0.18***	-0.04	0.07*
		[1.00]	(0.03)	(0.05)	(0.04)
Count of reliability defensive	3150	0.08	-0.08***	-0.02	0.02
apps. (normalized)		[1.11]	(0.02)	(0.06)	(0.03)
Has multi-phase system	2516	0.04	0.01*	0.01	-0.01
		[0.21]	(0.01)	(0.01)	(0.01)
Share of TVs plugged to TV guard	110	2.54	-1.31***	-0.36	0.16
(normalized)		[0.77]	(0.27)	(0.24)	(0.39)
Share of fridges plugged to fridge	232	1.35	-0.47***	-0.09	0.16
guard (normalized)		[0.45]	(0.14)	(0.10)	(0.20)

Additional results from Equation 2. The main outcomes are indices; we also show results for the index components for completeness. Indices are constructed as the sum of normalized components, and are then normalized to have mean 0 and SD 1 for control respondents in the baseline. In all the regressions, we control for respondent age, gender, education, whether the meter is paid directly by the user, number of meter users, whether the respondent is part of the household or business sample, whether the location includes both a household and a business, and district fixed effects. The control mean is the mean for control sites in the baseline period. Standard errors are clustered at the site level. * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Table D3: Impact of transformer injection intervention on additional business outcomes

	N	Control Mean (SD)	Post (SE)	Treat (SE)	Post x Treat (SE)
Temporary busines response type index	1658	0.00 [1.00]	-0.10 (0.06)	0.03 (0.09)	0.07 (0.10)
Temporary switch to alternative energy due to reliability (0-2)	1646	0.06 [0.29]	0.04*** (0.02)	0.02 (0.02)	-0.01 (0.03)
Temporary stop working, work less due to reliability (0-2)	1646	0.42 [0.71]	-0.03 (0.04)	0.02 (0.06)	-0.01 (0.06)
Temporary postpone working, woke same due to reliability (0-2)	1646	0.33 [0.63]	-0.13*** (0.03)	-0.02 (0.05)	-0.01 (0.05)
Temporary switch tools/labor due to reliability (0-2)	1646	0.16 [0.44]	0.01 (0.03)	-0.01 (0.03)	0.03 (0.04)
Temporary switch business activities due to reliability (0-2)	1646	0.15 [0.41]	-0.03 (0.03)	0.02 (0.03)	0.04 (0.04)
Temporary reduce labor due to reliability (0-2)	1646	0.20 [0.49]	-0.05 (0.04)	0.01 (0.04)	0.02 (0.05)
Other temporary response due to reliability	1646	0.02 [0.17]	-0.02* (0.01)	0.00 (0.01)	0.02 (0.02)
Temporary business response intensity index	1658	-0.00 [1.00]	-0.33*** (0.05)	0.61 (0.41)	-0.61 (0.41)
Days of switching to solar energy	1658	0.00 [0.00]	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)
Days of switching to generator	1658	0.01 [0.07]	-0.01* (0.00)	0.04 (0.04)	-0.05 (0.04)
Days of switching to wetcell	1658	0.00 [0.01]	-0.00 (0.00)	0.01 (0.01)	-0.01 (0.01)
Days stopping or postponing work in past 1 month	1658	0.00 [1.00]	-0.32*** (0.05)	0.02 (0.07)	-0.01 (0.07)
Percentage of business hours stopping work	1658	-0.00 [1.00]	-0.34*** (0.06)	0.09 (0.09)	-0.07 (0.09)
Permanent business response index	1658	0.00 [1.00]	-0.11 (0.07)	-0.09 (0.07)	0.27** (0.12)
Permanently substitute to non-electric tools or machines (0-1)	1646	0.02 [0.13]	-0.01 (0.01)	-0.01** (0.01)	0.01 (0.01)
Permanently substitute to more labor (0-1)	1646	0.01 [0.09]	-0.00 (0.00)	0.00 (0.01)	0.02 (0.01)
Permanently change industry/business (0-1)	1646	0.01 [0.12]	-0.00 (0.01)	-0.01 (0.01)	0.03** (0.01)
Purchase generator (0-1)	1646	0.01 [0.12]	-0.01 (0.01)	-0.01 (0.01)	0.01 (0.01)
Business qualitative assessments index	1658	0.00 [1.00]	-0.76*** (0.07)	0.00 (0.08)	-0.06 (0.09)
Perceived safety in area (1-5)	1656	3.30 [1.05]	0.00 (0.08)	-0.06 (0.10)	0.16 (0.11)
Importance of electricity as obstacle to business (1-5)	1646	3.90 [0.98]	-0.23*** (0.08)	0.01 (0.08)	-0.06 (0.11)
Belief that Dumsor is back (1-5)	1646	2.84 [1.31]	1.50*** (0.10)	0.14 (0.11)	-0.06 (0.12)
Expected reliability one year from today (1-3)	1078	2.34 [0.83]	0.35*** (0.08)	-0.00 (0.09)	0.05 (0.10)
Importance of finance/access to credit as a business obstacle (1-5)	1658	2.79 [1.29]	-0.37*** (0.11)	0.02 (0.09)	0.11 (0.15)

Additional results from Equation 2. All variables measuring values are in USD. Results are qualitatively unchanged when using logs. Indices are constructed as the sum of normalized components, and are then normalized to have mean 0 and SD 1 for control respondents in the baseline. In all the regressions, we control for respondent age, gender, education, whether the meter is paid directly by the user, number of meter users, whether the respondent is part of the household or business sample, whether the location includes both a household and a business, and district fixed effects. The control mean is the mean for control sites in the baseline period. Standard errors are clustered at the site level. * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$