Commerce Commission Consultancy Project

Electricity Distribution Businesses: Ownership, Incentives, and Performance Under Part 4 of the Commerce Act 1986

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1. Abstract

This report examines how ownership structure and regulatory settings under Part 4 of the Commerce Act 1986 influence the reliability and financial performance of New Zealand electricity distribution businesses (EDBs). Using Information Disclosure data from 2008–2025, we estimate baseline OLS models, a suite of Mundlak correlated random-effects panel regressions, and a set of fixed-effects difference -in -difference event studies evaluating major regulatory transitions, including Centralines' 2021 exemption from price-quality regulation and multiple Custom Price-Quality Pathway (CPP) entries and exits. Baseline OLS models provided initial descriptive assessment of how ownership categories correlate with reliability and financial outcomes, establishing simple cross-sectional patterns before accounting for unobserved heterogeneity. Across all Mundlak specifications, ownership structure was not a statistically significant predictor of outage duration (SAIDI), outage frequency (SAIFI), or financial outcomes once unobserved firm heterogeneity and operational controls were incorporated. Instead, network scale and expenditure patterns, particularly customer base, operating expenditure (OPEX), and capital expenditure (CAPEX), explain most observable variation. Short-run increases in OPEX and CAPEX are consistently associated with longer outages, while long-run expenditure levels correlate with improved reliability or higher regulated profit. Our Event-study analyses reveal that CPP entry typically produces temporary deterioration in reliability as intensive renewal programmes commence, followed by substantial improvement at CPP exit, indicating that CPPs function as intended to facilitate network modernisation. The study of Centralines' exemption shows stable costs and profitability but a marked rise in outage frequency, suggesting that while consumer-trust governance supports financial discipline, it may not fully replicate the reliability incentives embedded in price-quality regulation. Collectively, the evidence shows that Part 4's hybrid framework, combining incentive regulation with ownership-based accountability, remains effective, with regulatory transitions producing predictable investment and quality dynamics. The findings reinforce that performance differences across EDBs arise primarily from operational scale and investment cycles rather than ownership

type, and they highlight where regulatory oversight continues to play a critical role in supporting the long-term benefit of consumers.

2. Introduction

The main objective of this consultancy project is to investigate how the different types of ownership structures and regulatory settings in Part 4 of the Commerce Act 1986 influence the incentives and performance of New Zealand Electricity Distribution Businesses (EDBs). The behaviour of EDBs is shaped by both incentives caused by their different ownership structures and the regulation requirements set out in the Act. Based on economic theory and other studies, we examine the link between ownership and performance of these firms.

Due to the monopolistic nature of EDBs, effective regulation is essential to protect consumer interests. Studying the link between firms' ownership, the different regulation requirements they face, and their financial performance and reliability outcomes for consumers allows us to evaluate the appropriateness of the current regulatory framework.

Using publicly available Information Disclosure datasets from 2008–2025, we test whether ownership type, regulatory incentive category, size, location, and urban/rural classification result in systematic differences in service quality and firm profitability. We also examine return on investment and regulatory profit to evaluate whether outcomes support investment, improve efficiency and quality, share efficiency gains with consumers, and limit excessive profits. Analyses include baseline OLS models, Mundlak correlated random-effects panel regressions, and fixed-effects difference-in-difference event studies, including evaluations of Centralines' 2021 exemption from price-quality regulation and multiple Custom Price-Quality Pathway (CPP) entries and exits.

Our findings show that ownership structure is not a statistically significant determinant of reliability or financial outcomes once operational scale and expenditure patterns are considered. Variation in performance is primarily driven by network size, capital and operating expenditure, and investment cycles. CPP entry is associated with temporary reliability declines during intensive network renewal, followed by improvements at CPP exit, demonstrating that CPPs support network modernisation. Centralines' exemption shows stable costs and profitability but an increase in outage frequency, indicating that governance-based incentives maintain financial discipline but may not fully replicate reliability incentives.

Overall, the results suggest that the current regulatory framework under Part 4 of the Commerce Act remains effective, with performance differences arising mainly from operational factors rather than ownership type, and regulation supporting reliability and consumer benefit.

3. Industry Structure

Electricity is transmitted across the national grid, operated by Transpower, from generation points to grid exit points, and then distributed to homes and businesses by local EDBs. EDBs are natural monopolies because they rely on large, long-lived infrastructure such as poles, wires, and substations with high fixed costs and strong economies of scale. It is inefficient to duplicate these networks, so each region is served by one EDB. Consumers cannot choose which EDB distributes their electricity. This gives EDBs market power, and without regulation they could charge excessive prices, reduce service quality, or underinvest in maintenance and upgrades.

4. Ownership Structures of EDBs

The 29 Electricity Distribution Businesses (EDBs) in New Zealand have different ownership structures, which potentially influences how they behave and respond to regulation. The Commerce Act 1986 recognises these differences by allowing some firms to be exempt from price-quality regulation if they are consumer-owned (s 54D of the Commerce Act).

4.1 Consumer trust–owned

Trustees are elected by local electricity consumers, and these businesses often return surpluses to consumers through reinvestments, lower charges, or direct rebates. If at least 90 percent of voting rights are held by consumers and the network has fewer than 150,000 connections, the EDB qualifies for exemption from price-quality regulation under section 54D. Consumer trust ownership encourages stable pricing, reliability, and community benefit. These firms may accept lower profits in exchange for rebates or community returns. The exemption of many consumer-trust-owned EDBs under s 54D reflects that, as consumers are both beneficiaries and customers, the risk of excessive monopoly pricing is reduced as in theory, behaviour will be shaped by community expectations and benefits. As examined by ETNZ, because "these networks are owned by their customers … they can strike an appropriate balance between affordability … and investment for future generations."

4.2 Council-owned

Some EDBs are partly or wholly owned by local councils. These businesses often balance commercial objectives with regional development or public service goals. Examples include Orion (owned by Christchurch and Selwyn councils) and Aurora Energy (owned by Dunedin City Council). Council ownership encourages a balance between financial sustainability and regional development priorities, as councils face political accountability and public scrutiny. Councils may prioritise long-term investment in infrastructure due to the expectations and pressure of the regions' rate-payers.

4.3 Investor-owned

A smaller group of EDBs are privately owned by domestic or overseas investors, often as part of larger infrastructure funds. Their incentives are primarily profit-driven with a focus on return on investment. Regulation therefore plays a critical role in protecting consumers. Examples include Powerco (owned by QIC and Dexus), Firstlight Network (owned by Igneo Infrastructure Partners), and Wellington Electricity (owned by CK Infrastructure Holdings). Investor ownership drives a focus on cost efficiency and innovation within the limits of price-quality regulation, as investors seek competitive returns within the regulatory limits.

4.4 Mixed models

Some EDBs are structured as cooperatives or part-owned by a mix of trusts, councils, and investors. For example, Alpine Energy is owned by a combination of trusts and district councils. Mixed ownership models combine these influences, with outcomes depending on the relative weight of community and commercial incentives.

5. Regulation of New Zealand EDBs

EDBs are regulated under Part 4 of the Commerce Act 1986, which provides the legal framework for regulating firms with little or no competition such as electricity networks, gas pipelines, and airports (Commerce Act 1986, s 52A). These industries are regulated because they have features consistent with those of natural monopolies. Part 4 of the Act aims to protect consumers from these risks and promote outcomes similar to those that occur in competitive markets. Its purpose is to promote the long-term benefit of consumers by ensuring EDBs operate efficiently, invest appropriately, and share benefits fairly. The four consumer-focused objectives of Part 4 are to (1) incentivise investment and innovation, (2) improve efficiency and quality, (3) share efficiency gains with consumers, and (4) limit excessive profits (Commerce Act 1986, s 52A).

All 29 EDBs are subject to some form of regulation under Part 4 of the Act. The specific regulations each company faces depend on factors such as ownership structure, size, and significant expenditure requirements (Commerce Commission, 2024). Regulation aims to provide EDBs with incentives that benefit consumers by imposing maximum revenues and minimum output standards (Commerce Commission, 2024, p. 9).

The regulatory framework for EDBs and other essential service sectors focuses on balancing consumer protection, investor certainty, and efficiency. Regulation is used to ensure reliability, fair pricing, and incentives for long-term investment. This involves (1) promoting competition where possible, (2) regulating monopoly sectors where competition is not workable, and (3) protecting consumers from unfair or misleading conduct. There are two main forms of regulation under Part 4 of the Act: information disclosure (ID) regulation and price-quality (PQ) regulation.

5.1 Information disclosure regulation

Information Disclosure (ID) requirements apply to all 29 EDBs. Each company must publicly disclose financial, performance, and planning information. The Commerce Commission uses this information to monitor performance, identify risks, and compare companies. Disclosure is intended to influence behaviour by making performance visible to consumers, investors, and regulators (Commerce Commission, 2024). Information disclosed by electricity distributors from 2013 onwards, used for this report, is available on the Commerce Commission's website. A longer series of data (from 2003 to 2017) is also available on a more aggregated basis.

5.2 Price-quality (PQ) regulation

PQ regulation applies to EDBs that are not consumer-owned (as defined under section 54D). PQ regulation sets the maximum revenue an EDB can earn and the minimum quality standards it must meet.

PQ regulation is designed to maximise consumer benefits while allowing EDBs to remain viable. The importance of this was highlighted in the Auditor-General's overview of the EBD sector, recognising that with ageing infrastructure, significant expenditure and investment is required, and some firms (particularly smaller firms) may "struggle to keep up." This is particularly true when considering New Zealand's obligation to meet "net zero" carbon targets by 2050. It is therefore crucial that both the default price-quality pathway and any custom pathways in operation balance consumer interests with viability.

5.2.1 Default Price-Quality Pathways

Default price-quality paths (DPPs) are the standard form of regulation. They are designed to be a low-cost way of setting revenue caps and service standards across all regulated suppliers (Commerce Act 1986, ss 53M–53Z).

5.2.2 Custom Price-Quality Pathways

Customised price-quality paths (CPPs) are available if the DPP does not allow a supplier to meet its specific needs. For example, if major renewal or recovery work is required, an EDB can apply for a CPP with higher expenditure allowances (Commerce Act 1986, ss 53Q–53V).

The aim of PQ regulation is to create an appropriate level of investment to maintain reliability of service and improve productivity and efficiency, with gains returned to consumers so they pay less in the long run. Additionally, exclusion from DPP of some forecast expenditure due to uncertainty ensures that consumers are paying for the value of services delivered, not contributing to excessive profits. This allows for smoothed revenue recovery over the regulation period.

5.2.3 Quality Standards

Quality standards are a key part of PQ regulation. They are based on network reliability, measured by SAIDI (System Average Interruption Duration Index, which measures the average total duration of power outages a consumer experiences annually) and SAIFI (System Average Interruption Frequency Index, which measures the average number of power outages a consumer experiences annually), which are “regarded as the most important measures of quality to consumers” (Commerce Commission, 2024, p. 134). These measures ensure cost savings are not achieved at the expense of service reliability and encourage EDBs to invest in network capability and resilience.

5.2.4 Consumer Ownership Exemption

Under section 54G of the Commerce Act, an EDB is exempt from PQ regulation if it is “consumer-owned.” Exempt companies remain subject only to information disclosure regulations.

Section 54D sets out that a supplier is considered consumer-owned for the purpose of s54G if: (1) all control and equity return rights are held by customer or community trusts, or customer co-operatives; (2) trustees or shareholder committees are elected by the consumers of the supplier, with each consumer having an equal vote; (3) at least 90 percent of consumers directly benefit from income distributions; and (4) the supplier has fewer than 150,000 ICP connections.

The 13 EDBs currently exempt from PQ regulation (as of 2024) are Centralines, Counties Energy, Eastland Network, Electricity Ashburton, Electra, MainPower New Zealand, Network Tasman, Scanpower, The Lines Company, Top Energy, Waipa Networks, WEL Networks, and Westpower (Commerce Commission, 2024).

A MBIE review in 2018 concluded that consumer-owned EDBs should continue to be exempt from PQ regulation, as there was no evidence that the 12 (now 13) exempt EDBs were inefficient. Because of their ownership structure, they are not strongly profit-driven, and governance factors are likely to have a greater influence on performance than revenue caps (MBIE, 2018).

The Commerce Commission has similarly observed that governance quality, rather than ownership type, is often the key performance driver. There are examples of both good and poor governance across the sector, and no single ownership or investment model seems to consistently produce better results (Commerce Commission, 2024).

6. Summary of Regulation

Overall, Part 4 of the Commerce Act creates a regulatory framework that takes ownership structures into account, ensuring that all EDBs, regardless of ownership type, remain accountable and operate for the long-term benefit of consumers (Commerce Act 1986, s 52A).

7. Literature Review of EDB Regulations

7.1 Regulation & Ownership Theory: Information Asymmetry, Incentives, and Objective Functions

The Commerce Commission's role in regulating natural monopolies, such as EDBs, is driven by the goal of replicating competitive market outcomes, thereby securing low prices and welfare-maximizing service quality. The theoretical challenge of achieving this goal is rooted in an information asymmetry between the regulator and the regulated firm (Joskow, 2014).

The regulated entity has a strategic advantage because the regulator holds imperfect information regarding a firm's true cost and quality opportunities. This imbalance creates two problems, which are adverse selection (uncertainty about the firm's true costs) and moral hazard (the firm's lack of incentive for optimal cost-control effort) (Joskow, 2014). Incentive regulation is employed in order to overcome these issues, using pre-defined rules to "induce a regulated firm to employ its superior knowledge of industry conditions to achieve regulatory goals" (Sappington, 1994, as cited in Brown & Sappington, 2023).

Therefore, optimal incentive regulation must balance two competing objectives (Joskow, 2014): securing efficiency improvements (incentives) from the firm and minimizing the firm's excess profit (rent extraction). This tension is evident in the contrast between extremes like a Pure Price Cap (high incentive, poor rent extraction due to high set price) and Pure Cost-of-Service regulation (solves adverse selection by revealing cost but eliminates incentives and leads to moral hazard). The Commerce Commission's Price-Quality (PQ) regulation, like many incentive schemes, represents a compromise between these models.

The optimal balance of these regulatory trade-offs is directly connected to the firm's ownership structure (Hansmann, 1996). The regulatory design must consider that different ownership types place different weights on profit versus consumer welfare. For example, financial incentives (rewards or penalties) are generally less effective for non-profit entities, as they simply pass costs and penalties directly through to their customer-owners (Joskow, 2024). This difference in the firm's objective function forms the theoretical justification for the New Zealand exemption of certain consumer-owned EDBs from PQ regulation.

7.2 Quality-of-Service (SAIDI/SAIFI) Under Incentive Regulation

Incentive regulation has evolved in the past 20 years in terms of incorporating service quality measures. We will discuss three representative academic papers which were published in the past 20 years to show this evolution in the treatment of service quality within incentive regulation.

Giannakis et al. (2005) investigated how quality of service can be effectively incorporated into incentive regulation and benchmarking of EDBs in the UK. They analyzed the UK's PRI-X price cap regulation for EDBs from 1991 to 1999. As service quality metrics, the authors used the number of interruptions (NIIT) and customer time lost due to interruptions (TINT), which are equivalent to part of both SAIDI (System Average Interruption Duration Index) and SAIFI (System Average Interruption Frequency Index), which we employ as service quality metrics for our study. They found that cost-efficiency and quality are not highly correlated and that a trade-off between cost-efficiency and quality exists. While sector productivity increased between 12% and 38% during 1991-1999, the authors concluded that the improvements were driven not just by cost reduction but by a technological frontier shift and by better service quality. They concluded that regulators should jointly benchmark cost and quality to avoid biased efficiency assessments. The policy implication of this work is that price controls must include quality dimensions or monetized quality measures.

Another piece of research, by Ter-Martirosyan and Kwoka (2010), examined how incentive regulation affects service reliability (outages) and whether quality standards mitigated negative impacts in US EDBs between 1993 and 1999. This is a similar time range to the previous study by Giannakis et al. (2005). Their sample included 78 investor-owned US EDBs in 23 states. SAIDI and SAIFI were used as quality measures. The authors found that incentive regulation increases outage durations (and thus reduces reliability) unless quality standards are included in the regulation. This study's policy implication for regulation is the need to pair efficiency incentives with explicit reliability targets to prevent quality degradation.

The most recent study we consider is by Ajayi et al. (2022) who examined how inventive regulation affected productivity, quality, and environmental performance in Great Britain's EDBs between 1990 to 2019. During this period, Great Britain's incentive regulation moved from a PRI-X framework (simple price cap) to a RIIO (Revenue = Incentives + Innovation + Outputs) framework. The study shows the productivity improvements after the regulatory transitions. They found that while better customer service improves output, the accounting for environmental effects (emissions) lowers measured productivity, implying that environmental compliance increases costs. The authors concluded that incentive regulation improves productivity, but outcomes depend on how quality and environmental factors are integrated into the regulation. Their study is the first to integrate environmental metrics into a long-term productivity analysis of regulated networks and its resulting policy implication is that multi-objective frameworks (cost, quality, environment) are necessary for fair performance evaluations.

7.3 International Benchmarking

Researchers around the globe have been conducting empirical research in measuring efficiency in EDBs. We will introduce three of them. Each focuses on slightly different measures and geographic regions.

Estache & Rossi (2005) analyzed the impact of different regulatory regimes and ownership structures on the labour productivity of EDB firms in 14 Latin American countries between 1994 and 2001. The study categorized privatized firms into three groups based on the regulatory scheme each operated under: Price-Cap (PC), Hybrid Regime (HR), and Rate-of-Return (RoR), and used public firms as the baseline. The authors found three major results. The first is that incentive-based regulation (PC and HR) leads to higher efficiency. The estimates suggested that private firms operating under PC and HR, respectively, used about 60% and 20% less labour to produce a given bundle of output than public firms and private firms under RoR regulation. Secondly, price-cap regulation is the most efficient regime. And lastly, privatized RoR firms are not more efficient than public firms. The finding that PC (high incentive) and HR (sliding scale/compromise incentive) lead to higher efficiency than RoR (low incentive) validates the theoretical incentive/rent extraction trade-off, which was discussed previously.

Motivated by the wave of post-liberalization mergers and the regulatory need to determine optimal firm size, Growitsch et al. (2009) conducted a cross-country comparison of European EDBs. Their primary objective was to investigate whether the theoretical cost advantages of large natural monopolies are outweighed by the service benefits of smaller firms being “close to the customer.” Using Stochastic Frontier Analysis (SFA) on a sample of nearly 500 EDBs from seven European countries (2002 data), the authors specified two main models (cost-only model and cost-quality model) to test two hypotheses, which are the ‘Economies of scale’ hypothesis (firm size is associated with higher efficiency) and the ‘Proximity to customers’ hypothesis (small firms supply higher quality). The authors found four key results. Firstly, larger companies are more cost-efficient. Secondly, significant unexploited economies of scale and scope were found, suggesting that regulators should allow or encourage further mergers. Thirdly, the ‘Proximity to customers’ hypothesis was rejected; large companies were found to offer better value for money regarding quality than small firms. Lastly, the study highlighted that cost-only benchmarking provides an incomplete picture. Contrary to the expectation that small firms provide better service, including quality dimensions actually exposed their lower performance in this area, causing their efficiency scores to decrease significantly.

Tobiasson et al. (2021) analyzed how two key structural factors, vertical integration (between distribution and regional transmission) and ownership structure, impact the cost efficiency of EDBs in Norway. This research is relevant to our study because Norway has three ownership structures (state, council/municipal, and private), which is similar to the ownership types in New Zealand. This is in contrast to the Latin American study which only had a private and public distinction and the European study which did not take ownership structure into account. The study found that the type of public ownership matters significantly in terms of cost efficiency. An increase in council (local public) ownership is associated with higher efficiency compared to state ownership while an increase in private ownership does not have a significant impact on cost inefficiency when compared to state ownership.

7.4 Ownership Structure & Performance in New Zealand Context

Closest in scope to our analysis of the 2008-2025 period is the work of Meade and Söderberg (2020), who investigated the impact of ownership structure on New Zealand EDBs using historical data from 1995 to 2013. A key methodological contribution of their work was treating ownership choice as endogenous and instrumenting it with regional air quality regulations to control for selection bias. The authors used regulatory disclosure data from 29 New Zealand EDBs to estimate three key empirical models: a cost model (defined as operating expenditure plus depreciation), a quality model (measured by the SAIDI reliability index), and a price model (based on average network revenue). These results were combined with an approximated demand model to calculate total welfare (equal to consumer surplus and firm profit). Their empirical analysis found that customer-owned firms exhibited lower prices and costs, higher quality, and higher total welfare (11% higher than investor-owned EDBs). This means that customer ownership is associated with superior performance across all measured dimensions (costs, prices, quality, and overall welfare).

Providing a trans-Tasman comparison, Mountain (2019) investigated a significant financial disparity between government-owned and investor-owned EDBs in Australia following electricity distribution sector reforms in late 1990s. Using a panel that included Australian distributors alongside international peers (including New Zealand firms as a benchmark), he found that Australian government-owned EDBs were consistently granted substantially higher regulated revenues and asset values than private EDBs. As a result, government-owned firms experienced higher prices and declining productivity. Mountain identified government ownership as the primary driver of this financial disparity. He explained that the core issue stemmed from a regulatory rule that required government-owned entities to be funded at the same high rate of return as investor-owned firms, which are private and riskier. The mechanism starts with state governments perceiving their own cost of borrowing to be much lower than the high rate which regulator allowed them to charge. This discrepancy created a financial incentive for the governments to rapidly inflate their regulated asset bases. By doing so, they maximized the cash flows and the profits generated by the utilities, which were then transferred back to the state treasuries through taxes and fees. His study highlights the importance of understanding the link between ownership structures and the incentive mechanisms they create, demonstrating how regulatory gaps can be exploited by firms at a cost to consumers.

7.5 Ownership Abroad and Comparative Incentives

While New Zealand's EDB market has unique ownership models with consumer trust-owned, council-owned, investor-owned, and mixed models, international evidence on different non-investor ownership models (customer, municipal/council) can provide essential insights into performance incentives.

Kwoka (2005) challenged the conventional assumption that private ownership is universally superior in cost efficiency. He argued that the advantage depends on the specific service being provided, hypothesizing that public ownership performs better in functions like power distribution, where service quality is difficult to specify and enforce contractually. His econometric analysis of these distinct functions concluded that cost advantage is function specific. Private firms are more cost-efficient at power generation while public firms are better at power distribution. Kwoka attributed the cost advantage of public ownership in distribution to its structure of local governance and accountability. Also, publicly owned firms provided substantially more reliable service (lower SAIDI) than investor-owned entities. His findings support our hypothesis that ownership structure influences operational performance and service quality.

Biggar et al. (2024)'s research addressed the question of which ownership structure is best for a natural monopoly, when firms can choose different price-quality trade-offs. They studied Swedish EDBs and used customers' survey data regarding perceived value for money as well as quality attributes (e.g., satisfaction with staff, service reliability) to measure the performance of EDBs. They found that customer-owned firms are perceived to deliver the highest value for money and also scored highest on multiple quality attributes. This finding implies that regulation should be tailored to ownership type or that network monopolies owned by customers may warrant exemption from price-quality regulation, supporting the New Zealand's s54(g) exemption for customer-owned EDBs from the Part 4 regulation. This research paper provides the closest international comparison to our New Zealand ownership categories and helped us to establish our hypotheses that ownership structure influences operational performance, service quality, profitability and returns.

7.6 Empirical Modelling Strategy

Insights from the preceding literature highlight three econometric challenges central to EDB performance Analysis: the inherent trade-offs between cost and quality (Giannakis et al., 2005), the influence of structural heterogeneity such as scale and density (Growitsch et al., 2009), and the potential endogeneity of ownership choice (Meade & Söderberg, 2020). Given these complexities, a simple comparison of means is insufficient to determine the drivers of performance. To robustly isolate the causal impact of ownership and regulatory settings, we employ a multi-faceted empirical strategy designed to control for unobserved heterogeneity and omitted variable bias, and conduct a quasi-experimental policy evaluation.

7.6.1 Panel Data and Unobserved Heterogeneity (Mundlak CRE)

Our baseline model is a simple cross-sectional OLS model. But we also know that we must control for unobserved factors that are correlated with the explanatory variables. For example, EDBs in rural area may be smaller and naturally have worse SAIDI. Meade and Söderberg's 2020 study on New Zealand EDB shows that accounting for endogeneity of ownership is an established requirement for New Zealand EDB studies. Also, Tobiasson et al. (2021)'s paper on EDB in Norway demonstrates that advanced panel techniques, such as the heteroscedastic Stochastic Frontier Analysis they employed, are necessary for robustly analyzing the influence of complex structural factors on EDB performance. They noted that this specific application is often overlooked in the literature. In response to this, we use Mundlak CRE to overcome this limitation.

7.6.2 Mitigating Omitted Variable Bias (Control Variables)

The second approach we employed to isolate the true effect of Ownership and Regulation is to include non-ownership control variables such as Asset Age, Rurality, CAPEX, OPEX. Ignoring these factors risks overstating or misattributing effects. As shown by Growitsch et al. (2009), there is a need to control for network scale and density, as they did in their study on European EDBs when analyzing efficiency and quality, as they are fundamental factors affecting cost. Giannakis et al. (2005) and Ajayi et al. (2022) both included CAPEX and OPEX as control variables. Their aim was to empirically account for the cost-quality trade-off in incentive regulation (Ajayi et al.) and show that capital/operating expenditure choices directly influence service quality (Giannakis et al.).

7.6.3 Quasi-Experimental Policy Evaluation (Event Study/DiD)

We have identified that the EDB Centralines switched ownership structure in 2021 and therefore became exempt from price quality regulation. In order to perform a case study and examine outcomes over the period t = -3 to +3 years, we employ a Difference-in-Difference (DiD) model within an Event Study framework. This quasi-experimental design is necessary to estimate the average treatment effect by controlling for common time trends in the sector. This is a common and robust quasi-experimental design utilized in regulatory economics for evaluating discrete policy changes (e.g., Angrist & Pischke, 2009; Bertrand et al., 2004).

8. Reliability Outcomes

8.1 Baseline model

To estimate the relationship between ownership structure and EDB reliability, we begin with a simple linear regression model. This baseline specification provides an initial descriptive assessment of how ownership and network scale relate to reliability outcomes before introducing additional controls or panel data methods. The model is given by (1);

$$Y_{it} = \alpha + \beta_1 \mathrm{Ownership}_i + \beta_2 \ln(\mathrm{Customers}_{it}) + \varepsilon_{it} \qquad (1)$$

where Y_i represents one of two outcome variables relating to reliability:

1. SAIDI**:** average duration of outages measured in minutes (reliability quality),
2. SAIFI**:** average frequency of outages per customer per year (reliability frequency)

In this baseline model *ownership,* is treated as a categorical variable (*Investor, Consumer Trust, Council, Council & Trust, Consumer Cooperative, Charitable Trust),* and *ln(Customers)* was included to control for scale effects (larger EDBs may have systematically different outcomes). The purpose of this specification is to establish a basic association between ownership type and reliability performance and to provide preliminary evidence that motivates a more detailed investigation using panel-data approaches such as the Mundlak correlated random effects model. This stepwise progression allows us to first identify simple cross-sectional patterns and then assess whether these relationships persist once unobserved heterogeneity and time-varying factors are accounted for.

Table 1: Baseline OLS Regressions – Reliability Performance

Variable	SAIDI (Outage Duration)	SAIFI (Outage Frequency)
Constant	353.47*** (78.06) [0.000009]	2.89*** (0.71) [0.000063]
Charitable Trust	32.27 (41.29) [0.435]	0.18 (0.38) [0.642]
Consumer Cooperative	-138.41*** (30.53) [0.000009]	-1.53*** (0.28) [0.0000009]
Council	-110.60*** (25.70) [0.000023]	-1.16*** (0.23) [0.0000013]
Council & Trust	-47.54 (41.26) [0.250]	-1.25** (0.38) [0.0010]
Investor	-11.44 (26.850 [0.670]	-0.22 (0.240 [0.379]
ln(Customers)	-11.38 (7.50) [0.130]	-0.40 (0.07) [0.515]
Observations	290	290
Adjusted R^2	0.111	0.159

Notes: Robust standard errors in parentheses and p-values in brackets

*$p < 0.1$, **$p < 0.05$, ***$p < 0.01$.

Baseline ownership category: *Consumer Trust.*

Table 1 indicates that ownership structure is associated with reliability performance. Consumer Cooperative and Council-owned EDBs have substantially lower outage duration (SAIDI) and frequency (SAIFI) than the Consumer Trust baseline, with reductions of roughly 110–140 minutes and 1.1–1.5 outages per customer per year ($p < 0.01$). These are large, economically meaningful improvements in reliability. The standard errors for these coefficients are small relative to their magnitudes, confirming that the effects are precisely estimated and unlikely to be due to random variation. Council-and-Trust joint ownership also shows significantly fewer outages ($p \approx 0.001$), although its SAIDI effect is not statistically distinct from zero. Charitable-Trust and Investor-owned networks show small and much smaller in magnitude, statistically insignificant coefficients across both measures ($p > 0.3$), implying broadly similar reliability to Consumer Trust EDBs once network size is controlled for. The scale variable *ln(Customers)* is negative but insignificant, indicating that reliability differences are not necessarily explained by customer count. The models explain 11–16 % of cross-sectional variation, modest yet they provide initial evidence that ownership structure contributes to observed reliability outcomes.

8.2 Limitations of the Baseline Model & Motivation for Panel Analysis

The baseline cross-sectional model provides initial evidence that ownership is associated with variation in outage duration and frequency, even after controlling for network size. However, the simplicity of this model means it has several important limitations.

First it includes no time dimension. The baseline model ignores changes in reliability within networks over time. Differences may reflect long-term structural factors or temporary shocks (e.g., weather events, asset failures) rather than ownership effects. A panel model can control for these unobserved differences. Second the model is potentially affected by omitted variable bias because key operational and network characteristics, such as OPEX, CAPEX, asset age, circuit length, geographical location and demand, are excluded. Without these controls, the ownership coefficients risk capturing these other influences, overstating or misattributing effects. Finally, the baseline model treats each observation as independent, even though EDBs may face shared external conditions (e.g. regional weather). This could bias standard errors and exaggerate significance. To address these limitations, the next stage introduces panel regression modelling incorporating variation across network and time. By adding firm effects alongside richer control variables (e.g. OPEX, CAPEX, asset age, total system demand, circuit length), these models will provide a more credible assessment of whether ownership structure systematically influences reliability performance.

8.3 Panel analysis

In panel data analysis, the Fixed Effects (FE) estimator accounts for all unobserved, time-invariant differences across EDBs such as geography and infrastructure by giving each network its own baseline reliability level. This baseline captures everything about an EDB that remains constant over time, meaning the model focuses only on how reliability changes within each network from year to year, rather than differences *between* networks. By doing so, the FE model removes bias that could arise if these unobserved, time-invariant characteristics were correlated with the explanatory variables. However, these fixed baselines absorb all time-invariant traits, with variables that do not change over time, such as Ownership**,** being perfectly collinear with the fixed effects and are therefore dropped from the FE model during estimation. Therefore, a FE model will not be able to capture the relationship between Ownership and reliability. In this case there are two possible workarounds to this issue.

8.3.1 Random effects (RE) model

The RE model assumes that the unobserved, time-invariant differences between EDBs, such as geography and infrastructure are not correlated with the explanatory variables. Instead of giving each firm its own fixed baseline (as in FE), the RE model treats these firm-specific effects as random noise drawn from a common distribution. This allows both the within-firm and between-firm variation in the data to be used for estimation, meaning time-invariant variables like Ownership can be included in the model. However, if the assumption that unobserved firm effects are not correlated with the regressors fails, the RE estimates will be biased and inconsistent.

In practice, it is quite plausible that the unobserved factors are correlated with our explanatory variables. For instance, networks operating in more challenging environments may require higher maintenance spending and experience different reliability outcomes, meaning the RE independence assumption is unlikely to hold perfectly. Nonetheless, to confirm this empirically and ensure model selection is statistically justified, a Hausman test will be conducted using Model (2). This will compare the coefficients from the FE and RE estimators. The null hypothesis is that the RE model is consistent, that is, that the unobserved effects are uncorrelated with the regressors, while rejection of the null implies that the RE assumption fails and the FE estimator is preferred.

8.3.1.1 Hausman Test

$$Y_{it} = \alpha + \beta_1 \ln(\mathrm{Customers}_{it}) + \beta_2 \mathrm{ShareRural}_i + \varepsilon_{it} \qquad (2)$$

Table 2: Hausman Tests

Model	Test Statistic ($\chi 2$)	p-value	Decision	Preferred Model
SAIDI	47.67	4.45×10^{-11}	Reject H_0	Fixed Effects
SAIFI	8.32	0.0156	Reject H_0	Fixed Effects

Table 2 reports the results of the Hausman tests comparing the FE and RE for both reliability measures. Each model includes *logCustomers* to control for network scale and *Share Rural* to capture differences in network composition between urban and rural circuits. *Share Rural* is a proportion (ranging from 0 to 1) that represents how much of an EDB's overhead circuit length is in rural areas:

Share Rural = Circuit Length in Rural Areas / Total Circuit Length (Urban + Rural)

A value of 0 equals fully urban network (no rural overhead lines). A value of 1 equals a fully rural network (no urban overhead lines). A value such as 0.6 would mean 60% rural and 40% urban. Other potential control variables such as *OPEX, CAPEX,* and *Total system demand* were excluded due to severe multicollinearity, which made the model computationally unstable. The FE and RE models were both estimated using individual EDB-level effects across the 2015–2024 panel. The Hausman tests strongly reject the null hypothesis that the RE estimator is consistent for both models ($p < 0.05$), indicating that unobserved EDB-specific factors are correlated with the explanatory variables. This finding supports the initial expectation that unobserved factors are not random but systematically related to explanatory variables. While the Hausman test could not include all theoretically relevant explanatory variables due to the multicollinearity and model instability, its core function remains intact. The test evaluates whether unobserved, time-invariant characteristics of EDB's are correlated with the included explanatory variables. Even with a reduced set of variables, the test consistently rejects the null hypothesis of no correlation, implying that the RE model's assumption of exogeneity is violated. Consequently, the RE model is not a viable option of analysis. In this case with FE and RE both being unable to accurately capture the relationship between ownership structure and reliability a Mundlak (correlated random effects) approach will be used.

8.3.2 Mundlak (correlated random effects) Models

The Mundlak model retains the RE framework (allowing inclusion of time-invariant variables like ownership) but adds the firm-level means of time-varying variables (e.g., OPEX, CAPEX, Total system demand, etc) as additional regressors. This adjustment explicitly controls for the correlation between unobserved firm effects and explanatory variables, allowing consistent estimation of both within-firm and between-firm effects while keeping the ownership variable in the model.

The first empirical Mundlak CRE model we estimate is given by (3.1);

$$Y_{it} = \alpha + \beta_1 \text{Ownership}_i + \beta_2 \ln(\text{Customers}_{it}) + \beta_3 \overline{\ln(\text{Customers}_{it})} + \beta_4 \text{AssetAge}_i + \beta_5 \text{ShareRural}_{it} + \beta_6 \overline{\text{ShareRural}_{it}} + \varepsilon_{it} \qquad (3.1)$$

Table 3: Mundlak CRE Model (3.1)

Variable	SAIDI (Outage Duration)	SAIFI (Outage Frequency)
Constant	36.18 (291.87) [0.901]	-0.35 (2.90) [0.905]
Charitable Trust	22.06 (114.22) [0.847]	0.04 (1.14) [0.974]
Consumer Cooperative	-45.72 (93.54) [0.625]	-0.66 (0.93) [0.479]
Council	-26.13 (78.06) [0.738]	-0.40 (0.78) [0.606]

Council & Trust	-72.81 (113.11 [0.520]	-1.48 (1.13) [0.190]
Investor	28.29 (75.78) [0.709]	0.16 (0.75) [0.837]
ln(Customers)	701.15*** (101.92) [0.000]	2.36*** (0.84) [0.005]
Mean ln(Customers)	-705.05*** (104.03) [0.000]	-2.33*** (0.87) [0.007]
Asset Age	1.14 (3.52) [0.745]	0.02 (0.04) [0.574]
Share Rural	67.15 (226.28) [0.767]	0.89 (1.88) [0.634]
Mean Share Rural	178.50 (246.13 [0.468]	1.28 (2.11) [0.545]
Observations	290	290
Adjusted R^2	0.148	0.033

Notes: robust standard errors in parentheses and p-values in brackets

*p < 0.1, **p < 0.05, ***p < 0.01.

Baseline ownership category: *Consumer Trust.*

Table 3 reports the results of Model 3.1 for both *SAIFI* (outage frequency) and *SAIDI* (outage duration). By incorporating the firm-level means of time-varying regressors, the Mundlak specification explicitly controls for unobserved heterogeneity that may be correlated with the explanatory variables, while preserving the ability to estimate the effects of time-invariant factors such as *Ownership.* For both models the results indicate that ownership structure does not exhibit a statistically significant association with reliability performance once time-varying controls and unobserved firm-specific effects are accounted for. None of the *Ownership* categories are statistically significant at conventional levels ($p > 0.1$) in either model. This suggests that, after controlling for network scale and average firm characteristics, *ownership* structure does not meaningfully explain differences in reliability performance.

In contrast, *ln(Customers),* our scale variable, emerges as the most consistent and statistically significant predictor of both outage frequency and duration. For *SAIDI*, the coefficient on *ln(Customers)* is 701.15 **(**p < 0.01), while for *SAIFI* it is 2.36 ($p < 0.01$). Because the variable is logged, these coefficients imply that on average a 1% increase in number of customers leads to approximately 7 additional outage minutes and 0.024

additional outages per customer per year, holding all else constant. Indicating that EDBs with growing customer bases tend to experience longer and more frequent outages over time. In other words, increases in network size are associated with reduced reliability, all else being equal. However, this effect is reversed when considering the time-mean of the same variable. The coefficients on *Mean ln(Customers)* are -705.05 for *SAIDI* and -2.33 for S*AIFI* (both $p < 0.01$), implying that EDBs which have consistently large customer counts over the panel period tend to have significantly better reliability performance. It is worth noting that the variation in customer counts within most firms over the sample period is relatively small. As such, the estimated within-firm effect captured by *ln(Customers),* reflects modest year-to-year changes in customer counts. While the coefficient remains statistically significant, interpretation should be taken with caution, due to the limited time variation in this variable.

Other covariates, including *Asset Age, Share Rural, and Mean Share Rural,* do not display statistically significant effects in either model ($p > 0.1$), suggesting that these factors, at least in isolation, are not robust predictors of variation in network reliability. Although the coefficients for *Share Rural* and *Mean Share Rural* (see interpretation details in Appendix A.2) are positive, potentially indicating a directional link between rurality and poorer reliability, these estimates are not statistically distinguishable from zero. Likewise, the age of network assets does not appear to exert a meaningful effect on outage duration or frequency once other covariates are included. *Asset Age* is constructed as a time-invariant measure from 2024 installation decade data, which may partially explain its lack of precision (details in Appendix A.3).

Overall, the explanatory power of the models is modest, with adjusted R^2 values of 0.148 for the SAIDI model and 0.033 for the SAIFI model. While these values are relatively low, they reflect the likely influence of unobserved operational or environmental variables not captured in the dataset.

The second empirical Mundlak CRE model we estimate is given by (3.2);

$$Y_{it} = \alpha + \beta_1 \text{Ownership}_i + \beta_2 \text{TotalSystemDemand}_{it} + \beta_3 \overline{\text{TotalSystemDemand}_{it}} + \beta_4 \text{AssetAge}_i + \beta_5 \text{ShareRural}_{it} + \beta_6 \overline{\text{ShareRural}_{it}} + \varepsilon_{it} \qquad (3.2)$$

Table 4: Mundlak CRE Model (3.2)

Variable	SAIDI (Outage Duration)	SAIFI (Outage Frequency)
Constant	-18.95 (179.29) [0.916]	0.10 (1.78) [0.957]
Charitable Trust	22.56 (114.25) [0.843]	0.03 (1.14) [0.977]
Consumer Cooperative	-38.32 (92.71) [0.679]	-0.72 (0.92) [0.436]
Council	-27.41 (77.56) [0.724]	-0.39 (0.77) [0.612]
Council & Trust	-73.44 (113.11) [0.516]	-1.47 (1.13) [0.191]
Investor	22.38 (73.16) [0.760]	0.20 (0.73) [0.780]
Total System Demand	0.624* (0.250) [0.013]	0.001 (0.002) [0.460]
Mean Total System Demand	-0.615* (0.258) [0.017]	-0.002 (0.002) [0.459]
Asset Age	1.34 (3.63) [0.711]	0.02 (0.04) [0.619]
Share Rural	-60.45 (243.14) [0.804]	0.38 (1.90) [0.842]
Mean Share Rural	313.48 (263.06) [0.233]	1.73 (2.15) [0.421]
Observations	290	290
Adjusted R^2	0.030	0.008

Notes: Robust standard errors in parentheses and p-values in brackets.

*p < 0.05, **p < 0.01, ***p < 0.001.

Baseline ownership category: Consumer Trust.

Table 4 reports the results from a modified Mundlak CRE specification that serves as a robustness check against the main specification presented in Table 3**.** Specifically, the model in Table 4 replaces *logCustomers* as the scale variable with a more operationally grounded measure: *Total System Demand*, defined as the maximum coincident load in megawatts drawn across all consumer connection points on each EDB's network during the disclosure year. This adjustment is intended to test the robustness of the estimated ownership and control effects under an alternative proxy for network scale. The results are broadly consistent with those in Table 3 in showing that ownership structure is not a statistically significant predictor of reliability outcomes once firm-specific unobserved heterogeneity and time-varying controls are accounted for. Across both the *SAIDI* and *SAIFI* models, none of the Ownership categories display coefficients that are statistically different from zero at conventional levels ($p > 0.1$), reinforcing earlier findings that Ownership per se is not a robust determinant of network reliability.

In contrast to the previous model, where *ln(Customers)* exhibited strong and statistically significant effects on both SAIDI and SAIFI, the alternative *Total System Demand* variable shows a more subtle relationship**.** For SAIDI, the within-firm component of *Total System Demand* is positively associated with outage duration (coefficient = 0.624, $p = 0.013$), suggesting that short-term increases in network load contribute to longer outages. Meanwhile, the between-firm (time-averaged) component shows a negative association with SAIDI (coefficient = -0.615, $p = 0.017$), indicating that firms with structurally higher average demand tend to maintain better reliability performance. These dual effects mirror the pattern observed in Table 3 for customer counts and suggest that while temporary spikes in load may strain reliability, consistently higher demand may be associated with better resourcing or infrastructure investment. For SAIFI, however, neither component of *Total System Demand* is statistically significant.

Other control variables, including *Asset Age, Share Rural, and Mean Share Rural,* remain statistically insignificant in both models, consistent with prior findings. The interpretation of these variables remains unchanged: while coefficients for rurality are directionally positive, implying potentially lower reliability in more rural networks, the results are not statistically conclusive ($p > 0.1$). Likewise, the *Asset Age* variable, constructed from 2024 infrastructure data, continues to show weak and non-significant effects on reliability outcomes, likely due to both its time-invariant construction and limited sensitivity to condition or usage factors.

The adjusted R^2 values for Table 4 are slightly lower than those in Table 3 (0.030 for SAIDI and 0.008 for SAIFI), reflecting a marginally reduced explanatory power when switching from log-scaled customer counts to *Total system demand* as the scale proxy. Nonetheless, the general pattern of findings remains consistent: once appropriate controls are introduced, neither *Ownership* nor *Asset age* nor *Rurality* emerges as a reliable predictor of reliability performance, and only scale-related variables (particularly those capturing long-run structural differences between firms) demonstrate consistent explanatory power. In sum, Table 4 supports the robustness of the main conclusions drawn from Table 3, while providing an important cross-check using an alternative model specification. The stability of the results across different operational controls reinforces confidence in the conclusion that ownership effects are not independently driving variation in reliability outcomes across EDBs.

The third empirical Mundlak CRE model we estimate is given by (3.3);

$$Y_{it} = \alpha + \beta_1 \text{Ownership}_i + \beta_2 \text{ CAPEX}_{it} + \beta_3 \overline{\text{CAPEX}_{it}} + \beta_4 \text{AssetAge}_i + \beta_5 \text{ShareRural}_{it} + \beta_6 \overline{\text{ShareRural}_{\text{it}}} + \varepsilon_{it}$$

(3.3)

Table 5: Mundlak CRE Model (3.3)

Variable	SAIDI (Outage Duration)	SAIFI (Outage Frequency)
Constant	-36.64 (174.34) [0.834]	-0.11 (1.74) [0.948]
Charitable Trust	24.25 (113.79) [0.831]	0.04 (1.14) [0.970]
Consumer Cooperative	-38.12 (91.94) [0.727]	-0.65 (0.92) [0.478]
Council	-26.51 (77.15) [0.731]	-0.38 (0.77) [0.622]
Council & Trust	-72.77 (113.20) [0.523]	-1.47 (1.12) [0.192]
Investor	18.24 (72.97) [0.796]	0.17 (0.73) [0.819]
CAPEX	0.400*** (0.153) [0.009]	0.0015 (0.0012) [0.202]
Mean CAPEX	-0.24 (0.389) [0.523]	-0.0008 (0.0037) [0.824]
Asset Age	1.31 (3.59) [0.655]	0.02 (0.04) [0.560]
Share Rural	24.64 (248.94) [0.921]	0.82 (1.94) [0.672]
Mean Share Rural	234.16 (267.38) [0.381]	1.37 (2.18) [0.530]
Observations	290	290
Adjusted R^2	0.033	0.012

Notes: Robust standard errors in parentheses and p-values in brackets.

*p < 0.05, **p < 0.01, ***p < 0.001.

Baseline ownership category: Consumer Trust.

Table 5 presents the results of a Mundlak CRE model examining the relationship between Capital expenditure measured by *CAPEX* and EDB reliability, using *SAIDI* and *SAIFI* as dependent variables. In this specification, *CAPEX* is scaled into millions of dollars to improve numerical interpretability. While scaling does not change the underlying correlation structure, it reduces numerical instability in the estimation process, resulting in more reliable coefficient and standard error estimates.

The key finding from this model is that within-firm increases in *CAPEX* are positively and significantly associated with longer outage durations. Specifically, the coefficient on *CAPEX* in the *SAIDI* model is 0.400 **(**$p = 0.009$**),** indicating that a one-million-dollar increase in *CAPEX* is associated with an estimated 0.40-minute increase in average annual outage duration per customer**,** holding all else constant. This counterintuitive result suggests that in the short term, increased investment may be linked to greater disruption, perhaps due to the operational impact of infrastructure upgrades or replacements, which may require planned outages or system reconfiguration during implementation. In contrast, *CAPEX* does not have a statistically significant effect on *SAIFI* (coefficient = 0.0015, $p = 0.202$), implying that capital investments do not materially influence the frequency of outages, at least within the time frame and measurement structure of the panel. Similarly, the between-firm component *Mean CAPEX* is insignificant in both models, suggesting that firms with structurally higher average capital investment do not exhibit meaningfully different reliability outcomes compared to their peers.

Ownership variables remain statistically insignificant across both models, consistent with earlier findings, and reaffirming that ownership structure does not explain reliability performance once controls for infrastructure investment, rurality, and asset age are included. *Asset Age, Share Rural*, and their respective time-means also remain insignificant, offering no robust evidence of their individual effects on outage duration or frequency. The explanatory power of the model is limited, with adjusted R^2 values of 0.033 for SAIDI and 0.012 for SAIFI**,** comparable to prior models. This suggests that although *CAPEX* explains some within-firm variation in outage duration, reliability performance is likely influenced by a wider range of unobserved factors either not captured in the model or not available in the data.

To explore the possibility of delayed effects, additional models were estimated incorporating one-, two-, and three-year lags of *CAPEX (*see Appendix A.4)**.** Across all lag specifications, the positive and statistically significant relationship between *CAPEX* and SAIDI persisted**,** suggesting that the observed effect is not merely a short-term anomaly. In each model, lagged *CAPEX* coefficients remained near 0.40, and statistically significant at conventional thresholds ($p < 0.01$). This consistency provides robust evidence that higher capital investment, even when lagged by several years, is associated with longer outage durations. For SAIFI *CAPEX* lagged versions did not exhibit a statistically significant effect**,** implying that capital expenditure does not materially influence the frequency of outages, at least within the time frame and measurement structure of the panel. Similarly, the between-firm component *Mean CAPEX* is insignificant the models.

Overall, the results provide limited and somewhat paradoxical evidence on the role of investment in improving reliability. While increased *CAPEX* appears to be associated with longer outages in the short term, this likely reflects temporary implementation disruptions rather than a deterioration of service quality and does not preclude potential long-term reliability improvements that fall outside the window of the panel. It is also possible that the observed relationship partly reflects limitations in the empirical specification, as with any panel-data model, rather than the true effect of investment on reliability.

The fourth empirical Mundlak CRE model we estimate is given by (3.4);

$$Y_{it} = \alpha + \beta_1 \text{Ownership}_i + \beta_2 \text{OPEX}_{it} + \beta_3 \overline{\text{OPEX}_{it}} + \beta_4 \text{AssetAge}_i + \beta_5 \text{ShareRural}_{it} + \beta_6 \overline{\text{ShareRural}_{it}} + \varepsilon_{it} \quad (3.4)$$

Table 6: Mundlak CRE Model (3.4)

Variable	SAIDI (Outage Duration)	SAIFI (Outage Frequency)
Constant	-25.66 (175.43) [0.884]	-0.09 (1.75) [0.957]
Charitable Trust	-23.51 (114.17) [0.837]	0.04 (1.14) [0.971]
Consumer Cooperative	-35.46 (92.17) [0.727]	-0.66 (0.92) [0.476]
Council	-28.96 (77.42) [0.708]	-0.39 (0.77) [0.611]
Council & Trust	-78.99 (112.98) [0.513]	-1.47 (1.13) [0.190]
Investor	20.47 (73.34) [0.780]	0.17 (0.73) [0.819]
OPEX	3.428*** (0.67) [0.001]	0.0143** (0.0054) [0.0076]
Mean OPEX	-3.205*** (1.073) [0.002]	-0.0129 (0.0099) [0.193]
Asset Age	1.43 (3.59) [0.691]	0.02 (0.04) [0.566]
Share Rural	92.57 (236.83) [0.696]	1.17 (1.90) [0.538]
Mean Share Rural	161.49 (256.07) [0.528]	1.01 (2.13) [0.635]
Observations	290	290
Adjusted R^2	0.091	0.030

Notes: Robust standard errors in parentheses and p-values in brackets.

*p < 0.05, **p < 0.01, ***p < 0.001.

Baseline ownership category: Consumer Trust.

Table 6 presents the results of a Mundlak (CRE) model estimating the relationship between Operating Expenditure *(OPEX)* and EDB reliability, using *SAIDI* and *SAIFI* as dependent variables. *OPEX* has been scaled to scaled into millions of dollars to improve numerical interpretability. While scaling does not change the underlying correlation structure, it reduces numerical instability in the estimation process, resulting in more reliable coefficient and standard error estimates.

The key finding to report is that within-firm increases in *OPEX* are positively and statistically significantly associated with both longer outage durations and higher outage frequency**.** Specifically, a one-million-dollar increase in annual *OPEX* is associated with a 3.43-minute increase in *SAIDI* ($p = 0.001$) and a 0.014 increase in *SAIFI* ($p = 0.008$) per year. Although these effects are statistically precise, their magnitudes are economically small: a million-dollar rise in operating expenditure corresponds to only a few minutes of additional outage duration and virtually no meaningful change in outage frequency. This somewhat counterintuitive result again may possibly reflect disruptions caused by maintenance activities**,** short-term implementation effects**,** or *OPEX* being allocated to non-reliability-related functions. In contrast, the between-firm term for *OPEX, Mean OPEX* is negative and statistically significant for *SAIDI* **(**–3.21, $p =$ 0.0028**),** indicating that EDBs with structurally higher levels of operating expenditure tend to experience shorter outages on average. For *SAIFI*, *Mean OPEX* is statistically insignificant, suggesting that long-term *OPEX* levels *do not* meaningfully explain differences in outage frequency across firms. Together, these results imply that while increased *OPEX* may be associated with short-term disruptions**,** sustained operational investment is linked to better long-run performance, particularly in reducing outage duration. The explanatory power of the model remains modest, with adjusted R^2 values of 0.091 for *SAIDI* and 0.030 for *SAIFI***,** consistent with previous specifications.

The fifth empirical Mundlak CRE model we estimate is given by (3.5);

$$Y_{it} = \alpha + \beta_1 \text{Ownership}_i + \beta_2 \ln(\text{Customers}_{it}) + \beta_3 \overline{\ln(\text{Customers}_{it})} + \beta_4 \text{AssetAge}_i + \varepsilon_{it} \tag{3.5}$$

Table 7: Mundlak CRE Model (3.5)

Variable	SAIDI (Outage Duration)	SAIFI (Outage Frequency)
Constant	411.87 (282.21) [0.144]	2.97 (2.73) [0.277]
Charitable Trust	38.24 (127.96) [0.765]	0.18 (1.24) [0.885]
Consumer Cooperative	-145.11 (95.30) [0.128]	-1.54* (0.92) [0.096]
Council	-111.78 (78.97) [0.157]	-1.16 (0.77) [0.130]
Council & Trust	-46.79 (126.39) [0.711]	-1.25 (1.22) [0.309]
Investor	-13.54 (82.99) [0.870]	-0.21 (0.80) [0.790]
ln(Customers)	697.11*** (100.83) [0.001]	2.31*** (0.84) [0.0057]
Mean ln(Customers)	-710.02*** (103.43) [0.001]	-2.36*** (0.87) [0.0064]
Asset Age	-1.20 (3.81) [0.752]	-0.00 (0.04) [0.977]
Observations	290	290
Adjusted R^2	0.133	0.018

Notes: Robust standard errors in parentheses and p-values in brackets.

*p < 0.05, **p < 0.01, ***p < 0.001.

Baseline ownership category: Consumer Trust.

Table 7 serves as a robustness specification that indirectly captures the influence of urban versus rural network composition by replacing the rurality variables used in empirical models 3.1–3. 4 *Share Rural* and *Mean Share Rural* with a continuous measure of network size, *ln(Customers)***.** The rural variables in earlier models consistently displayed positive but statistically insignificant coefficients**,** suggestive of a directional link between greater rural exposure and poorer reliability**.** Table 7 Provides stronger and statistically significant evidence of this relationship through the lens of network scale. This interpretation rests on the assumption that EDBs with more customers are more likely to serve urbanised areas, reflecting the higher population density and infrastructure concentration typical of urban networks. As such, *logCustomers* is used here as a proxy for urbanisation, capturing variation in the urban–rural composition of networks.

Specifically, the within-firm (over time) component of *ln(Customers)* which is positively associated with both outage duration **(**SAIDI = 697.11, $p < 0.001$**)** and outage frequency **(**SAIFI = 2.31, $p = 0.006$). Interpretation of these coefficients can be understood as a 1% increase in EDB's customer base increases *SAIDI* by approximately 6.97 additional minutes and *SAIFI* by 0.023 additional outages, on average holding all else constant. Indicating that short-term growth in customer numbers, often linked to urban expansion, can strain network performance. However, the between-firm (cross-sectional) effect, captured by *Mean ln(Customers)* is negative and highly significant for both *SAIDI* (–710.02, $p < 0.001$) and *SAIFI* (–2.36, $p = 0.006$). These coefficients imply that a 1% larger long-run customer base is associated, on average and holding all else constant, with roughly 7.10 fewer minutes of outages and 0.024 fewer outages, suggesting that EDBs operating consistently larger, and likely more urbanised, networks enjoy significantly better reliability outcomes. These findings reinforce the directional results from Models 3.1– 3.4, where rurality appeared linked to diminished reliability, and help support the hypothesis that urban networks benefit from structural advantages. In this way, Table 7 offers a conceptually and statistically stronger proxy for urban–rural differences, lending robustness to the interpretation of rural effects in the main models, even if those effects were not individually significant.

9. Financial Outcomes

9.1 Baseline Model

To examine the relationship between ownership structure and financial performance, we begin with the same simple linear regression framework used for reliability. This baseline specification provides an initial descriptive assessment of how ownership type and network scale relate to financial outcomes, prior to introducing panel data methods or additional controls. The model is given by (4);

$$Y_{it} = \alpha + \beta_1 \text{Ownership}_i + \beta_2 \ln(\text{Customers}_{it}) + \varepsilon_{it} \qquad (4)$$

where Y_{it} represents one of two outcome variables relating to financial outcomes:

1. Return on Investment (ROI)
2. Regulatory Profit (RegProfit)

Ownership is again treated as a categorical variable (*Investor, Consumer Trust, Council, Council & Trust, Consumer Cooperative, Charitable Trust*), and *logCustomers* was included to control for scale effects (larger EDBs may have systematically different outcomes). The purpose of this model is to establish a basic association between ownership and financial performance and to determine whether simple cross-sectional patterns warrant further investigation. As with reliability, this baseline regression serves as an exploratory starting point, motivating the subsequent use of more comprehensive panel-data approaches, such as the Mundlak CRE model, to account for unobserved heterogeneity and to test whether these initial associations persist once between- and within-EDB variation is separated.

Table 8: Baseline OLS Regressions – Financial Performance

Variable	ROI	RegProfit
Constant	0.0572*** (0.0128) [0.0000]	-303,769,243*** (17,018,957) [0.0000]
Charitable Trust	0.0209** (0.0068) [0.0023]	-6,923,206 (9,001,005) [0.4425]
Consumer Cooperative	0.0065 (0.0050) [0.1941]	12,450,747* (6,655,860) [0.0624]
Council	0.0031 (0.0042) [0.4702]	-11,609,857** (5,602,089) [0.0391]
Council & Trust	0.0184** (0.0068) [0.0071]	-9,141,428 (8,995,561) [0.3104]
Investor	0.0081 (0.0041) [0.0683]	-4,751,556 (5,853,527) [0.4176]
ln(Customers)	0.0002 (0.0012) [0.8481]	31,743,094*** (1,635,311) [0.0000]
Observations	290	290
Adjusted R^2	0.044	0.601

Notes: Robust standard errors in parentheses and p-values in brackets.

*$p < 0.05$, **$p < 0.01$, ***$p < 0.001$.

Baseline ownership category: Consumer Trust.

Table 8 reports the baseline OLS regressions linking ownership structure to financial performance. The models indicate that ownership structure is associated with financial performance, although the relationship differs between the two measures. In the *ROI* model, Horizon Networks (Charitable-Trust EDB) records higher returns than Consumer Trusts, approximately 2.1 percentage points greater ($p = 0.002$). Council-and-Trust EDBs also earn higher returns of about 1.8 percentage points ($p = 0.007$). These effects are not only statistically significant but also economically meaningful, particularly in a regulated rate-of-return framework where allowable returns typically vary within a narrow band around the cost of capital. Other ownership types, including *Consumer Cooperative, Council*, and *Investor*-owned networks, exhibit small and statistically insignificant coefficients ($p > 0.05$), suggesting broadly similar rates of return once network size is controlled for. The scale variable, *ln(Customers),* has a negligible and highly insignificant effect ($p = 0.85$), confirming that *ROI* is largely independent of network size. The model's adjusted R^2 (0.044) shows that ownership and size together explain very little of the variation in *ROI* consistent with the regulatory framework designed to equalise returns near the allowed cost of capital.

In contrast, the *RegProfit* model shows a stronger association. Consumer Cooperative networks report approximately $12.5 million higher annual profit than Consumer Trusts ($p = 0.062$), while Council-owned networks earn about $11.6 million less ($p = 0.039$). Although both effects are statistically significant at conventional levels, their standard errors are relatively large, indicating some uncertainty around the precise magnitude of these differences. Larger networks achieve higher profits, as reflected in the large and precisely estimated *logCustomers* coefficient (31.7 million, $p < 0.01$). The model explains roughly 60 percent of the variation in regulatory profit (adjusted $R^2 = 0.601$), highlighting the dominant influence of scale and ownership structure on absolute profitability. Taken together, these results suggest that while returns on investment are relatively uniform across ownership types, absolute profitability differs significantly. Cooperative EDBs tend to outperform Consumer Trusts by a substantial margin, approximately 54 percent higher regulatory profit on average, whereas Council-owned networks earn roughly 50 percent less. However, these ownership categories include only a few firms compared to the baseline group, meaning their estimates should be interpreted with caution.

While these baseline regressions offer an initial sense of how ownership structure correlates with financial outcomes, they remain descriptive and cannot distinguish short-run within-EDB changes from long-run differences between EDBs. To address this, as seen in our reliability outcomes section, the next section applies Mundlak CRE models, which separate within- and between-EDB variation to test whether these associations persist under a more robust panel-data framework.

9.2 Mundlak CRE Models

The first empirical models related to financial outcomes we estimate are be given by (5.1, 5.2) ;

$$Y_{it} = \alpha + \beta_1 \text{Ownership}_i + \beta_2 \ln(\text{Customers}_{it}) + \beta_3 \overline{\ln(\text{Customers}_{it})} + \beta_4 \text{OPEX}_{it} + \beta_5 \overline{\text{OPEX}_{it}} + \beta_6 \text{SAIDI}_{it} + \beta_7 \overline{\text{SAIDI}_{it}} + \beta_8 \text{SAIFI}_{it} + \beta_9 \overline{\text{SAIFI}_{it}} + \varepsilon_{it} \qquad (5.1)$$

$$Y_{it} = \alpha + \beta_1 \text{Ownership}_i + \beta_2 \ln(\text{Customers}_{it}) + \beta_3 \overline{\ln(\text{Customers}_{it})} + \beta_4 \text{CAPEX}_\text{i} + \beta_5 \overline{\text{CAPEX}_{it}} + \beta_6 \text{SAIDI}_{it} + \beta_7 \overline{\text{SAIDI}_{it}} + \beta_8 \text{SAIFI}_\text{i} + \beta_9 \overline{\text{SAIFI}_{it}} + \varepsilon_{it} \qquad (5.2)$$

Table 9: Mundlak CRE ROI Models (5.1, 5.2)

Variable	5.1	5.2
Constant	0.0608 (0.0421) [0.149]	0.0685* (0.0365) [0.061]
Charitable Trust	0.0217* (0.0115) [0.061]	0.0220* (0.0115) [0.057]
Consumer Cooperative	0.0068 (0.0090) [0.454]	0.0066 (0.0090) [0.465]
Council	0.0031 (0.0075) [0.682]	0.0033 (0.0076) [0.660]
Council & Trust	0.0222* (0.0123) [0.07]	0.0227* (0.0124) [0.066]
Investor	0.0087 (0.0075) [0.247]	0.0089 (0.0075) [0.234]

ln(Customers)	0.0764** (0.0386) [0.048]	0.0747** (0.0340) [0.028]
Mean ln(Customers)	-0.0764** (0.0389) [0.049]	-0.0755** (0.0342) [0.027]
OPEX	-0.000054 (0.000230) [0.814]	–
Mean OPEX	0.000042 (0.000285) [0.882]	–
CAPEX	–	-0.000013 (0.000043) [0.760]
Mean CAPEX	–	0.000024 (0.000072) [0.744]
SAIDI	0.000088 (0.000266) [0.741]	0.000086 (0.000265) [0.745]
Mean SAIDI	-0.000063 (0.000056) [0.260]	-0.000068 (0.000057) [0.231]
SAIFI	0.00099 (0.00320) [0.757]	0.000098 (0.00320) [0.760]
Mean SAIFI	0.00415 (0.00601) [0.490]	0.00461 (0.00605) [0.446]
Observations	290	290
Adjusted R^2	0.012	0.012
Notes: Robust standard errors in parentheses and p-values in brackets. *p < 0.05, **p < 0.01, ***p < 0.001. Baseline ownership category: Consumer Trust.		

Table 9 presents the results of Mundlak (CRE) models estimating the determinants of *ROI,* providing insight into whether financial outcomes align with the consumer-focused objectives of Part 4. Two specifications are reported: Model (5.1) includes *OPEX*, while Model (5.2) includes *CAPEX*, with both variables scaled to millions of dollars for interpretability. The inclusion of firm-level means of time-varying variables follows the Mundlak approach, allowing the models to capture both within-firm (over-time) and between-firm (cross-sectional) effects while controlling for unobserved EDB-specific heterogeneity.

A consistent and statistically significant finding across both specifications is the effect of network scale, measured by the logarithm of customer numbers. The within-firm (over-time) component of *ln(Customers)* is positive and statistically significant in both Model (5.1) (0.076, $p = 0.048$) and Model (5.2) 0.075, $p =$

0.028), indicating that short-term customer growth is associated with higher *ROI*. This pattern suggests that temporary network expansion or increased utilization may improve returns, consistent with the efficiency and innovation goals of the regulatory framework. In contrast, the between-firm (cross-sectional) component, captured by *Mean ln(Customers),* is negative and significant in both models (–0.076, $p = 0.049$ in Model 5.1; –0.075, $p = 0.027$ in Model 5.2), implying that EDBs operating structurally larger networks tend to earn lower long-run returns. This result aligns with the regulatory objective of limiting excessive profits, as larger, more mature networks appear to experience tighter profit constraints or operate closer to the allowed rate of return. Further, neither *OPEX* nor *CAPEX*, whether measured within firms over time or as firm-level averages, display statistically significant effects on *ROI*. This indicates that higher short-term expenditure or long-term investment intensity does not translate into higher financial returns within the current regulatory framework. Ownership effects are largely insignificant across both models, except for Charitable Trust and Council & Trust EDBs, which exhibit modestly higher *ROI* (≈ 2.2 percentage points) relative to Consumer Trusts . While not conclusive, this suggests that some variation in financial outcomes may exist across ownership structures, though the broader pattern reinforces the view that ownership is not a primary determinant of profitability once network scale and cost characteristics are accounted for. The inclusion of reliability indicators (SAIDI and SAIFI) provides an additional test of whether financial performance is linked to service quality. Across both specifications, reliability measures, whether current-year or long-run averages, do not exhibit statistically significant effects on *ROI*. Indicating that variations in outage duration or frequency are not associated with differences in *ROI*. This finding implies that firms delivering higher reliability may not achieve higher financial returns, suggesting that under Part 4's incentive regime, service quality improvements may be decoupled from profit outcomes.

Overall, the Mundlak models indicate that *ROI* outcomes are primarily explained by short-term fluctuations in network scale rather than by expenditure or governance factors. However, the weak relationship between investment variables and *ROI* implies that the incentive mechanisms designed to promote innovation and long-term efficiency improvements may not be strongly reflected in actual financial returns.

The second empirical models related to financial outcomes we estimate are given by (5.3, 5.4);

$$Y_{it} = \alpha + \beta_1 \mathrm{Ownership}_i + \beta_2 \ln(\mathrm{Customers}_{it}) + \beta_3 \overline{\ln(\mathrm{Customers}_{it})} + \beta_4 \mathrm{OPEX}_{it} + \beta_5 \overline{\mathrm{OPEX}}_{\mathrm{it}} + \beta_6 \mathrm{SAIDI}_{it} + \beta_7 \overline{\mathrm{SAIDI}_{it}} + \beta_8 \mathrm{SAIFI}_{it} + \beta_9 \overline{\mathrm{SAIFI}_{it}} + \varepsilon_{it} \qquad (5.3)$$

$$Y_{it} = \alpha + \beta_1 \mathrm{Ownership}_i + \beta_2 \ln(\mathrm{Customers}_{it}) + \beta_3 \overline{\ln(\mathrm{Customers}_{it})} + \beta_4 \mathrm{CAPEX}_{\mathrm{it}} + \beta_5 \overline{\mathrm{CAPEX}_{it}} + \beta_6 \mathrm{SAIDI}_{it} + \beta_7 \overline{\mathrm{SAIDI}_{it}} + \beta_8 \mathrm{SAIFI}_{it} + \beta_9 \overline{\mathrm{SAIFI}_{it}} + \varepsilon_{it} \qquad (5.4)$$

Table 10: Mundlak CRE RegProfit Models (5.3, 5.4)

Variable	5.3	5.4
Constant	28,782,028 (28,136,609) [0.306]	-37,459,178 (24,420,068) [0.125]
Charitable Trust	2,867,489 (7,708,007) [0.710]	2,436,298 (7,713,173) [0.752]
Consumer Cooperative	2,096,951 (6,037,082) [0.728]	1,354,240 (6,047,258) [0.823]
Council	-9,443,541* (5,020,405) [0.060]	-2,135,626 (5,084,299) [0.674]
Council & Trust	-8,770,264 (8,190,166) [0.284]	-2,875,081 (8,264,668) [0.728]
Investor	2,736,254 (5,031,692) [0.587]	667,974 (5,020,191) [0.894]
ln(Customers)	-8,355,537 (28,062,502) [0.766]	82,911,279** (26,710,070) [0.002]
Mean ln(Customers)	5,128,436 (28,210,192) [0.856]	-78,435,739** (26,821,000) [0.003]
OPEX	1,559,331*** (167,480) [0.001]	—
Mean OPEX	50,123 (201,481) [0.804]	—
CAPEX	—	205,658*** (33,434) [0.001]
Mean CAPEX	—	356,644*** (51,505) [0.001]
SAIDI	-7,811 (19,319) [0.686]	-1,069 (20,833) [0.959]
Mean SAIDI	24,539 (38,285) [0.522]	4,454 (39,381) [0.910]
SAIFI	605,622 (2,326,950) [0.795]	910,372 (2,512,260) [0.717]
Mean SAIFI	-3,958,664 (4,119,179) [0.337]	-2,905,306 (4,255,453) [0.495]

Observations	290	290
Adjusted R²	0.769	0.759
Notes: Robust standard errors in parentheses and p-values in brackets. *p < 0.05, **p < 0.01, ***p < 0.001. Baseline ownership category: Consumer Trust.		

Table 10 presents the results of Mundlak (CRE) models estimating the determinants of *RegProfit.* As in the *ROI* analysis, two specifications are reported: Model (5.3) includes *OPEX,* while Model (5.4) replaces O*PEX* with *CAPEX.*

A key finding across both models is that expenditure intensity is a major driver of profitability. In Model 5.3, *OPEX* has a large and highly significant positive association with *RegProfit* (1.56 million, $p = 0.001$), indicating that increases in operational spending are linked to higher short-term profits. The long-run or mean level of *OPEX,* however, is statistically insignificant, suggesting that persistent differences in operating cost intensity do not translate into sustained profitability advantages across EDB's. Model 5.4 reveals a similarly strong pattern for investment activity. Both *CAPEX* (205.7 thousand, $p < 0.001$) and its firm-mean component (356.6 thousand, $p < 0.001$) are positive and highly significant, implying that higher capital expenditure is closely associated with greater profitability, both in the short and long run. This result suggests that investment-heavy networks achieve higher regulated profits, consistent with a framework that allows capital recovery through the regulated asset base. Taken together, these findings indicate that expenditure decisions, particularly capital investment, play a key role in shaping profit outcomes within the limits of regulatory oversight.

Network scale also exhibits a mixed relationship with profitability. The within-firm (over-time) coefficient on *ln(Customers)* is negative and statistically insignificant in Model 5.3 ($p = 0.77$), but positive and significant in Model 5.4 (82.9 million, $p = 0.002$), while the between-firm *Mean ln(Customers)* component is consistently negative and significant (–78.4 million, $p = 0.003$). This pattern implies that short-term customer growth contributes to higher profits, potentially through expanding demand and revenue, but that firms with structurally larger customer bases tend to earn lower long-run profits. The latter effect is consistent with Part 4's objective of limiting excessive returns, as larger, established networks appear more tightly constrained by the regulatory regime. Ownership effects are again small and largely insignificant across both models. This reinforces the earlier conclusion that ownership structure is not a primary determinant of financial performance once expenditure and scale factors are considered. Finally, the inclusion of reliability measures (SAIDI and SAIFI) and their means reveal no statistically significant relationship with *RegProfit,* indicating that neither short-term nor persistent reliability outcomes are associated with profit variation. This finding mirrors the *ROI* analysis, suggesting that under the current incentive regime, service quality improvements do not directly translate into higher profitability. Overall, the results of Table 10 show that profitability in the sector is most strongly influenced by expenditure intensity, particularly capital investment rather than by ownership, reliability, or long-run scale effects.

10. EBDs Event Studies

This section presents a series of event studies assessing how regulatory transitions under Part 4 affected EDBs. The purpose is to identify how firms adjust their reliability, expenditure, and financial performance when regulatory settings change, and to evaluate whether the incentives embedded in Part 4 operate as intended. Each analysis uses a fixed-effects difference-in-differences event-study design to trace the dynamic effects of major regulatory events, such as exemption from price-quality regulation or movement onto and off a Custom Price-Quality Pathway (CPP). These transitions provide natural experiments that reveal whether firms respond with higher investment, improved reliability, or financial normalisation in line with regulatory objectives. Only the difference-in-differences graphs are shown in the main text to focus attention on the overall pattern of effects. The underlying t-statistics supporting all interpretations are fully reported in the appendices.

10.1 Centralines Exemption Event Study

Centralines was recognised as a consumer-trust-owned distributor in 2021, making it exempt from price-quality regulation under section 54(g) of the Commerce Act 1986. This exemption provides an opportunity to observe how the removal of regulatory oversight affects firm behaviour and consumer outcomes.

The event year is set as 2021, when Centralines became exempt (Regulated = 0). All other years are coded as event-time dummies (evt_m3, evt_m2, evt_p0, evt_p1, evt_p2, evt_p3) to capture dynamic changes before and after exemption. Comparable EDBs that remained regulated under Part 4, including Alpine Energy, EA Networks, FirstLight Network, Nelson Electricity, and Unison Networks, serve as control firms. These benchmarks allow the design to isolate the effects of exemption from wider industry movements.

The dataset contains annual observations for each firm with variables for company, year, regulated status, and event time. The model is estimated in R using the run_event_study() function:

$$Y_{it} = \alpha_i + \lambda_t + \sum_k \ \beta_k \text{EventTime}_{k,it} + \varepsilon_{it}$$

This fixed-effects specification functions as a difference-in-differences design, comparing within-firm changes before and after the exemption while using the regulated group to account for sector-wide variation. Firm and year fixed effects control for unobserved differences across firms and over time, ensuring that estimated effects reflect changes associated with the exemption rather than structural characteristics of each business. Standard errors are clustered at the firm level. Each coefficient β_k represents the deviation in performance relative to 2021, with 95 percent confidence intervals illustrating the precision of the estimates.

We focus on t-statistics rather than p-values because they provide a clearer indication of the magnitude and direction of effects in a small-sample panel. T-statistics indicate how many standard errors each coefficient differs from zero, supporting comparisons across variables and avoiding binary significance thresholds. This aligns with accepted practice for small-N fixed-effects and DiD settings, where the scale of estimated effects is often more informative than formal significance.

To ensure that observed changes were genuinely linked to the 2021 exemption rather than broader sectoral dynamics, a placebo test was estimated using 2016 as a false event year. The absence of spurious effects confirmed that the observed post-2021 changes were specific to the exemption. Centralines' earlier performance pattern was consistent with effective regulatory incentives, indicating that the exemption recognised the ability of its consumer-trust ownership structure to achieve the outcomes Part 4 intends to secure.

10.2 PQR Pathways: Entry and Exit of Custom Price-Quality Pathways (CPPs)

Each of the following event studies examines how transitions between the Default Price-Quality Pathway (DPP) and the Custom Price-Quality Pathway (CPP) shaped performance under Part 4. These transitions create natural experiments for assessing how firms respond when they begin a CPP, undertake intensive investment programmes, and later return to the DPP.

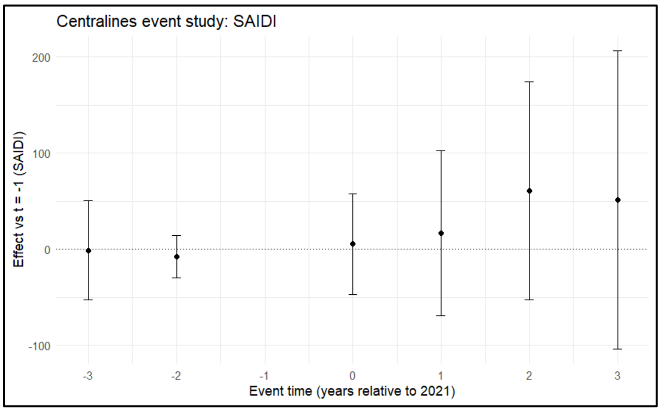
All models and interpretations use the same methodological framework as the Centralines analysis, applying fixed-effects event-study regressions to trace within-firm changes before and after the regulatory change.

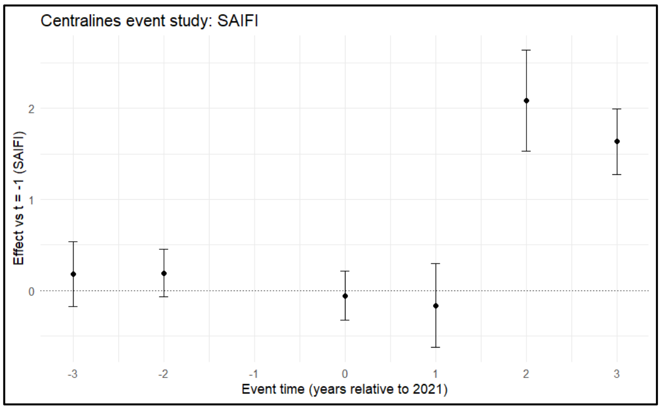
If a CPP is functioning as intended, the entry phase should show temporarily elevated Capex and Opex as firms undertake network renewal and service improvements, which may be accompanied by short-term increases in outage duration or frequency. Over time, as investments are completed and efficiencies are realised, SAIDI and SAIFI should decline, indicating improved reliability, while ROI should stabilise or rise moderately as performance gains are shared with consumers. At exit, a well-implemented CPP should therefore display lower outage measures, normalised expenditure, and steady profitability, signalling a return to efficient, sustainable operation under the DPP.

10.2.1 Centralines Customer Quality Interest

Centralines became exempt from price-quality regulation in 2021 after being recognised as a consumer-trust-owned distributor under section 54(g) of the Commerce Act 1986. The exemption reflected the view that community ownership can align managerial incentives with consumer welfare, allowing a firm to maintain efficiency and accountability without direct regulatory oversight.

The reliability results show that outage duration remained stable, while outage frequency increased once the firm was no longer regulated. SAIDI coefficients remain close to zero across the event window (t-values between −0.91 and 1.37), with all confidence intervals overlapping zero, confirming no statistically significant change in outage duration. In contrast, SAIFI shows large positive and significant coefficients at +2 (t = 8.05) and +3 (t = 11.6), with confidence intervals entirely above zero. This indicates a clear and sustained rise in outage frequency following exemption.

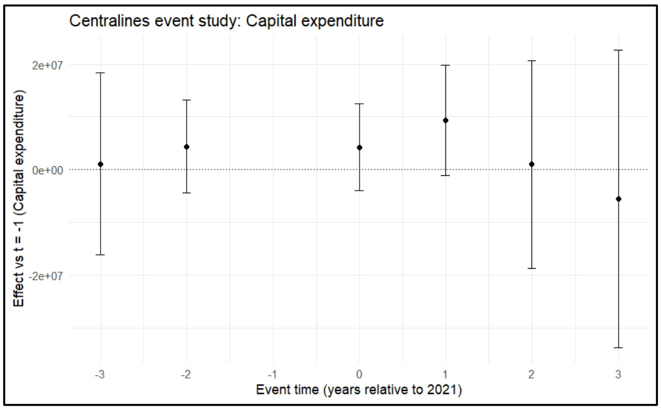


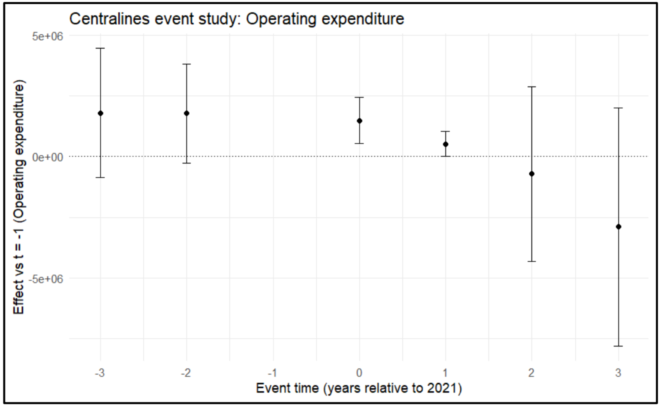


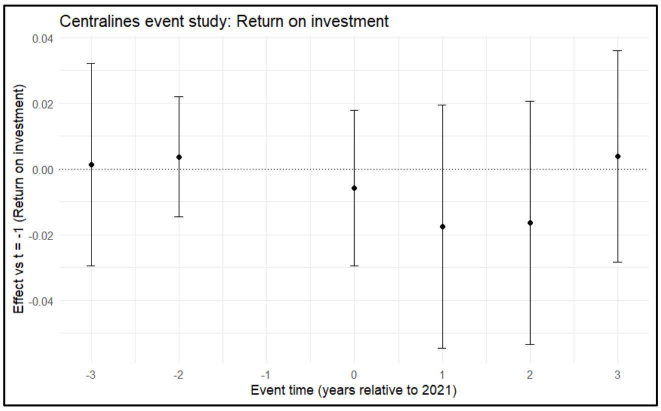
These findings suggest that once regulation ended, the incentives supporting reliability performance weakened, even though service duration and overall cost control remained steady. Without formal performance requirements or penalties, reliability discipline appears to have softened, reflecting the reduced external pressure of price-quality regulation. While community ownership continued to promote prudent management and consumer-focused governance, the results indicate that trust ownership alone may not fully reproduce the reliability incentives built into the regulatory framework.

10.2.2 Centralines Efficiency and Profitability Interest

The expenditure and profitability results indicate short-term adjustment but long-term stability following exemption. Capital expenditure is mostly insignificant, apart from a one-year increase at +1 (t = 2.30), likely reflecting transitional project timing as the firm adjusted to deregulation. Operating expenditure rose significantly around the exemption period (−2 t = 2.25; 0 t = 4.06; +1 t = 2.68) before returning to baseline by +2, suggesting temporary adjustment costs rather than sustained inefficiency. The timing of these increases aligns with the rise in outage frequency, implying that short-term operational changes rather than reduced maintenance effort explain the variation. Return on investment remained statistically insignificant across all years, indicating stable profitability and confirming that the exemption did not produce abnormal financial outcomes. This aligns with the consumer-trust model, where surpluses are typically reinvested in the network or returned to consumers through rebates rather than retained as profit. Taken together, these findings show that Centralines adapted well to deregulation. The firm preserved financial stability and efficiency while managing a short transitional phase of operational adjustment.



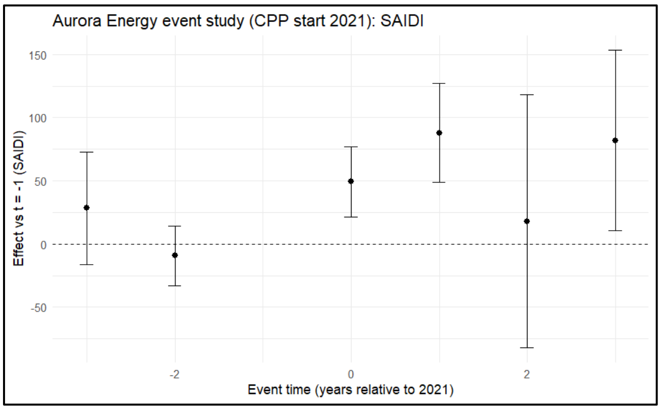


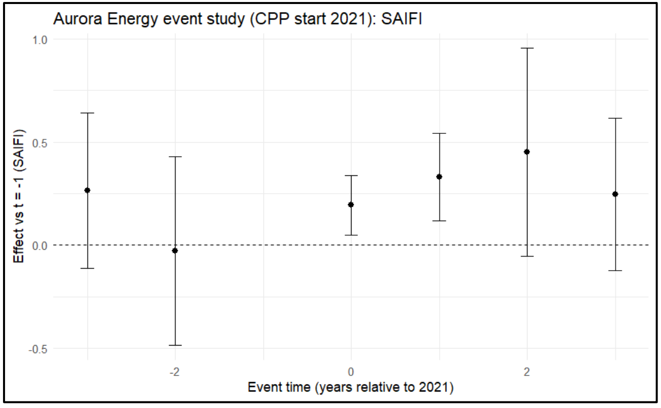


10.2.3 Aurora Energy Entry (2021)

10.2.3.1 Customer Quality Interest

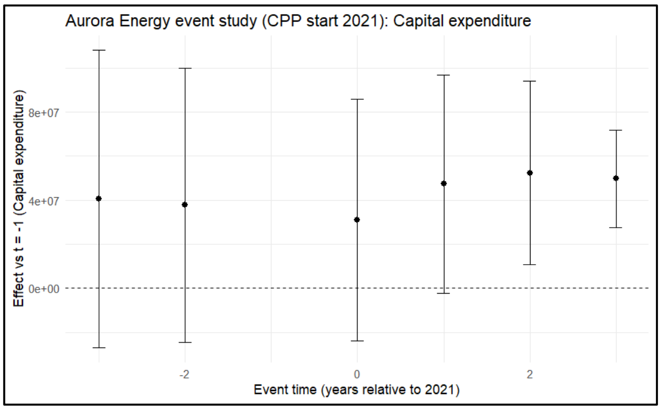
Aurora Energy's entry into the CPP in 2021 coincided with a short-term deterioration in reliability indicators, reflecting transitional adjustment pressures as major network renewal began. SAIDI rises significantly across the event and post-event years (+0 t = 3.89, +1 t = 4.91, +3 t = 2.50), showing that outage durations increased during intensive works. SAIFI is also positive and significant at +0, +1, and +2 years (t = 2.90, 3.39, 1.94), confirming more frequent interruptions in the early CPP period. These results suggest that reliability temporarily weakened as construction, replacement, and safety programmes were implemented, consistent with the CPP's role as a mechanism to enable large-scale investment following a period of underperformance.

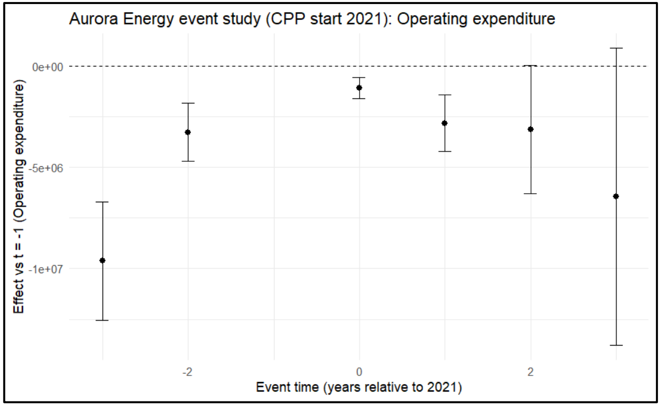


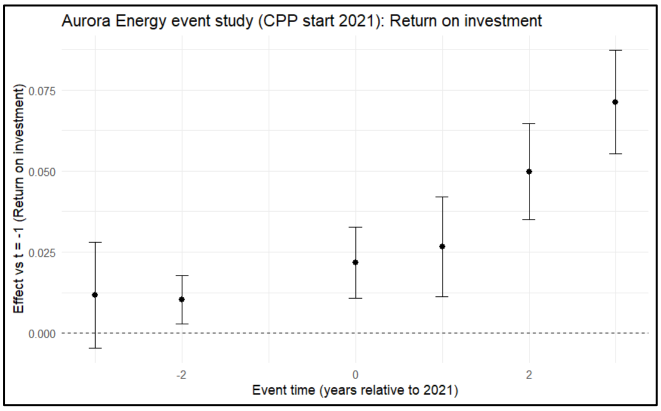


10.2.3.2 *Efficiency and Profitability Interest*

The expenditure and profitability patterns reflect the intended investment-led restructuring under the CPP. Capital expenditure increased strongly across post-entry years (+1 t = 2.08, +2 t = 2.74, +3 t = 4.92), confirming a front-loaded asset renewal phase. Operating expenditure declined significantly over the same period, indicating resource reallocation toward long-term network projects. Return on investment rose steadily from −2 to +3 years (t = 3.04 to 9.72), showing that efficiency benefits began materialising as new assets came into service. Collectively, these results demonstrate the CPP's capacity to facilitate capital-intensive modernisation while containing operating inefficiencies, even at the cost of short-term reliability stress.

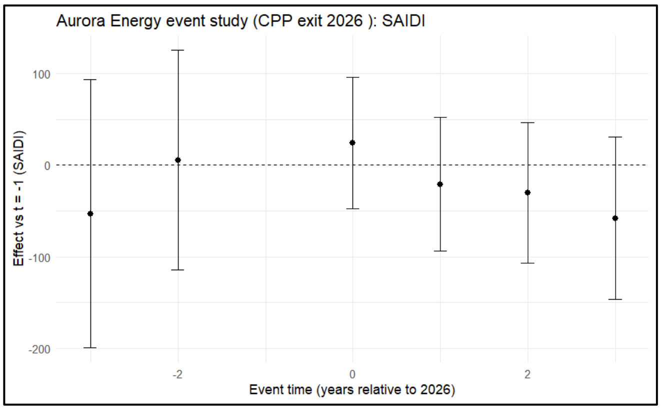


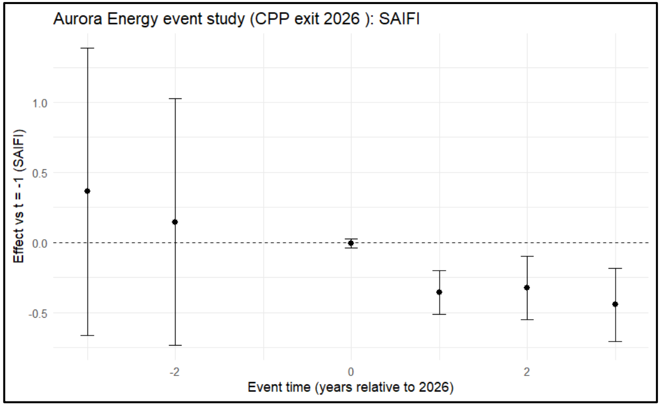




10.2.4 Aurora Energy Exit (2026)

By the projected exit year 2026, reliability trends reverse direction, with SAIDI turning (non-significant) negative coefficients (−20 to −58) and SAIFI significantly negative across +1 to +3 years (t = −4.92, −3.03, −3.61). This pattern confirms that network upgrades are expected to produce durable service-quality gains as Aurora returns to default regulation. The full cycle illustrates the intended CPP trajectory: temporary disruption during heavy investment, followed by sustained improvements in reliability and efficiency once the network stabilises.

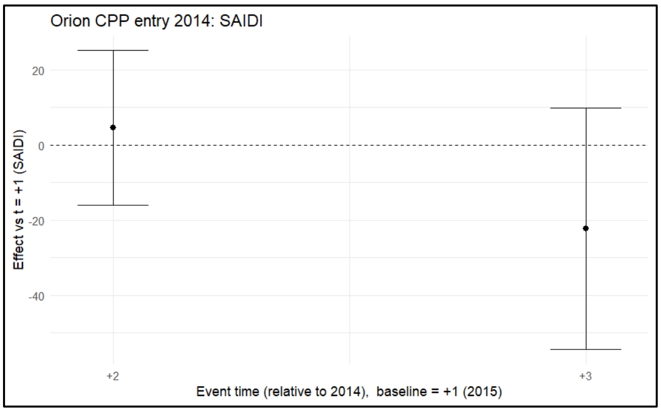


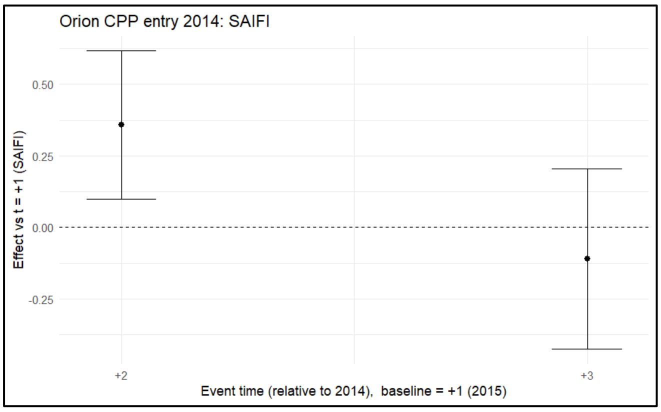


10.2.5 Orion NZ Entry (2014)

10.2.5.1 Customer Quality Interest

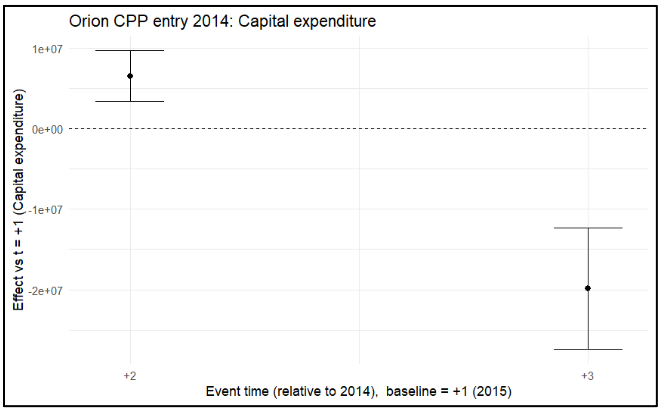
Orion NZ's entry into the CPP in 2014 produced no measurable quality improvements and a temporary increase in outage frequency. Only SAIFI rises significantly at +2 (t = 2.91), indicating more frequent outages in the short term. These results reflect a system still managing operational stress after the Canterbury earthquakes. The CPP's purpose at this stage was recovery, not optimisation, giving Orion flexibility to restore essential assets while maintaining continuity of supply.

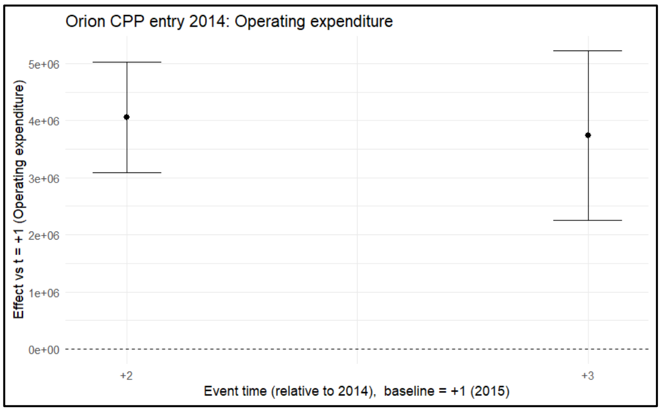


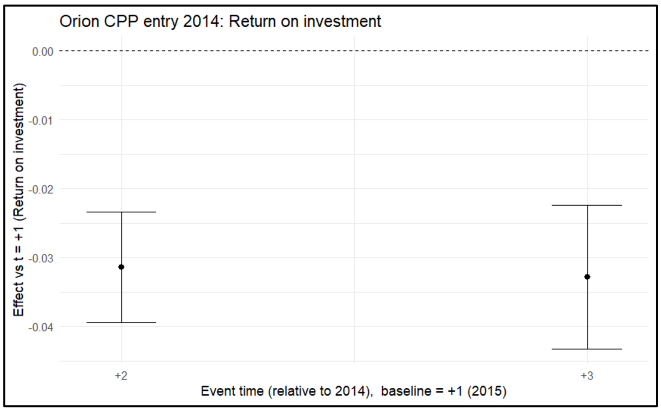


10.2.5.2 Efficiency and Profitability Interest

Capital expenditure rose sharply at +2 (t = 4.47) and then fell sharply by +3 (t = −5.58), showing that major reconstruction projects were completed early in the CPP term. Operating expenditure increased significantly in +2 and +3 (t = 8.88, 5.34), capturing ongoing costs of repair and maintenance, while return on investment declined over the same period (t = −8.27, −6.68). These patterns confirm that Orion's CPP primarily functioned as a stabilisation measure. It restored network integrity and compliance capacity but did not yet yield efficiency or profitability gains.

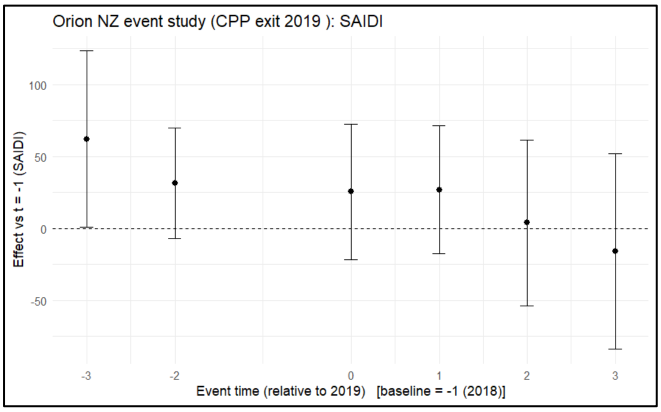


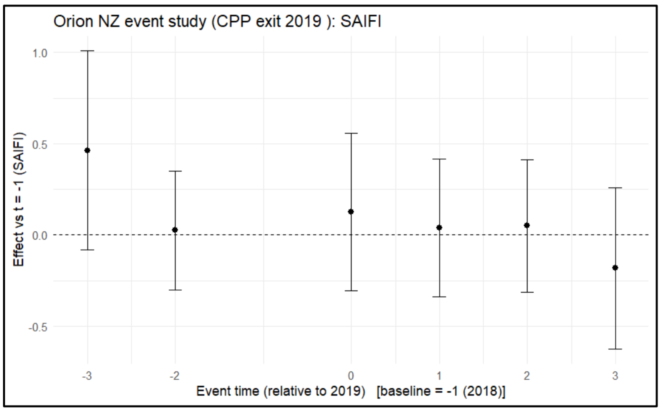


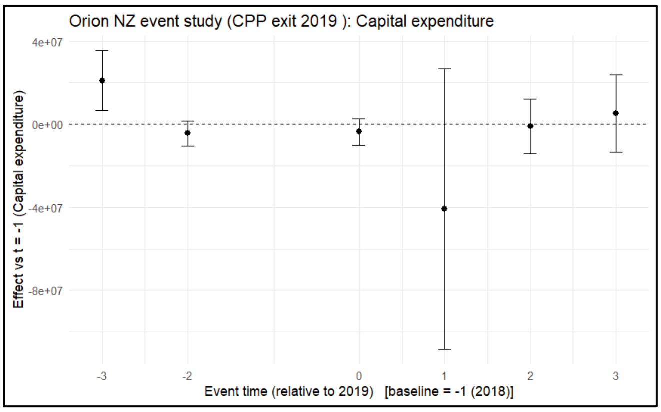


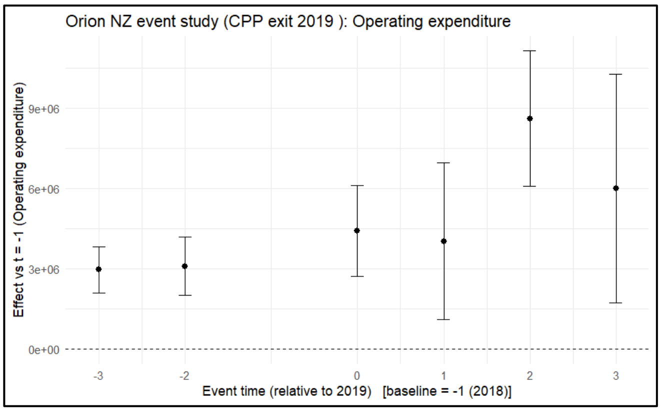
10.2.6 Orion NZ Exit (2019)

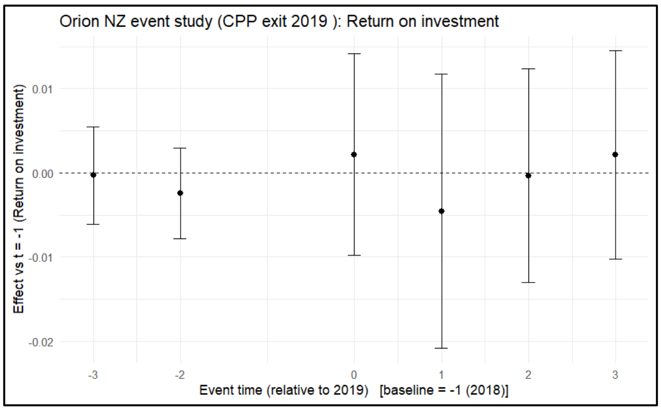
During exit, reliability and efficiency outcomes indicate stabilisation after earlier strain. SAIDI and SAIFI are mildly positive at −3 (t = 2.21 and 1.85) but become insignificant thereafter, suggesting reliability had normalised by the time of transition. Capital expenditure remains significant only at −3 (t = 3.20), matching the late-CPP investment phase identified earlier. Operating expenditure stays high across most years, while ROI remains unchanged. Together, these results show that Orion's CPP achieved its primary purpose: restoring steady operations and reliability after crisis conditions, even if longer-term productivity improvements were still developing.









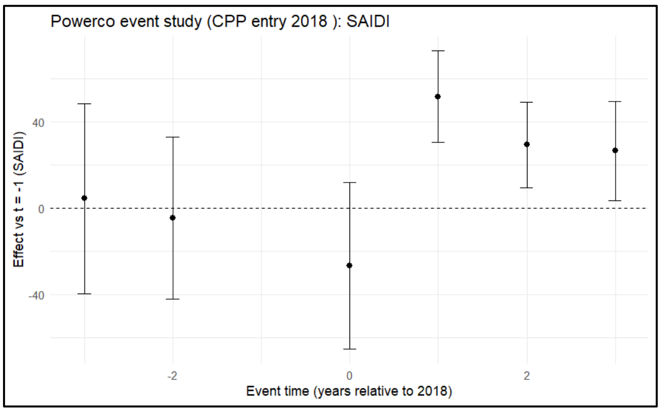


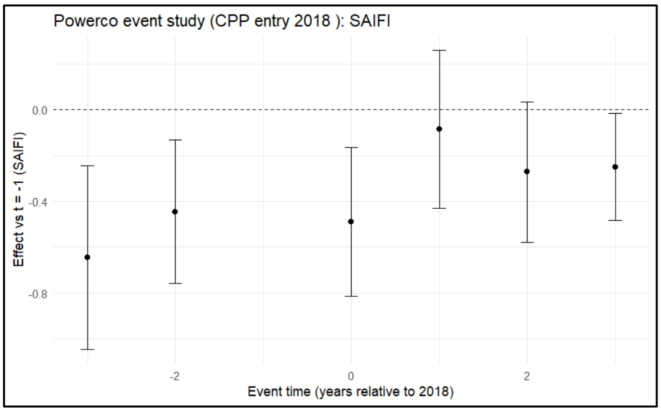
10.2.7 Powerco Entry (2018)

10.2.7.1 Customer Quality Interest

At CPP entry in 2018, Powerco experienced a mix of planned disruption and underlying improvement. SAIDI rises significantly across all post-entry years (+1 t = 5.32, +2 t = 3.21, +3 t = 2.50), showing longer outages as network renewal projects intensified. SAIDI effects prior to entry

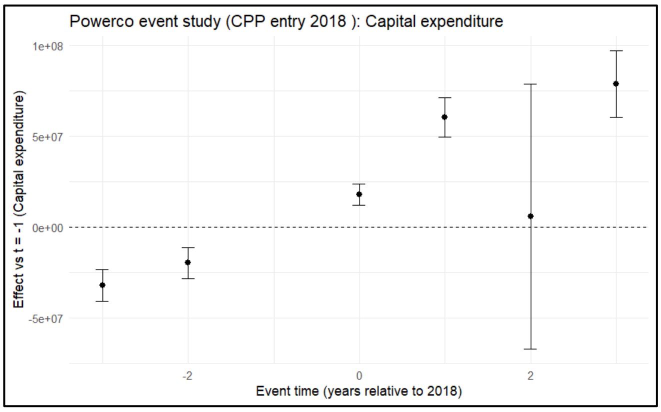
(−3, −2) are insignificant, meaning the shift occurs only once CPP works begin. SAIFI is negative and significant across much of the event window, with reductions at −3 (t = −3.52), −2 (t = −3.10), 0 (t = −3.28), and +3 (t = −2.34), indicating that outages became less frequent overall. SAIFI at +2 is borderline (t = −1.94, p = 0.076). This combination of fewer but longer interruptions indicates deliberate system upgrades rather than instability. It reflects the expected transition period where the CPP enables substantial asset renewal and reliability enhancement over the medium term.

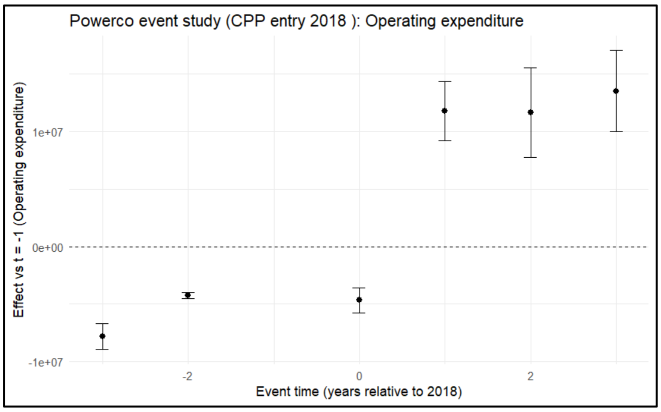

Powerco event study (CPP entry 2018): SAIDI

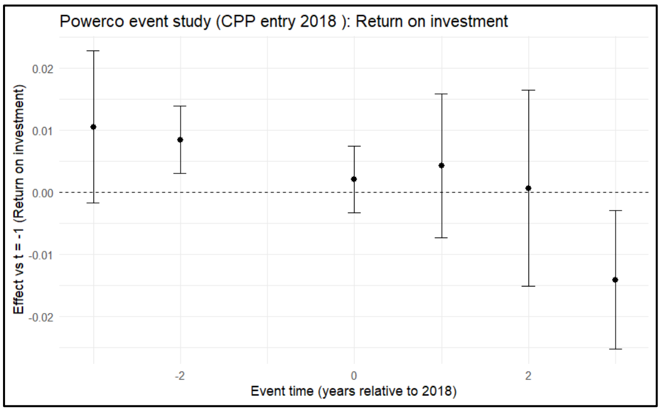

Powerco event study (CPP entry 2018): SAIFI

10.2.7.2 Efficiency and Profitability Interest

Capital expenditure was significantly lower before entry (−3 t = −8.13, −2 t = −4.99) but rose sharply afterward (0 t = 6.48, +1 t = 12.14, +3 t = 9.39), consistent with front-loaded network investment financed through the custom pathway. Operating expenditure followed the same trajectory, falling steeply before entry (−3 t = −15.28, −2 t = −33.15, 0 t = −9.30) and then rising substantially afterward (+1 t = 9.91, +2 t = 6.48, +3 t = 8.37). ROI improved modestly pre-entry at −2 (t = 3.37) but showed a significant decrease at +3 (t = −2.77), reflecting profitability compression during the capital-intensive phase. Together, these trends indicate that Powerco used the CPP strategically to implement planned infrastructure renewal, accepting temporary financial strain in pursuit of long-term network resilience.

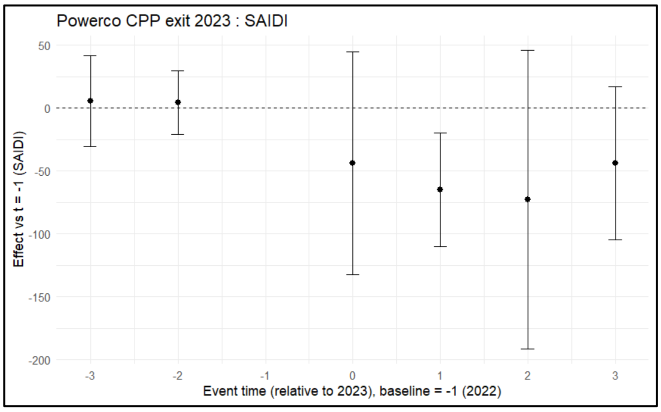

Powerco event study (CPP entry 2018): Capital expenditure

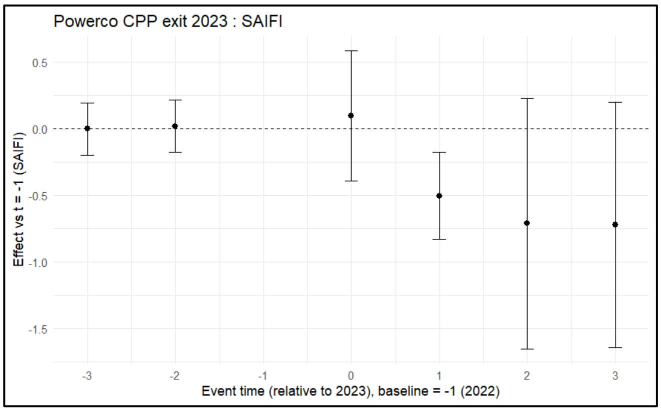


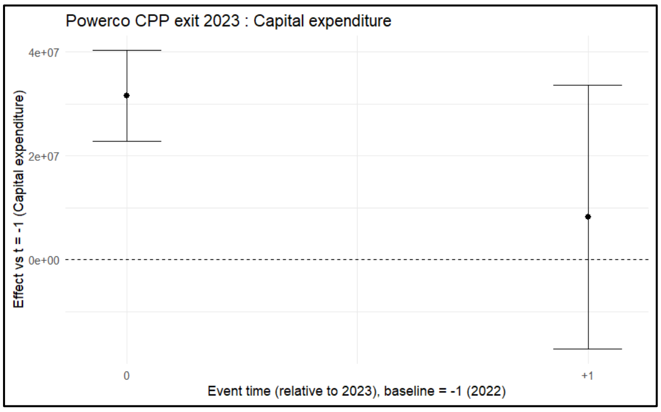


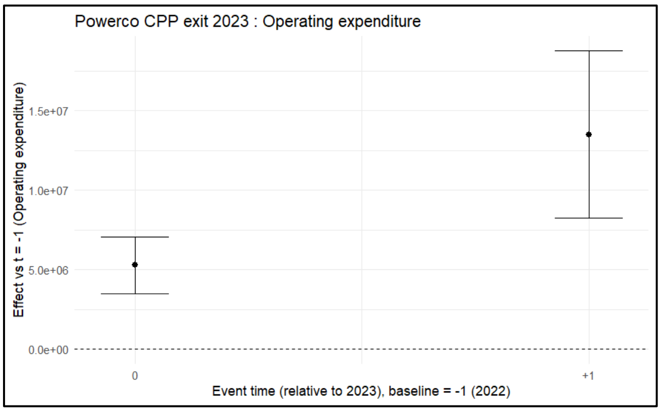
10.2.8 Powerco Exit (2023)

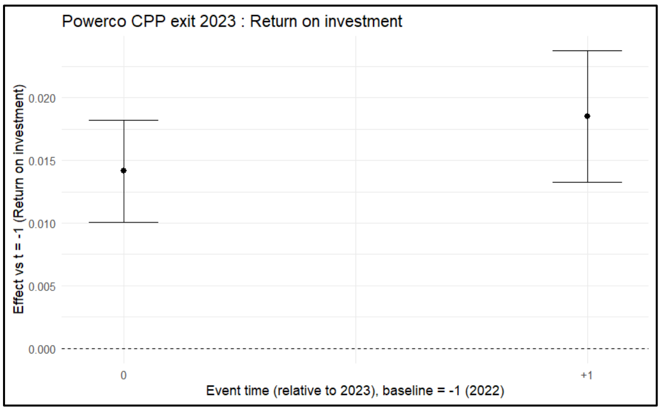
At exit, reliability measures show that investment gains had stabilised. SAIDI is unchanged, while SAIFI is significantly negative at +1 (t = −3.32), indicating a sustained reduction in outage frequency after the completion of major works. Capital expenditure records a large and highly significant spike prior to exit (t = 7.73), followed by a sharp normalisation at +1 where the effect is no longer significant, consistent with the end of project-intensive investment. Operating expenditure is significantly elevated at both exit and +1 (t = 6.34, 5.51), reflecting higher operational activity during commissioning and a subsequent return to steady-state maintenance levels. ROI increases strongly at exit (t = 7.48) and again post-exit (t = 7.60), signalling financial recovery as capital pressure subsides. Powerco's CPP therefore displays a complete exit profile: reliability gains locked in, investment intensity falling away, operating activity stabilising, and financial performance returning to normal conditions.







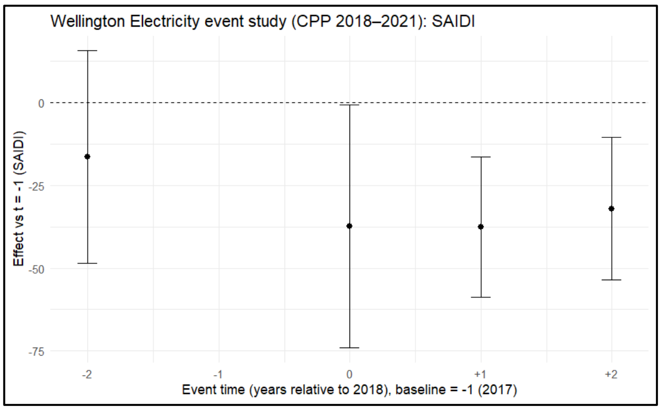


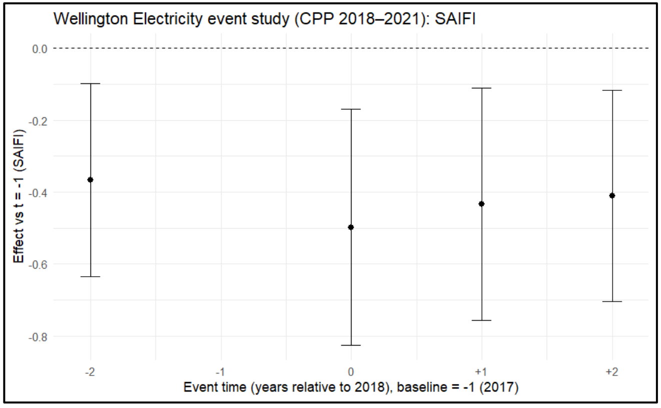


10.2.9 Wellington Electricity Entry (2018)

10.2.9.1 Customer Quality Interest

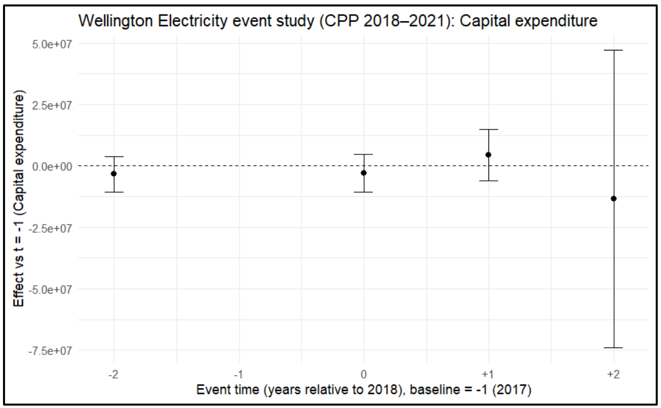
Wellington Electricity's entry shows immediate reliability gains followed by a mild reversal. SAIDI declines significantly in +0 and +1 (t = −2.18, −3.80), indicating shorter outages after entering the CPP, but rises again by +2 (t = 3.19) as further network works occurred. SAIFI remains consistently negative and significant across the window (−2 t = −2.93, 0 t = −3.25, +1 t = −2.88, +2 t = −2.99), showing fewer outages overall. These outcomes imply that the CPP initially improved reliability and that temporary setbacks were likely linked to planned maintenance rather than performance deterioration.

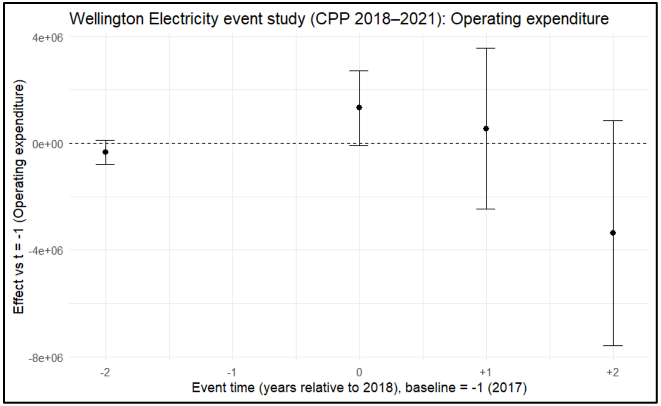


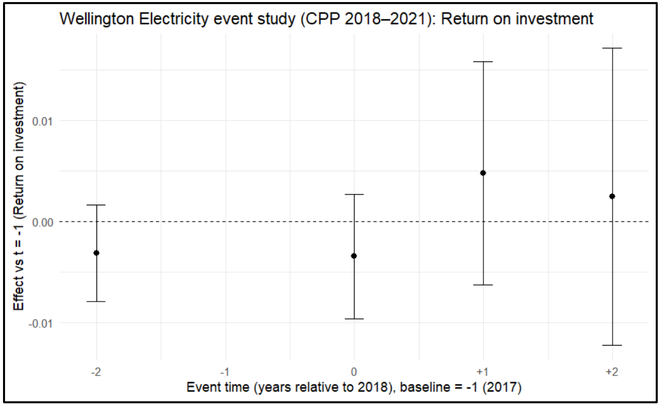


10.2.9.2 Efficiency and Profitability Interest

Capital expenditure shows no significant variation, suggesting reliability gains stemmed from targeted operational adjustments rather than major asset investment. Operating expenditure increases slightly after entry (t = 2.02), consistent with intensified maintenance to deliver early quality improvements. ROI remains insignificant, showing a neutral financial impact. Overall, Wellington's CPP entry demonstrates operational optimisation within existing resources rather than system-wide renewal, aligning with the CPP's flexibility to address specific quality issues efficiently.

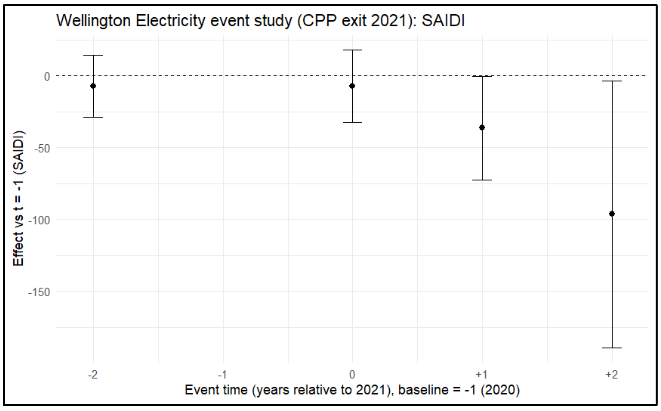


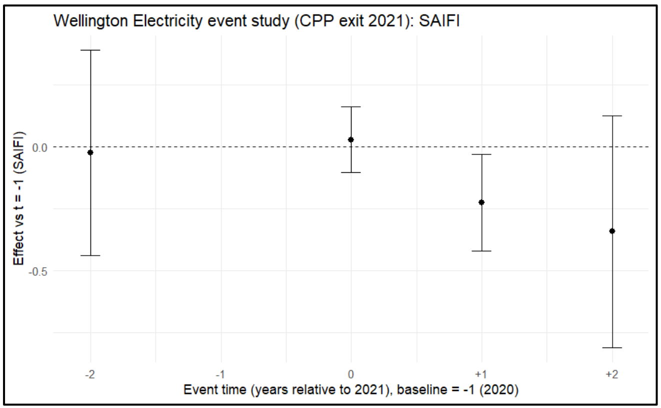


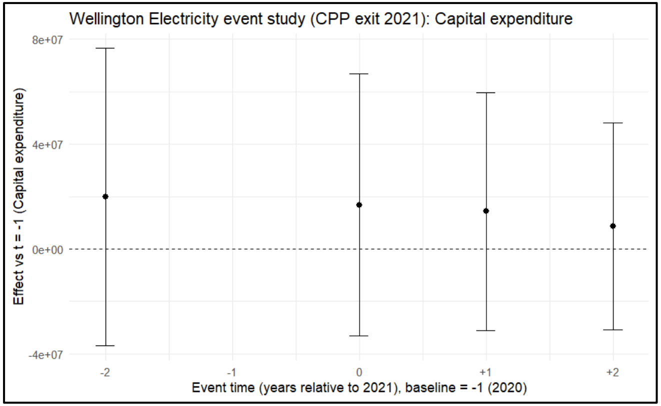


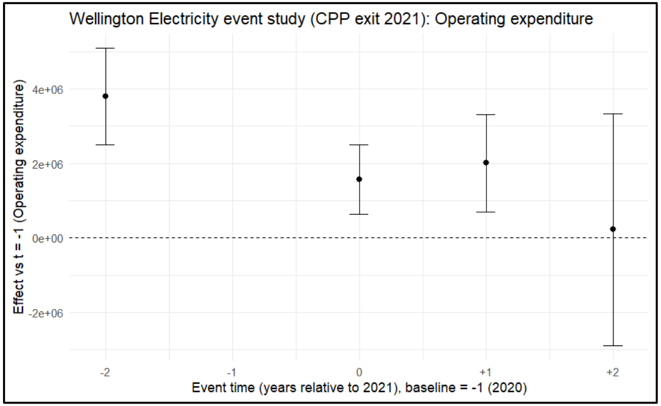
10.2.10 Wellington Electricity Exit (2021)

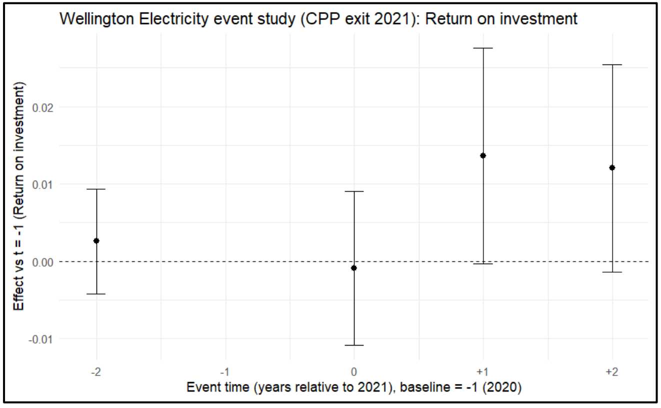
By exit, reliability results confirm that the earlier improvements were retained. SAIDI remains significantly negative at +1 and +2 (t = −2.17, −2.24), and SAIFI declines further at +1 (t = −2.49). These results show that outage duration and frequency continued to improve under default regulation, confirming the durability of CPP-driven service gains. Capital expenditure remains insignificant, while operating expenditure is significantly positive (−2 t = 6.31, 0 t = 3.64, +1 t = 3.32), indicating that ongoing maintenance supported reliability levels. ROI rises modestly (+1 t = 2.10, +2 t = 1.83), showing gradual profitability recovery. Together, these findings demonstrate that Wellington exited the CPP in a strong operational position, with sustained reliability and controlled costs consistent with Part 4's goal of long-term consumer benefit.




Wellington Electricity event study (CPP exit 2021): SAIFI


Wellington Electricity event study (CPP exit 2021): Capital expenditure


Wellington Electricity event study (CPP exit 2021): Operating expenditure

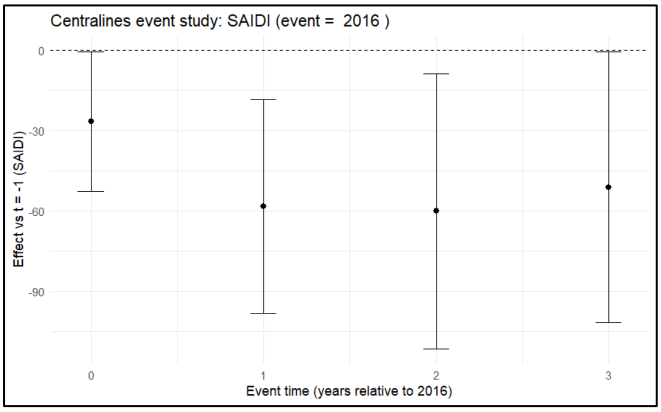

Wellington Electricity event study (CPP exit 2021): Return on investment

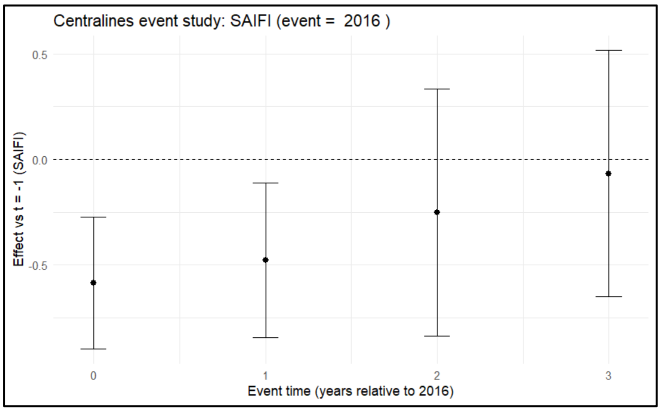
10.3 Discussion

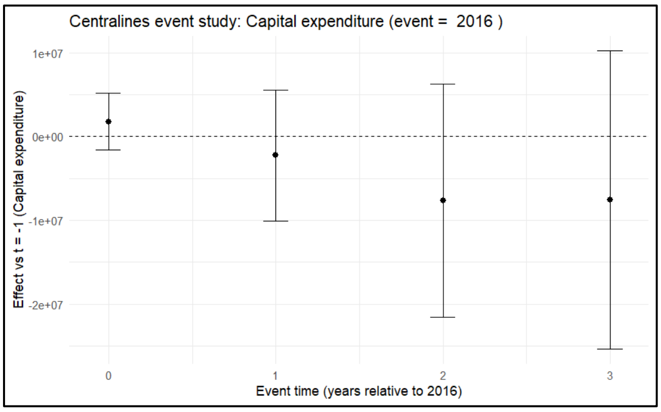
10.3.1 Centralines Regulatory Effectiveness and Ownership Interest

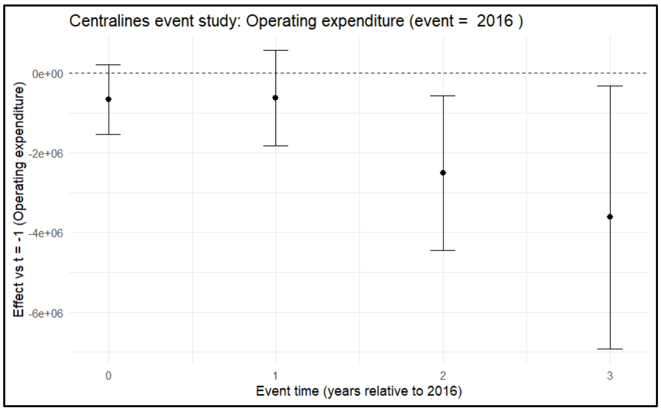
To understand how Centralines performed under full regulation, a placebo test was run using 2016 as a false event year. Because the firm was regulated under Part 4 at that time, the test provides a benchmark for how regulation aligned incentives before exemption.

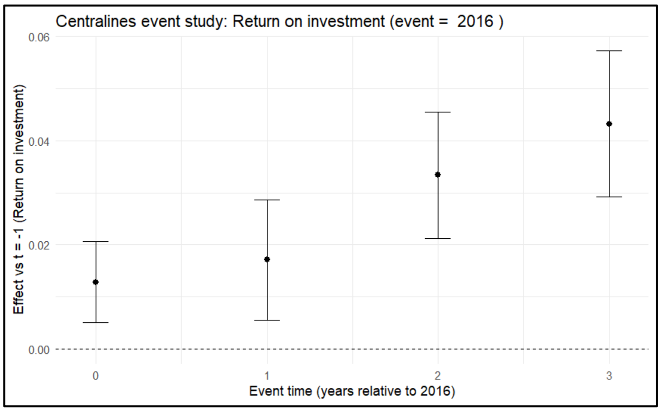
The 2016–2019 results demonstrate that the regulatory framework was functioning effectively. SAIDI coefficients are negative and significant at +0 (t = −2.19), +1 (t = −3.14), +2 (t = −2.51), and +3 (t = −2.17), while SAIFI also decreases significantly at +0 (t = −4.03) and +1 (t = −2.82). These results show consistent improvements in reliability under regulation, with both the frequency and duration of outages declining. Capital expenditure remained stable, suggesting these gains were achieved through operational efficiency rather than expanded spending. Operating expenditure fell significantly at +2 (t = −2.78) and +3 (t = −2.36), indicating improved cost discipline alongside reliability gains. Return on investment increased steadily across all post-event years (t = 3.54, 3.18, 5.95, 6.66), confirming that efficiency gains translated into stronger returns without evidence of excessive profit-taking.











Viewed together, these findings help explain why Centralines was later recognised for exemption under section 54(g). Under regulation, the firm consistently met the objectives of Part 4 by maintaining reliability, managing costs, and improving financial performance. The 2021 exemption therefore did not signal that regulation was unnecessary but rather acknowledged that Centralines had demonstrated the capability to sustain these outcomes independently.

This evidence supports the view that consumer-trust ownership can reproduce many of the behavioural incentives of formal regulation. When governance is community-based, management decisions are shaped by direct accountability to consumers, creating an internal pressure to balance affordability, reliability, and efficiency. In Centralines' case, the 2016–2019 results show that this ownership structure worked effectively alongside regulation, reinforcing rather than replacing the performance alignment that Part 4 seeks to achieve.

10.3.2 Comparison with Literature

10.3.2.1 Re-evaluating the New Zealand Benchmark: Ownership versus Scale

Our analysis provides a critical update to the benchmark New Zealand study by Meade and Söderberg (2020). Using data from 1995-2013, they found that customer-owned EDBs consistently delivered higher welfare, characterised by lower prices, lower costs, and higher reliability. Their work supported the argument that customer ownership naturally aligns incentives with consumer wellbeing, potentially reducing the need for intensive regulation.

Our results for the 2008-2025 period suggest a more nuanced picture. Once we accounted for unobserved heterogeneity using Mundlak CRE models, ownership structure ceased to be a statistically significant predictor of either reliability (SAIDI/SAIFI) or financial returns. This finding may reflect differences in the time periods studied, changes in the regulatory environment since 2013, or methodological differences in how network heterogeneity is controlled for. Instead of ownership, our results indicate that network scale and expenditure intensity are the primary drivers of performance differences across New Zealand.

Furthermore, our event study of the Centralines exemption provides evidence on the role of regulatory oversight. We found a statistically significant increase in outage frequency (SAIFI at +2 (t = 9.68) and +3 (t = 11.60)). This suggests that customer ownership alone, absent regulatory quality targets, may be insufficient to maintain reliability standards – supporting the continued role of Part 4 regulation even for customer-owned networks. While customer ownership supports financial discipline (stable costs), the regulatory framework provides critical reliability incentives that complement ownership structures.

10.3.2.2 The Investment-Reliability Trade-off

While our ownership findings diverge from the local literature, our results regarding expenditure are strongly consistent with international findings on incentive regulation. Giannakis et al. (2005) and Ajayi et al. (2022) both argue that efficiency and quality do not always move in tandem, particularly during periods of intense network modernisation.

Our empirical finding that short-run increases in capital expenditure are associated with higher SAIDI (longer outages) confirms this “construction disruption” effect. This is clearly visible in the CPP entries for Aurora and Powerco, where reliability metrics temporarily worsened as major works were undertaken. This extends the evidence provided by Ter-Martirosyan and Kwoka (2010), who demonstrated that reliability is highly sensitive to utility expenditure direction. While they focused on the risks of cost-cutting reducing quality, our results highlight the inverse: that necessary capital upgrades can also create temporary reliability trade-offs. Importantly, our event studies show this is a temporary trade-off. As firms exited their CPPs, reliability generally improved, confirming that the regulatory mechanism is successfully facilitating long-term network resilience.

10.3.2.3 Investment Efficiency and Regulatory Effectiveness

Finally, our financial results provide evidence on investment efficiency under New Zealand’s Part 4 framework. The investment spikes observed in our CPP analysis appear to be operationally driven and time-limited, rather than strategic attempts to inflate regulated returns. ROI generally compressed during high-expenditure phases and recovered only as new assets began delivering service. We examined investment cycles and financial returns during regulatory transitions and found no systematic patterns suggesting strategic inflation. This suggests that the Part 4 framework is effectively constraining opportunistic behaviour while still allowing firms (regardless of whether they are investor, council, or trust-owned) to recover the costs of necessary infrastructure investment.

In contrast to concerns raised in the Australian context by Mountain (2019) regarding strategic asset base inflation, our CPP analysis shows investment patterns consistent with operational necessity rather than rent-seeking behaviour. This difference may reflect New Zealand's distinct regulatory settings and the effectiveness of the Commerce Commission's investment approval processes.

10.4 Future Analytical Direction

A natural extension of this analysis is to test whether Centralines' 2016–2019 performance exceeded that of investor-owned firms under full regulation would strengthen the empirical case that trust ownership can independently achieve the outcomes required for exemption under section 54(g). Extending this reasoning, if Top Energy, another consumer-trust-owned distributor still regulated under Part 4, demonstrates performance comparable to Centralines' pre-exemption results and continues to outperform investor-owned firms, it could signal readiness for future recognition. Evidence of such patterns would suggest that exemption depends not only on financial soundness but on sustained reliability, efficiency, and accountability. This line of research would help clarify whether community ownership can uphold the consumer protection objectives of Part 4 without continued price-quality oversight and identify the performance benchmarks needed for future exemption.

11. Conclusion

This consultancy project examined how ownership structures and regulatory settings under Part 4 of the Commerce Act 1986 affect the reliability and financial performance of New Zealand electricity distribution businesses. Using Information Disclosure data from 2008–2025, our analysis assessed whether ownership type and specific regulatory pathway systematically influence service quality, investment behaviour, or profitability.

The results show that ownership structure itself is not a statistically significant determinant of either reliability or financial performance once differences in operational scale and expenditure are accounted for. Variation across EDBs can largely be explained by network size, customer base, and investment cycles reflected in operating and capital expenditure. Differences in performance across the sector appear to be driven more by structural and operational factors than by ownership form, with governance quality important.

Event-study evidence also supports the effectiveness of regulatory mechanisms under Part 4. Entry into Custom Price-Quality Pathways is associated with short-term reliability declines during periods of intensive network renewal, followed by stabilisation and improvement as investments are completed. Financial outcomes during these periods show temporary pressure on returns rather than sustained excess profitability, suggesting investment-driven behaviour rather than regulatory gaming.

The Centralines exemption provides further insight into the role of regulation as we were able to observe the effects of the change in regulatory pathway. While consumer-trust governance appears sufficient to maintain financial stability even without direct PQ regulation, the observed increase in outage frequency following exemption indicates that regulatory quality incentives remain important to ensure consumer interests are protected.

These findings are important for policymakers and regulators because they clarify where regulatory attention is most effectively directed. For consumer-trust-owned distributors, the analysis highlights that ongoing regulatory oversight, particularly of quality standards, may still be necessary to preserve reliability outcomes.

Overall, however, the findings confirm the effectiveness of the current regulatory framework in supporting consumer interests while allowing firms to maintain viability, and show that ownership structure does not significantly impact reliability or financial performance.

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13. Appendix

Appendix A. Variable Construction and Data Notes

A.1 Treatment of Missing Rural data

Nelson Electricity did not report rural circuit length data for 2015–2020 and 2022–2024. However, the available 2021 data indicated that the network is entirely urban (Share Rural = 0). Therefore, missing values were imputed as 0 for all years, consistent with the network's composition.

A.2 Interpretation of Mean Share Rural

SAIFI model: Coefficient = 1.28, $p = 0.545$. Moving from a fully urban network (Share Rural = 0) to a fully rural network (Share Rural = 1) is associated with 1.28 more outages per customer per year, on average. A 10-percentage point increase in rural share (e.g., from 0.5 to 0.6) corresponds to a 0.128 increase in SAIFI. However, this relationship is not statistically significant ($p > 0.1$), so caution is warranted in interpreting the result as definitive evidence of an effect.

SAIDI model: Coefficient = 178.50, $p = 0.468$. For SAIDI the same shift from a fully urban to a fully rural network is associated with 178.5 more outage minutes per customer annually. A 10-percentage point increase in rural share corresponds to approximately 17.85 additional minutes of outage per customer per year. Again, the effect is not statistically significant ($p > 0.1$).

A.3 Asset Age Variable (Construction & Interpretation)

The variable Asset Age serves as a proxy for the overall maturity and potential degradation of network infrastructure across electricity distribution businesses (EDBs). It reflects the weighted average installation year of power poles, derived from three asset categories: wood poles, concrete/steel structures, and other pole types.

A.3.1 Construction Method:

Age data were only available for the year 2024, which provided asset counts by installation decade (e.g., 1950s, 1960s, etc.). To convert these into a usable numerical variable, each decade was assigned a midpoint year (e.g., “1950s” → 1955), and the weighted average installation year was computed for each EDB using the number of poles as weights. The resulting value was subtracted from 2024 to generate an Asset Age variable i.e. ($AssetAge = 2024 - AvgInstallYear$). Since this data was available only for 2024, the resulting Asset Age value was assumed to be time-invariant and was assigned to all years for each EDB in the panel dataset. This simplification reflects the slow-changing nature of infrastructure aging, under the assumption that there were no major asset replacements during the study period.

A.3.2 Regression Interpretation:

In the Mundlak models for both SAIDI and SAIFI, the Asset Age coefficient is positive but statistically insignificant. Specifically, the point estimates suggest that older networks may experience slightly more frequent and longer outages (consistent with expectations of aging infrastructure), but the size and significance of these effects are too weak to draw firm conclusions. This lack of statistical significance could stem from two factors. Either the use of a static 2024 snapshot for all years may understate year-to-year variation in asset conditions. Or Asset Age alone may be an incomplete proxy for reliability-related deterioration, as it does not capture the condition, usage intensity, or maintenance quality of the assets.

Nonetheless, including Asset Age as a control variable helps mitigate potential omitted variable bias and ensures that the estimated effects of ownership and network characteristics (like rural exposure) are not conflated with differences in infrastructure maturity.

A.4 Lagged CAPEX Regression Output

Appendix A.4 Table 1: Mundlak CRE Model (3.3) 3 -Year Lagged CAPEX

Variable	SAIDI (Outage Duration)	SAIFI (Outage Frequency)
Constant	-36.64 (174.34) [0.834]	-0.11 (1.74) [0.948]
Charitable Trust	24.25 (113.79) [0.831]	0.04 (1.14) [0.970]
Consumer Cooperative	-32.14 (92.13) [0.727]	-0.65 (0.92) [0.478]
Council	-26.51 (77.15) [0.731]	-0.38 (0.77) [0.622]
Council & Trust	-72.77 (112.60) [0.518]	-1.47 (1.12) [0.192]
Investor	18.24 (72.79) [0.796]	0.17 (0.73) [0.819]
Mean CAPEX	-0.24 (0.389) [0.523]	-0.0008 (0.0037) [0.824]
Lagged CAPEX (3 years)	0.404** (0.153) [0.009]	0.0015 (0.0012) [0.202]
Asset Age	1.61 (3.59) [0.655]	0.02 (0.04) [0.560]
Share Rural	24.64 (248.94) [0.921]	0.82 (1.94) [0.672]
Mean Share Rural	234.16 (267.38) [0.381]	1.37 (2.18) [0.530]
Observations	290	290
Adjusted R^2	0.033	0.012

Notes: Robust standard errors in parentheses and p-values in brackets.

*$p < 0.05$, **$p < 0.01$, ***$p < 0.001$.

Baseline ownership category: Consumer Trust.

Appendix B. Variable Construction and Data Notes

CPP Event Windows, Outcomes, and Data Constraints

EDB	CPP Period	Context	Event Window	Variables Included	Notes
Aurora Energy	2021–2026	Exit	−3 to +3	SAIDI, SAIFI	Because the EDB dataset ends in 2024, the analysis uses Commerce Commission forecast variables to model reliability beyond that point. The exit study focuses on SAIDI and SAIFI, which have full forecast coverage. Capex, Opex, and ROI are excluded as post-2024 forecasts are disaggregated and cannot be consistently compared.
Orion	2014–2019	Entry	+1 to +3 (2015 baseline)	SAIDI, SAIFI, Capex, Opex, ROI	As the dataset begins in 2015, +1 (2015) is used as the baseline year, with +2 and +3 capturing the main post-entry effects.
Powerco	2018–2023	Exit	SAIDI/SAIFI: −3 to +3; Capex/Opex/ROI: −1 to +1	SAIDI, SAIFI, Capex, Opex, ROI	The exit-phase event window is −1 to +1 for Capex, Opex, and ROI. For SAIDI and SAIFI, the standard −3 to +3 year window is used because additional forecast data are available.
Wellington Electricity	2018–2021	Entry & Exit	−2 to +2	SAIDI, SAIFI, Capex, Opex, ROI	To balance pre- and post-entry dynamics, the event window is set at −2 to +2 years.

Appendix C. Event-Study Regression Outputs (Event-Time Coefficients and t-Statistics)

C1. Centralines Exemption Event (2021)

Centralines Exemption Event					
Centralines_2021_event_SAIDI					
term	**estimate**	**std.error**	**t.value**	**p.value**	**signif**
evt_m3	-1.24035	20.06038	-0.06183	0.953093	
evt_m2	-7.84527	8.594593	-0.91281	0.403208	
evt_p0	5.265442	20.48208	0.257076	0.807364	
evt_p1	16.50183	33.30188	0.495522	0.641239	
evt_p2	60.58614	44.16185	1.371911	0.228445	
evt_p3	51.14213	60.30358	0.848078	0.435103	
Centralines_2021_event_SAIFI					
term	**estimate**	**std.error**	**t.value**	**p.value**	**signif**
evt_m3	0.180235	0.13872	1.299266	0.250533	
evt_m2	0.191075	0.101192	1.888247	0.117624	
evt_p0	-0.05703	0.103706	-0.54989	0.606057	
evt_p1	-0.16572	0.178305	-0.92944	0.395322	
evt_p2	2.084634	0.215398	9.678046	0.0002	***
evt_p3	1.636115	0.140957	11.60716	8.33E-05	***
Centralines_2021_event_Capital expenditure					
term	**estimate**	**std.error**	**t.value**	**p.value**	**signif**
evt_m3	1086435	6702534	0.162093	0.877579	
evt_m2	4340775	3423136	1.26807	0.260611	
evt_p0	4239146	3207590	1.321599	0.243541	
evt_p1	9349923	4068426	2.298167	0.069932	.
evt_p2	1005755	7659847	0.131302	0.900656	
evt_p3	-5576690	10956334	-0.50899	0.632417	
Centralines_2021_event_Operating expenditure					
term	**estimate**	**std.error**	**t.value**	**p.value**	**signif**

evt_m3	1807309	1034526	1.746991	0.141068	
evt_m2	1792345	796258.2	2.25096	0.074188	.
evt_p0	1492394	367581.7	4.060034	0.009729	**
evt_p1	526081.6	196637.2	2.675393	0.044063	*
evt_p2	-718202	1398236	-0.51365	0.629383	
evt_p3	-2897956	1914907	-1.51337	0.190602	
Centralines_2021_event_Return on investment					
term	**estimate**	**std.error**	**t.value**	**p.value**	**signif**
evt_m3	0.001289	0.011967	0.107744	0.918388	
evt_m2	0.00364	0.007122	0.51114	0.631016	
evt_p0	-0.0058	0.009217	-0.62909	0.556908	
evt_p1	-0.01754	0.014384	-1.21932	0.2771	
evt_p2	-0.01649	0.014395	-1.14521	0.303962	
evt_p3	0.003814	0.012476	0.305709	0.772144	

C2. Aurora CPP Entry and Exit (2021-2026)

Aurora CPP Entry					
Aurora_2021_entry_SAIDI					
term	**estimate**	**std.error**	**t.value**	**p.value**	**signif**
evt_m3	28.25469	20.52461	1.376625	0.19377	
evt_m2	-9.37013	10.91633	-0.85836	0.407513	
evt_p0	49.2083	12.64812	3.890562	0.002146	**
evt_p1	87.94303	17.894	4.914667	3.57E-04	***
evt_p2	18.00381	45.89324	0.392298	0.701717	
evt_p3	81.98205	32.7022	2.506928	0.027563	*
Aurora_2021_entry_SAIFI					
term	**estimate**	**std.error**	**t.value**	**p.value**	**signif**
evt_m3	0.264458	0.1735	1.524252	0.153358	
evt_m2	-0.02675	0.21006	-0.12735	0.90077	
evt_p0	0.19403	0.066896	2.900468	0.013315	*
evt_p1	0.330153	0.097137	3.398821	0.005281	**
evt_p2	0.450052	0.231535	1.943777	0.075744	.

evt_p3	0.247238	0.169134	1.461787	0.169488	
Aurora_2021_entry_Capital expen					
term	**estimate**	**std.error**	**t.value**	**p.value**	**signif**
evt_m3	40541082	31001466	1.307715	0.215469	
evt_m2	37692751	28597491	1.318044	0.212095	
evt_p0	30970395	25177354	1.230089	0.242234	
evt_p1	47329864	22717188	2.083438	0.059261	.
evt_p2	52368676	19103328	2.741338	0.017887	*
evt_p3	49725087	10098189	4.924159	3.51E-04	***
Aurora_2021_entry_Operating exp					
term	**estimate**	**std.error**	**t.value**	**p.value**	**signif**
evt_m3	-9622417	1342648	-7.16674	1.14E-05	***
evt_m2	-3258434	657420.4	-4.95639	3.33E-04	***
evt_p0	-1064638	238692.9	-4.46028	7.79E-04	***
evt_p1	-2813824	639431.3	-4.40051	8.65E-04	***
evt_p2	-3130551	1450564	-2.15816	0.051881	.
evt_p3	-6448885	3365578	-1.91613	0.079472	.
Aurora_2021_entry_Return on inv					
term	estimate	std.error	t.value	p.value	signif
evt_m3	0.011697	0.007474	1.565187	0.143516	
evt_m2	0.010321	0.003386	3.048545	0.010112	*
evt_p0	0.021784	0.005028	4.33272	9.74E-04	***
evt_p1	0.026667	0.007056	3.779479	0.002626	**
evt_p2	0.04982	0.006819	7.306383	9.39E-06	***
evt_p3	0.071212	0.007321	9.726618	4.83E-07	***

Aurora CPP Exit					
Aurora_2026_exit_SAIDI					
term	estimate	std.error	t.value	p.value	signif
evt_m3	-52.8646	68.65506	-0.77	0.453255	
evt_m2	5.739678	56.16768	0.102188	0.919961	
evt_p0	24.2074	33.78957	0.716416	0.48474	

evt_p1	-20.8608	34.21193	-0.60975	0.551152	
evt_p2	-30.1587	35.83985	-0.84149	0.413291	
evt_p3	-57.8297	41.58032	-1.3908	0.184577	
Aurora_2026_exit_SAIFI					
term	estimate	std.error	t.value	p.value	signif
evt_m3	0.362226	0.480289	0.754185	0.462414	
evt_m2	0.145737	0.4126	0.353217	0.728841	
evt_p0	-0.00821	0.015597	-0.52657	0.60619	
evt_p1	-0.35804	0.072724	-4.92321	1.84E-04	***
evt_p2	-0.32504	0.107262	-3.03035	0.008435	**
evt_p3	-0.44581	0.123351	-3.61415	0.002551	**

C3. Orion CPP Entry and Exit (2014-2019)

Orion CPP Entry					
Orion_2014_entry_SAIDI					
term	estimate	std.error	t.value	p.value	signif
evt_p2	4.583601	9.718988	0.471613	0.64357	
evt_p3	-22.289	15.1692	-1.46936	0.161124	
Orion_2014_entry_SAIFI					
term	estimate	std.error	t.value	p.value	signif
evt_p2	0.356669	0.122291	2.916567	0.010088	*
evt_p3	-0.11005	0.148563	-0.74077	0.469564	
Orion_2014_entry_Capital expend					
term	estimate	std.error	t.value	p.value	signif
evt_p2	6577323	1470794	4.471953	3.85E-04	***
evt_p3	-2E+07	3554892	-5.58405	4.11E-05	***
Orion_2014_entry_Operating expe					
term	estimate	std.error	t.value	p.value	signif
evt_p2	4060856	456951.6	8.886841	1.38E-07	***
evt_p3	3738154	698963.1	5.348143	6.53E-05	***
Orion_2014_entry_Return on inve					
term	estimate	std.error	t.value	p.value	signif

evt_p2	-0.0314	0.003795	-8.27457	3.57E-07	***
evt_p3	-0.03283	0.00491	-6.68574	5.23E-06	***

Orion CPP Exit					
Orion_2019_exit_SAIDI					
term	estimate	std.error	t.value	p.value	signif
evt_m3	62.18747	28.10495	2.212688	0.047053	*
evt_m2	31.63329	17.68207	1.789004	0.098865	.
evt_p0	25.52398	21.68681	1.176936	0.262039	
evt_p1	26.95457	20.52461	1.31328	0.213646	
evt_p2	4.081443	26.47208	0.154179	0.880031	
evt_p3	-15.9801	31.14	-0.51317	0.617149	
Orion_2019_exit_SAIFI					
term	estimate	std.error	t.value	p.value	signif
evt_m3	0.462386	0.250257	1.847648	0.089441	.
evt_m2	0.023954	0.14963	0.160091	0.875473	
evt_p0	0.124621	0.197756	0.630176	0.540394	
evt_p1	0.036852	0.1735	0.212403	0.835358	
evt_p2	0.049971	0.166402	0.300304	0.769084	
evt_p3	-0.18308	0.202905	-0.9023	0.384652	
Orion_2019_exit_Capital expendi					
term	estimate	std.error	t.value	p.value	signif
evt_m3	21040829	6566812	3.204116	0.007574	**
evt_m2	-4393092	2748432	-1.5984	0.135937	
evt_p0	-3646514	2913595	-1.25155	0.234581	
evt_p1	-4.1E+07	31001466	-1.31423	0.213338	
evt_p2	-912025	6068925	-0.15028	0.883042	
evt_p3	5287713	8550339	0.618421	0.547857	
Orion_2019_exit_Operating expen					
term	estimate	std.error	t.value	p.value	signif
evt_m3	2955071	400748	7.373888	8.57E-06	***
evt_m2	3093456	501501	6.168395	4.81E-05	***

evt_p0	4404822	776763.2	5.67074	1.04E-04	***
evt_p1	4029175	1342648	3.000916	0.011048	*
evt_p2	8603472	1161959	7.404283	8.23E-06	***
evt_p3	5993084	1958151	3.060584	0.009888	**
Orion_2019_exit_Return on inves					
term	estimate	std.error	t.value	p.value	signif
evt_m3	-3.28E-04	0.002671	-0.12269	0.904384	
evt_m2	-0.00245	0.002466	-0.99294	0.34034	
evt_p0	0.002174	0.005489	0.396009	0.699049	
evt_p1	-0.00455	0.007474	-0.60889	0.553948	
evt_p2	-3.66E-04	0.005832	-0.06284	0.950928	
evt_p3	0.002117	0.005677	0.372828	0.715779	

C4. Powerco CPP Entry and Exit (2018-2023)

Powerco CPP Entry					
Powerco_2018_entry_SAIDI					
term	estimate	std.error	t.value	p.value	signif
evt_m3	4.508096	20.17184	0.223485	0.826918	
evt_m2	-4.58075	17.14947	-0.26711	0.793921	
evt_p0	-26.5819	17.68207	-1.50333	0.158609	
evt_p1	51.54019	9.687532	5.320259	1.82E-04	***
evt_p2	29.24354	9.106576	3.211255	0.007475	**
evt_p3	26.4215	10.57741	2.497919	0.028022	*
Powerco_2018_entry_SAIFI					
term	estimate	std.error	t.value	p.value	signif
evt_m3	-0.64612	0.183799	-3.51535	0.00426	**
evt_m2	-0.44564	0.143936	-3.09612	0.009256	**
evt_p0	-0.49007	0.14963	-3.27518	0.006639	**
evt_p1	-0.08696	0.158182	-0.54975	0.592576	
evt_p2	-0.27228	0.140258	-1.94131	0.07607	.
evt_p3	-0.25061	0.107205	-2.33768	0.037543	*
Powerco_2018_entry_Capital expe					

term	estimate	std.error	t.value	p.value	signif
evt_m3	-3.2E+07	3965249	-8.13449	3.17E-06	***
evt_m2	-2E+07	3987371	-4.99041	3.14E-04	***
evt_p0	17820513	2748432	6.483883	3.01E-05	***
evt_p1	60333862	4968910	12.14227	4.24E-08	***
evt_p2	5638875	33443534	0.168609	0.868913	
evt_p3	78608287	8370307	9.391327	7.03E-07	***
Powerco_2018_entry_Operating ex					
term	estimate	std.error	t.value	p.value	signif
evt_m3	-7808580	510985.7	-15.2814	3.14E-09	***
evt_m2	-4240864	127918.8	-33.1528	3.60E-13	***
evt_p0	-4665917	501501	-9.3039	7.76E-07	***
evt_p1	11784170	1189614	9.905879	3.97E-07	***
evt_p2	11639478	1795308	6.483277	3.01E-05	***
evt_p3	13507473	1614538	8.366154	2.37E-06	***
Powerco_2018_entry_Return on in					
term	estimate	std.error	t.value	p.value	signif
evt_m3	0.010477	0.005611	1.86739	0.086456	.
evt_m2	0.008419	0.002496	3.372695	0.005543	**
evt_p0	0.001999	0.002466	0.810888	0.433219	
evt_p1	0.004217	0.005307	0.794648	0.442252	
evt_p2	5.96E-04	0.007244	0.082255	0.9358	
evt_p3	-0.01412	0.005106	-2.76563	0.0171	*

Powerco CPP Entry					
Powerco_2023_exit_SAIDI					
Term	Estimate	Std. Error	t value	p value	signif
evt_m3	5.42845	16.7514	0.324059	0.7510481	
evt_m2	4.36588	11.7353	0.372028	0.7158656	
evt_p0	-43.99420	41.0867	-1.070764	0.3037532	
evt_p1	-65.13311	20.9383	-3.110720	0.0082742	**
evt_p2	-72.94942	54.8667	-1.329576	0.2065181	

evt_p3	-43.87890	28.2626	-1.552545	0.1445296	
Powerco_2023_exit_SAIFI					
term	estimate	std.error	t.value	p.value	signif
evt_m3	-0.003848	0.090715	-0.042424	0.9668056	
evt_m2	0.016816	0.090521	0.185773	0.8554899	
evt_p0	0.093144	0.225396	0.413246	0.6861618	
evt_p1	-0.503665	0.151715	-3.319822	0.0055327	**
evt_p2	-0.713153	0.434364	-1.641834	0.1245815	
evt_p3	-0.719634	0.425539	-1.691112	0.1146339	
Powerco_2023_exit_Capital expen					
term	estimate	std.error	t.value	p.value	signif
evt_p0	31480855	4071538	7.731932	2.0317e-06	***
evt_p1	8231704	11812885	0.696841	0.49731	
Powerco_2023_exit_Operating exp					
term	estimate	std.error	t.value	p.value	signif
evt_p0	5278682	833100.3	6.33619	1.8403e-05	***
evt_p1	13509894	2452776.4	5.50800	7.7119e-05	***
Powerco_2023_exit_Return on inv					
term	estimate	std.error	t.value	p.value	signif
evt_p0	0.014142	0.001890	7.48382	2.9504e-06	***
evt_p1	0.018495	0.002434	7.59902	2.4788e-06	***

C5. Wellington Electricity CPP Entry and Exit (2018-2021)

Wellington Electricity CPP Entry					
Wellington_2018_cpp_SAIDI					
term	estimate	std.error	t.value	p.value	signif
evt_m2	-16.4222	14.91118	-1.10133	0.289327	
evt_p0	-37.3493	17.07554	-2.1873	0.046186	*
evt_p1	-37.6044	9.886609	-3.80357	0.001937	**
evt_p2	-32.044	10.04079	-3.19138	0.006532	**
Wellington_2018_cpp_SAIFI					
term	estimate	std.error	t.value	p.value	signif

evt_m2	-0.36674	0.125101	-2.93154	0.010938	*
evt_p0	-0.49764	0.152854	-3.25568	0.005747	**
evt_p1	-0.4333	0.150435	-2.88028	0.012105	*
evt_p2	-0.40993	0.136987	-2.99249	0.009695	**
Wellington_2018_cpp_Capital exp					
term	estimate	std.error	t.value	p.value	signif
evt_m2	-3308358	3369882	-0.98174	0.342889	
evt_p0	-2880396	3584937	-0.80347	0.435132	
evt_p1	4303132	4881884	0.881449	0.392957	
evt_p2	-1.3E+07	28214036	-0.47779	0.640175	
Wellington_2018_cpp_Operating e					
term	estimate	std.error	t.value	p.value	signif
evt_m2	-348870	208885.2	-1.67015	0.117086	
evt_p0	1319653	650100.2	2.029922	0.061814	.
evt_p1	549852.6	1399436	0.39291	0.700303	
evt_p2	-3362446	1965406	-1.71081	0.109172	
Wellington_2018_cpp_Return on i					
term	estimate	std.error	t.value	p.value	signif
evt_m2	-0.00317	0.002228	-1.42114	0.177167	
evt_p0	-0.00347	0.002873	-1.20737	0.247292	
evt_p1	0.004733	0.005153	0.918517	0.373902	
evt_p2	0.002427	0.006851	0.354203	0.728464	

Wellington Electricity CPP Exit					
Wellington_2021_exit_SAIDI					
term	estimate	std.error	t.value	p.value	signif
evt_m2	-7.21358	9.948127	-0.72512	0.481228	
evt_p0	-7.45106	11.67556	-0.63818	0.53444	
evt_p1	-36.3163	16.67766	-2.17754	0.048453	*
evt_p2	-96.4718	43.03015	-2.24196	0.043042	*
Wellington_2021_exit_SAIFI					
term	estimate	std.error	t.value	p.value	signif

evt_m2	-0.02624	0.191549	-0.137	0.89313	
evt_p0	0.027443	0.060968	0.450114	0.660043	
evt_p1	-0.22569	0.090316	-2.49887	0.026646	*
evt_p2	-0.34384	0.216651	-1.58709	0.136506	
Wellington_2021_exit_Capital ex					
term	estimate	std.error	t.value	p.value	signif
evt_m2	19807460	26234396	0.755019	0.463698	
evt_p0	16786299	23171629	0.724433	0.481635	
evt_p1	14288148	21038664	0.679138	0.508962	
evt_p2	8670589	18300519	0.473789	0.643508	
Wellington_2021_exit_Operating					
term	estimate	std.error	t.value	p.value	signif
evt_m2	3787786	599853.7	6.314515	2.68E-05	***
evt_p0	1572339	431891.5	3.640588	0.002991	**
evt_p1	2011552	604298.2	3.328741	0.005439	**
evt_p2	225158.9	1441012	0.156251	0.878236	
Wellington_2021_exit_Return on					
term	estimate	std.error	t.value	p.value	signif
evt_m2	0.002578	0.003133	0.822679	0.425524	
evt_p0	-9.36E-04	0.004594	-0.20381	0.841657	
evt_p1	0.01359	0.006453	2.106098	0.055198	.
evt_p2	0.012015	0.006221	1.93144	0.075524	.

C6. Centralines Placebo Event (2016)

Centralines Placebo Event					
Centralines_2016_event_SAIDI					
term	**estimate**	**std.error**	**t.value**	**p.value**	**signif**
evt_m3	28.25469	20.52460	1.376625	0.1937702	
evt_m2	-9.37013	10.91630	-0.858359	0.4075126	
evt_p0	49.20830	12.64810	3.890562	0.0021464	**
evt_p1	87.94303	17.89400	4.914667	0.0003570	***
evt_p2	18.00381	45.89320	0.392298	0.7017168	

evt_p3	81.98205	32.70220	2.506928	0.0275628	*

Centralines_2016_event_SAIFI

term	**estimate**	**std.error**	**t.value**	**p.value**	**signif**
evt_m3	0.264458	0.173500	1.524252	0.1533576	
evt_m2	-0.026752	0.210060	-0.127353	0.9007702	
evt_p0	0.194030	0.066896	2.900468	0.0133147	*
evt_p1	0.330153	0.097137	3.398821	0.0052812	**
evt_p2	0.450052	0.231535	1.943777	0.0757444	.
evt_p3	0.247238	0.169134	1.461787	0.1694881	

Centralines_2016_event_ Capital ex

term	**estimate**	**std.error**	**t.value**	**p.value**	**signif**
evt_m3	40541082	31001466	1.30772	0.21546902	
evt_m2	37692751	28597491	1.31804	0.21209549	
evt_p0	30970395	25177354	1.23009	0.24223391	
evt_p1	47329864	22717189	2.08344	0.05926073	.
evt_p2	52368676	19103328	2.74134	0.01788698	*
evt_p3	49725087	10098189	4.92416	0.00035133	***

Centralines_2016_event_ Operating

term	**estimate**	**std.error**	**t.value**	**p.value**	**signif**
evt_m3	-9622417	1342648.5	-7.16674	0.000011376	***
evt_m2	-3258434	657420.4	-4.95639	0.00033278	***
evt_p0	-1064638	238692.9	-4.46028	0.00077876	***
evt_p1	-2813824	639431.3	-4.40051	0.00086462	***
evt_p2	-3130551	1450563.7	-2.15816	0.051881	.
evt_p3	-6448885	3365578.1	-1.91613	0.079472	.

Centralines_2016_event_ Return on

term	**estimate**	**std.error**	**t.value**	**p.value**	**signif**
evt_m3	0.011697	0.007474	1.56519	0.14352	
evt_m2	0.010321	0.003386	3.04854	0.010112	*
evt_p0	0.021784	0.005028	4.33272	0.00097403	***

Appendix C. Event-Study Regression Outputs (Event-Time Trends)

Figure 1. Centralines exemption (2021)

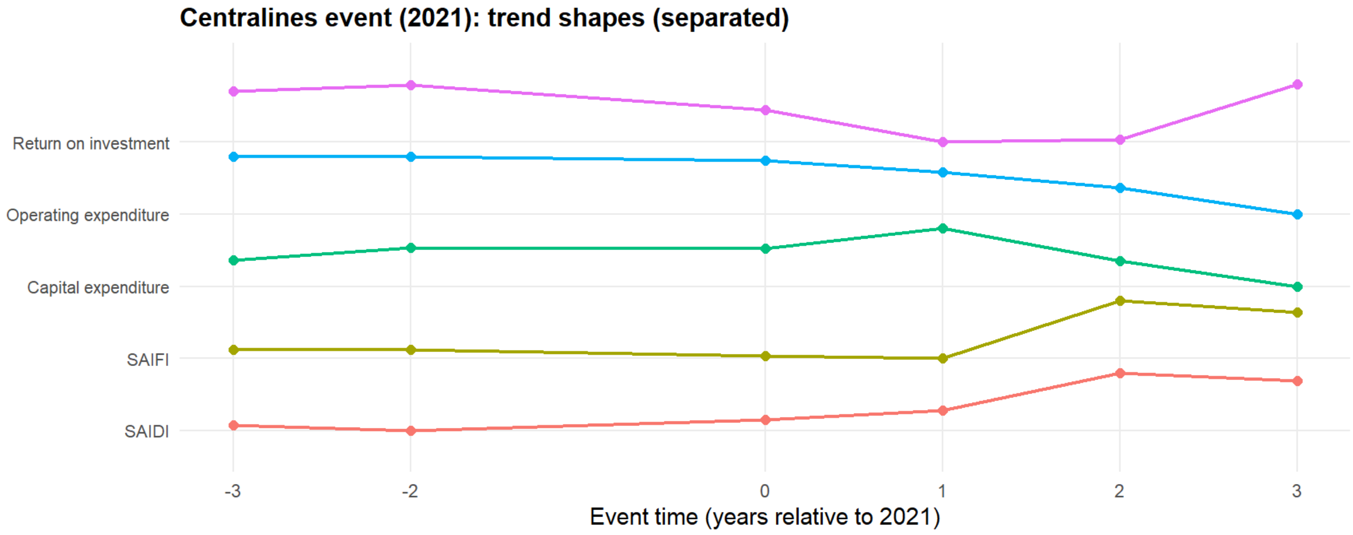


Figure 2. Centralines placebo (2016)

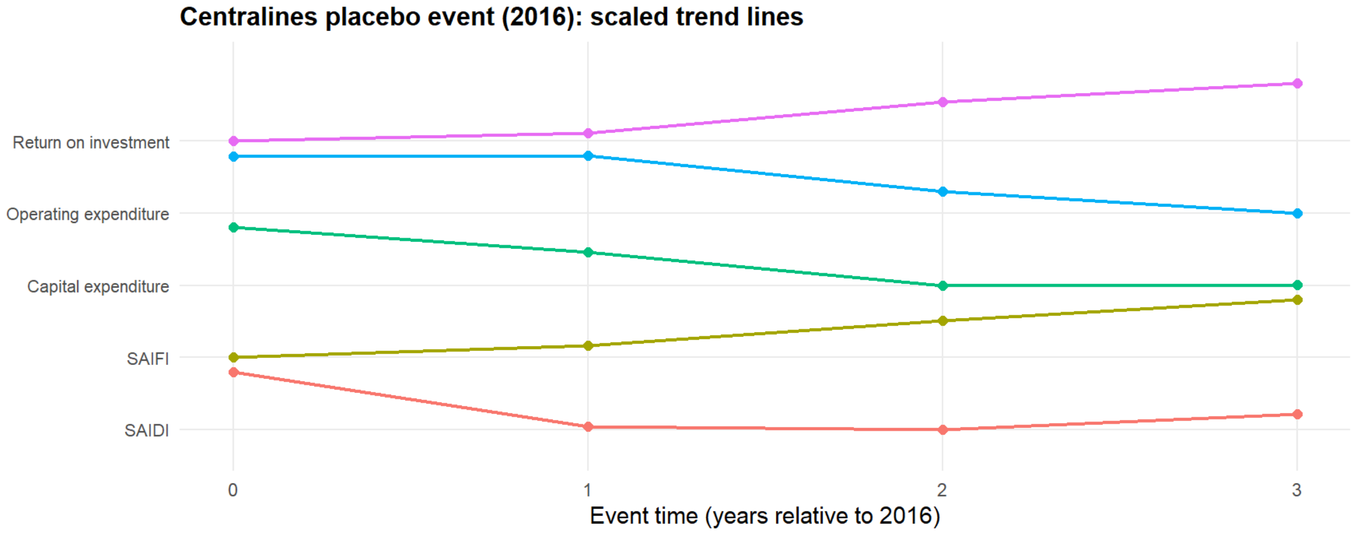


Figure 3. Aurora Energy CPP entry (2021)

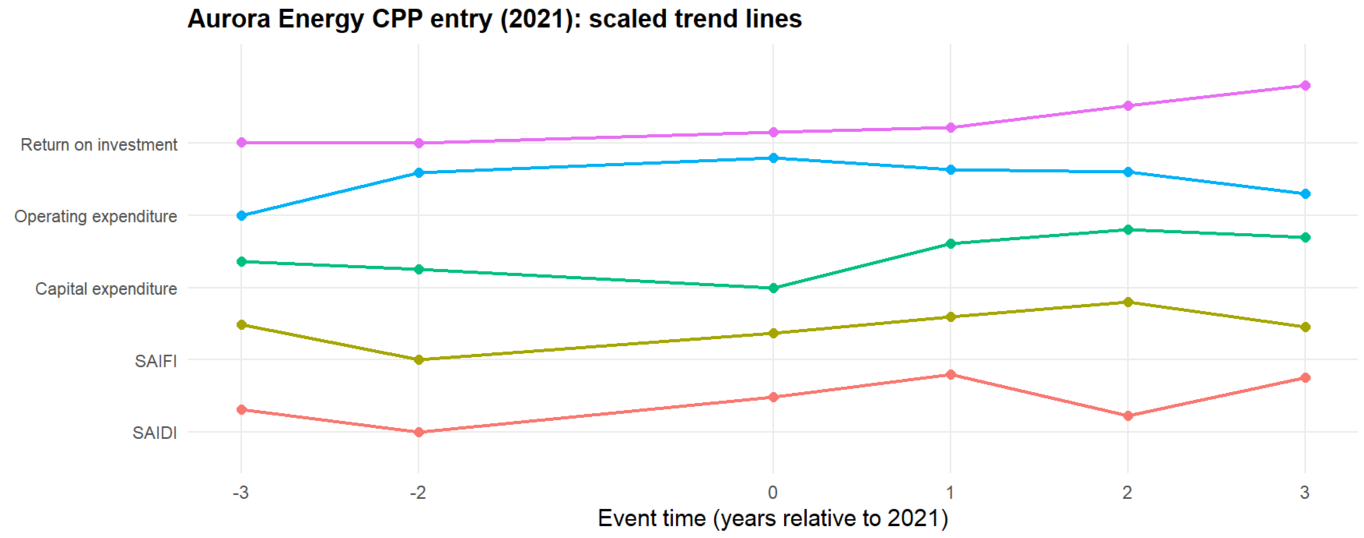


Figure 4. Aurora Energy CPP exit (2026)

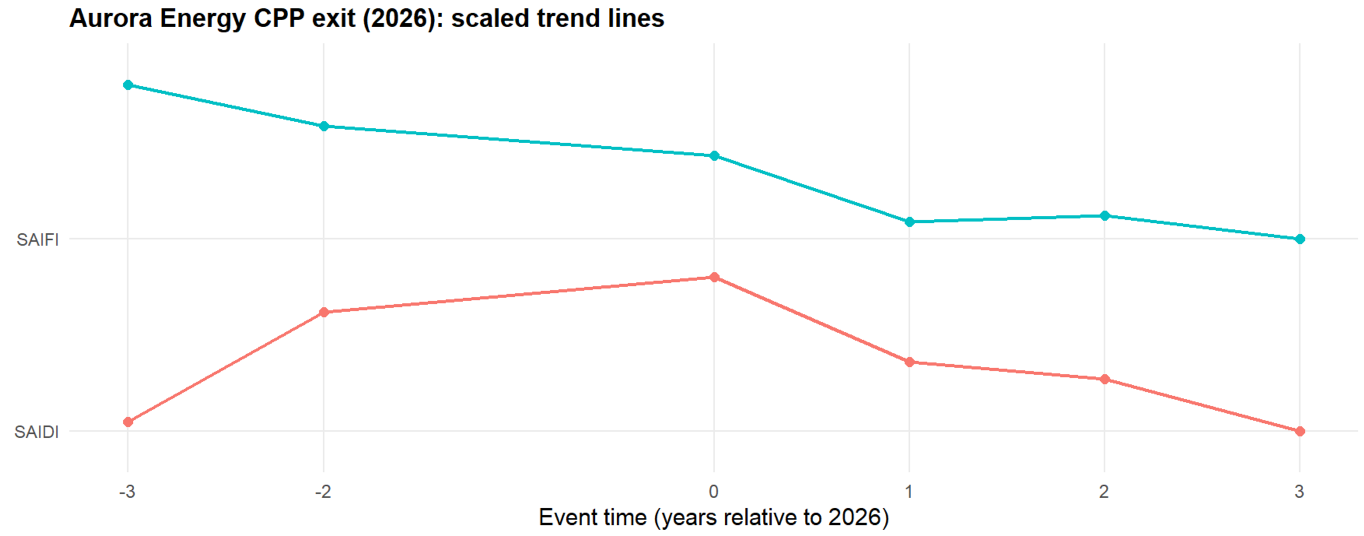


Figure 5. Aurora Energy CPP SAIDI

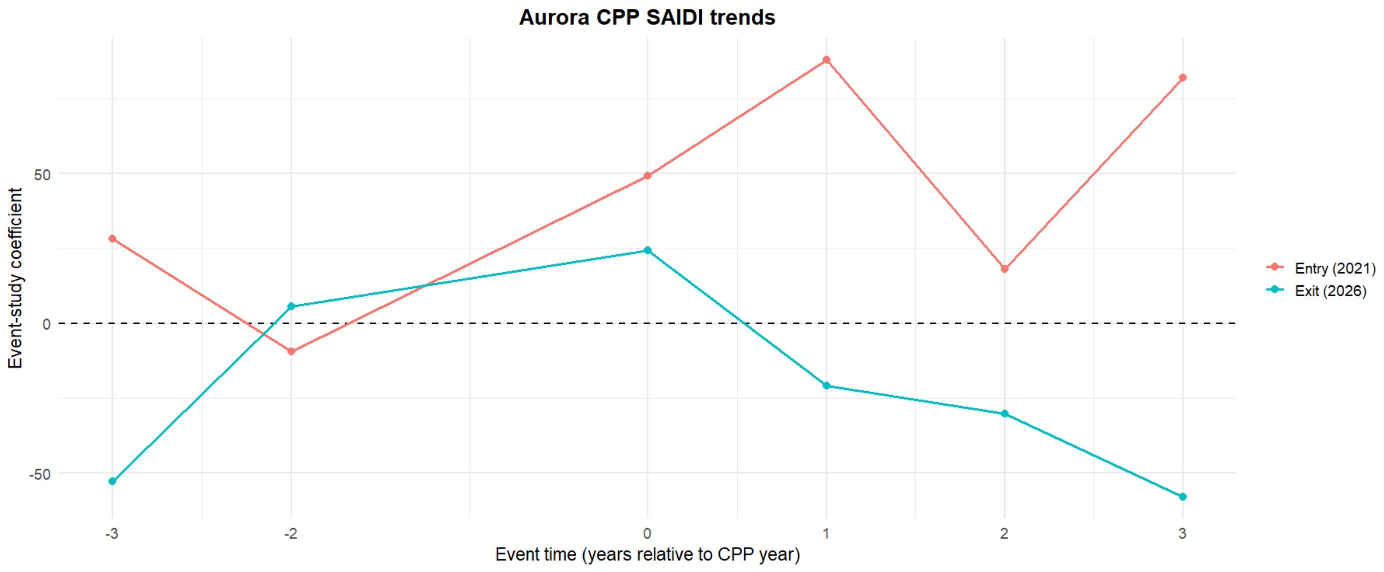


Figure 6. Aurora Energy CPP SAIFI

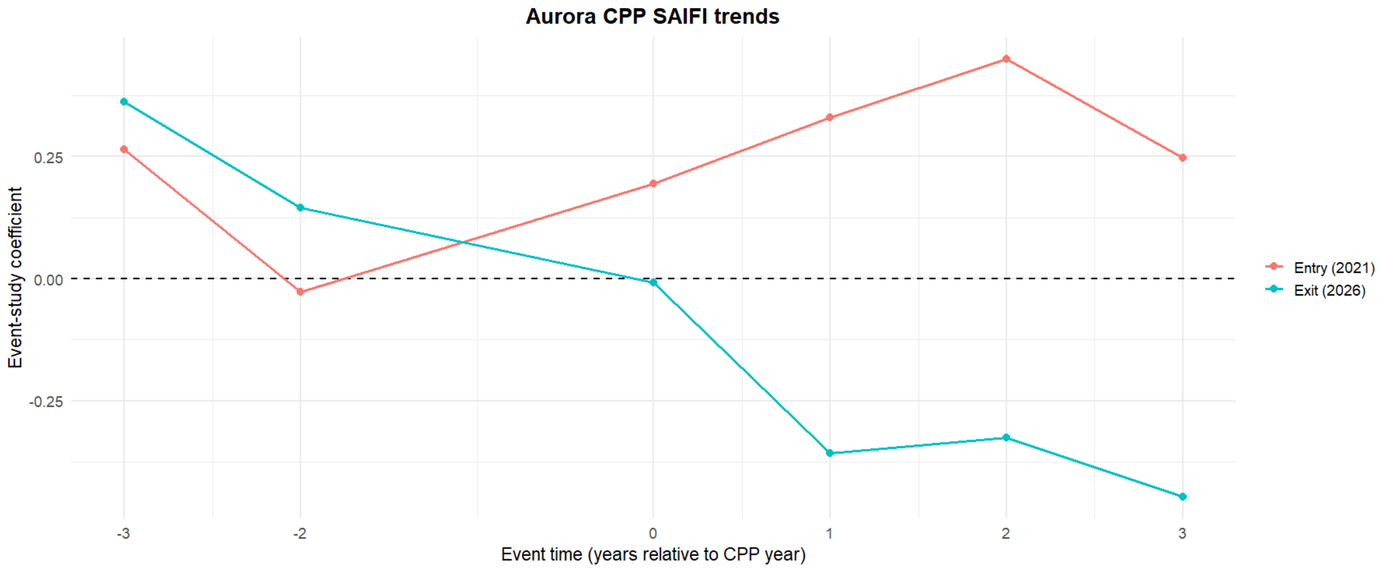


Figure 7.Orion CPP entry (2014)

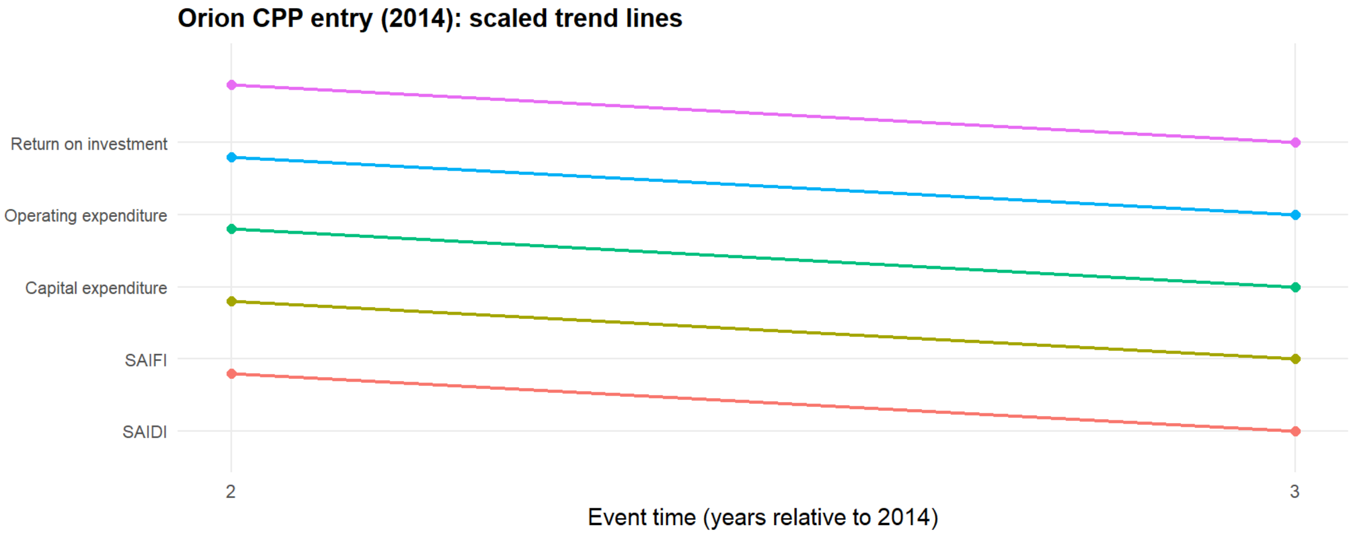


Figure 8.Orion CPP exit (2019)

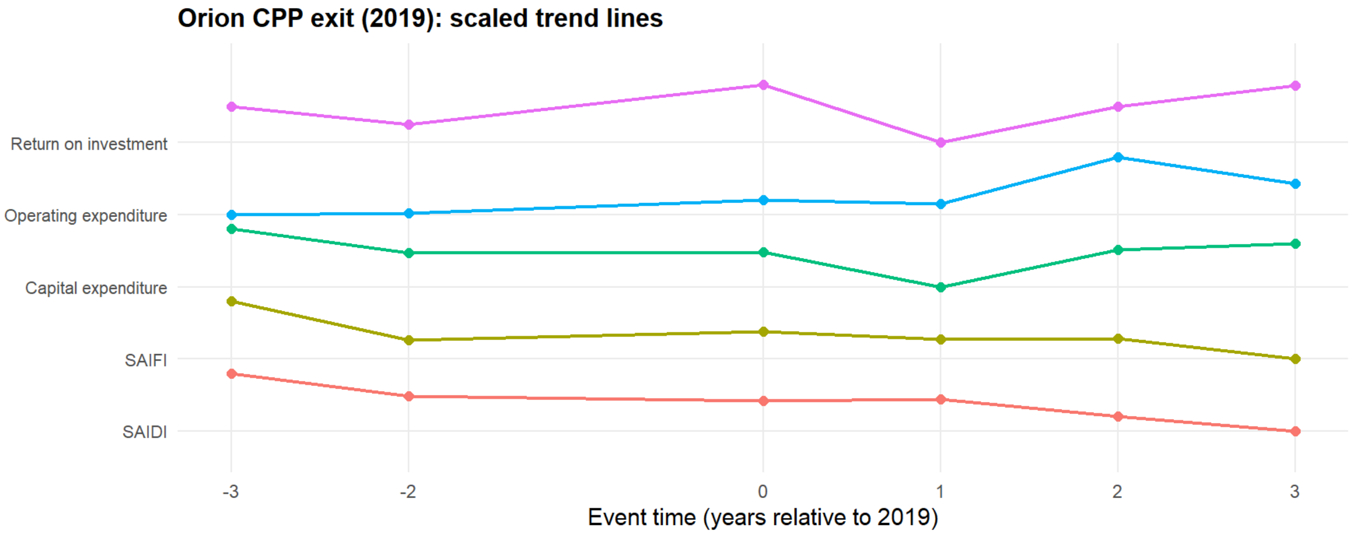


Figure 9.Orion CPP SAIDI

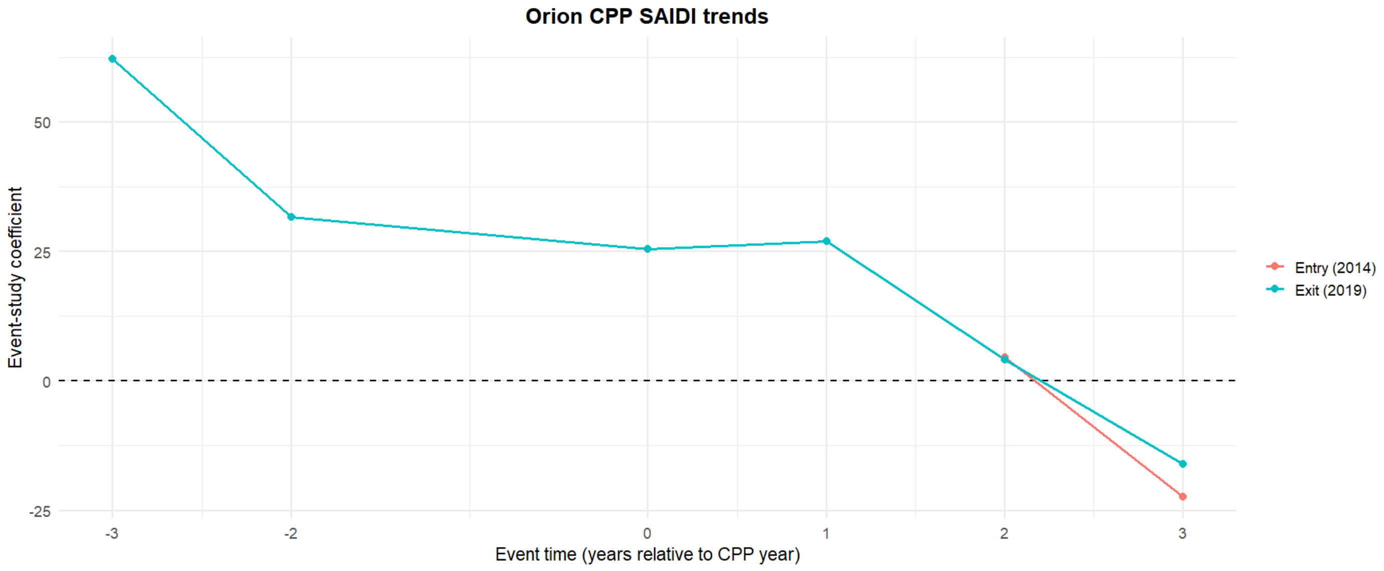


Figure 9.Orion CPP SAIFI

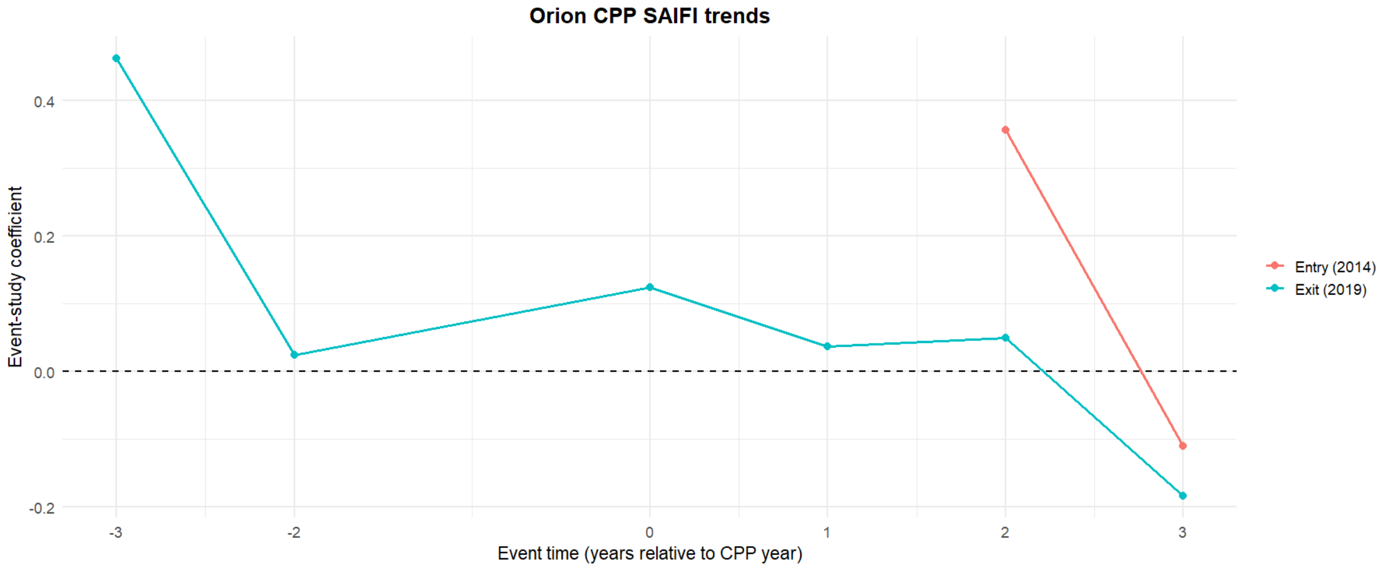


Figure 10.Orion CPP CAPEX

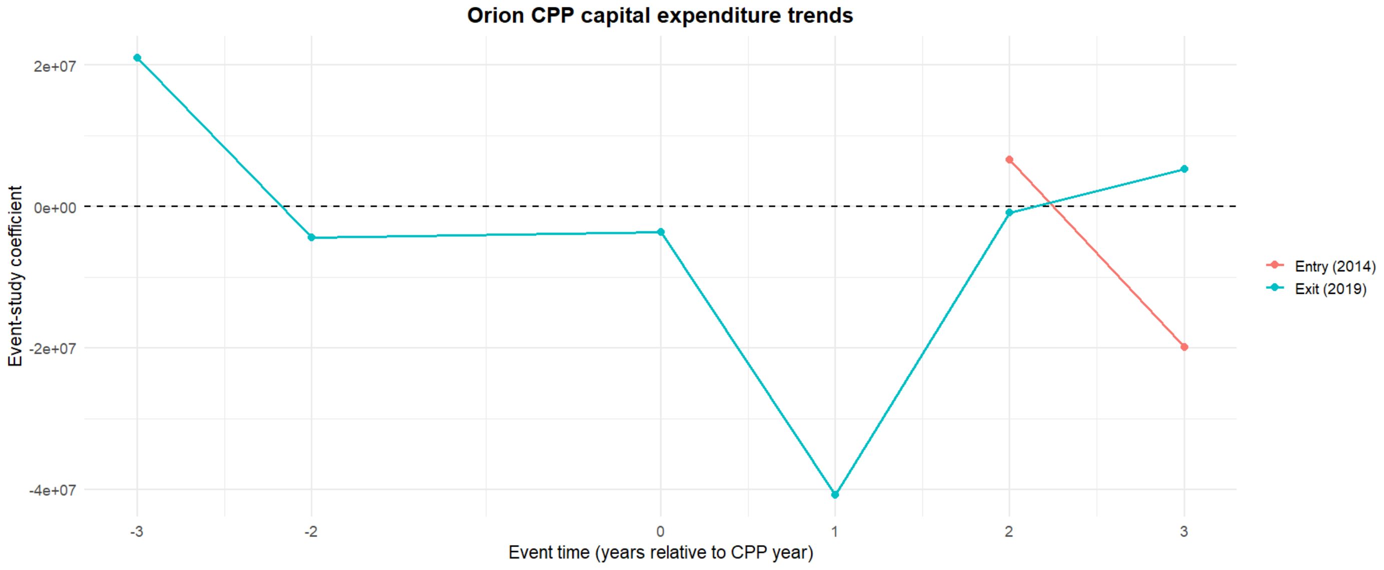


Figure 11.Orion CPP OPEX

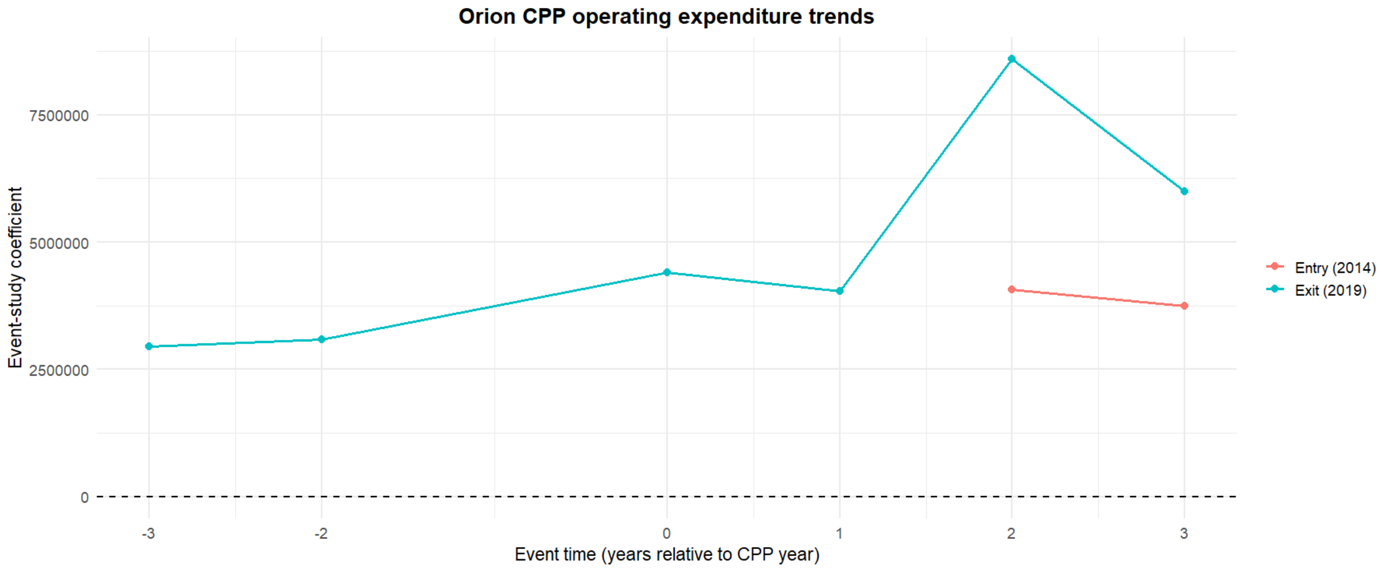


Figure 12.Orion CPP ROI

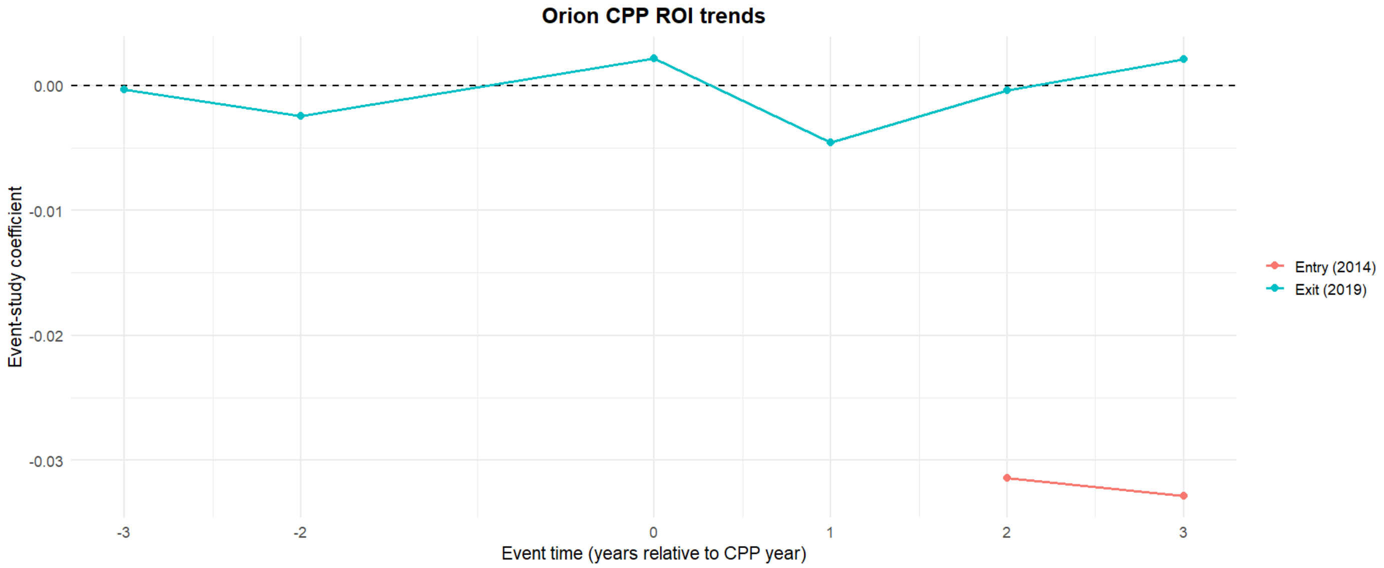


Figure 13. Powerco CPP entry (2018)

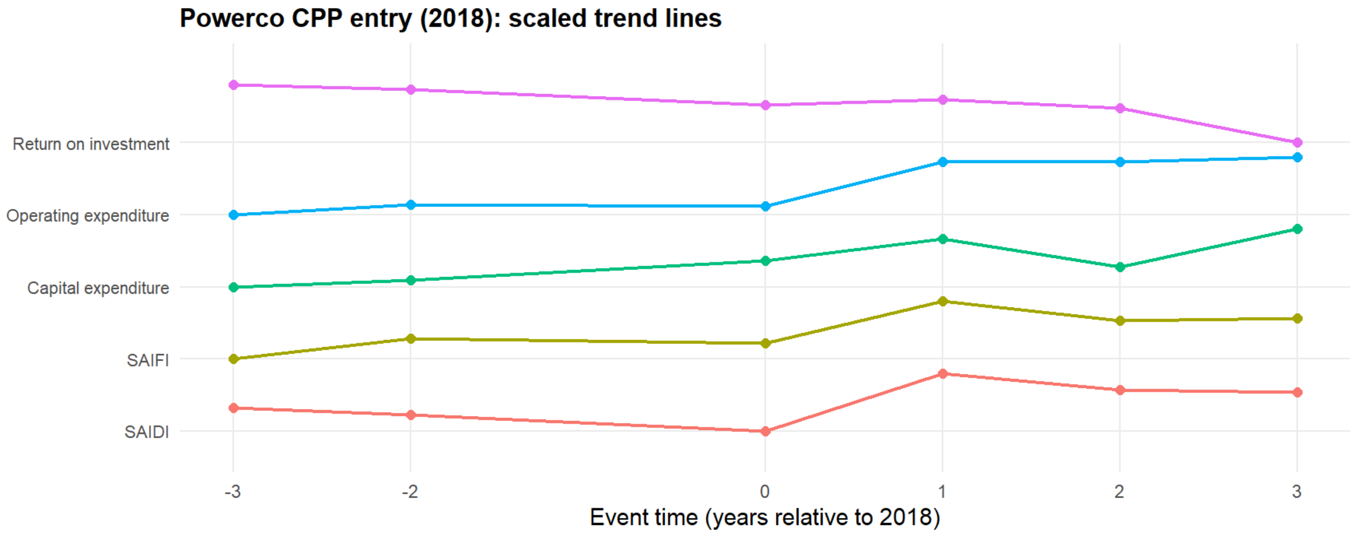


Figure 14. Powerco CPP exit (1) (2023)

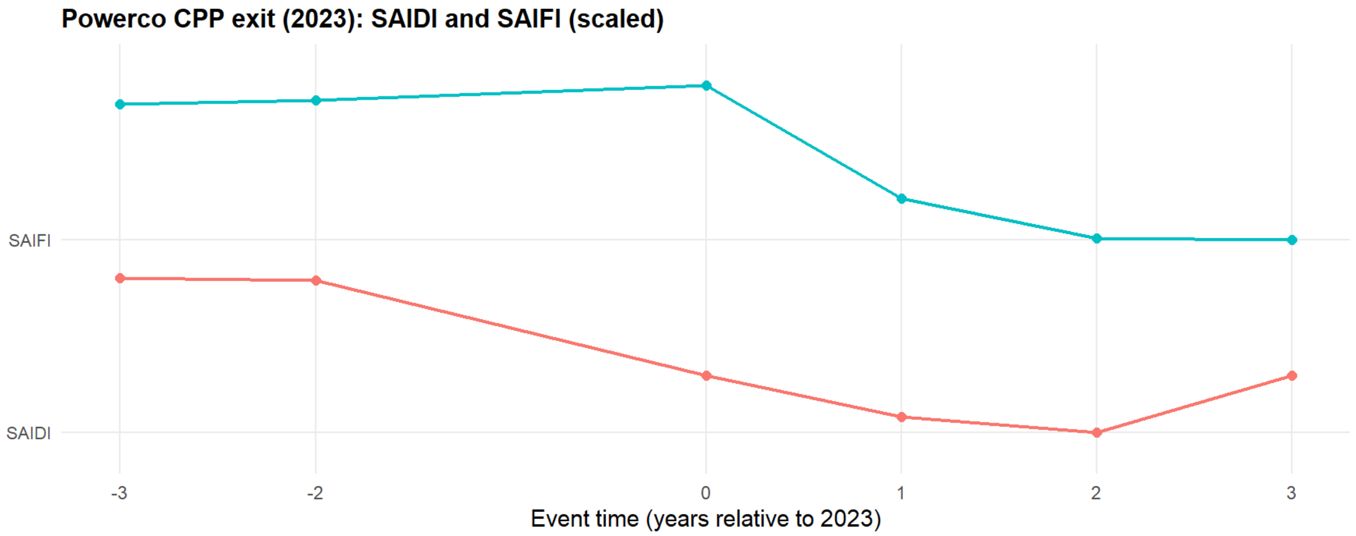


Figure 15. Powerco CPP SAIDI

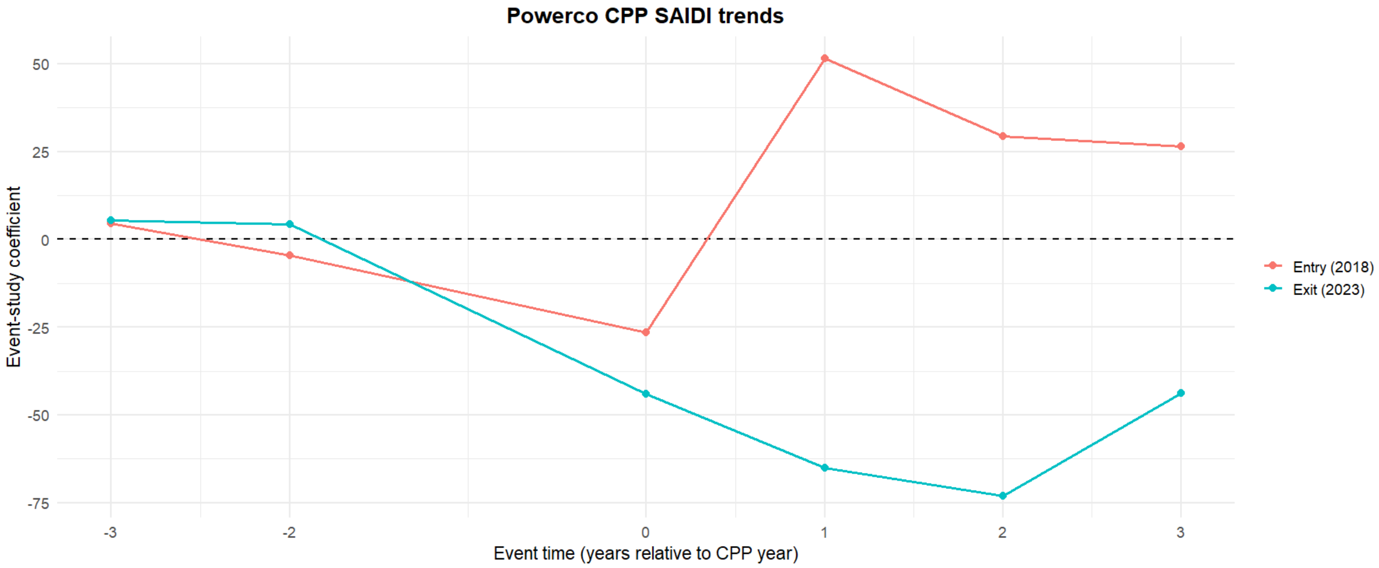


Figure 16. Powerco CPP SAIFI

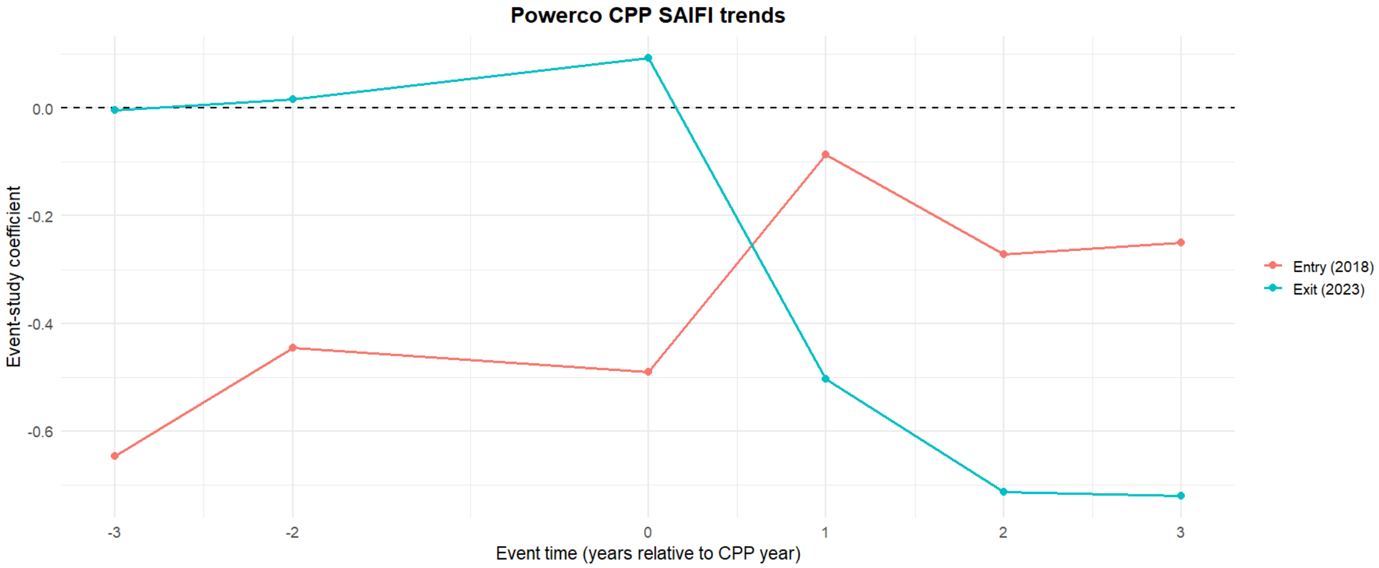


Figure 17. Powerco CPP exit (2) (2023)

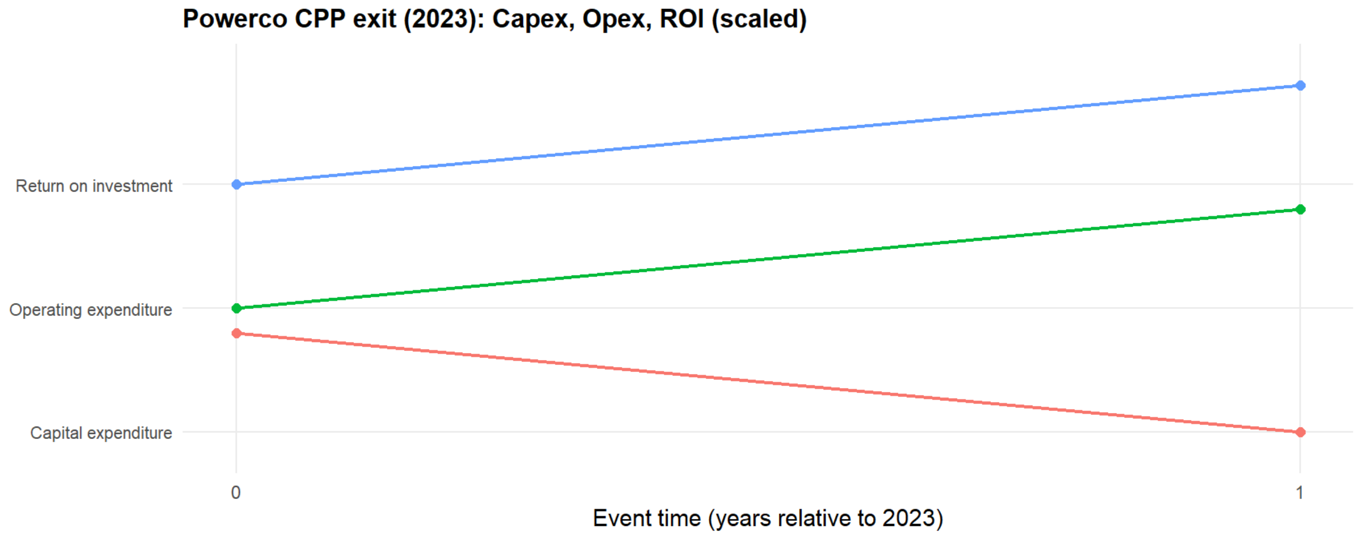


Figure 18. Powerco CPP CAPEX

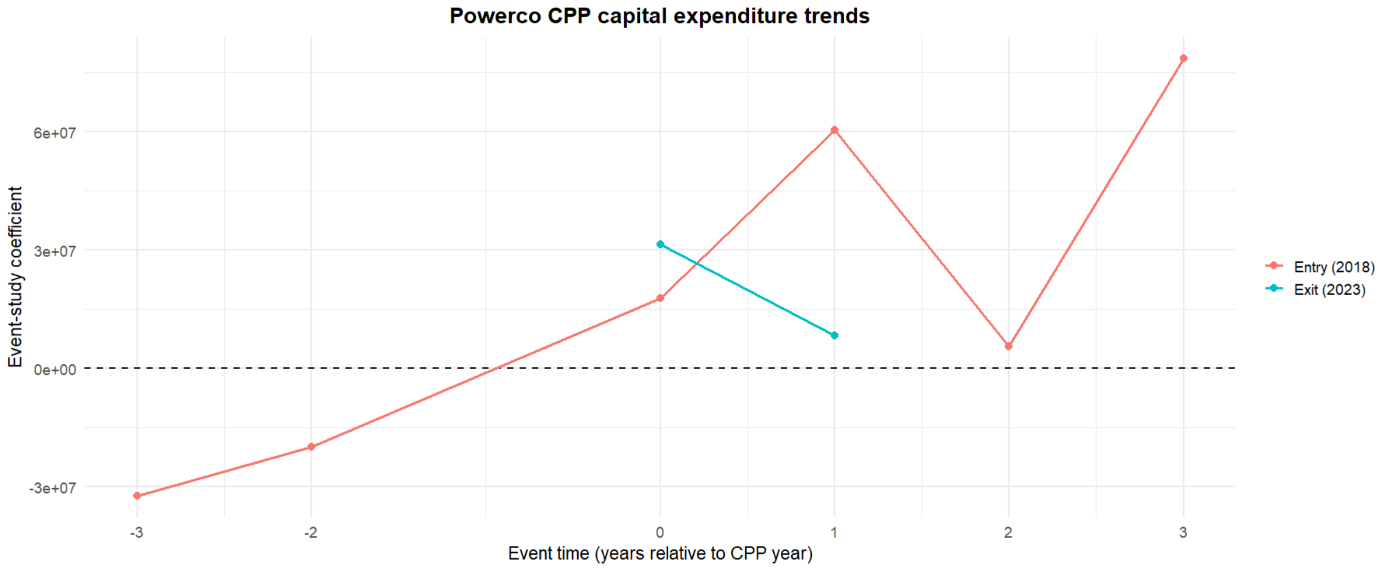


Figure 19. Powerco CPP OPEX

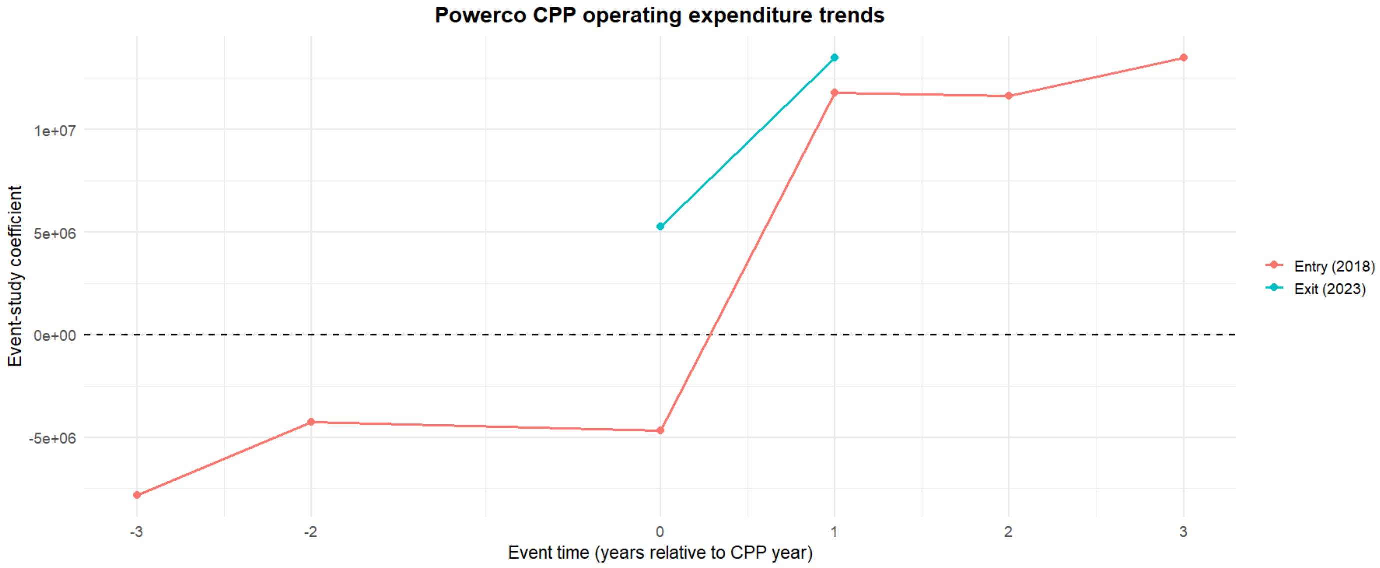


Figure 20. Powerco CPP ROI

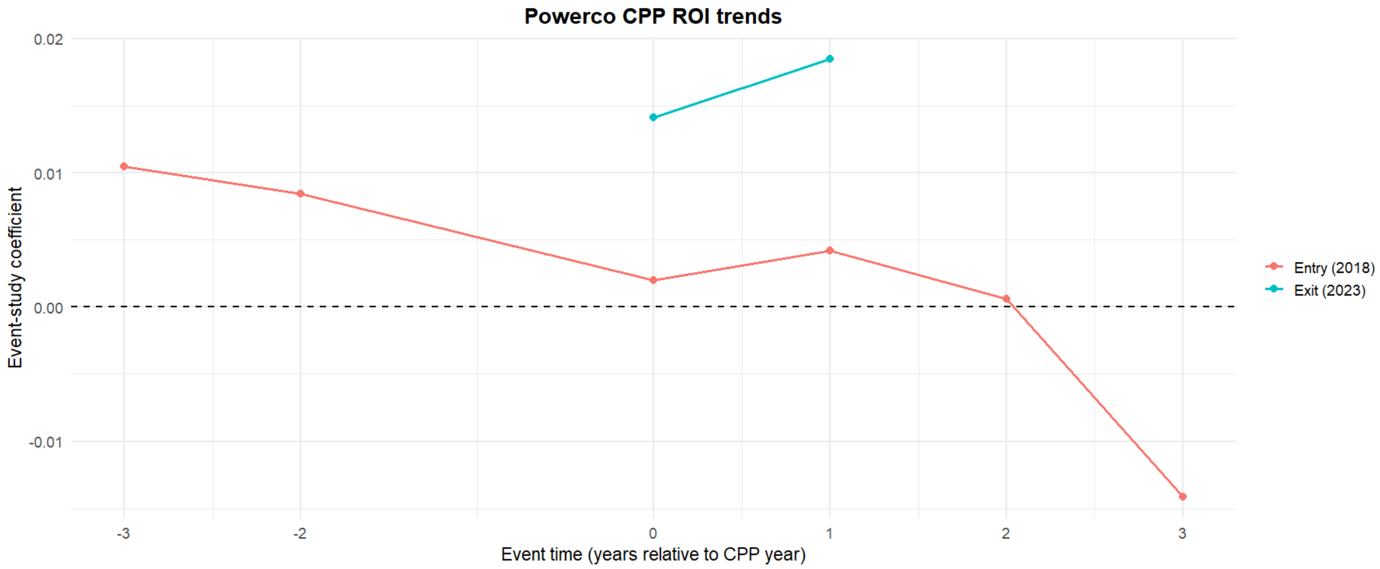


Figure 21. Wellington Electricity CPP entry (2018)

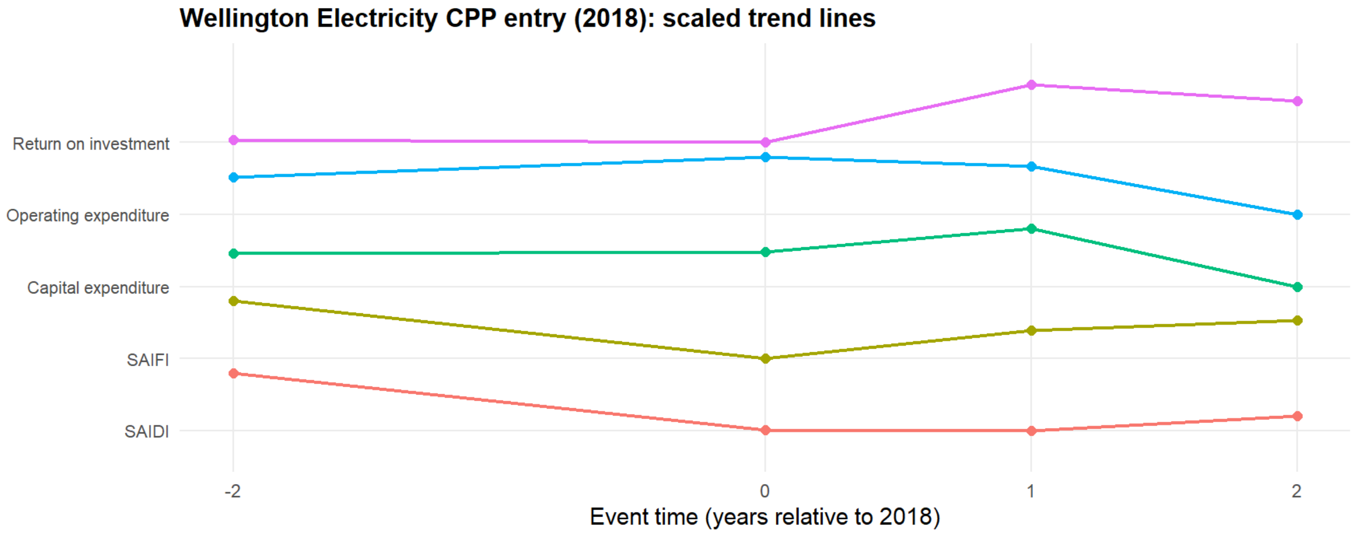


Figure 22. Wellington Electricity CPP exit (2021)

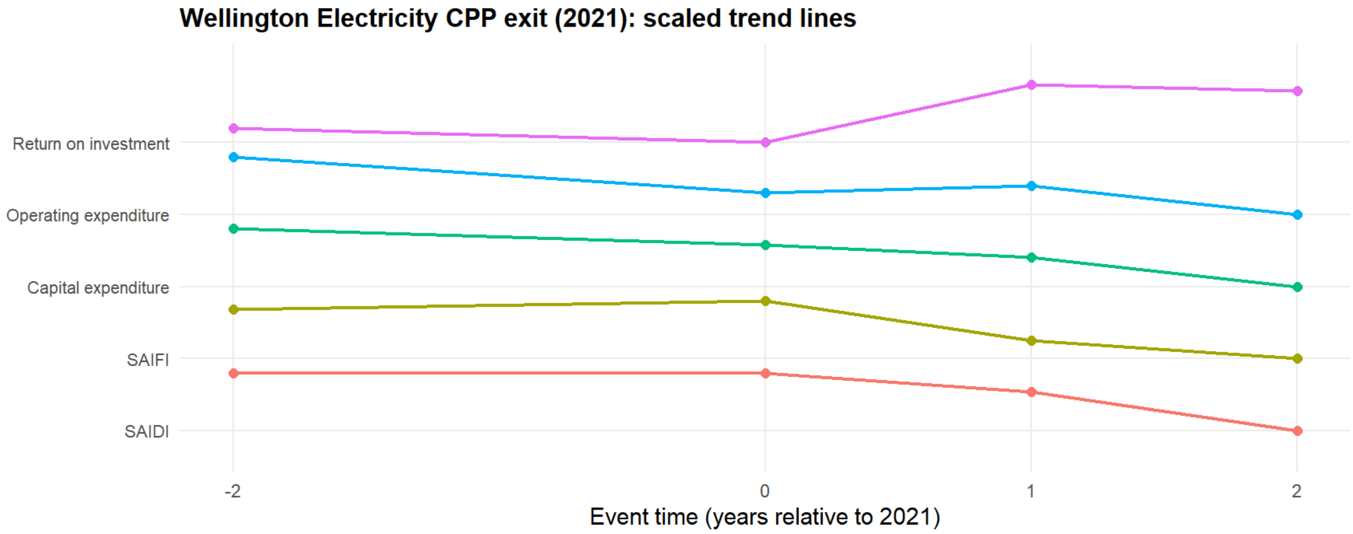


Figure 23. Wellington Electricity CPP SAIDI

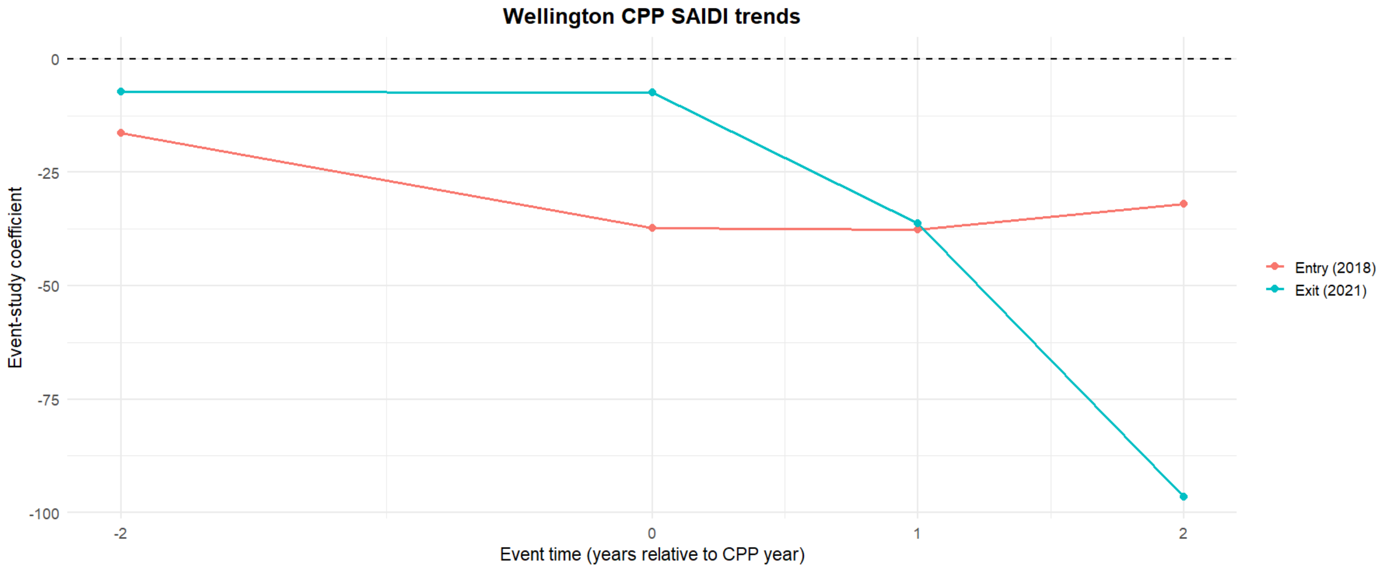


Figure 24. Wellington Electricity CPP SAIFI

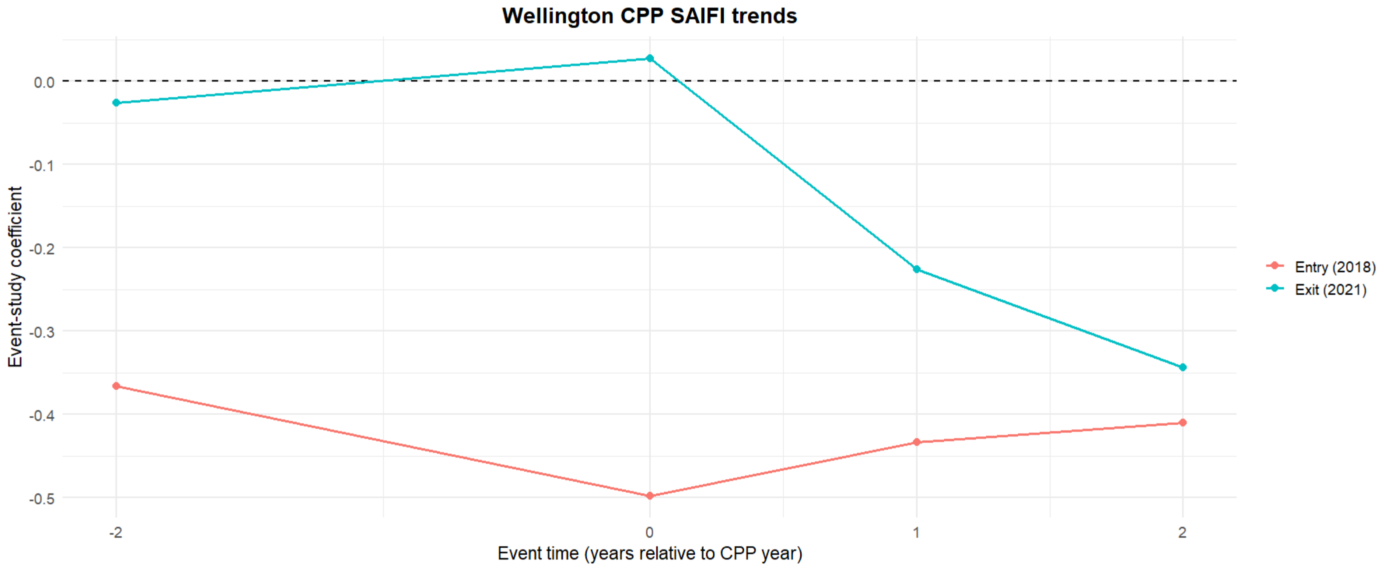


Figure 25. Wellington Electricity CPP CAPEX

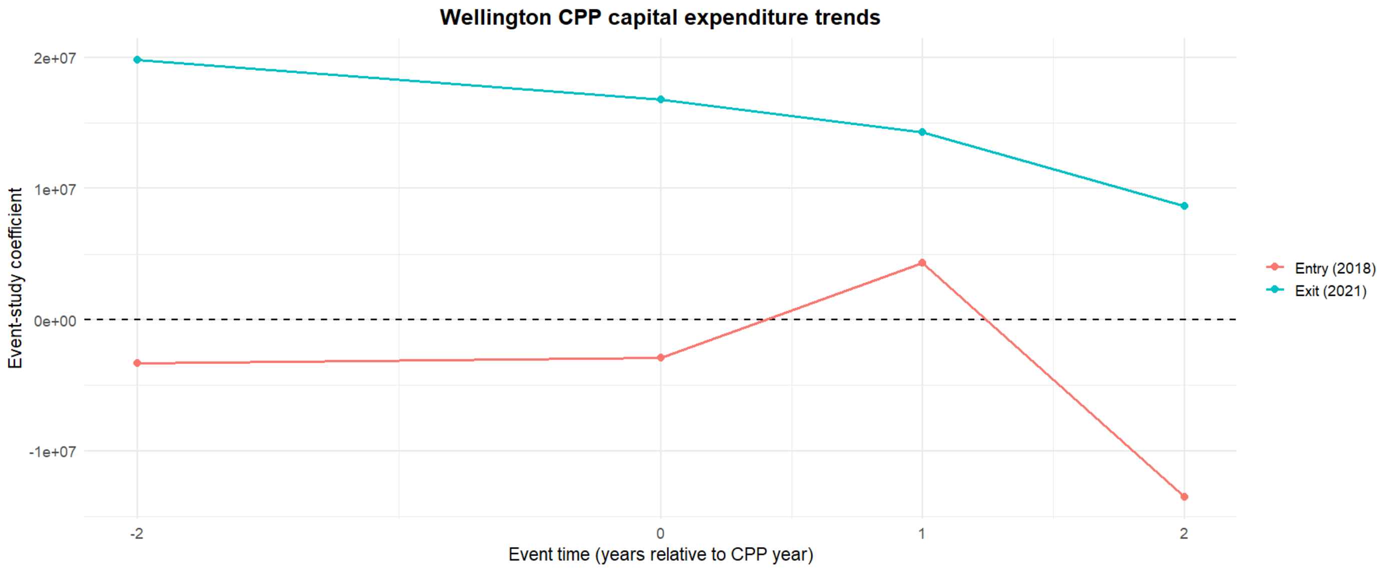


Figure 22. Wellington Electricity OPEX

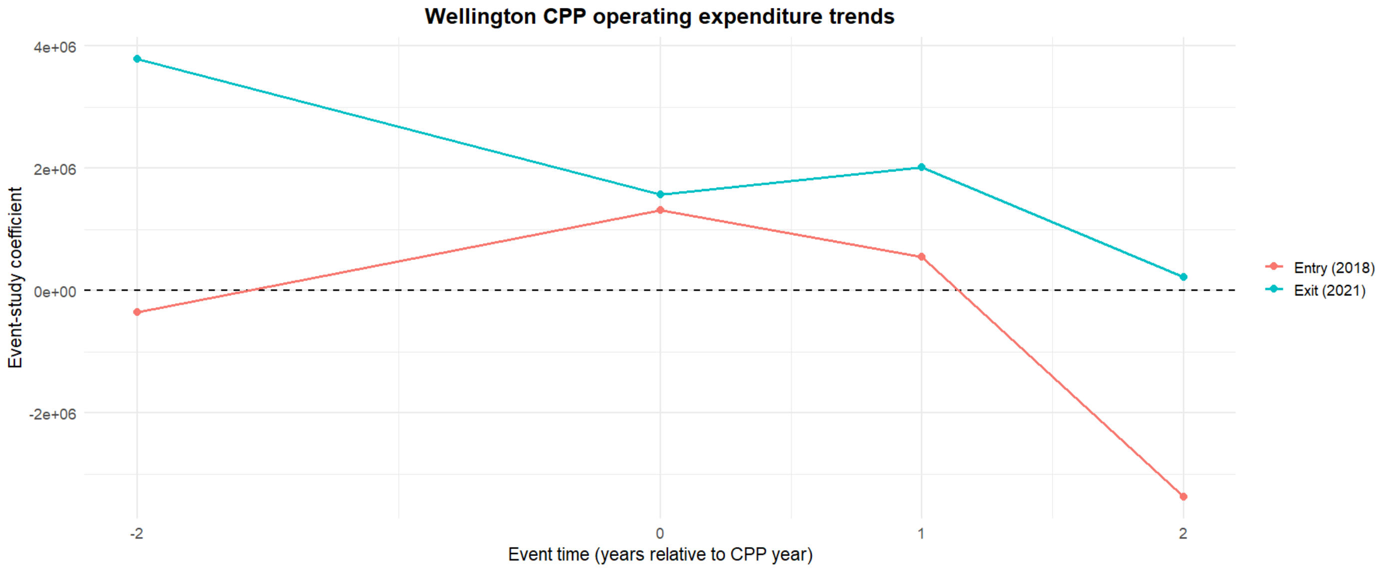
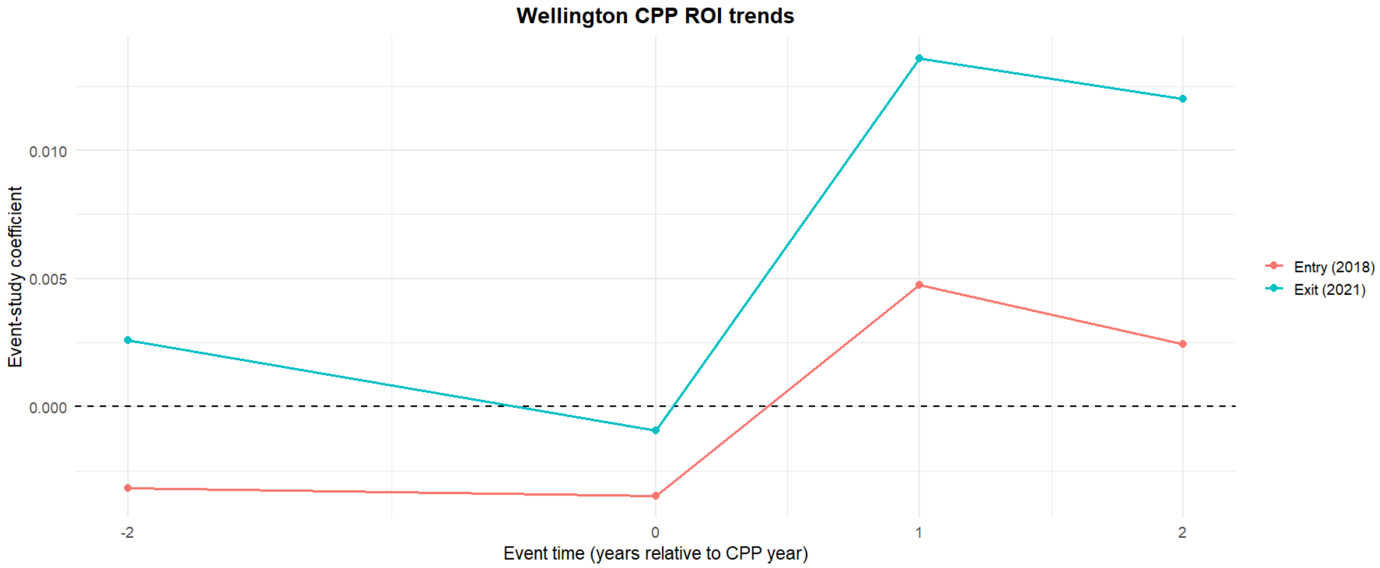


Figure 22. Wellington Electricity ROI



Appendix E. R Event Studies Request

For access to the full R code used in all event study calculations by Myfanwy Stuart for the EDB analysis, including Centralines' 2021 exemption under section 54(g) of the Commerce Act 1986, Aurora Energy 2021 to 2026, Orion 2014 to 2019, Powerco 2018 to 2023, and Wellington Electricity 2018 to 2021 CPPs, please contact stuartmiffy@gmail.com