Electricity Invercargill Ltd

Asset Management Plan 2012 - 2022

Publicly disclosed in March 2012

Contents

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0. Summary

This section summarises some of the main points from the Asset Management Plan.

0.1 Background and Objectives

The purpose of the AMP is to provide a governance and management framework that ensures that Electricity Invercargill Limited (EIL):

- Sets service levels for EIL's electricity network that will meet customer, community and regulatory requirements.
- Understands the network capacity, reliability and security of supply that will be required both now and in the future and the issues that drive these requirements.
- Have robust and transparent processes in place for managing all phases of the network life cycle from commissioning to disposal.
- Has adequately considered the classes of risk EIL's network business faces and that there are systematic processes in place to mitigate identified risks, with a focus on earthquakes in the short term.
- Has made adequate provision for funding all phases of the network lifecycle.
- Makes decisions within systematic and structured frameworks at each level within the business.
- Has an ever-increasing knowledge of EIL's asset locations, ages, conditions and the assets' likely future behaviour as they age and may be required to perform at different levels.

EIL works to the below strategies at the corporate and asset level:

Corporate Strategies

Asset Management Strategies	Manage its operations in a progressive and commercial manner.	Undertake new investments, which are 'core business', acceptable return for risk involved, and maximises commercial value.	Strive to become an efficient and effective operation.	Provide its customers with above average levels of service.
Continuation of the undergrounding of the distribution and network.	✓			✓
Application of new technology and equipment			✓	✓
Replace critical assets near to their technical end-of-life.				✓
Undertake safety, seismic and environmental improvements.	✓	✓	✓	
Achieve 100% regulatory compliance.	✓		✓	

This plan covers the period 1 April 2012 to 31 March 2022, and was approved by the EIL Board on 28 March 2012.

Management of the assets is undertaken by PowerNet Limited which uses external contractors to operate, maintain, renew, upsize and expand the network. As some works are tendered, costs of individual projects are not publicly disclosed in this document.

The processes and systems used by PowerNet are described in section 8.

0.2 Details of the Assets

EIL supplies 17,351 customers in two electrically separate networks; Invercargill city and Bluff, with a total population of 34,713. The EIL network includes residential, commercial, light industrial and heavy industrial areas which have differing daily load profiles with peaks occurring at different times of the day due to, for example, migration of people from residential zones into the CBD area for their work day. These areas follow similar seasonal load variation peaking over the winter months.

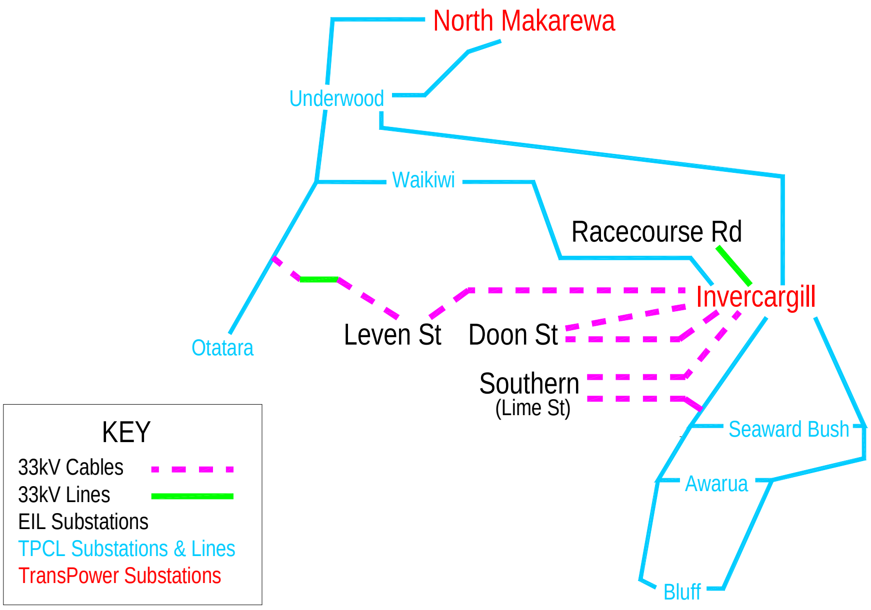

Figure 1: Overview of EIL Subtransmission Network 1 April 2012

There is:

- 1.4km of 33kV lines and 24.8km of 33kV cable.
- Four zone substations to transform High Voltage (HV) to Medium Voltage (MV).
- Two 11kV feeders supplying the bluff network area from The Power Company Limited's Bluff Substation.
- 23.55km of 11kV lines and 155.67km of 11kV cables.
- 448 distribution transformers.
- The low voltage (230V) has 30.50km of overhead lines and 366.91km of cable supplying 17,351 customers.

The age of the network is relatively young, 56% of standard life remaining, with most assets in good condition as the undergrounding programme has renewed most parts of the city network over the last 41 years.

0.3 Proposed Service Levels

Customers are content with the present level of service and no major changes in service levels are proposed. This was the outcome of customer consultation undertaken by a telephone survey.

The surveyed customers have indicated that they value continuity and then restoration most highly; therefore EIL's primary service levels are continuity and restoration. To measure performance in these areas two internationally accepted indices have been adopted:

- SAIDI – System Average Interruption Duration Index. This is a measure of how many system minutes of supply are interrupted per year per customer connected to the network.
- SAIFI – System Average Interruption Frequency Index. This is a measure of how many system interruptions occur per year per customer connected to the network.

EIL's targets for these measures for the next five years ending 31 March 2016 are set out in Table 1.

Table 1: EIL Reliability Projections

Measure	Class	Limit	2012/13	2013/14	2014/15	2015/16	2016/17
SAIDI	B (planned)		4.79	4.79	4.79	4.79	4.79
	C (unplanned)		35.27	35.27	35.27	35.27	35.27
	Total	**45.65**	**40.06**	**40.06**	**40.06**	**40.06**	**40.06**
SAIFI	B (planned)		0.02	0.02	0.02	0.02	0.02
	C (unplanned)		0.75	0.75	0.75	0.75	0.75
	Total	**1.13**	**0.77**	**0.77**	**0.77**	**0.77**	**0.77**

Note this target is based on normalising extreme events to the following daily boundary values: SAIDI 45.65, SAIFI 1.13 i.e. cannot get more than 45.65 customer minutes of SAIDI occurring on a single day.

Target network efficiency measures are shown in Table 2.

Table 2: Energy Efficiency Measures

Measure	2012/13	2013/14	2014/15	2015/16	2016/17
Load Factor	50%	50%	50%	50%	50%
Loss Ratio	5.0%	5.0%	5.0%	5.0%	5.0%
Capacity Utilisation	45%	44%	43%	42%	41%

0.4 Development Plans

The maximum demand on the network has increased 1.3% per annum over the last 10 years with energy increasing by 0.6% per annum. Maximum Demand and Energy growth since 1950 are shown in Figure 2.

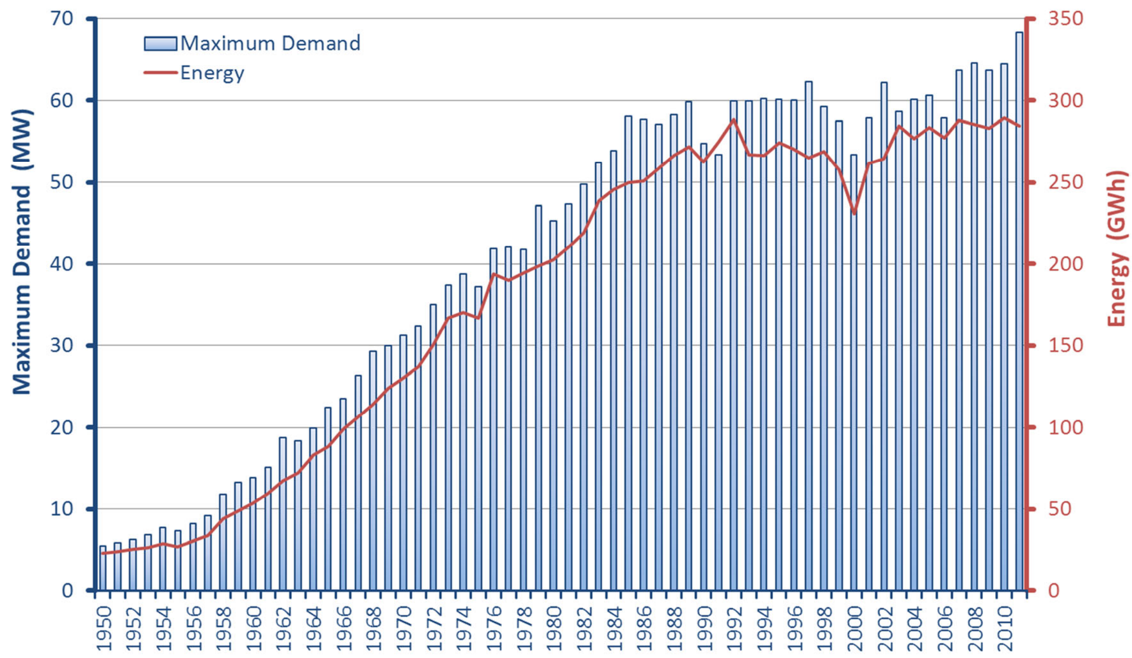

Figure 2: Maximum Demand and Energy Transmitted

The network will be upsized to meet this expected growth with reviews of loadings at zone substations used to trigger actual projects.

The focus for the next ten years is to maintain service levels by:

- Improving safety at zone substations, including removal of all automatic earth switches.
- Upgrading areas to maintain acceptable voltages.
- Renewing unsafe and poorly performing assets.
- Meeting customer and distributed generator requests for new connections.
- Improving efficiency of the network by up-sizing of assets that have high losses and exchanging overloaded distribution transformers with currently installed underutilised units.
- Extending remote monitoring and control to field devices.

Renewals of transformers, ring main units and pillar boxes are expected to have a significant on-going cost.

Capital expenditure each year varies from $4.93 million in 2012/2013 and $5.83 million in 2013/2014 to $2.71 million in 2021/22.

Planned subtransmission network for 2022 is shown in Figure 3:

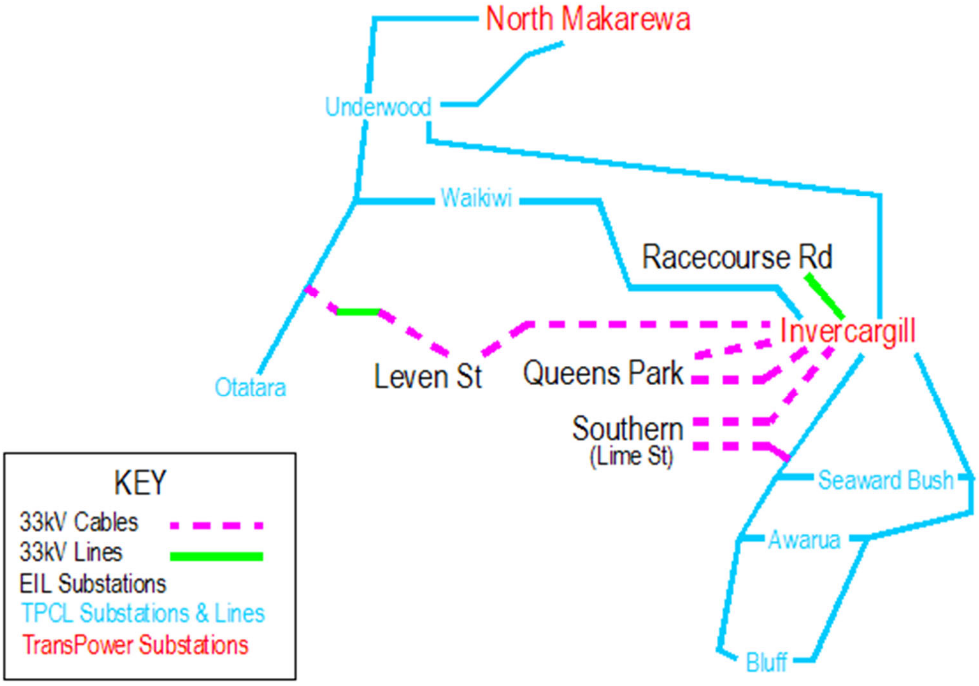

Figure 3: Proposed Network Configuration 2022

0.5 Managing the Asset's Lifecycle

The asset lifecycle used by EIL once assets are built, is: Operation, Maintenance, Renewal, Up-sizing, Extensions and Retirement.

Analysis is done to review network operation to check if any trigger is exceeded and actions planned to maintain planned service levels.

Inspection, monitoring and routine maintenance of assets is expected to cost $0.94 million pa.

Asset refurbishment and renewal maintenance is planned to spend $0.20 million pa.

Fault restoration and repairs is expected to cost $0.54 million pa.

0.6 Risk Management

The business is exposed to a wide range of risks. This section examines EIL's risk exposures, describes what it has done and will do about these exposures and what it will do when disaster strikes.

Risk management is used to bring risk within acceptable levels.

0.7 Funding the Business

EIL's revenue is primarily from retailers who pay for conveying energy over EIL's lines and from customer contributions for the uneconomic portion of new connections or upgrades.

Customer surveys found that only 10% would like to pay more for an improvement in service, so is insufficient to warrant a change in the rate of maintaining and renewing the network.

0.8 Processes and Systems

EIL's management company PowerNet uses a system based on ISO9000 quality system but has not maintained certification. Asset information resides in three key locations: Geographical Information System (GIS), Asset Management System (AMS), and Supervisory Control And Data Acquisition (SCADA). Some of this information is excellent but the accuracy of pole ages is poor with 63% having age estimated.

Condition information is planned to be better collected by use of a scanned form to collect the 20% of the network inspected each year. Planners can then use this data to plan work more efficiently.

0.9 Performance and Improvement

Performance against primary service targets set in the 2010 AMP were not achieved due to a single very low probability fault event affecting one of the Doon Street transformers while the second unit was out of service for maintenance.

Capital expenditure was 14.6% under budget and 5.2% under for maintenance.

Efficiency measures loss ratio and capacity utilisation were better than performance targets. Load factor was 2% below the 50% load factor target but is difficult to improve.

Some strategies are planned to improve productivity.

0.10 Feedback and Comments

Comment on this plan is welcome and should be addressed to the Chief Engineer, PowerNet Ltd, PO Box 1642, Invercargill or email amp_powernet.co.nz. The next review of this AMP is planned for publishing in March 2013.

1. Background and Objectives

Electricity Invercargill Limited (EIL) is the electricity lines business that conveys electricity to the majority of Invercargill and to Bluff for approximately 17,266 customer connections on behalf of six energy retailers. The wider EIL entity also includes the following associations;

- A 50% stake in PowerNet, an electricity lines management company jointly owned with The Power Company Limited (TPCL). This is an unregulated entity and is therefore not subject to any disclosure requirements.
- A 50% stake in Electricity Southland Limited (ESL), which distributes electricity in the Frankton area of Central Otago. ESL is currently below the thresholds for disclosure.
- A 24.5% stake in OtagoNet. The entity for disclosure is OtagoNet Joint Venture (OJV), and its AMP is prepared and disclosed by PowerNet in Invercargill which manages the OJV assets along with those of TPCL and EIL.
- A 24.5% stake in Otago Power Services Ltd, an electrical contracting company based in Balclutha.
- A 49% stake in Power Services Ltd, an electrical contracting company based in Invercargill.

The interrelationship of these entities with the various holding companies and shareholders, along with the accounting treatment of results, is described in EIL's annual report.

This AMP deals solely with the EIL electricity network assets.

1.1 Purpose of the Asset Management Plan

[Addresses the Handbook requirement 4.5.2(a)]

The purpose of the AMP is to provide a governance and management framework that ensures that EIL:

- Sets service levels for EIL's electricity network that will meet customer, community and regulatory requirements.
- Understands the network capacity, reliability and security of supply that will be required both now and in the future and the issues that drive these requirements.
- Have robust and transparent processes in place for managing all phases of the network life cycle from commissioning to disposal.
- Has adequately considered the classes of risk EIL's network business faces and that there are systematic processes in place to mitigate identified risks.
- Has made adequate provision for funding all phases of the network lifecycle.
- Makes decisions within systematic and structured frameworks at each level within the business.
- Has an ever-increasing knowledge of EIL's asset locations, ages and conditions as well as the assets' likely future behaviour as they age and may be required to perform at different levels.

Disclosure of EIL's AMP in this format will also assist in meeting the requirements of Section 7 and 18 and Schedules 12, 13 and 14 of the Electricity Distribution (Information Disclosure) Requirements 2008.

This AMP is not intended to be a detailed description of EIL's assets (these lie in other parts of the business), but rather a description of the thinking, the policies, the strategies, the plans and the resources that EIL uses and will use to manage the assets.

1.2 Interaction with Other Goals and Drivers

All of the assets exist within a strategic context that is shaped by a wide range of issues including EIL's vision statement, asset strategy, the prevailing regulatory environment, government policy objectives, commercial and competitive pressures and technology trends. EIL's assets are also influenced by technical regulations, asset deterioration, the laws of physics and risk exposures independent of the strategic context.

1.2.1 Strategic Context

EIL's strategic context includes many issues that range from the state of the local economy to developing technologies. Issues that EIL considers include:

- The prevailing regulatory environment which guides prices, requires no material decline in SAIDI and requires EIL to compile and disclose performance and planning information.
- Government policy objectives, such as the promotion of distributed generation (particularly renewables).
- EIL's commercial goal which is primarily to deliver a sustainable earnings stream to EIL's owners that are the best use of their funds.
- Competitive pressures from other lines companies which might try to supply EIL customers.
- Pressure from substitute fuels both at end-user level (such as substituting electricity with coal or oil at a facility level) and at bulk generation level (wind farms).
- Advancing technologies such as gas-fired fuel cells that could strand conventional wire utilities.
- Local, national and global economic cycles which effect growth and development.
- Changes to the Southland climate that include more storms and hotter, drier summers.
- Interest rates which can influence the rate at which new customers connect to the network.
- Ensuring sufficient funds and skilled people are available long term to resource EIL's service requirements.

1.2.2 Independence from Strategic Context

It is also important to recognise that although EIL's assets must be shaped by the strategic issues identified in section 1.2.1 they will also be influenced (and even constrained) by issues that are independent of the strategic context.

These issues include:

- Technical regulations including such matters as limiting harmonics to specified levels.
- Asset configuration, condition and deterioration. These parameters will significantly limit the rate at which EIL can re-align 54km of lines, 600km of cables and 454 transformers to fit ever-changing strategic goals.
- The laws of physics which govern such fundamental issues as power flows, losses insulation failure and faults.

- Physical risk exposures. Exposure to events such as flooding, wind, snow, earthquakes and vehicle impacts are generally independent of the strategic context. Issues in which EIL's risk exposure might depend on the strategic context could be in regard to natural issues such as climate change (increasing severity and frequency of storms) or regulatory issues (say if LTNZ required all poles to be moved back from the carriage way).
- Safety requirements such as earthing of exposed metal and line clearances.

1.2.3 Annual Business Plan and Works Plans

Each year, the first year of the AMP is consolidated with any recent strategic, commercial, asset or operational issues into EIL's annual business plan. This defines the priorities and actions for the year ahead which will contribute to EIL's long-term alignment with the strategic context, fully understanding that this alignment process is very much one of "moving goal posts".

An important component of the Annual Business Plan is the Annual Works Programme which scopes and costs each individual activity or project that the company expects to undertake in the year ahead. A critical activity is to firstly ensure that this annual works program accurately reflects the current year's projects in the AMP and secondly ensures that each project is implemented according to the scope prescribed in the works program.

1.3 Key Planning Documents

[Addresses the Handbook requirement 4.5.2(b)]

The key planning documents are expanded below and the interactions of the key planning issues, processes and documents are shown in Figure 4:

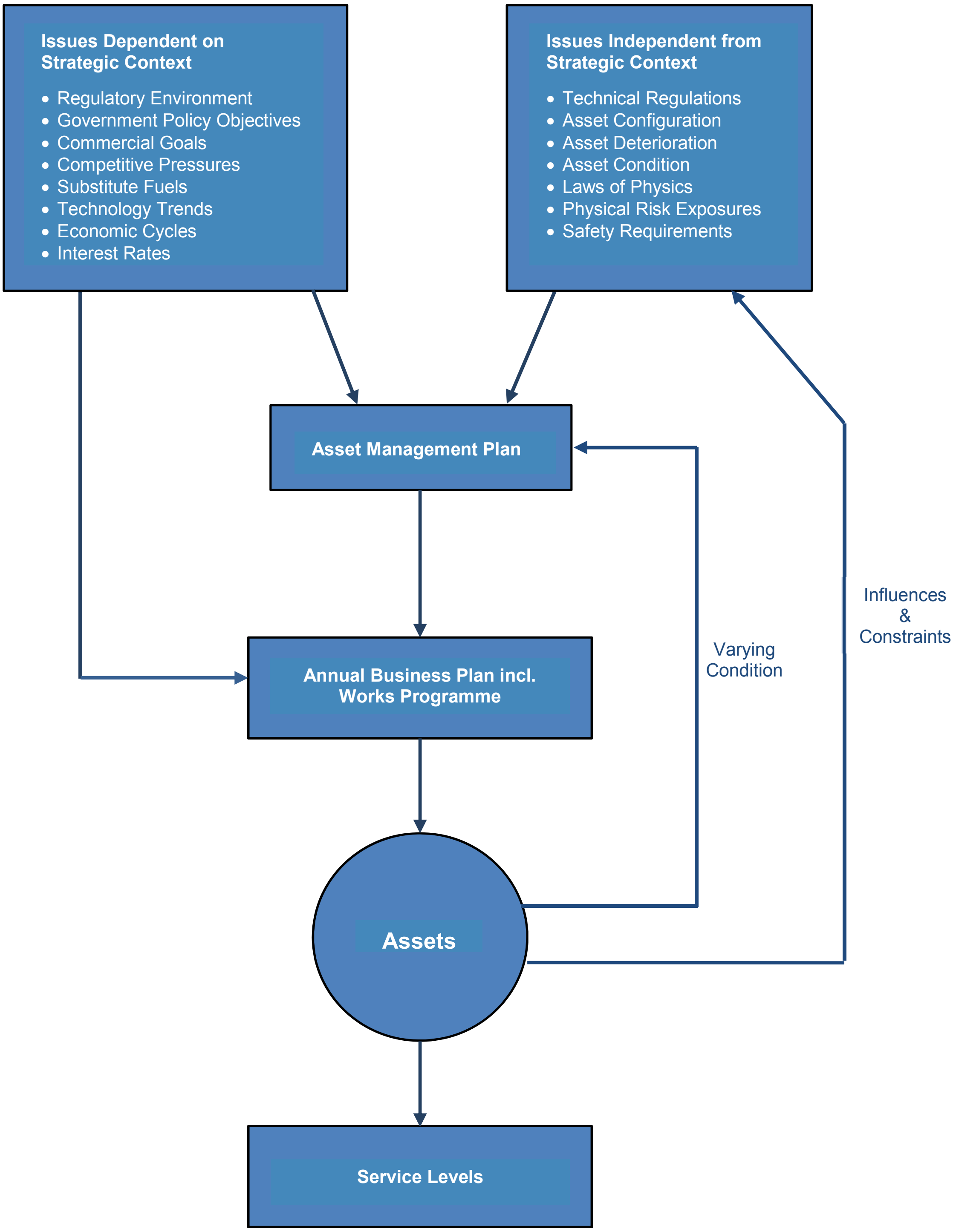

Figure 4: Interaction of Key Plans

1.3.1 Statement of Intent

EIL's Statement of Intent (SOI) is a requirement under the constitution of the company, and forms the principal accountability mechanism between EIL's board and the shareholder; Invercargill City Holdings. The SOI includes performance and reliability projections, which form the heart of the asset management activity and implicitly recognise the inherent trade-off between price and supply quality.

The SOI is available at http://www.powernet.co.nz on the Line Owners area under Company Information.

1.3.1.1 Performance Targets: Financial

EBIT% - Percentage Earnings Before Tax and Interest on Assets Employed

	2012	2013	2014	2015	2016
NPBT	8,390,683	8,845,839	9,170,655	9,486,781	9,985,940
Interest	1,166,042	1,204,688	1,359,479	1,433,750	1,433,750
NPBI&T	9,556,725	10,050,527	10,530,135	10,920,531	11,419,690
Total Assets	131,048,801	135,108,988	138,737,131	141,109,542	143,651,322
EBIT %	**7.29%**	**7.44%**	**7.59%**	**7.74%**	**7.95%**

NPAT% - Percentage Tax Paid Profit on Equity

	2012	2013	2014	2015	2016
NPAT	5,962,120	6,019,356	6,253,224	6,491,996	6,851,391
Equity	90,013,727	92,479,851	95,044,210	97,576,692	100,265,794
NPAT %	**6.32%**	**6.51%**	**6.58%**	**6.65%**	**6.83%**

Percentage of Consolidated Equity to Total Assets

	2012	2013	2014	2015	2016
Equity	90,013,727	92,479,851	95,044,210	97,576,692	100,265,794
Total Assets	131,048,801	135,108,988	138,737,131	141,109,542	143,651,322
% Equity/ Assets	**68.69%**	**68.45%**	**68.51%**	**69.15%**	**69.80%**

1.3.1.2 Performance Targets: Quality

SAIFI - System Average Interruption Frequency Index (the average number of times each customer connected to the network is without supply)

2012	2013	2014	2015	2016
0.80	0.80	0.80	0.80	0.80

SAIDI - System Average Interruption Duration Index (the average total time in minutes each customer connected to the network is without supply)

2012	2013	2014	2015	2016
31.54	31.54	31.54	31.54	31.54

The Commerce Commission Supply Quality Thresholds are:

SAIFI	1.97
SAIDI	83.36 minutes

1.3.2 Vision Statement

To be a top performing New Zealand Lines Company.

1.3.3 Strategic Plan

Key asset management drivers from EIL's Strategic Plan are:

1. Manage its operations in a progressive and commercial manner.
2. Undertake new investments, which are:
   - Within the core business.
   - Aimed at yielding a return acceptable for the degree of risk.

  - Undertaken in a manner which will maximise the commercial value of the business.

3. Strive to become an efficient and effective operation within the electricity industry and provide its customers with competitive prices and above average levels of service.

1.3.4 Asset Strategy

EIL asset strategy follows these guiding principles:

- Continuation of the undergrounding of the distribution network.
- Application of new technology and equipment.
- Replace critical assets near to their technical end-of-life.
- Undertake safety, seismic and environmental improvements.
- Achieve 100% regulatory compliance.

1.3.5 Prevailing Regulatory Environment

EIL's assets are subject to a price and quality regulation established under Part 4 of the Commerce Act 1986. EIL is subject to information disclosure requirements (including the requirement to publish an AMP) along with other structural regulations such as restrictions on generating and retailing energy, and the requirement to connect embedded generation.

1.3.6 Government Policy Objectives

Electricity lines businesses are being increasingly required to give effect to many aspects of government policy, namely:

- Facilitating the connection of distributed generation on a regulated basis.
- Improving the already high levels of public safety around power lines and transformers.
- Offering increasingly variable tariffs to promote demand reduction despite the most economically efficient tariff structure for a lines business being a fixed cost.

1.3.7 Annual Business Plan

An Annual Business Plan (ABP) is produced by PowerNet and contains the following:

- Core Business, Vision Statement and Critical Success Factors.
- Commercial Objectives, The Nature and Scope of Commercial Activity and Company Polices.
- Annual Capital Works Programme and the Annual Works Plan (AWP) for the following four years.
- Business Plan Financials and Business Unit Reports.

1.3.8 Annual Works Plan

The AWP is produced by PowerNet that details the works to be undertaken for each financial year, and is incorporated into the ABP. All of next year's works, listed in the AMP, are included in the AWP.

1.4 Interaction of Goals/Strategies

Table 3: Corporate and Asset Management Strategy LinkageTable 3 below shows the linkage between the Corporate and Asset Management Strategies.

Table 3: Corporate and Asset Management Strategy Linkage

Corporate Strategies

- Provide its customers with above average levels of service.
- Strive to become an efficient and effective operation.
- Undertake new investments, which are 'core business', acceptable return for risk involved, and maximises commercial value.
- Manage its operations in a progressive and commercial manner.

Asset Management Strategies	Manage its operations in a progressive and commercial manner.	Undertake new investments, which are 'core business', acceptable return for risk involved, and maximises commercial value.	Strive to become an efficient and effective operation.	Provide its customers with above average levels of service.
Continuation of the undergrounding of the distribution network.	✓			✓
Application of new technology and equipment			✓	✓
Replace critical assets near to their technical end-of-life.				✓
Undertake safety, seismic and environmental improvements.	✓	✓	✓	
Achieve 100% regulatory compliance.	✓		✓	

1.5 Period Covered by the Asset Management Plan

[Addresses the Handbook requirement 4.5.2(c)]

This edition of EIL's AMP covers the period 1 April 2012 to 31 March 2022. It was prepared during November 2011 to March 2012, approved by EIL's Board on 28 March 2012 and publicly disclosed at the end of March 2012.

There is a degree of uncertainty in any predictions of the future, and accordingly the AMP is uncertain. Customer demand driven by turbulent commodity markets, public policy trends and possible generation opportunities within EIL's demand profile means the future is perhaps less certain than many other infrastructure businesses that have greater scale. Accordingly EIL has attached certainties to the timeframes of the AMP as summarised in Table 4.

Table 4: Certainty for AMP Planning Period

Timeframe	Residential & Commercial	Large Industrial	Intending Generators
Year 1	Very certain	Reasonable certainty	Reasonable certainty
Years 2 to 5	Certain	Little if any certainty	Little if any certainty
Years 6 to 10	Little if any certainty	Little if any certainty	Little if any certainty

1.6 Stakeholder Interests

[Addresses the Handbook requirement 4.5.2(d)]

1.6.1 Stakeholders

A stakeholder is defined as any person or class of persons who does or may do one or more of the following:

- Has a financial interest in EIL (be it equity or debt).
- Pays money to EIL (either directly or through an intermediary) for delivering service levels.
- Is physically connected to EIL's network.
- Uses EIL's network for conveying electricity.
- Supplies EIL with goods or services (includes labour).

- Is affected by the existence, nature or condition of the network (especially if it is in an unsafe condition).
- Has a statutory obligation to perform an activity in relation to the EIL network's existence or operation (such as request disclosure data, regulate prices, investigate accidents or District Plan requirements).

1.6.2 Stakeholder Interests

The interests of the stakeholders are defined in Table 5 below:

Table 5: Key stakeholder interests

	Interests				
	Viability	Price	Quality	Safety	Compliance
Shareholder – Invercargill City Holdings	✓	✓	✓	✓	✓
Bankers	✓	✓		✓	✓
Connected Customers	✓	✓	✓	✓	
Contracted Manager (PowerNet)	✓	✓	✓	✓	✓
Energy Retailers	✓	✓	✓		
Mass-market Representative Groups	✓	✓	✓		
Industry Representative Groups	✓	✓	✓		
Staff and Contractors	✓			✓	✓
Suppliers of Goods and Services	✓				
Public (as distinct from customers)				✓	✓
Land owners				✓	✓
Councils (as regulators)				✓	✓
Transport Agency				✓	✓
Ministry of Economic Development		✓	✓	✓	✓
Energy Safety Service				✓	✓
Commerce Commission	✓	✓	✓		✓
Electricity Authority					✓
Electricity & Gas Complaints Commission			✓		✓
Ministry of Consumer Affairs			✓		✓

Table 6 below demonstrates how stakeholder's expectations and requirements are identified.

Table 6: How Stakeholder's Expectations are Identified

Stakeholder	How expectations are identified
Invercargill City Holdings	By their approval or required amendment of the SOI Regular meetings between the directors, executive and the trustees
Bankers	Regular meetings between the bankers, PowerNet's Chief Executive and Chief Financial Officer. By adhering to EIL's treasury/borrowing policy By adhering to banking covenants
Connected Customers	Regular discussions with large industrial customers as part of their on-going development needs Annual customer surveys
Contracted Manager (PowerNet)	Board Chairman weekly meeting with the Chief Executive
Energy Retailers	Annual consultation with retailers
Mass-market Representative Groups	Informal contact with group representatives
Industry Representative Groups	Informal contact with group representatives
Staff & Contractors	Regular staff briefings Regular contractor meetings
Suppliers of Goods & Services	Regular supply meetings Newsletters
Public (as distinct from customers)	Word of mouth around the city Feedback from the Trust's public meetings
Land Owners	Individual discussions as required
Councils (as regulators)	Formally as necessary to discuss issues such as assets on Council land Formally as District Plans are reviewed
Transport Agency	Formally as required
Ministry of Economic Development	Regular bulletins on various matters Release of legislation, regulations and discussion papers Analysis of submissions on discussion papers
Energy Safety Service	Promulgated regulations and codes of practice Audits of EIL's activities Audit reports from other lines businesses
Commerce Commission	Regular bulletins on various matters Release of discussion papers Analysis of submissions on discussion papers Conferences following submission process
Electricity Authority	Weekly update Release of discussion papers Briefing sessions Analysis of submissions on discussion papers Conferences following submission process General information on their website
Electricity & Gas Complaints Commission	Reviewing their decisions in regard to other lines companies
Ministry of Consumer Affairs	Release of legislation, regulations and discussion papers General information on their website

1.6.3 Meeting Stakeholder's Interests

Table 7 provides a broad indication of how stakeholder's interests are accommodated:

Table 7: Meeting stakeholder interests

Interest	Description	How EIL meets interests
Viability	Viability is necessary to ensure that the shareholder and other providers of finance such as bankers have sufficient reason to keep investing in EIL.	Stakeholder's needs for long-term viability are accommodated by delivering earnings that are sustainable and reflect an appropriate risk-adjusted return on employed capital. In general terms this will need to be at least as good as the stakeholders could obtain from a term deposit at the bank plus a margin to reflect the ever-increasing risks to the capital in the business. Earnings are set by estimating the level of expenditure that will maintain Service Levels within targets and the revenue set to provide the required returns.
Price	Price is a key means of both gathering revenue and signalling underlying costs. Getting prices wrong could result in levels of supply reliability that are less than or greater than EIL's customers want.	EIL's total revenue is constrained by the price path threshold regime. Prices will be restrained to within the limits prescribed by the price path threshold, unless it comprises safety or viability. Failure to gather sufficient revenue to fund reliable assets will interfere with customer's business activities, and conversely gathering too much revenue will result in an unjustified transfer of wealth from customers to shareholders. EIL's pricing methodology is expected to be cost-reflective, but issues such as the Low Fixed Charges requirements can distort this.
Supply quality	Emphasis on continuity, restoration of supply and reducing flicker is essential to minimising interruptions to customers' businesses.	Stakeholder's needs for supply quality will be accommodated by focusing resources on continuity and restoration of supply. The most recent mass-market survey indicated a general satisfaction with the present supply quality but also with many customers indicating a willingness to accept a reduction in supply quality in return for lower line charges.
Safety	Staff, contractors and the public at large must be able to move around and work on the network in total safety.	The public at large are kept safe by ensuring that all above-ground assets are structurally sound, live conductors are well out of reach, all enclosures are kept locked and all exposed metal is earthed. The safety of our staff and contractors is ensured by providing all necessary equipment, improving safe work practices and ensuring that they are stood down in unsafe conditions. Contractors will use all necessary safety equipment, improve their safe work practices and ensure that they stand down in unsafe conditions. Motorists will be kept safe by ensuring that above-ground structures are kept as far as possible from the carriage way within the constraints faced in regard to private land and road reserve.
Compliance	Compliance is necessary with many statutory requirements ranging from safety to disclosing information.	All safety issues will be adequately documented and available for inspection by authorised agencies. Performance information will be disclosed in a timely and compliant fashion.

1.6.4 Managing Conflicting Interests

Priorities for managing conflicting interests are:

- Conflict identified.
- Analysis of issues and options using the following priority hierarchy:
    - Safety. Top priority is given to safety. The safety of staff, contractors and the public will not be compromised even if budgets are exceeded.
    - Viability. Second priority is viability (as defined above), because without it EIL will cease to exist which makes supply quality and compliance pointless.
    - Pricing. EIL will give third priority to pricing as a follow on from viability (noting that pricing is only one aspect of viability). EIL recognises the need to adequately fund its business to ensure that customers' businesses can operate successfully, whilst ensuring that there is not an unjustified transfer of wealth from its customers to its shareholders.
    - Supply quality is the fourth priority. Good supply quality makes customers, and therefore EIL, successful.
    - Compliance. A lower priority is given to compliance that is not safety and supply quality related.
- Report with recommendation made to management.
- Decision made by Management Team, or escalated to EIL Board.

1.6.5 Customer Consultation

A face to face survey using a survey company was undertaken with four key clients. It was found businesses had a positive view of PowerNet and were generally happy with the current level of reliability. However they would like to see planned outage times reduced or the flexibility to dictate when these outages occur as well as more feedback regarding restoration time during unexpected outages.

PowerNet is perceived to have a good public profile regarding community support however some businesses expressed a desire for more face to face contact with PowerNet staff to make them more aware of pricing and reliability options.

Individual customers are also consulted as they undertake connection to the network. For example, the connection of the show grounds subdivision where options and negotiations occurred before the supply was agreed on.

1.7 Accountabilities for Asset Management

[Addresses the Handbook requirement 4.5.2(e)]

EIL's ownership, governance and management structure is depicted in

Figure 5:

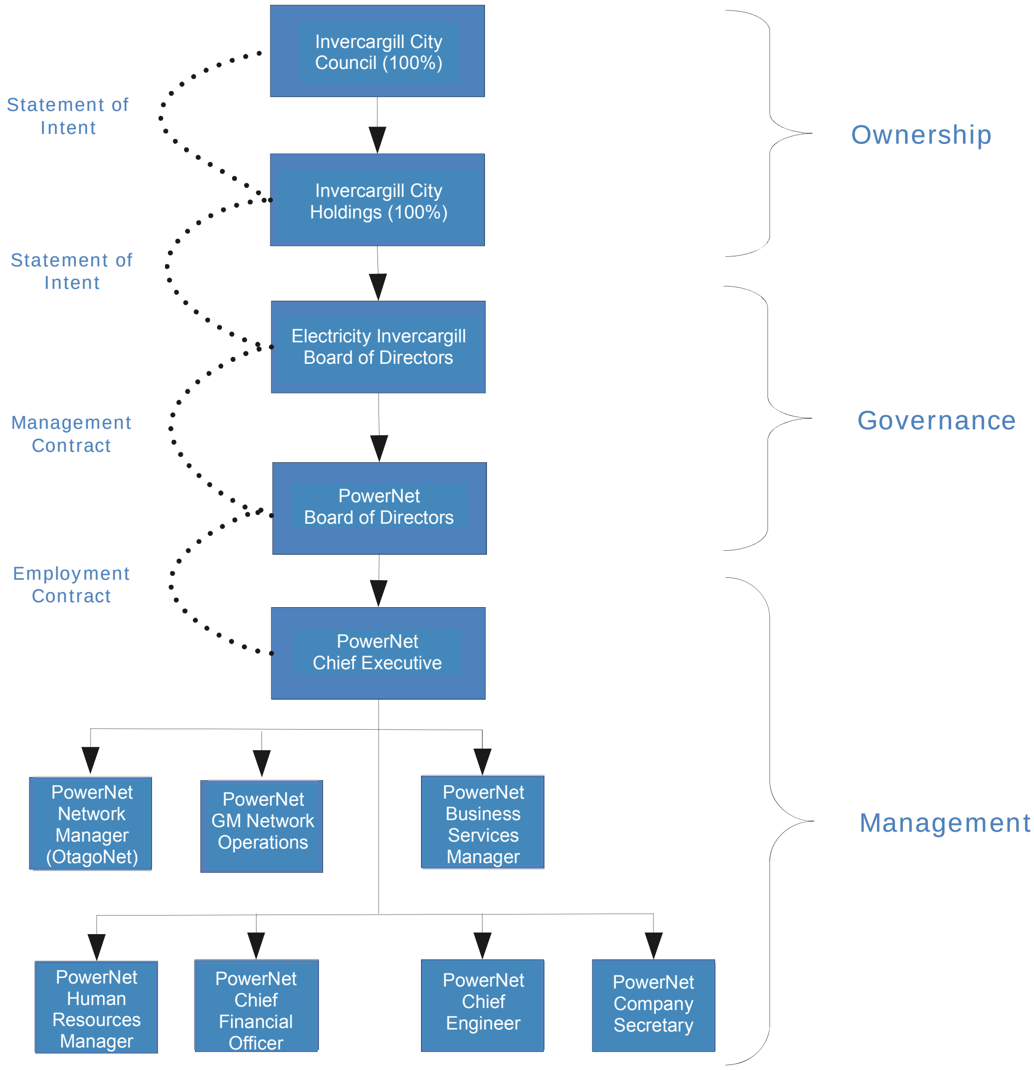

Figure 5: Governance and management accountabilities

The ultimate accountability is to the connected customers, and it is therefore pleasing to note that the Commerce Amendment Bill has recognised this accountability and removes the price path threshold for such customer owned lines businesses.

1.7.1 Accountability at Ownership Level

EIL has a single shareholder – Invercargill City Holdings (Holdco) acting for Invercargill City Council as a CCTO (council controlled trading organisation). The CCTO currently has five directors;

- Norman Elder (Chairman)
- Alan Dennis
- Grahame Sycamore
- Cam McCulloch
- Tim Loan

The CCTO is subject to the following accountability mechanisms;

- Directors are appointed to Holdco and subsidiary company directors are approved by Invercargill City Council.

1.7.2 Accountability at Governance Level

As EIL uses a contracted management company (PowerNet Limited) to manage the assets, there is effectively a two-tier governance structure as follows:

The first tier of governance accountability is between EIL's Board and shareholder with the principal mechanism being the Statement of Intent (SOI). Inclusion of SAIDI and SAIFI targets in this statement makes EIL's Board intimately accountable to EIL's shareholder for these important asset management outcomes whilst the inclusion of financial targets in the statement makes EIL's Board additionally accountable for overseeing the price-quality trade-off inherent in projecting expenditure and SAIDI.

EIL currently has five directors:

- Neil Boniface (Chairman)
- Philip Mulvey
- Tom Campbell
- Ross Smith
- Darren Ludlow

The second tier of governance accountability is between EIL's Board and the PowerNet Board with the principal mechanism being the management contract that specifies a range of strategic and operational outcomes to be achieved.

1.7.3 Accountability at Executive Level

Overall accountability for the performance of the electricity network rests with the Chief Executive of PowerNet. The principal accountability mechanism is the Chief Executive's employment agreement with the PowerNet Board which reflects the outcomes specified in the management contract between EIL's Board and PowerNet.

1.7.4 Accountability at Management Level

There are seven level two managers reporting directly to PowerNet's Chief Executive with the principal accountability mechanisms being their respective employment agreements.

The individual manager who has the most influence over the long-term asset management outcomes will be the Chief Engineer through his preparation of the AMP which will guide the nature and direction of the other managers' work.

1.7.5 Accountability at Operational Level

PowerNet's Operations Team manages the work to the external contractors to achieve the outcomes in the Annual Works Plan. Contracts are structured on the following mechanisms:

- Purchase Order – generally only minor work
- Fixed Lump Sum Contract – generally on-going work: faults service, checks and inspections
- Contract – specific project work

Each type details the work to be undertaken, the standards to be achieved, detail of information to be provided and payments.

Data and information from the contractors' inspections and checks are used to plan works for the following years.

1.7.6 Accountability at Work-face Level

All field work is done by external contractors managed by the PowerNet Operations Team.

There are three contractors with long term contracts with PowerNet.

- Power Services Limited
- Otago Power Services Limited
- Transfield Services E & T NZ Limited

Some of the other contractors used include:

- DECOM Limited
- Electrix Services Limited
- Local Electrical Inspectors (M Jarvis, I Sinclair, W Harper)
- Total Power Services Limited
- Asplundh Tree Expert (NZ) Limited
- MasterTrade Limited
- Consultants (S Sinclair, SKM, Millpower, Mitton Electronet)

The principal accountability mechanism is through contracts that reflect the outcomes PowerNet must create for EIL.

1.7.7 Key Reporting Lines

The EIL board receives monthly commercial and network reports that cover the following items:

- Network reliability – this lists all outages over the last month, and trends regarding the SOI reliability targets
- Network Quality – detail of outstanding voltage complaints and annual statistics on them
- Network Connections – monthly and yearly details of connections to the network
- Use of Network – trend of the energy conveyed through the network
- Revenue – detail on the wheeling fees received
- Retailer activity – detail on volumes and numbers per energy retailer operating on the network
- Works Programme – monthly and year-to-date (YTD) expenditure on each works programme item and percentage complete, with notes on major variations.

Each level of management has defined financial limits in the PowerNet Financial Authorities Policy. This requires any new project over $100,000 or variation to the approved Annual Works Plan by more than +10% or -30%, to have Board approval. Generally most projects are approved by the board in the Annual Business Plan process.

1.8 Systems and Processes

[Addresses the Handbook requirement 4.5.2(f)]

Systems and processes are described in section 8 of this AMP.

2. Details of the Assets

This section summarises EIL's assets and asset configurations, but begins by describing EIL's geographical coverage, what sort of activities the underlying community uses electricity for, and the issues that are driving key asset parameters such as demand changes.

2.1 Distribution Area

2.1.1 Geographical Coverage

[Addresses the Handbook requirement 4.5.3(a)(i).]

The distribution area includes:

- The part of Invercargill bounded by Racecourse Road to the east, the Waihopai Stream to the north and west (except for Invercargill Airport which is in EIL's area) and Elizabeth, Moulson and Brown Streets and Tramway Road to the south. Shown in Figure 6.
- The borough of Bluff extending as far west as the former Ocean Beach freezing works. Shown in Figure 7.

The topography is densely urban and built-up in both Invercargill and Bluff. Invercargill is almost totally flat (lying about 3m to 5m above sea level) whilst Bluff varies from flat to steep hills.

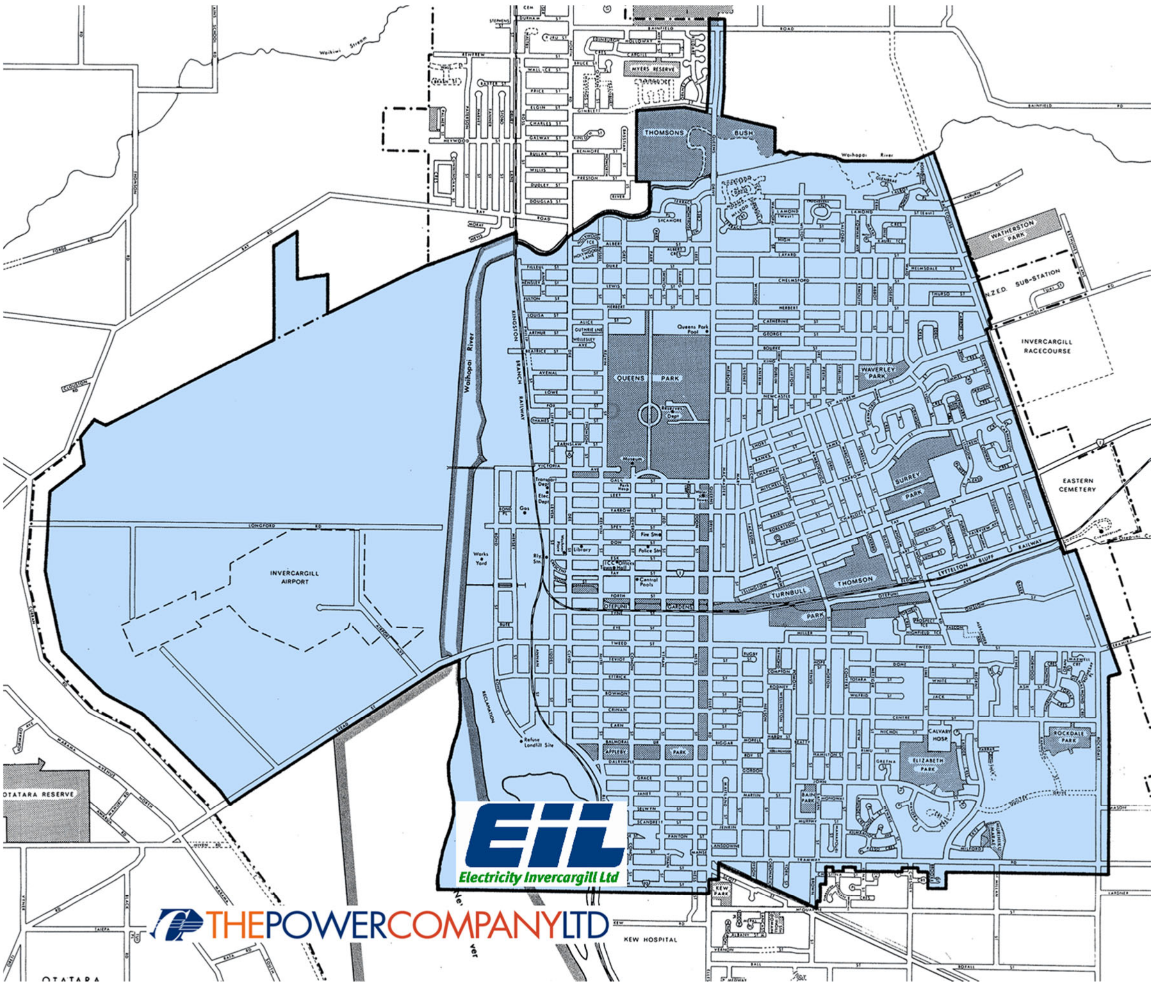

Figure 6: EIL Invercargill Distribution Area

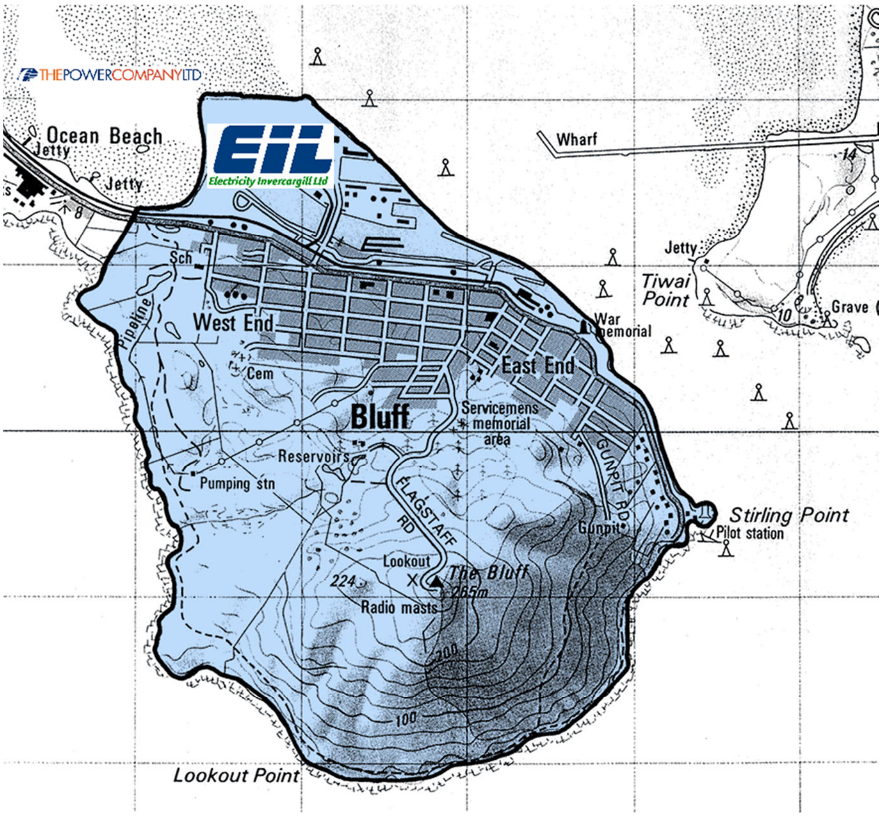

Figure 7: EIL Bluff Distribution Area

2.1.2 Demographics

The population of EIL's distribution area is approximately 34,713. Classification of areas within EIL's distribution area is as shown in Table 8:

Table 8: EIL Population Projection by Area Classification

		2006 Census[1]		2021 Projection[2]		
Description	**Includes**	**Count**	**≥ 65**	**Medium**	**High**	**≥ 65**
Invercargill	Invercargill excluding areas supplied by TPCL	32,925	15%	31,950	35,590	20%
Bluff	Bluff township supplied via EIL feeders from the Bluff TPCL substation	1,788	15%	1,690	1,870	21%
Total		**34,713**	**15%**	**33,640**	**37,460**	**20%**

It is interesting to note the number of people 65 years and older is projected to increase from 15% in 2006 to 20% in 2021.

[1] 2006 Census Statistics

[2] 2006 Statistics NZ Population Projection, December 2007

2.1.3 Key Industries

EIL's largest customer is a large port in the Bluff distribution area which regularly peaks at about 1.3MW and consumes approximately 5.8GWh per year.

No individual EIL customers are considered large enough to have any significant impact on network operations or asset management planning other than ensuring that adequate supply capacity is maintained.

Certain areas on the network have differing load densities and rates of growth which are more likely to influence asset management planning. Growth rates on the network however are relatively low and significant new connections are generally unpredictable so planning tends to be more reactive than proactive to avoid over investment.

The Bluff distribution area also includes associated heavy industries as well as residential and commercial customers.

The Invercargill distribution area is predominantly residential but does include a medium-sized CBD, a heavy industrial area immediately west of the CBD and a light industrial area in the south east.

2.1.4 Load Characteristics

[Addresses handbook requirement 4.5.3(a)(iii)]

Domestic: Standard household demand peaks in the morning (8am) and evening (6:30pm). The use of heat pumps is increasing electricity usage, with no noticeable impact over the summer hot period yet. Peaks normally occur in the winter months as heating requirements increase.

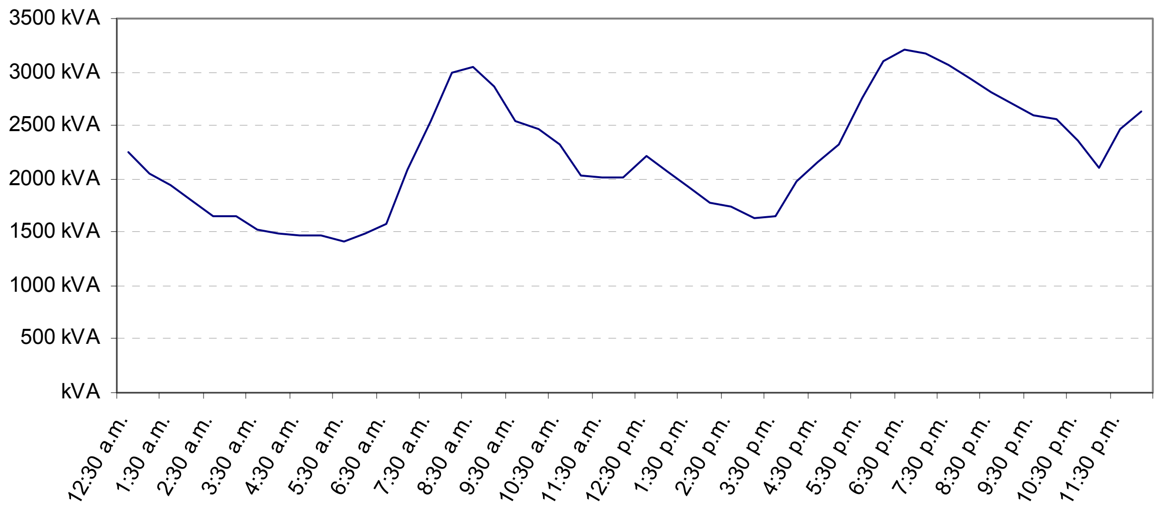

Figure 8: Typical Domestic Daily Load Profile (5 June 2009, Racecourse Road CB12)

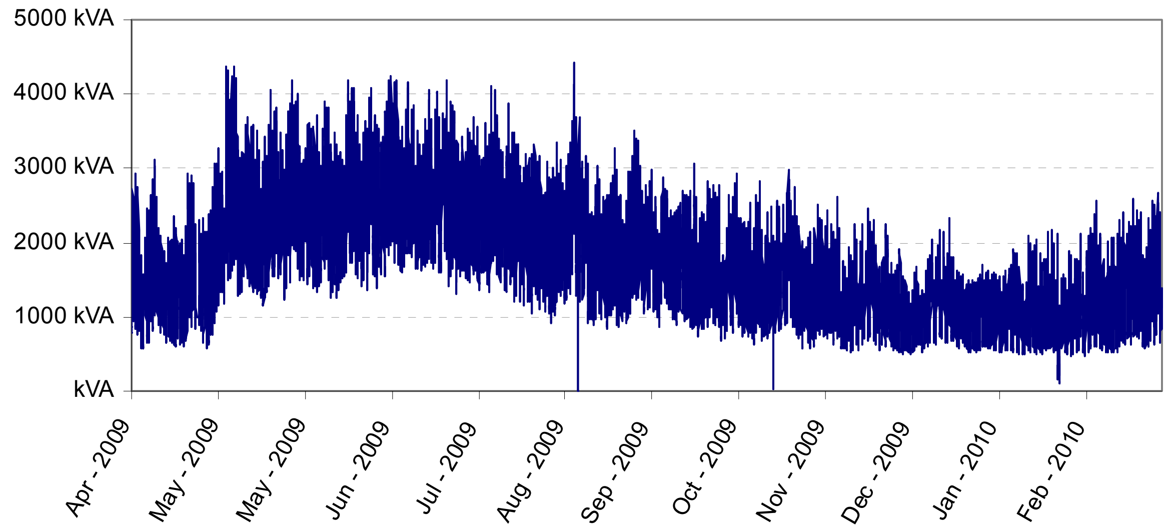

Figure 9: Typical Domestic Feeder Yearly Load Profile (Racecourse Road CB12)

CBD: Load peaks in the CBD later in the day (10:00am) as people migrate into the area for their work day. Week day loading is typically significantly higher than over the weekends corresponding to work patterns of the businesses in the CBD. Seasonal variation in the CBD load profile is similar to that of domestic loading with peak load occurring over the winter months.

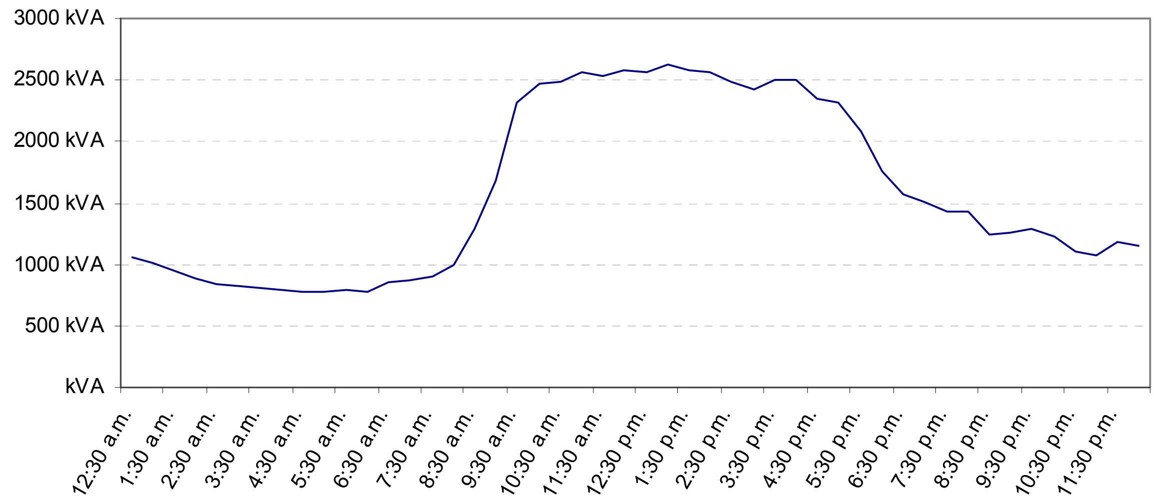

Figure 10: Typical CBD Feeder Daily Load Profile (5 June 2009, Leven Street CB8)

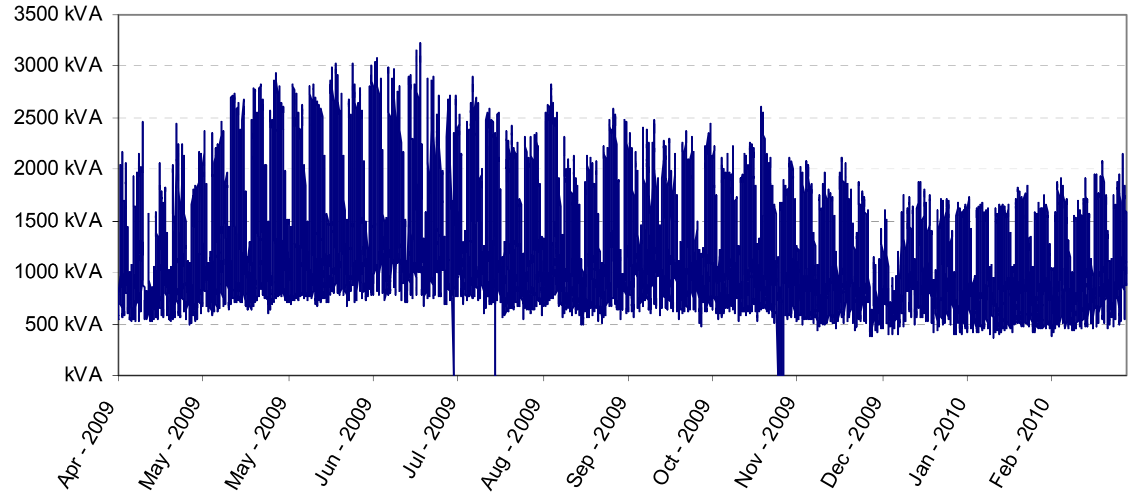

Figure 11: Typical CBD Feeder Yearly Load Profile (Leven Street CB8)

2.1.5 Other Drivers of Electricity Use

Other drivers of electricity use include:

- Low temperatures during winter (-5°C frosts are not uncommon in the area).
- The use of heat pumps as air conditioners in the 25°C summer heat. Increased electrical heating due to heat pump conversion is thought to be mostly offset by more efficient electrical heating replacing stand-alone electric heaters.
- Improving home insulation due to 'Warm Homes' project.
- Increased energy efficiency due to Government campaigns. (Compact Fluorescent light bulbs.)

2.1.6 Energy and Demand Characteristics

[Addresses handbook requirement 4.5.3(a)(iv)]

Key energy and demand figures for the YE 31 March 2011 are as shown in Table 9.

Table 9: Energy and Demand

Parameter	Value	Long-term trend (10yr)
Energy conveyed	284.47 GWh	Variation around steady growth 0.9%
Maximum demand[3]	68.34 MW	Variation around steady growth 1.8%[4]
Load factor	48%	Reasonably constant[4]
Losses	3.8%	Varying

Note values are inclusive of those for the Bluff area network as the Disclosure Requirements definition for "Non-contiguous network" states that Line Business activities serving less than 2000 ICPs are not to be regarded as geographically separate.

[3] This is different from the sum of the individual demands at each GXP, which will be greater than the coincident demand due to diversity.

[4] Step change in Maximum Demand occurred due to new Transpower Pricing Methodology, with individual GXP peaks now replaced by Lower South Island peaks across multiple GXP's.

2.2 Network Configuration

To supply the 17,351 customers EIL owns and operates two electrically separate networks that are both supplied by a single Grid Exit Point (GXP) at Invercargill. By way of explanation the Bluff network comprises two 11kV feeders supplied by TPCL's zone substation situated just west of Bluff Township. EIL also owns interconnectors to TPCL's Otatara and Seaward Bush 33kV lines that provide alternative supplies to the Leven Street and Southern zone substations respectively.

2.2.1 Bulk Supply Assets and Embedded Generation

[Addresses handbook requirement 4.5.3(b)(i)]

2.2.1.1 Invercargill GXP

Invercargill GXP comprises a strong point in the 220kV grid which is tied to Roxburgh and Manapouri power stations and to the North Makarewa GXP. Invercargill is also a major supply node for the Tiwai Point Smelter.

The 33kV supply arrangement at Invercargill comprises an indoor switchboard that is energised by two three-phase 120MVA 220/33kV transformers. There are eleven 33kV feeders each supplied through its own circuit breaker. EIL takes supply from seven of these feeders in normal operation including the two parallel TPCL feeders which supply Bluff. Back up supplies are available from other TPCL feeders and are used from time to time.

EIL owns the segments of 33kV line (but not the circuit breakers or bus) that run within the GXP land area and also accommodates a control room that oversees the operation of the network. EIL also owns one of the two 33kV 216⅔Hz ripple injection plants on the west side of the GXP site. The second plant is owned by TPCL with each providing backup capability to the other.

2.2.1.2 Bulk Supply Characteristics

Table 10: EIL Bulk Supply Characteristics

	Voltage	Rating	Firm Rating	MD[5]	CD[6]
Invercargill GXP	220/33kV	210MVA	105MVA	97.12MW	72.73MW
EIL	*(GXP assets shared with TPCL)*			68.63MW	49.69MW

2.2.2 Subtransmission Network

[Addresses handbook requirement 4.5.3(b)(ii)]

EIL's subtransmission network is a single electrically connected network that takes supply from a single GXP at Invercargill and can take emergency supply from the North Makarewa GXP through TPCL's 33kV network as depicted in Figure 12.

[5] Maximum Demand 1 September 2010 to 31 August 2011

[6] LSI Peak Coincident Demand (at 13:30hrs, 16 August 2011)

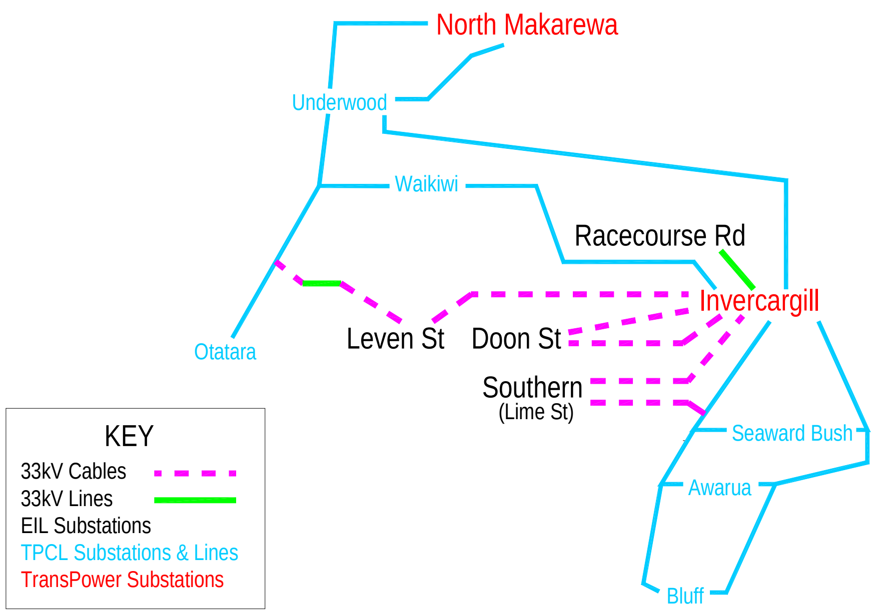

Figure 12: Subtransmission network

Note that EIL's two Bluff 11kV feeders are supplied from TPCL's 33kV subtransmission network. EIL's subtransmission network comprises 1.4km of 33kV line and 24.8km of 33kV cable and has the following characteristics:

- Two points of interconnection with TPCL's 33kV network which provides alternative supplies to Leven Street and Southern zone substations.
- It is almost totally underground except for short lengths of overhead line between Invercargill GXP and Racecourse Road zone substation (about 200m long) and in the middle of the tie between Leven Street zone substation and TPCL's Otatara 33kV feeder.
- It is predominately a ring topology except for Racecourse Road which is a spur.

2.3 Zone Substations

EIL currently owns and operates four zone substations as described in Table 11.

Table 11: EIL substations

Substation	Nature of load	Description of substation
Doon Street	Part CBD, mainly residential.	Substantial dual-transformer urban substation with two separate 33kV cable supplies.
Leven Street	CBD and heavy industrial.	Substantial dual-transformer urban substation supplied by a single 33kV cable but with an alternative 33kV supply from an alternative GXP via TPCL's Otatara 33kV feeder.
Racecourse Road	Residential.	Substantial single-transformer urban substation supplied by a single 33kV overhead line.
Southern	Residential, some light industrial.	Substantial single-transformer urban substation supplied by a single 33kV cable but with an alternative 33kV supply from TPCL's Seaward Bush 33kV feeder.

2.3.1 Distribution Network

[Addresses handbook requirement 4.5.3(b)(iii)]

2.3.1.1 Configuration

The 11kV distribution network is heavily meshed throughout the entire Invercargill area, with most distribution transformers being able to be supplied by two separate 11kV supplies. In the CBD most supplies to each transformer are protected by 'Solkor' unit protection.

Distribution in Bluff is mainly meshed except at the extremes.

2.3.1.2 Construction

The 11kV distribution network construction is as follows:

- All underground cable within the Invercargill CBD. Cable type (PILC or XLPE) depends on date of original installation, repairs and renewals.
- Suburban areas of Invercargill are either XLPE cable or overhead line. A gradual overhead to underground (OHUG) program has been implemented over the last 41 years and has only 11.74km of overhead left.
- Bluff is almost totally overhead construction due to the shallow soil over rock substrata. Originally all Bluff was operated at 3.3kV distribution with conversion to 11kV occurring after EIL took over the assets.

2.3.1.3 Per Substation Basis

EIL's split of distribution network on a per substation basis is presented in Table 12. Safety and reliability are EIL's strongest drivers for allocation of resources, with customer density providing an indication of priority of other works.

Table 12: Distribution network per substation

Substation	Line Length (km)	Cable Length (km)	Customers	Customer density
Doon Street	0.00	52.03	6329	121.64 /km
Leven Street	4.80	30.33	2165	61.63 /km
Racecourse Road	3.95	23.37	2942	107.69 /km
Southern	1.61	44.73	4894	105.61 /km
Bluff – EIL feeders	13.19	5.21	1021	55.49 /km
Total/average	**23.55**	**155.67**	**17351**	**96.81 /km**

2.3.2 Distribution Substations

[Addresses handbook requirement 4.5.3(b)(iv)]

Just as zone substation transformers form the interface between the subtransmission and the 11kV distribution networks, distribution transformers form the interface between the 11kV distribution and 400V distribution networks. The distribution substations range from a few remaining pole-mounted transformers with only minimal fuse protection to 3-phase 1,000kVA ground-mounted transformers with remote indication and control that supply CBD customers or special customers, like the Stadium Southland event centre. There are a few sites located underground, particularly in the CBD where land for ground mounted equipment was not economic or available. Table 13 shows distribution transformer numbers by rating.

Table 13: Number of distribution substations

Rating	Pole	Ground
1-phase up to 15kVA	2	1
1-phase 30kVA	1	1
3-phase up to 15kVA	-	1
3-phase 30kVA	-	4
3-phase 50kVA	1	3
3-phase 75kVA	-	1
3-phase 100kVA	3	16
3-phase 200kVA	7	62
3-phase 300kVA	11	240
3-phase 500kVA	-	53
3-phase 750kVA	2	31
3-phase 1,000kVA	-	8
Total	**27**	**421**

Each distribution transformer has MV protection by MV fuses. This is achieved in two configurations:

- Individual with a fuse at each site or,
- Group Fusing where a single fuse is located at the take-off from the main cable with up to two downstream units.

Low voltage protection is by DIN[7] standard HRC[8] fuses sized to protect overload of the distribution transformer.

[7] Deutsches Institut für Normung e.V. (DIN; in English, the German Institute for Standardization) is the German national organization for standardization and is that country's ISO member body.

[8] High Rupture Capacity.

2.3.3 LV Network

[Addresses handbook requirement 4.5.3(b)(v)]

2.3.3.1 Coverage

Unlike a rural network the 400V distribution network almost totally overlays the 11kV distribution network although the coverage of each individual transformer tends to be limited by volt-drop to about a 200m radius.

2.3.3.2 Configuration

The 400V distribution network has a moderate degree of interconnection that enables many customer connections to be supplied from "either end" in the event of a transformer failure. The limitation tends to be transformer loading rather than distance.

2.3.3.3 Construction

The 400V distribution network construction is as follows:

- All underground cable within the Invercargill CBD. Cable type (PILC or XLPE) depends on date of original installation, repairs and renewals.
- Suburban areas of Invercargill are PVC, XLPE or PILC cable with a few remaining areas of overhead line.
- Bluff is overhead construction with underbuilt reticulation on most 11kV poles. Some undergrounding has occurred in a few locations using XPLE cable.

2.3.3.4 Per Substation Basis

On a per substation basis the split of LV network is as shown in Table 14.

Table 14: LV network per substation

Substation	Line Length (km)	Cable Length (km)	Customers	Customer density
Doon Street	0.00	126.02	6329	50.22 /km
Leven Street	3.35	49.38	2165	41.06 /km
Racecourse Road	2.47	63.70	2942	44.46 /km
Southern	1.09	126.67	4894	38.31 /km
Bluff - EIL	23.59	1.14	1021	41.29 /km
Total / average	**30.50**	**366.91**	**17351**	**43.66 /km**

2.3.4 Customer Connection Assets

EIL has 17,351 customer connections - for which revenue is earned for providing a connection to the network via the six retailers which convey electricity over the network. All of the "other assets" convey energy to these customer connections and essentially are a cost to EIL that has to be matched by the revenue derived from the customer connections. These customer connections generally involve assets ranging in size from a simple fuse on a pole or in a suburban distribution pillar to dedicated lines and transformer installations supplying single large customers. The number and changes over the year are shown in Table 15.

Table 15: Classes of customer connections

	8kW 1ph	10% Fixed	20kW 1ph	15kW 3ph	30kW 3ph	50kW 3ph	75kW 3ph	100kW 3ph	Non ½hr Metered Individual	½hr Metered Individual	Total
Apr-10	362	2,740	12,581	69	719	370	123	72	52	120	**17,208**
May-10	367	2,799	12,523	69	717	369	123	72	52	120	**17,211**
Jun-10	368	2,805	12,515	70	718	369	122	72	51	121	**17,211**
Jul-10	369	2,786	12,535	72	714	370	122	72	51	122	**17,213**
Aug-10	372	2,801	12,521	72	716	371	123	70	51	122	**17,219**
Sep-10	374	2,798	12,530	73	719	368	123	70	52	121	**17,228**
Oct-10	375	2,932	12,400	73	718	370	125	70	53	121	**17,237**
Nov-10	376	2,932	12,402	73	720	371	124	70	53	121	**17,242**
Dec-10	373	2,985	12,349	73	721	372	124	70	53	121	**17,241**
Jan-11	376	3,001	12,330	73	720	371	124	70	53	121	**17,239**
Feb-11	376	3,012	12,333	74	721	370	125	70	54	121	**17,256**
Mar-11	378	3,054	12,296	74	721	372	126	70	53	122	**17,266**

In most cases the fuse forms the demarcation point between EIL's network and the customer's assets (the "service main") and this is usually located at or near the physical boundary of the customer's property.

2.3.5 Secondary Assets and Systems

[Addresses handbook requirement 4.5.3(b)(vi)]

2.3.5.1 Load Control Assets

EIL currently owns and operates the following load control transmitter facilities for control of ripple relays:

- One main 33kV 216⅔Hz 125kVA injection plant at Invercargill, with backup provided from the adjacent TPCL plant.

2.3.5.2 Protection and Control

(a) Key Protection Systems

EIL's network protection includes the following broad classifications of systems:

Circuit Breakers

- Circuit breakers provide powered switching (usually charged springs or DC coil) enabling operational control of isolation and fault interruption of all faults.
- Circuit breaker protection relays which have always included over-current and earth-fault functions. More recent equipment also includes voltage, frequency, directional and circuit breaker fail functionality in addition to the basic functions.
- May also be driven by the following to protect downstream devices:
  - Transformer and tap changer temperature sensors.
  - Surge sensors.
  - Explosion vents.
  - Oil level sensors.

Fuses

- Fuses provide fault current interruption of some faults and may be utilised by manual operation to provide isolation.
- As fuses are a simple over-current device they do not provide a reliable earth fault operation, or any other protection function.

Switches

- Switches provide no protection function but allow simple manual operation to provide control/isolation.

Links

- Links provide no protection function but allow difficult manual operation to provide control/isolation.

(b) DC Power Supplies

Batteries, battery chargers and battery monitors provide the direct current (DC) supply systems for circuit breaker control and protection functions. This allows continued operation of plant throughout any power outage.

(c) Tap Changer Controls

Voltage Regulating Relays (VRR's) provide automatic control of the 'Tap Change On Load' (TCOL) equipment on power transformers to regulate the outgoing voltage to within set limits.

2.3.5.3 SCADA and Communications

SCADA is used for control and monitoring of zone substations and remote switching devices and for activating load control plant.

(a) Master Station

EIL's SCADA master station is located at PowerNet's System Control centre at the Findlay Road GXP, Invercargill. This system is based on the process industry standard 'iFIX' with a New Zealand developed add-on 'iPOWER' to provide full Power Industry functions.

(b) Communications Links

EIL currently owns and operates the following communication links:

- Multicore network between Zone substations and CBD distribution sites and the Control room, that carries SCADA and protection functions.
- Dataradio that links to the Control room Dataradio from:
    - Gore Street circuit breaker
    - Surrey Park RMU
    - Doon Street Substation
    - Racecourse Road Substation
    - Southern Substation

(c) Remote Stations

EIL currently owns and operates the following remote stations:

- Eight GPT mini RTU, HDLC protocol over 1200 baud modem
- One Harris D20M multiple rack RTU, DNP3.0 protocol over 9600 baud Modem

- One Nulec recloser controller acting as an Intelligent Electronic Device (IED), DNP3.0 protocol over 9600 baud Modem
- Five Kingfisher RTU, DNP3.0 protocol over 9600 baud Modem.

2.3.5.4 Other Assets

(a) Mobile Generation

None, but PowerNet own two diesel generators rated at 275kW and a 350kW which EIL can utilise.

(b) Stand-by Generators

None.

(c) Power Factor Correction

None.

(d) Mobile Substations

None, but EIL can utilise a TPCL owned trailer mounted 3MVA 11kV regulator and circuit breaker with cable connections.

(e) Metering

Most zone substations have time-of-use (TOU) meters on the incomers that provide details of energy flows and power factor. General integrating energy meters are provided to general customers with retailers providing TOU meters for larger customers, generally all over 100kVA capacity.

2.4 Age and Condition of EIL's Assets by Category

[Addresses handbook requirement 4.5.3(c)]

2.4.1 Bulk Supply Assets and Embedded Generation

The company owns assets within the GXP as detailed in Table 16.

Table 16: Injection Plants

Voltage	Location	Quantity	Manufactured	Condition
33kV	Invercargill 2	1	1988	Good, all gear is indoor

Remaining life of this plant according to ODV standard life is one year, but due to the condition and minor replacements the expected remaining life of this plant is at least 10 years.

The injection plant at Invercargill was commissioned in 1989, with all plant enclosed within the building. This provides protection from the elements and therefore an expected greater extended life for the non-electronic components. The electronic components continue to provide good service with the power supply unit upgraded in 2005, after failures at other sites.

2.4.2 Subtransmission Network

Details of EILs subtransmission circuits are detailed in Table 17. All circuits are within their rating with no known problems.

Table 17: Subtransmission Circuit Details

Voltage	Location	Quantity	Manufactured	Condition
33kV	Invercargill 122 to Southern	Cable 5.0 km	1968 RL = 26yrs	Good, only lightly loaded*
33kV	Invercargill 152 to Doon Street	Cable 3.5 km	1970 RL = 28yrs	Good, moderately loaded*
33kV	Invercargill 272 to Doon Street	Cable 3.5 km	1975 RL = 33yrs	Good, moderately loaded*
33kV	Invercargill 252 to Leven Street	Cable 5.2 km	1983 RL = 16yrs	Good, only lightly loaded.
33kV	Bluff Line to Southern	Cable 1.5 km	1999 RL = 32yrs	Good, not loaded.
33kV	Otatara Line to Leven	Cable 3.7 km Line 1.1 km	2000 RL = 33yrs	Good, not loaded.
33kV	Invercargill 162 to Racecourse Road	Line 0.3 km	1975 RL = 8yrs	Good, short cross country, concrete poles.

*however there has been some doubt raised recently over the understood ratings and reliability of these oil cables. As part of the relocation of the existing Doon St substation project it is expected that some cable length will become redundant which allows for normally invasive condition analysis to be carried out with much reduced risk of cable disturbance. The condition of the redundant cable sections can then be used to provide good indication of the remaining in service oil cable condition.

2.4.3 Zone Substations

2.4.3.1 HV Switchgear

The latest switchboard at Leven Street Substation is indoor and in good condition. The oldest circuit breaker is an outdoor unit located at Southern substation and still has 12 years life remaining. The outdoor equipment at Southern Substation has been damaged by vandalism requiring the installation of protective barriers around critical equipment.

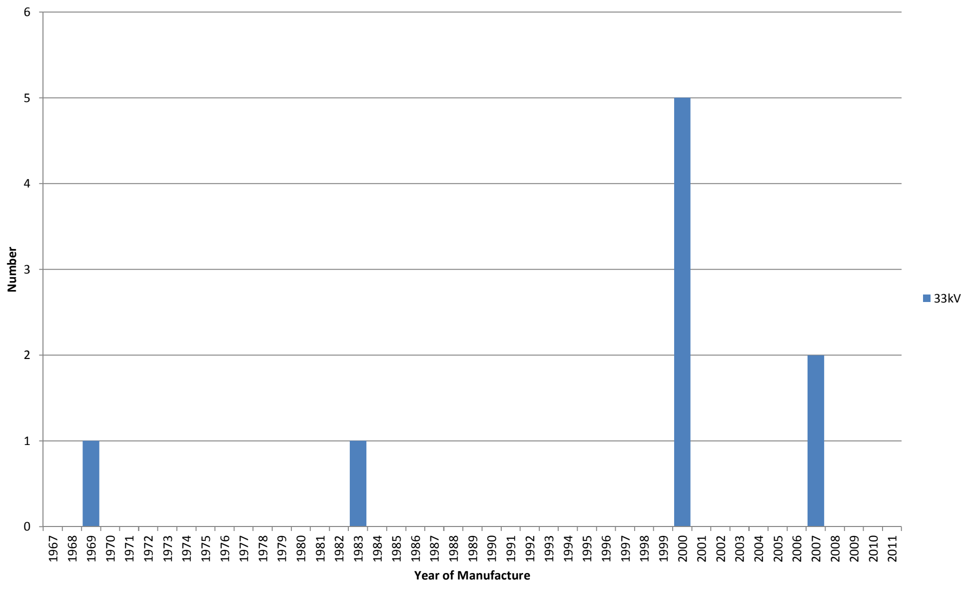

Figure 13: HV Circuit Breakers

2.4.3.2 Subtransmission Cables

EIL has three oil filled cables supplying the Doon St and Southern substations. The oldest of these cables has approximately 40% of expected life, 26 years, remaining so should be in good condition. However there are concerns with the rating of the cables and with the joints which have been found to be unreliable by other distribution companies. These issues will be further investigated following the relocation of Doon St substation which will allow invasive analysis to be performed on redundant sections of two of these cables.

The other cables are XLPE cables which are lightly loaded and in good condition. Some of these are unloaded cables used occasionally for backup. The earlier XLPE cables are understood to have a slightly shorter expected life however the oldest of these cables is still expected to have a remaining life beyond the 10 year planning horizon.

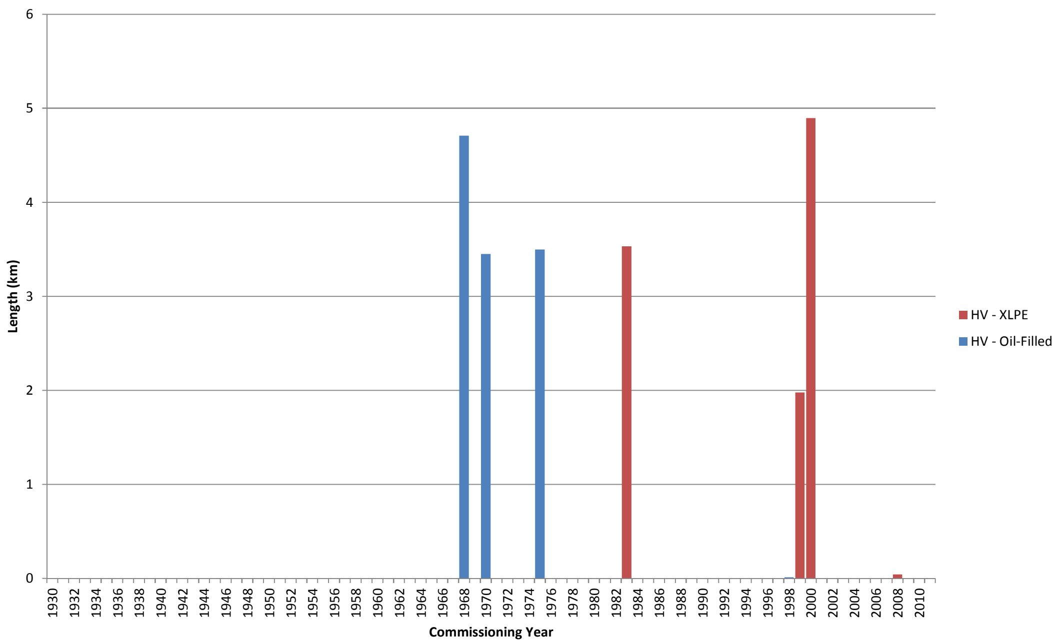

Figure 14: Subtransmission Cables

2.4.3.3 Power Transformers

The Power Transformers on the network are all of emergency rating design permitting loading up to 23MVA, if the ambient temperature is less than 5ºC. Each unit is under the ONAN rating and Dissolved Gas Analysis monitoring shows each is in good condition.

Due to this condition assessment and the age of the units there are no transformer replacements expected within the next 10 years, however one of the two Doon St transformers unexpectedly failed in service recently and has been temporarily replaced with a 10MVA unit borrowed from TPCL. There is therefore less confidence in the condition of the remaining Doon St transformer which is of a similar manufacture, age and operational history.

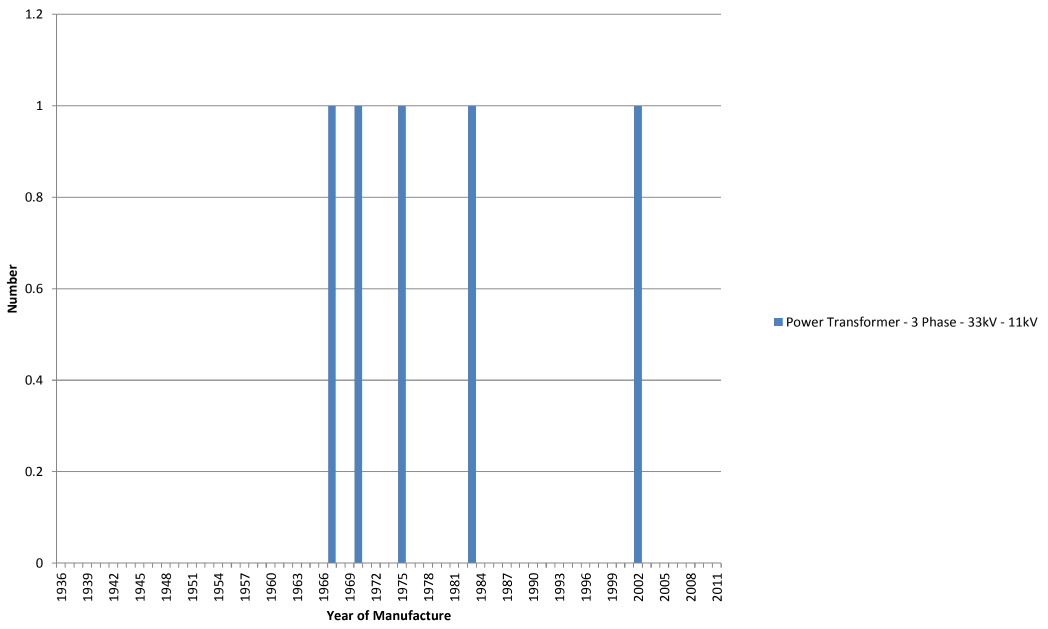

Figure 15: Power Transformers

2.4.3.4 MV Switchgear

Condition of the gear is generally good however the oldest of this equipment is at end of life. Some units are located in underground substations in the city CBD. Planning will commence for replacements and refurbishment at these sites in the next year with the work programme being carried out over the following 10 year period.

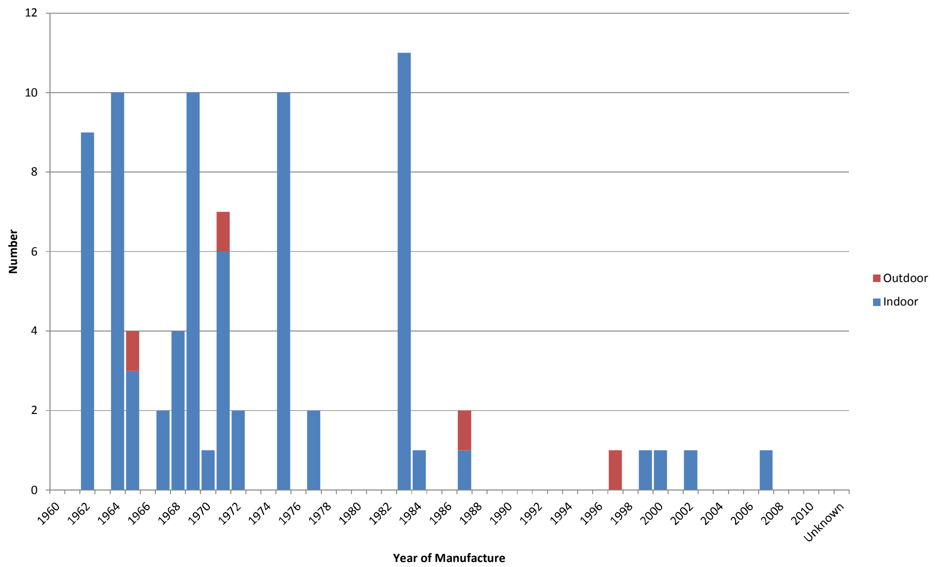

Figure 16: MV Circuit Breakers

2.4.4 Distribution Network

The chart below displays the estimated age based remaining life of the MV poles on the network. The majority of these will be in the Bluff region with most poles in Invercargill city being removed as part of the undergrounding programme.

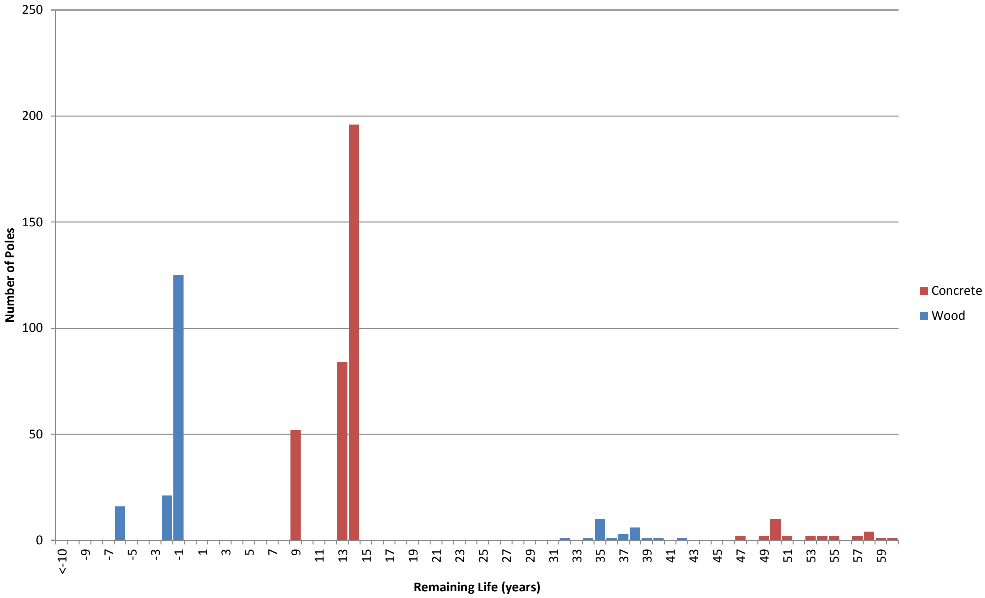

Figure 17: MV Poles by Type

In theory for wooden poles, all lines built prior to 1977 should be replaced before the end of 2022. Five yearly checks are made of all MV lines with remedial repairs or renewal planned based on information obtained.

Most of the poles in the Invercargill network area will be retired over the next five years as the remaining undergrounding projects are completed. Poles identified for renewal from the few remaining in the Invercargill industrial area and in the Bluff network area as shown in Figure 18 will be renewed during the planning period.

Figure 18: MV Poles with 10 years or less life remaining

Figure 19 below displays the age of the MV cables on the network. Data on the exact material is not recorded and it is uneconomic to collect.

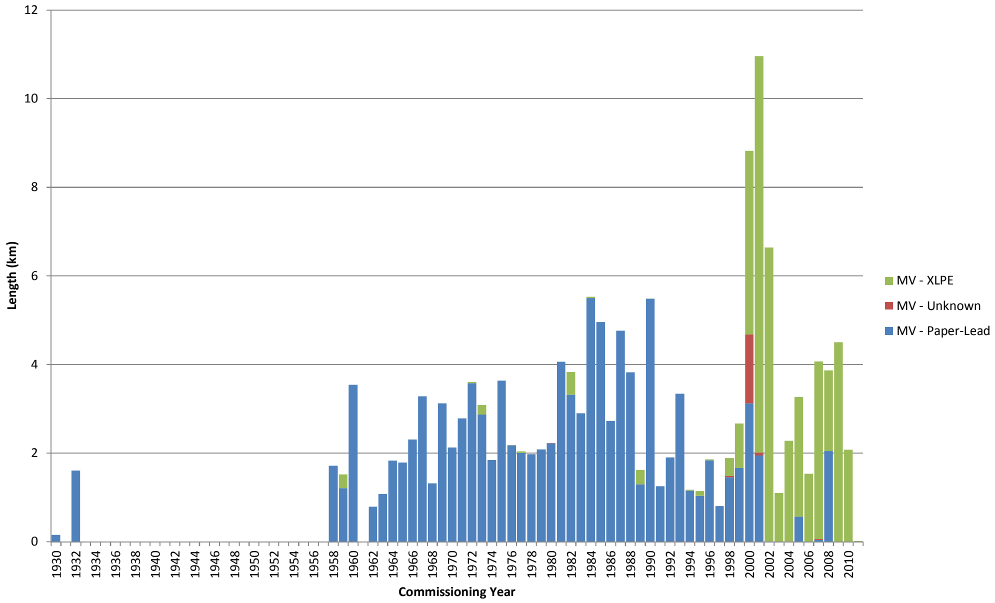

Figure 19: MV Cables

Most cables are lightly loaded but there have been termination failures.

Actual accepted lives for cables are likely to be greater than the ODV standard lives and on-going monitoring of actual performance will be utilised in planning.

2.4.5 Distribution Substations

The chart below displays the age profile of the distribution transformers on the network.

Most of these are ground mounted and as the on-going undergrounding programme progresses, remaining pole mounted transformers are either replaced with new ground mounted units or, for newer units, refurbished and converted to ground mounting.

As ground mounted units must be enclosed, the weather impact is reduced and the condition of these transformers is very good.

Transformers found to be in poor condition after five yearly inspections may be refurbished or replaced.

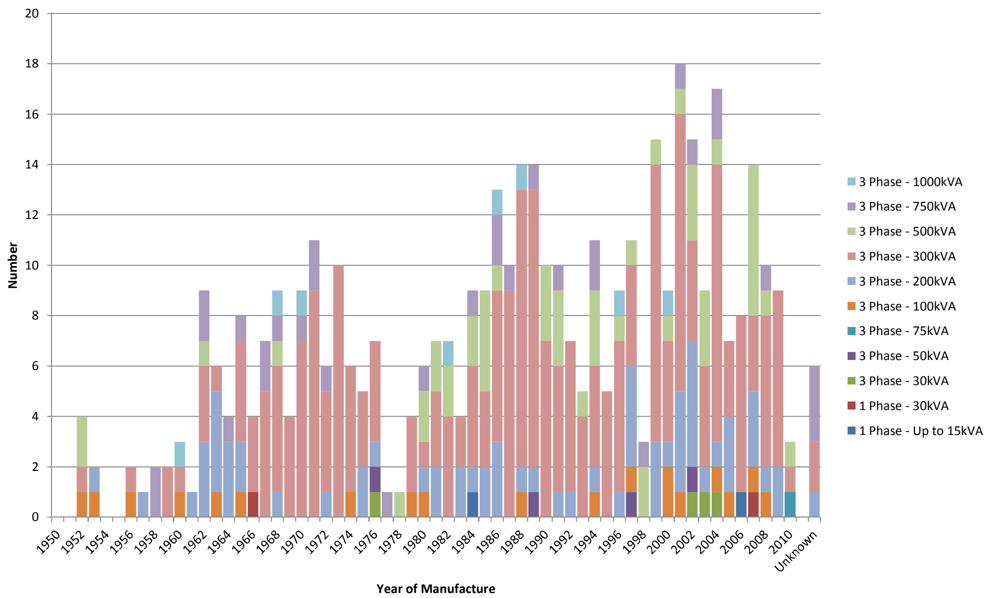

Figure 20: Distribution Transformers

2.4.6 LV Network

Age profiles are shown below and highlight that based on age, a number of assets should be renewed. In practice, cables are left in service until performance deteriorates impacting on service levels.

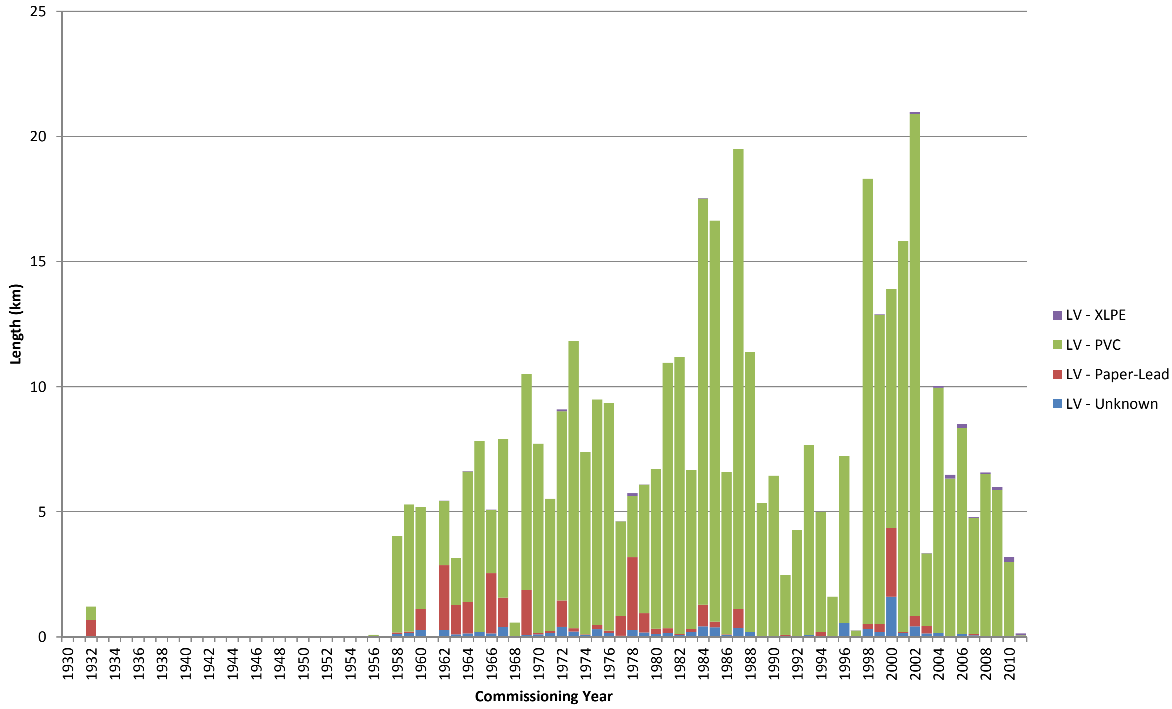

Figure 21: LV Cables

The 400V cables installed in the early 1970s are now reaching capacity due to inbuild and greater demand per household. This is typically seen as an increase in voltage complaints received due to excessive volt drop during periods of peak loading.

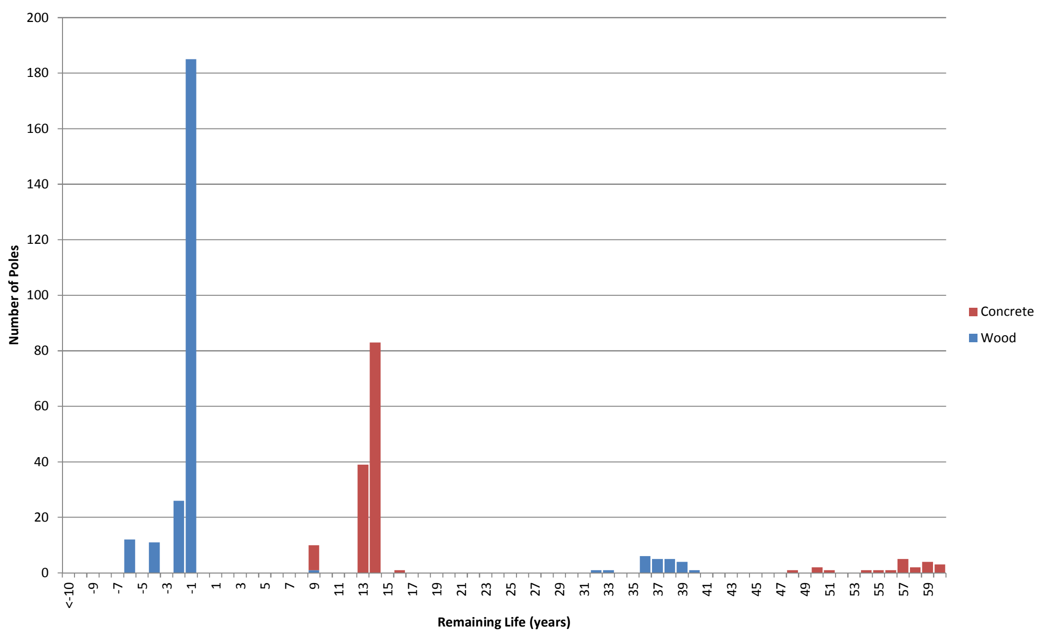

Figure 22: LV Poles

Almost all LV (400V) poles in the city will be removed as part of the undergrounding programme. Poles in Bluff will be renewed as required being identified during the regular inspections of the network.

Figure 23 shows LV poles which are targeted for renewal over the 10 year planning period.

Figure 23: LV Poles with 10 years or less life remaining

2.4.7 Customer Connection Assets

No accurate age data exists for customer connection assets and generally these are renewed as they fail or are augmented for increased customer requirements.

2.4.8 Load Control Assets

The installation of Load Control started with the injection plant at Invercargill in 1989 and finished at North Makarewa in 1994. Details are included with the GXP installed equipment. All 33kV plants are enclosed within buildings providing protection from the elements and therefore there is an expected greater extended life for the non-electronic components. The electronic components continue to provide good service with the power supply units upgraded in 2005 after failures at other sites.

2.4.9 Protection and Control

2.4.9.1 Key Protection Systems

The ground mount field circuit breakers are included with the 11kV zone substation circuit breakers, see section 2.4.3.4.

(a) Circuit Breakers

Table 18: Pole Mount Field Circuit Breakers

Voltage	Location	Type	Manufactured	Condition
11kV	Gore Street	Nulec N24	1997	Average

(b) Switches

Details on the age of ABS's are limited but most will be removed as part of the undergrounding programme.

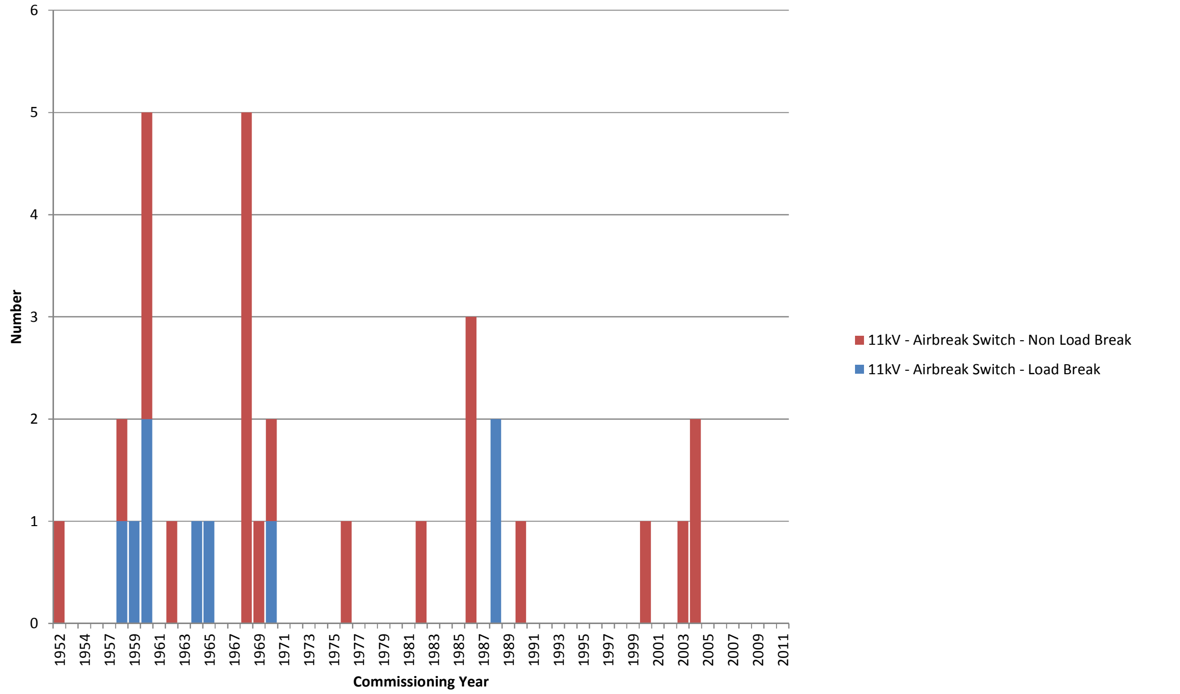

Figure 24: Distribution Switchgear

The age profile of RMU's below shows a small number of units which have reached their standard life of 45 years; however these units are enclosed and are still providing good service. The age of a large number of ring mains is unknown.

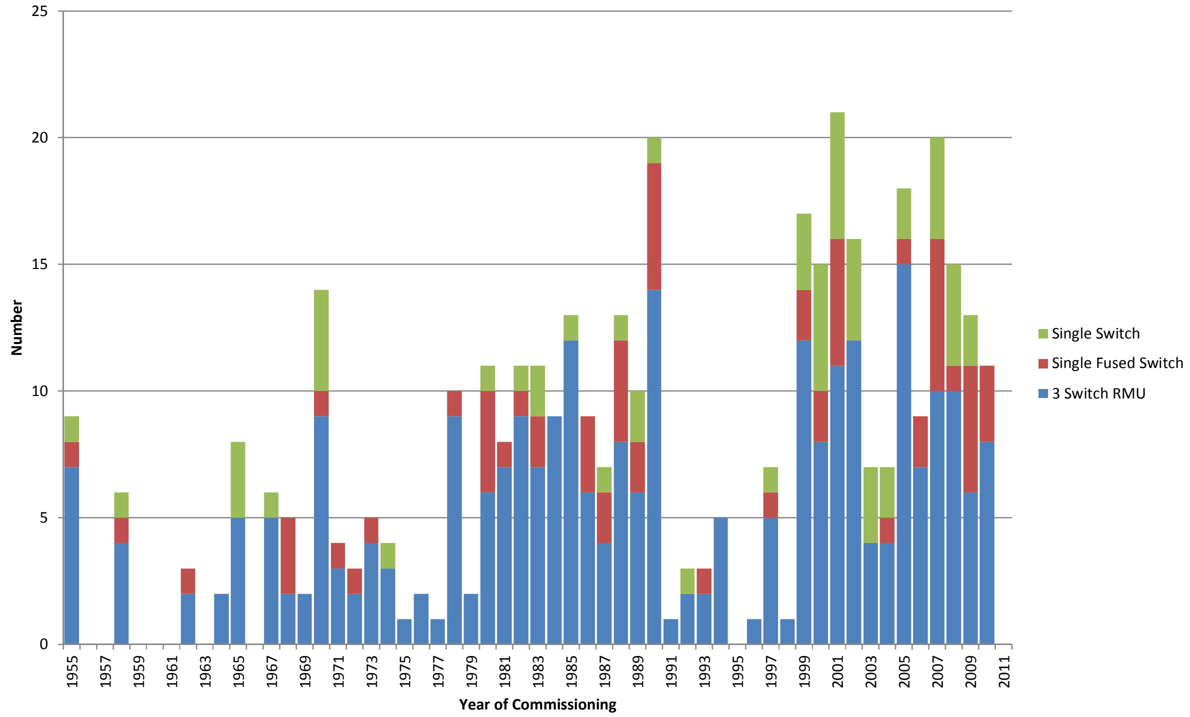

Figure 25: Ring Main Units

(c) Fuses

Most of the drop out fuses on the network are in the city and will be removed due to the undergrounding programme.

2.4.9.2 DC Power Supplies

As DC batteries are essential to the safe operation of protection devices, regular checks are carried out and each battery is replaced prior to the manufacturer's recommended life.

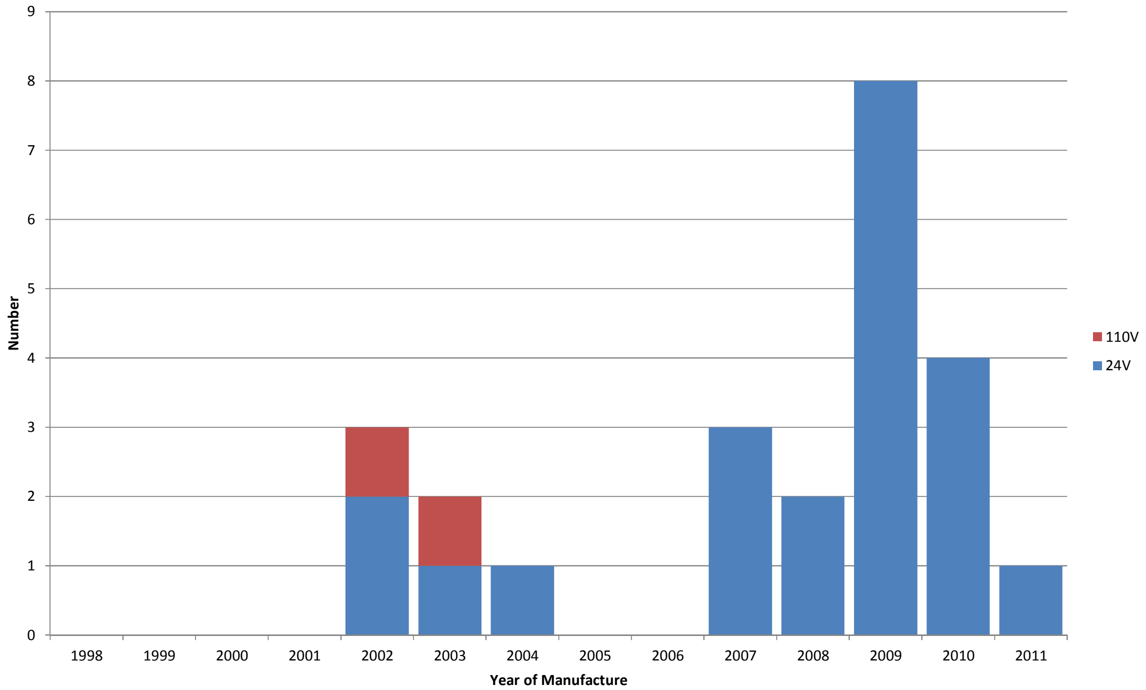

Figure 26: DC Batteries

The chart shows no batteries are more than nine years old.

2.4.9.3 Tap Changer Controls

Six voltage regulating relays are in service and most have been installed with the associated transformer. The recent second transformer at Leven Street used an existing spare unit. The condition of these is good with no recent problems.

2.4.10 SCADA and Communications

2.4.10.1 Master Station

The initial system was commissioned in 1999 with a more recent upgrade of the Server PC's in 2005. The software has been developed with the latest version being implemented with the new servers in 2005. Both operator stations now have LCD screens.

2.4.10.2 Communications Links

The communications links have been upgraded over the last four years and the equipment is still in as-new condition.

2.4.10.3 Remote Stations

The RTU age profile shows that most units are modern. The early GPT mini RTU's were installed in 1995 and continue to provide patchy service - generally failing at the time of faults. Replacement of these units will generally line up with other replacement and refurbishments at the particular site unless performance deteriorates to unacceptable level necessitating earlier replacement.

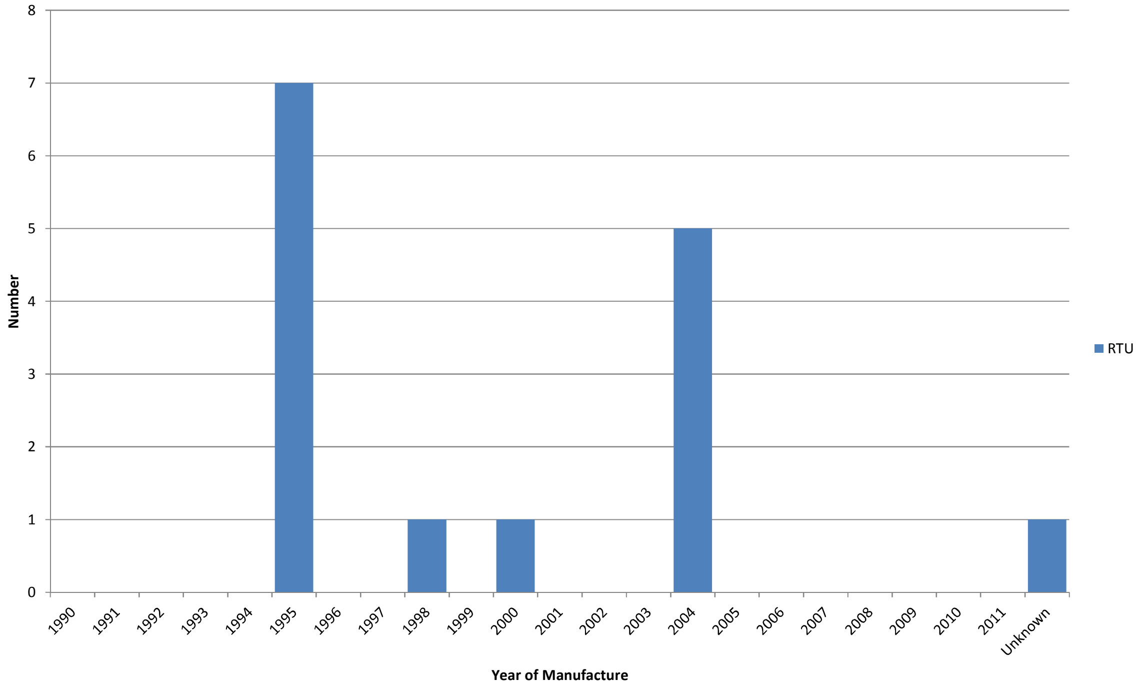

Figure 27: Remote Terminal Unit Assets

2.4.11 Other Assets

2.4.11.1 Mobile generation

None, but PowerNet own two mobile diesel generators rated at 275kW and 350kW which EIL can utilise.

2.4.11.2 Stand-by Generators

None.

2.4.11.3 Power Factor Correction

None.

2.4.11.4 Mobile Substations

None.

2.4.11.5 Metering

EIL has 'Time Of Use' (TOU) meters on its incoming circuit breakers to provide accurate loading information on each zone substation. There are also TOU meters on some feeders to provide indicative load profiles for certain load groups. The age profile of these is in Figure 28.

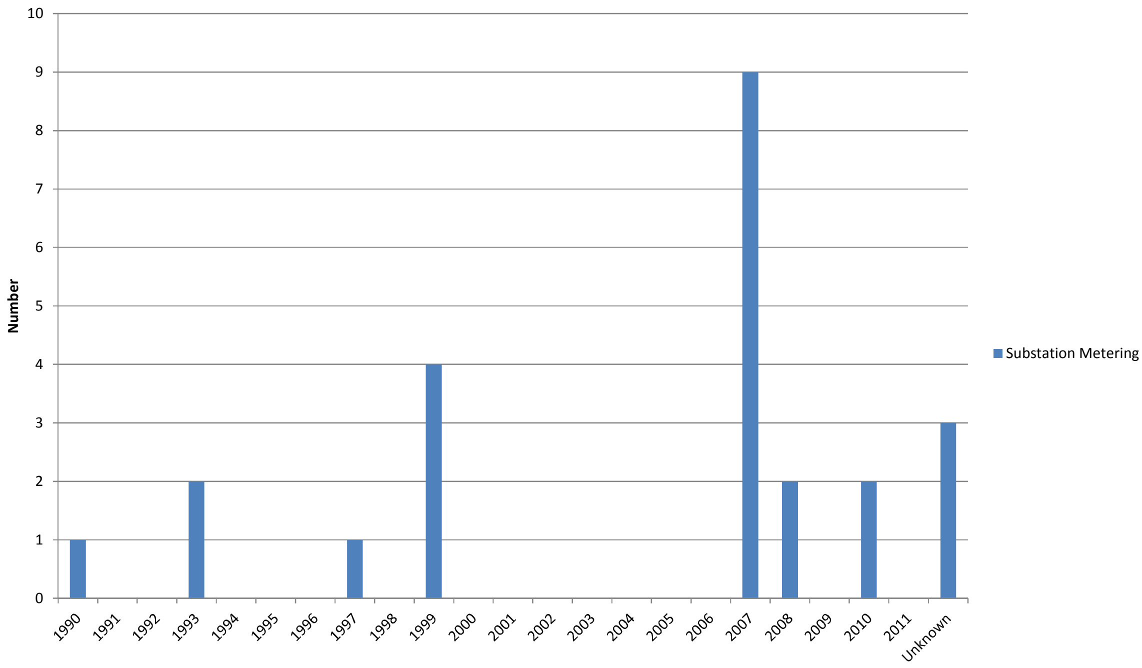

Figure 28: Metering Assets

2.4.12 Summary

EIL's assets at the 2011 Directors valuation are summarised in Table 19.

Table 19: Summary of assets by category (as at 2011 Director Valuation)

Asset description	2011 Quantity	Unit	Average remaining life as a percentage of ODV standard life	Condition summary	2011 RC[9] ($000)	% of RC
Ripple Injection	2	total	15%	Good	375	0.3
33kV line	1.3	km	32%	Good	116	0.1
33kV cable	22.1	km	36%	Good	6,910	5.0
Other zone substation assets		total	54%	Average	1936	1.4
33kV switchgear	13	each	72%	Average	577	0.4
11kV switchgear	115	each	25%	Average	2,542	1.8
Power transformers	6	each	45%	Average	4,520	3.3
Spares		each	50%	Average	84	0.1
MV line	24	km	23%	Average	2,738	2.0
MV cable	157.6	km	75%	Average	32,319	23.3
Distribution transformers and site	1000	each	50%	Average	20,976	15.1
MV switchgear	538	each	55%	Average	9,546	6.9
400V lines	31.8	km	20%	Average	2,545	1.8
400V cable	399	km	50%	Average	31,177	22.5
400V switches, links etc	127	each	26%	Average	2396	1.7
Street lighting circuits	167	km	45%	Average	5,751	4.2
SCADA	33	each	55%	Average	413	0.3
Land and buildings	35	each	38%	Average	4,498	3.2
Customer Service Connections	16,647	each	72%	Average	5,905	4.3
Total					**138,558**	

9 RC = Replacement Cost, DRC = Depreciated Replacement Cost, ODRC = Optimised Replacement Cost, ODV = Optimised Deprival Value.

2.5 Justifying the Assets

[Addresses the Handbook requirement 4.5.3(d)]

EIL creates stakeholder service levels by carrying out a number of activities (described in Section 5) on the assets, including the initial step of actually building assets such as lines and substations. Some of these assets need to deliver greater service levels than others e.g. the Leven Street substation supplying the Invercargill CBD has a higher capacity and security level than the Racecourse Road zone substation supplying the residential areas in north-east Invercargill. Hence a greater level of investment will be required that will generally reflect the magnitude and nature of the demand.

Matching the level of investment in assets to the expected service levels requires the following issues to be considered:

- It requires an intimate understanding of how asset ratings and configurations create service levels such as capacity, security, reliability and voltage stability.
- It requires the asymmetric nature of under-investment and over-investment to be clearly understood i.e. over-investing creates service levels before they are needed but under-investing can lead to service interruptions (which typically cost about 10x to 100x, as much as over-investing as was discovered in Auckland in June 2006).
- It requires the discrete "sizes" of many classes of components to be recognised e.g. a 220kVA load will require a 300kVA transformer that is only 73% loaded. In some cases capacity can be staged through use of modular components.
- Recognition that EIL's existing network has been built up over 80 years by a series of incremental investment decisions that were probably optimal at the time but when taken in aggregate at the present moment may well be sub-optimal.
- The need to accommodate future demand growth (noting that the Optimised Deprival Valuation (ODV) Handbook now prescribes the number of years ahead that such growth can be accommodated).

In theory an asset would be justified if the service level it creates is equal to the service level required. In a practical world of asymmetric risks, discrete component ratings, non-linear behaviour of materials and uncertain future growth rates, EIL considers an asset to be justified if its resulting service level is not significantly greater than that required subject to allowing for demand growth and discrete component ratings.

A key practical measure of justification is the ratio of EIL's optimised depreciated replacement cost (ODRC) to EIL's Depreciated Replacement Cost (DRC) which is 0.9876, with a ratio close to 1, indicating a high level of justification.

3. Proposed Service Levels

[Addresses handbook requirement 4.5.4]

This section describes how EIL set its various service levels according to the following principles:

- What is most important to stakeholders? (Section 1.6)
  - Safety
  - Viability
  - Quality
  - Compliance
- How well is EIL meeting those important objectives?
- What trade-off's exist between differing stakeholders? i.e.
  - Desire for Return On Investment (ROI) verses desire for low price with good reliability.
  - Safety at any cost?
  - Restoration ahead of compliance? (i.e. South Canterbury snow storm)

3.1 Creating Service Levels

EIL creates a broad range of service levels for all stakeholders, ranging from capacity, continuity and restoration for connected customers (who pay for these service levels) to ground clearances, earthing, absence of interference, compliance with the District Plan and submitting regulatory disclosures (which are subsidised by connected customers), which are shown in Figure **Error! Reference source not found.** below. This section describes those service levels in detail and how EIL justifies the service levels delivered to its' stakeholders.

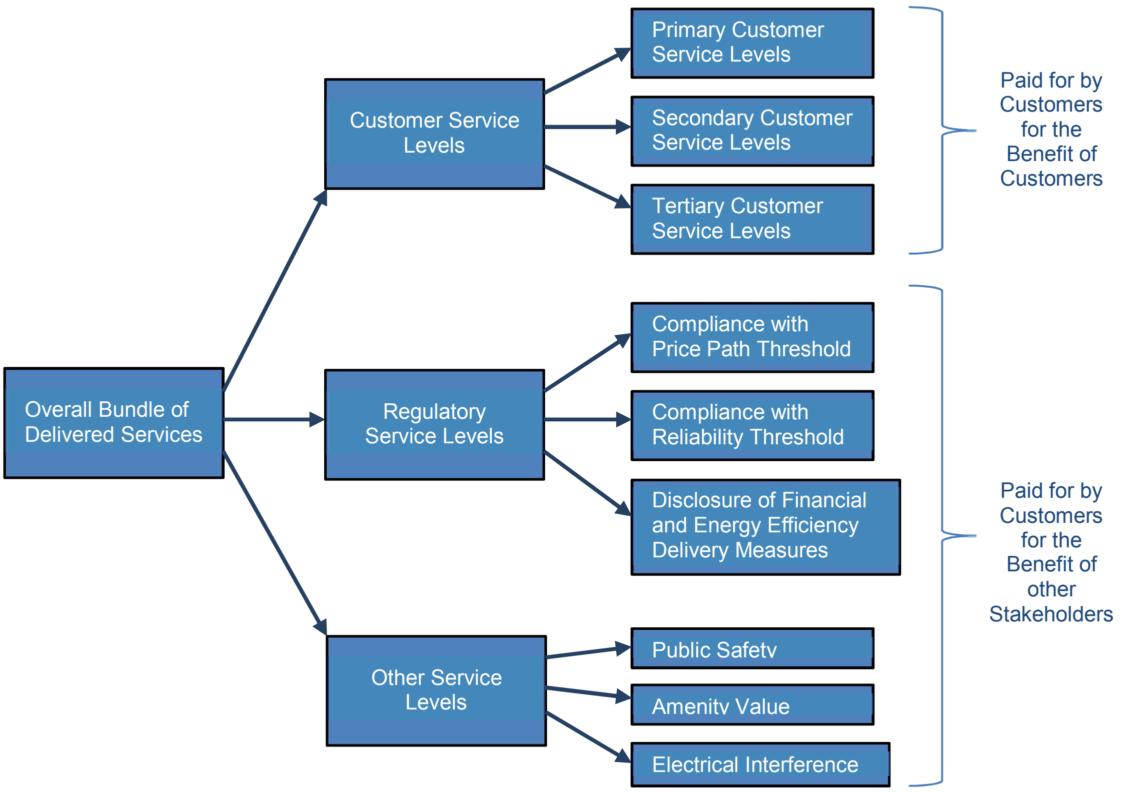

Figure 29: Types of Service Levels

3.2 Customer Oriented Service Levels

[Addresses handbook requirement 4.5.4(a)]

This section firstly describes the customer service levels EIL expects to create which are what the customers pay for and secondly the service levels EIL expects to create for other key stakeholder groups which the customers are expected to subsidise.

Research indicates that customers value continuity and restoration of supply more highly than other attributes such as answering the phone quickly, quick processing of new connection applications etc. It has also become apparent from EIL's research that there is an increasing value by customers placed on the absence of flicker, sags, surges and brown-outs. Other research however indicates that flicker is probably noticed more often than it is actually a problem.

The difficulty with these conclusions is that the service levels most valued by customers depend strongly on fixed assets and hence require capital expenditure solutions (as opposed to process solutions) to address which in itself raises the following three issues:

- Limited substitutability between service levels e.g. customers prefer EIL to keep the power on rather than answer the phone quickly.
- Averaging effect i.e. all customers connected to an asset will receive about the same level of service.
- Free-rider effect i.e. customers who choose not to pay for improved service levels would still receive improved service due to their common connection[10].

3.2.1 Primary Service Levels

The surveyed customers have indicated that they value continuity and then restoration most highly; therefore EIL's primary service levels are continuity and restoration. To measure performance in this area two internationally accepted indices have been adopted:

- SAIFI – system average interruption frequency index. This is a measure of how many system interruptions occur per year per customer connected to the network.
- SAIDI – system average interruption duration index. This is a measure of how many system minutes of supply are interrupted per year per customer connected to the network.

EIL's projections of these measures for the next five years ending 31 March 2017 are shown in Table 20.

Table 20: EIL Reliability Projections

Measure	Class	Limit	2012/13	2013/14	2014/15	2015/16	2016/17
SAIDI	B (planned)		4.79	4.79	4.79	4.79	4.79
	C (unplanned)		35.27	35.27	35.27	35.27	35.27
	Total	**45.65**	**40.06**	**40.06**	**40.06**	**40.06**	**40.06**
SAIFI	B (planned)		0.02	0.02	0.02	0.02	0.02

[10] This is the case with Invercargill and North Makarewa GXP's as they are more secure, due to the reliability required by the New Zealand Aluminium Smelter at Tiwai point.

	C (unplanned)		0.75	0.75	0.75	0.75	0.75
	Total	**1.13**	**0.77**	**0.77**	**0.77**	**0.77**	**0.77**

In practical terms this means EIL's customers can broadly expect the reliability shown in Table 21:

Table 21: Expected fault frequency and restoration time

General location	Expected reliability	
Invercargill CBD 33kV Fault 11kV Fault	Frequency of faults ▪ One every 20 years ▪ One every 1.4 years	Estimated restoration[11]: ▪ 1 min ▪ 5 min
Invercargill other than CBD 33kV Fault 11kV Fault	Frequency of faults ▪ One every 7 years ▪ 4.5 every year	Estimated restoration[11]: ▪ 15 min ▪ 30 min
Bluff 33kV Fault 11kV Fault	Frequency of faults ▪ 3 every year ▪ 2.9 every year	Estimated restoration[11]: ▪ 1 min ▪ 45 min

Customers in all market segments surveyed indicated a preference for paying about the same line charges to receive about the same level of supply reliability.

3.2.2 Secondary Service Levels

Secondary service levels are the attributes of service that EIL customers have ranked below the first and second most important attributes of supply continuity and restoration. The key point to note is that some of these service levels are process driven which has two implications:

- They tend to be cheaper than fixed asset solutions e.g. staff could work a few hours overtime to process a back log of new connection applications and could divert an over-loaded phone, or EIL could improve the shut-down notification process.
- They are heterogeneous in nature i.e. they can be provided exclusively to customers who are willing to pay more in contrast to fixed asset solutions which will equally benefit all customers connected to an asset regardless of whether they pay.

These attributes include:

- How satisfied customers are after communication regarding:
    - Tree trimming
    - Connections
    - Faults
- Time taken to respond to voltage complaints and time to remedy justified voltage complaints.

[11] Except if supplied directly off the faulty section of line or cable.

- Are customers given sufficient notice of planned shutdowns?

Table 22 sets out the projections of these service levels for the next 3 years (either as a percentage or on a scale of 1 to 5, where 1 is poor and 5 is excellent).

Table 22: Secondary service levels

Attribute	Measure	2012/13	2013/14	2014/15
Customer Satisfaction: Inquiries	Percentage satisfied with PowerNet staff. {CES: Q9(b)}[12]	>80%	>80%	>80%
Customer Satisfaction: New Connections	Phone: Friendliness and courtesy. {CSS: Q3(c)}[13]	>3.5[14]	>3.5	>3.5
	Phone: Time taken to answer call. {CSS: Q3(a)}	>3.5	>3.5	>3.5
	Overall level of service. {CSS: Q5}	>3.5	>3.5	>3.5
	Work done to a standard which meet your expectations. {CSS: Q4(b)}	>3.5	>3.5	>3.5
Customer Satisfaction: Faults	Power restored in a reasonable amount of time. {CES: Q4(b)}	>90%	>90%	>90%
	Information supplied was satisfactory. {CES: Q8(b)}	>80%	>90%	>90%
	PowerNet first choice to contact for faults. {CES: Q6}	>20%	>25%	>35%
Voltage Complaints {Reported in Network report}	Number of customers who have made voltage complaints {NR}	<12	<12	<12
	Number of customers who have justified voltage complaints regarding power quality	<4	<4	<4
	Average days to complete investigation	<30	<30	<30
	Period taken to remedy justified complaints	<60	<60	<60
Planned Outages	Provide sufficient information. {CES: Q3(a)}	>75%	>75%	>75%
	Satisfaction regarding amount of notice. {CES: Q3(c)}	>75%	>75%	>75%
	Acceptance of maximum of three planned outages per year. {CES: Q1}	>50%	>50%	>50%
	Acceptance of planned outages lasting four hours on average. {CES: Q1}	>50%	>50%	>50%

Targets are set based on trending of historical results, expected impact of future projects and slight improvement due to improvement of internal process.

[12] CES = Customer Engagement Survey of 200 customers, undertaken by phone annually.

[13] CSS = Customer Satisfaction Survey undertaken by sending questionnaire to customers with invoices.

[14] Where 1 = poor and 5 = excellent

3.3 Other Service Levels

In addition to the service levels that are of primary and secondary importance to customers and which they pay for there are a number of service levels that benefit other stakeholders such as safety, amenity value, absence of electrical interference and performance data. Some (in fact most) of these service levels are imposed on EIL by statute and while they are for the public good, i.e. necessary for the proper functioning of a safe and orderly community, EIL is expected to absorb the associated costs into its overall cost base.

3.3.1.1 Safety

Various legal requirements require EIL's assets (and customer's plant) to adhere to certain safety standards which include earthing exposed metal and maintaining specified line clearances from trees and from the ground:

- Health and Safety In Employment Act 1992.
- Electricity (Safety) Regulations 2010
- Electricity (Hazards From Trees) Regulations 2003.
- Maintaining safe clearances from live conductors (NZECP34:2001).
- EEA Guide to Power System Earthing Practice 2009 as a means of compliance with the Electricity (Safety Regulations).

3.3.1.2 Amenity Value

There are a number of Acts and other requirements that limit where EIL can adopt overhead lines:

- The Resource Management Act 1991.
- The operative District Plans.
- Relevant parts of the operative Regional Plan.
- Land Transport requirements.
- Civil Aviation requirements.

3.3.1.3 Electrical Interference

Under certain operational conditions EIL's assets can interfere with other utilities such as phone wires and railway signalling or with the correct operation of EIL's own equipment or EIL customer's plant. The following two codes impose service levels on us.

- Harmonic levels (NZECP36:1993).
- SWER load limitation to 8A (NZECP41:1993).

3.4 Regulatory Service Levels

[Addresses handbook requirement 4.5.4(b)]

Various Acts and Regulations require EIL to deliver a range of outcomes within specified timeframes, such as the following;

- Ensure a wide degree of customer satisfaction with both pricing and reliability to avoid being placed under a restraining regime.
- Publicly disclose an AMP each year.

- Publicly disclose prescribed performance measures each year.

EIL is also required to disclose a range of internal performance and efficiency measures as required by the Electricity (Information Disclosure) Requirements 2004. The complete derivation of these measures is included in EIL's disclosure to 31 March 2011.

3.4.1 Financial Efficiency Measures

EIL's projected financial efficiency measures are shown in Table 23. These measures are:

- Ratio of OPEX to RC – [Operational Expenditure] / [Replacement cost of System Fixed Assets at year end]
- Indirect costs per ICP – [General Management, Administration and Overheads expenditure] / [Number of Connection Points (at year end)].
- All factors as defined in the Information Disclosure requirements.

Trending of historic figures was not done, as definitions have changed with the 2008 Information Disclosure requirements, and data only disclosed in 2010.

Table 23: Financial efficiency measures

Measure	2011/12	2012/13	2013/14	2014/15	2015/16
OPEX/RC	4.18%	4.06%	4.10%	4.08%	4.08%
Indirect costs	$112.05	$111.16	$110.38	$112.39	$113.60

3.4.2 Energy Delivery Efficiency Measures

Projected energy efficiency measures are shown in Table 24. These measures are:

- Load factor – [kWh entering EIL's network during the year] / [[max demand for the year] x [hours in the year]].
- Loss ratio – [kWh lost in EIL's network during the year] / [kWh entering EIL's network during the year].
- Capacity utilisation – [max demand for the year] / [installed transformer capacity].

Slight improvements are targeted but changes in peak management requirements have impacted the load factor. It may take a number of years for the LSI peak to settle down to a predictable level.

Loss ratio has varied due to reliance on annum sales quantities from retailers. As retailers are not reading the customers meter at midnight of the 31 December, some estimation methodology is required.

Table 24: Energy efficiency measures

Measure	2012/13	2013/14	2014/15	2015/16	2016/17
Load Factor	50%	50%	50%	50%	50%
Loss Ratio	5.0%	5.0%	5.0%	5.0%	5.0%
Capacity Utilisation	45%	44%	43%	42%	41%

3.5 Justifying the Service Levels

[Addresses handbook requirement 4.5.4(c)]

EIL's service levels are justified in five main ways:

- Positive cost benefit within revenue capability.
- By what is achievable in the face of skilled labour and technical shortages.
- By the physical characteristics and configuration of EIL's assets which are expensive to significantly alter but which can be altered if a customer or group of customers agrees to pay for the alteration.
- By a customer's specific request and agreement to pay for a particular service level.
- When an external agency imposes a service level on EIL or in some cases an unrelated condition or restriction that manifests as a service level such as requirement to place all new lines underground or a requirement to increase clearances.

Customer surveys over the last four years have indicated that customers' preferences for price and service levels are reasonably static – there is certainly no obvious widespread call for increased supply reliability. However EIL does note the following issues:

- The service level called "Safety" may need to increase as the requirements of the amended Electricity Act 1992 become operative.
- Food and drink processing, storage and handling are subject to increasing scrutiny by overseas markets, and in particular interruptions to cooling and chilling are less acceptable. This requires EIL's cold storage customers to have higher levels of continuity and restoration.
- Economic downturn may increase the instance of theft of materials and energy.

3.5.1 Basis for Service Level Targets

Statistics for the last five years are listed in Table 25:

Table 25: Reliability and Energy Efficiency Results for the Past Five Years

Measure	2006/07*	2007/08	2008/09	2009/10	2010/11
SAIDI	35.6	54.7	32.9	27.2	44.7
SAIFI	1.21	1.15	0.84	0.83	1.18
Load factor	52%	49%	51%	51%	48%
Loss ratio	2.5%	3.9%	4.6%	5.1%	3.8%
Capacity utilisation	43.7%	44.8%	43.5%	44.5%	46.4%

(*To old Information Disclosure requirements.)

Target levels are set based on trending of results of previous years and the following factors:

SAIDI - results over the last four years show EIL is one of the leading networks in terms of the amount of time without supply experienced by customers. While EIL will not specifically be attempting to improve SAIDI, a slight improvement is expected due to the completion of the final stages of the undergrounding programme as well as more focused maintenance, refurbishment, renewal and replacements.

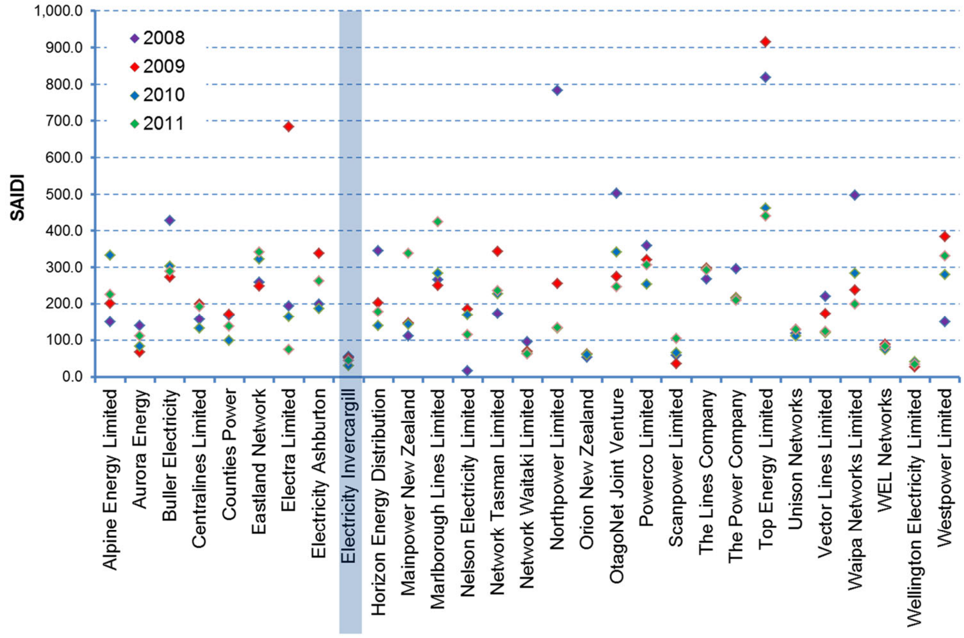

Figure 30: SAIDI for Local Distribution Networks 2008 to 2011

SAIFI - results over the last four years show EIL is one of the leading networks in terms of the number of faults experienced by customers. While EIL will not specifically be attempting to improve SAIFI, a slight improvement is expected due to the completion of the final stages of the undergrounding programme as well as more focused maintenance, refurbishment, renewal and replacements.

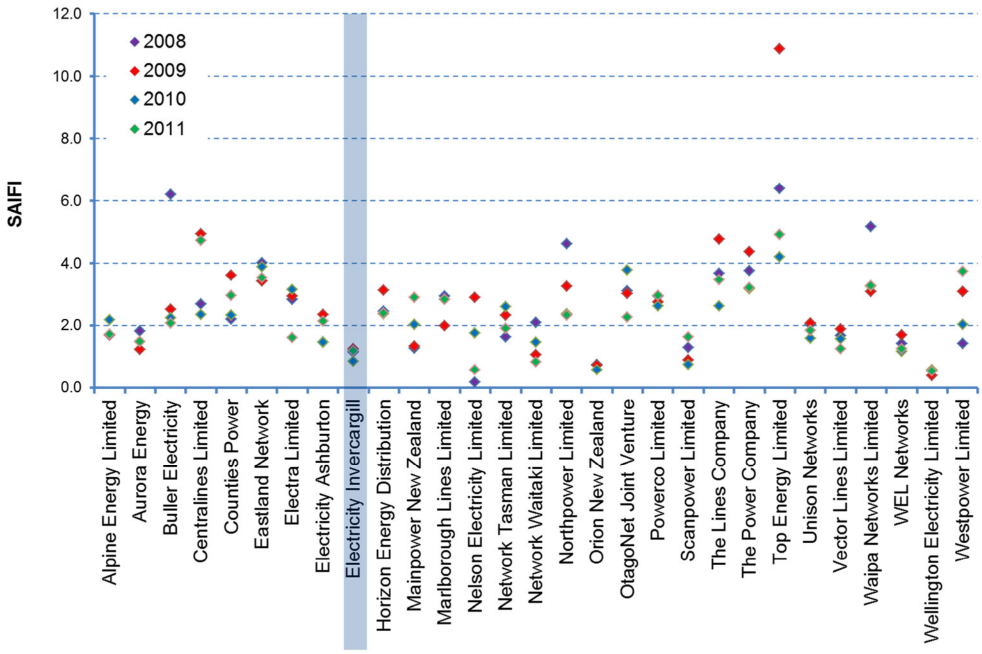

Figure 31: SAIFI for Local Distribution Networks 2008 to 2011

Load Factor - EIL's peak during winter months has not coincided with the LSI peak over the last four years which has tended to be late spring. This meant that peak load control was not required in winter resulting in a higher peak, as load control for peak reduction on each GXP was not needed. This has had an adverse effect on load factor. Comparison with other networks shows that EIL's load factor is relatively low and is an area for improvement however it is difficult to influence customer's consumption patterns since any line charge incentives offered are repackaged by retailers billing methodologies. Load factor is expected remain at current levels in the short term.

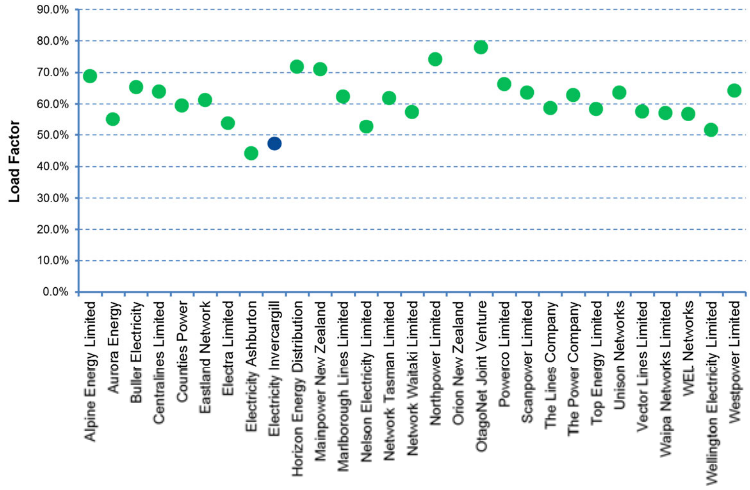

Figure 32: Load Factor for Local Distribution Networks

Loss Ratio - As the losses are paid for by retailers, there is no financial incentive for the network company to reduce these, apart from other technical issues, such as poor voltage or current rating of equipment. Network equipment is generally upgraded as growth occurs which is expected to maintain losses at present levels. Comparison with other network companies shows EIL's network is among the most efficient. Trending over a five year period shows an increase in network losses however trending over most other time periods up to the last ten years shows a decrease. EIL can expect a long term average of about 4% to be maintained however year to year results can vary considerably due to retailer estimations and a slightly higher target has therefore been set.

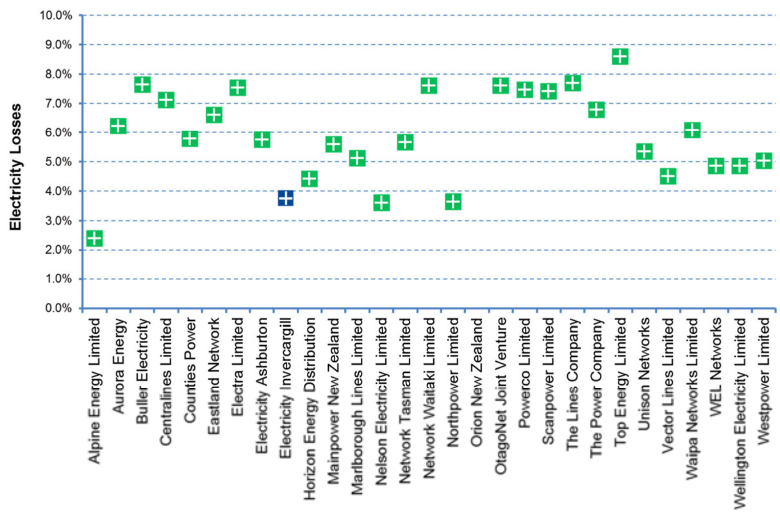

Figure 33: Losses for Local Distribution Networks

Capacity Utilisation - rationalisation[15] of transformers should improve capacity utilisation on the network however this will be offset somewhat by replacing overloaded transformers with appropriately sized units of standard ratings. Comparison to other network companies highlights that EIL has a poor capacity utilisation factor and is therefore an area for improvement. Capacity factor may also be influenced by load factor however as mentioned above influencing customer's consumption patterns is difficult.

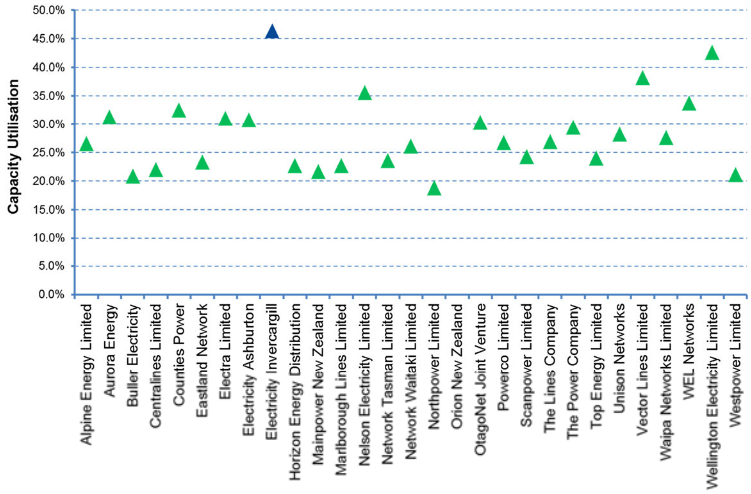

Figure 34: Capacity Utilisation for Local Distribution Networks

Financial service levels – Calculation and forecasting is carried out to project cost allocations for future years. Comparing ratio of OPEX to RC against other networks shows EIL is above average for this measure. A slight improvement is expected as greater degrees of planning are undertaken and resources are more effectively scheduled.

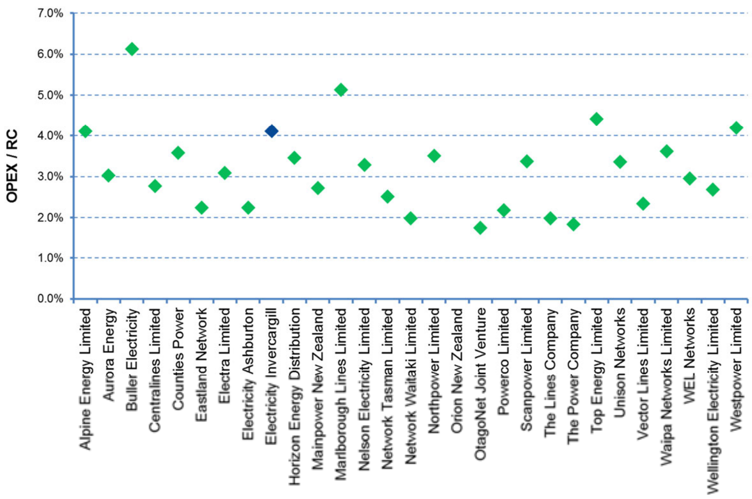

Figure 35: Ratio of OPEX to RC for Local Distribution Networks

[15] Rationalisation is where one transformer is used to supply multiple customers, with peaks occurring at differing times a smaller installed capacity usually results. e.g. dairy shed transformer of 50kVA can normally supply the farm house, but due to distances usually requires its own 15kVA transformer.

Customer Survey – targets are set based on historic trends and the anticipated impact of targeted improvement initiatives, for example, more Public Relations with newsletters and fridge-magnets should increase PowerNet as first point of contact for faults. Targeted improvement initiatives would result from dissatisfaction being expressed by customers however survey results show that for the most part customers are happy with the current level of service.

4. Development Plans

Development plans are driven primarily by:

- Increasing customer demand; which can be due to growth or generation
- Asset renewal requirements
- Statutory requirements to improve service levels (Security of supply, safety or environmental compliance.)
- Internally generated initiatives to improve service levels

At its most fundamental level, demand is created by individual customers drawing (or injecting) energy across their individual connections. The demand at each connection aggregates "up the network" to the distribution transformer, then to the distribution network, the zone substation, the subtransmission network to the GXP and ultimately through the grid to a power station.

4.1 Planning Approach and Criteria

[Addresses Handbook requirement 4.5.5(a)]

4.1.1 Planning Unit

EIL has adopted the 11kV feeder as EIL's fundamental planning unit which typically represents one or perhaps two of the following combinations of customer connections:

- An aggregation of up to 2,000 urban domestic customer connections.
- An aggregation of up to 300 urban commercial customer connections.
- An aggregation of up to 20 or 30 urban light industrial customer connections.
- A cluster of large commercial customer connections such as a CBD tower block.
- A single large industrial customer especially if that customer is likely to create a lot of harmonics or flicker.
- Injection of generation.

Physically this planning unit will usually be based around the individual lines or cables emanating from a zone substation. For a single load of more than 1MW (i.e., beyond what is considered incremental) EIL's planning principles and methods still apply, but the likely outcome is new assets at 11kV or higher.

4.1.2 Planning Approaches

EIL plans its assets in three different ways; strategically, tactically and operationally as shown in Table 26.

Table 26: Planning approaches

Attribute	Strategic	Tactical	Operational
Asset description	Assets within GXP. Subtransmission lines and cables. Major zone substation assets. Load control injection plant. Central SCADA and telemetry. Distribution configuration e.g. decision to upgrade to 22kV.	Minor zone substation assets. All individual distribution lines (11kV). All distribution line hardware. All on-network telemetry and SCADA components. All distribution transformers and associated switches. All HV customer connections.	All 400V lines and cables. All 400V customer connections. All customer metering and load control assets.
Number of customers supplied	Anywhere from 500 upwards.	Anywhere from one to about 500.	Anywhere from one to about 50.
Impact on balance sheet and asset valuation	Individual impact is low. Aggregate impact is moderate.	Individual impact is moderate. Aggregate impact is significant.	Individual impact is low. Aggregate impact is moderate.
Degree of specificity in plans	Likely to be included in very specific terms, probably accompanied by an extensive narrative.	Likely to be included in specific terms and accompanied by a paragraph or two.	Likely to be included in broad terms, with maybe a sentence describing each inclusion.
Level of approval required	Approved in principle in annual business plan. Individual approval by Board and possibly shareholder.	Approved in principle in annual business plan. Individual approval by Chief Executive.	Approved in principle in annual business plan. Individual approval by Chief Engineer.
Characteristics of analysis	Tends to use one-off models and analyses involving a significant number of parameters and extensive sensitivity analysis.	Tend to use established models with some depth, a moderate range of parameters and possibly one or two sensitivity scenarios.	Tends to use established models based on a few significant parameters that can often be embodied in a "rule of thumb".

EIL has developed the following "investment strategy matrix" shown in Figure 36, which broadly defines the nature and level of investment and the level of investment risk implicit in different circumstances of growth rates and location of growth.

Location of Demand Growth		Low	High
	Outside of existing network footprint	**Quadrant 3** • Capital Expenditure will be dominated by new assets that require both connection to the existing assets and possibly upstream reinforcement • Likely to absorb lots of cash – may need capital funding • Easily diverts attention away from legacy assets • Likely to result in low capacity utilisation unless modular construction can be adopted • May have high stranding risk	**Quadrant 4** • Capital Expenditure will be dominated by new assets that require both connection to existing assets and possibly upstream reinforcement • Likely to absorb lots of cash – may need capital funding • Easily diverts attention away from legacy assets • Need to confirm regulatory treatment of growth • May have a high commercial risk profile if a single consumer is involved
	Within existing network footprint	**Quadrant 1** • Capital Expenditure will be dominated by renewals (driven by condition) • Easy to manage by advancing or deferring straightforward Capital Expenditure projects • Possibility of stranding if demand contracts	**Quadrant 2** • Capital Expenditure will be dominated by enhancement rather than renewal (assets become too small rather than worn out) • Regulatory treatment of additional revenue arising from volume throughput as well as additional connections may be difficult
		Prevailing Load Growth	

Figure 36: Investment strategy matrix

Predominant CAPEX modes are:

- Large industrial loads such as a new factory which involves firstly extension and then usually up-sizing sit in Quadrant 4 which has desirable investment characteristics. This mode of investment does however carry the risk that if demand growth doesn't occur as planned, stranding can occur and the investment slips into Quadrant 3 which has less desirable investment characteristics.
- Dairy conversions involve extensions and then sometimes up-sizing but due to the lumpy nature of constructing line assets these may fall into Quadrant 3 which carries some risk of stranding or delayed recovery of investment.
- Declining cost of domestic heat pumps primarily requires urban up-sizing which fits mainly in Quadrant 2, which has reasonably desirable investment characteristics.
- Residential subdivisions around urban areas tend to have large up-front capital costs but recovery of costs through line charges often lags well behind. The size of the subdivision will dictate whether it falls in Quadrant 1 or 3, neither of which has particularly desirable investment characteristics. Hence some form of developer contribution is almost certain to be expected.

4.1.3 Trigger Points for Planning New Capacity

As new capacity has ODV, balance sheet, depreciation and ROI implications for EIL, endeavours will be made to meet demand by other, less investment-intensive means. This discussion also links strongly to EIL's discussion of asset life cycle in section 5.1.

The first step in meeting future demand is to determine if the projected demand will exceed any of EIL's defined trigger points for asset location, capacity, reliability, security or voltage. These points are outlined for each asset class in Table 27.

If a trigger point is exceeded EIL will then move to identify a range of options to bring the asset's operating parameters back to within the acceptable range of trigger points. These options are described in section 4.2 which also embodies an overall preference for avoiding new capital expenditure.

Table 27: Summary of capacity "trigger points"

		Asset class		
Type	**Trigger**	**LV lines and cables**	**Distribution substations**	**Distribution lines and cables**
Extension	Location	Existing LV lines and cables don't reach the required location.	Load cannot be reasonably supplied by LV configuration therefore requires new distribution lines or cables and substation.	Load cannot be reasonably supplied by LV configuration therefore requires new distribution lines or cables and substation.
Up-sizing	Capacity	Tends to manifest as fuse blowing when current exceeds circuit rating.	Where fitted, MDI reading exceeds 90% of nameplate rating.	Analysis calculates that the peak current exceeds the thermal rating of the circuit segment.
	Reliability	Not applicable. Normally a Maintenance or Operational trigger, as no requirement for Up-sizing.		
	Security	Excursion beyond triggers specified in section 3.2.1.		
	Voltage	Voltage at customers' boundary consistently drops below 0.94pu.	Voltage at customers' boundary consistently drops below 0.94pu, which cannot be remedied by LV Up-sizing.	Voltage at MV terminals of transformer consistently drops below 10.45kV and cannot be compensated by local tap setting.
Renewal	Condition	Asset deteriorated to an unsafe condition. Third party requests work. Neighbouring assets being replaced.		

		Asset class		
Type	Trigger	Zone substations	Subtransmission lines and cables	Network equipment within GXP
Extension	Location	Load cannot be reasonably supplied by distribution configuration therefore requires new subtransmission lines or cables and zone substation.	Load cannot be reasonably supplied by distribution configuration therefore requires new subtransmission lines or cables and zone substation.	Load cannot be reasonably supplied by new or extended Subtransmission or substation therefore requires new GXP equipment.
Up-sizing	Capacity	Max demand consistently exceeds 100% of nameplate rating.	Analysis calculates that the peak current exceeds the thermal rating of the circuit segment.	Max demand consistently exceeds 80% of nameplate rating.
	Reliability	Not applicable. Normally a Maintenance or Operational trigger, as no requirement for Up-sizing.		
	Security	Excursion beyond triggers specified in section 3.2.1.		
	Voltage	Voltage at MV terminals of transformer consistently drops below 10.45kV and cannot be compensated by OLTC.	Voltage at HV terminals of transformer consistently drops below 0.87pu and cannot be compensated by OLTC.	Not applicable.
Renewal	Condition	Asset deteriorated to an unsafe condition. Third party requests work.		

4.1.4 Quantifying New Capacity

The two major issues surrounding constructing new capacity are:

- How much capacity to build – this comes back to the trade-off between cost and building in extra capacity for security and safety (risk-avoidance).
- When to build the new capacity – the obvious theoretical starting point for timing new capacity is to build just enough just in time, and then add a bit more over time.

However EIL recognises the following practical issues:

- The need to avoid risks associated with over-loading and catastrophic failure.
- The need to limit investment to what can be recovered under the price-path threshold and the ODV valuation methodology.
- The standard size of many components (which makes investment lumpy).
- The one-off costs of construction, consenting, traffic management, access to land and reinstatement of sealed surfaces (which make it preferable to install large lumps of capacity and not go back to the site).

Selection of the right capacity to build is based on the following:

Cables

- Allow 100% growth

Distribution transformers

- Individual customers, size to customer capacity.
- Domestic customers based on diversity as shown in Table 28.

Table 28: Customer Diversity and Distribution Transformer Size

Customers	Transformer Size
2	15kVA
6	30kVA
10	50kVA
20	100kVA
50	200kVA
80	300kVA
150	500kVA

Line equipment

- Use standard ratings (e.g. ABS 400A, Recloser 400A)

Power transformers

- Allow expected area growth over 20 years

Substation equipment

- Use standard ratings

Subtransmission lines

- Allow expected area growth over 20 years

EIL's guiding principle is therefore to minimise the level of investment ahead of demand, while minimising the costs associated with doing the work.

4.2 Prioritisation Methodology

4.2.1 Options for Meeting Demand

Table 27 defines the trigger points at which the capacity of each class of assets needs to be increased. In a broad order of preference, actions to increase the capacity of individual assets within these classes can take the following forms:

- Do nothing and simply accept that one or more parameters have exceeded a trigger point. In reality, do nothing options would only be adopted if the benefit-cost ratios of all other reasonable options were unacceptably low and if assurance was provided to the Chief Executive that the do nothing option did not represent an unacceptable increase in risk to EIL. An example of where a do nothing option might be adopted is where the voltage at the far end of a remote rural feeder is unacceptably low for a short period at the height of the holiday season – the benefits of correcting such a constraint are simply too low.
- Operational activities, in particular switching on the distribution network to shift load from heavily-loaded to lightly-loaded feeders to avoid new investment or winding up a tap changer to mitigate a voltage problem. The downside to this approach is that it may increase line losses, reduce security of supply or compromise protection settings.

- Influence customers to alter their consumption patterns so that assets perform at levels below the trigger points. Examples might be to shift demand to different time zones, negotiate interruptible tariffs with certain customers so that overloaded assets can be relieved or assist a customer to adopt a substitute energy source to avoid new capacity. EIL notes that the effectiveness of line tariffs in influencing customer behaviour is dampened by the retailer's practice of repackaging fixed and variable charges.
- Construct distributed generation so that an adjacent asset's performance is restored to a level below its trigger points. Distributed generation would be particularly useful where additional capacity could eventually be stranded or where primary energy is going to waste e.g. waste steam from a process.
- Modify an asset so that the asset's trigger point will move to a level that is not exceeded e.g. by adding forced cooling. This is essentially a subset of the above approach but will generally involve less expenditure. This approach is more suited to larger classes of assets such as power transformers.
- Retrofitting high-technology devices that can exploit the features of existing assets including the generous design margins of old equipment. An example might include using advanced software to thermally re-rate heavily-loaded lines, using remotely switched air-break switches to improve reliability or retrofit core temperature sensors on large transformers to allow them to operate closer to temperature limits.
- Install new assets with a greater capacity that will increase the assets trigger point to a level at which it is not exceeded. An example would be to replace a 200kVA distribution transformer with a 300kVA so that the capacity criterion is not exceeded.

In identifying solutions for meeting future demands for capacity, reliability, security and satisfactory voltage levels, EIL considers options that cover the above range of categories. The benefit-cost ratio of each option is considered including estimates of the benefits of environmental compliance and public safety and the option yielding the greatest benefit is adopted. EIL uses the model in Figure 37 to broadly guide adoption of various approaches.

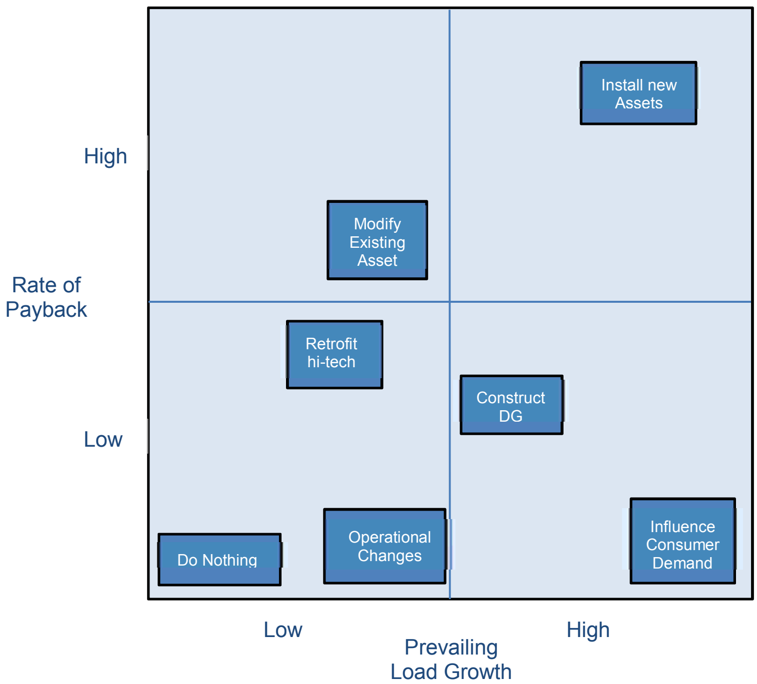

Figure 37: Options for Meeting Demand

4.2.2 Meeting Security Requirements

A key component of security is the level of redundancy that enables supply to be restored independently of repairing or replacing a faulty component. Typical approaches to providing security to a zone substation include:

- Provision of an alternative substation-transmission circuit into the substation, preferably separated from the principal supply by a 33kV bus-tie.
- Provision to back-feed on the 11kV from adjacent substations where sufficient 11kV capacity and interconnection exists. This obviously requires those adjacent substations to be restricted to less than nominal rating.
- Use of local generation.
- Use of interruptible load (water heating).

The most pressing issue with security is that it involves a level of investment beyond what is obviously required to meet demand and it can be easy to let demand growth erode this surplus capacity. This was one of the key conclusions of the Electricity Distribution and Service Delivery Report into the blackouts following the storms in Queensland in 2004.

4.2.2.1 Prevailing Security Standards

The commonly adopted security standard in New Zealand is the EEA Guidelines which reflect the UK standard P2/5 that was developed by the Chief Engineers Council in the late 1970's. P2/5 is a strictly deterministic standard i.e. it states that "this amount and nature of load will have this level of security" with no consideration of individual circumstances.

Deterministic standards are now beginning to give way to probabilistic standards in which the value of lost load and the failure rate of supply components is estimated to determine an upper limit of investment to avoid interruption.

4.2.2.2 Issues with Deterministic Standards

A key characteristic of deterministic standards such as P2/5 and the EEA Guidelines is that rigid adherence generally results in at least some degree of over investment. Accordingly the EEA Guidelines recommend that individual circumstances be considered.

4.2.2.3 Contribution of Local Generation to Security

To be of any use from a security perspective, local generation would need to have 100% availability which is unlikely from a reliability perspective and even less likely from a primary energy perspective such as run-of-the-river hydro, wind or solar. For this reason, the emerging UK standard P2/6 provides for minimal contribution of such generation to security.

4.2.2.4 EIL Security Standards

Table 29 describes the security standards adopted by EIL, whilst Table 30, lists the level of security at each zone substation and justifies any shortfall. In setting target security levels the following guiding principles are used:

- Where a substation is for the predominant benefit of a single customer, their wish for security will over-ride prevailing industry guidelines.
- The preferred means of providing security to urban zone substations will be by secondary subtransmission assets with any available back-feeding on the 11kV providing a third tier of security.

Table 29: Target security levels

Description	Load type	Security level
AAA	Greater than 12MW or 6,000 customers.	No loss of supply after the first contingent event.
AA	Between 4 and 12MW or 2,000 to 6,000 customers.	All load restored within 15 minutes of the first contingent event.
A(i)	Between 1 and 4MW	All load restored within 2 hours of a first contingent event by isolation and back-feeding.
A(ii)	Less than 1MW	All load restored in time to repair after the first contingent event.

Table 30: substation security levels

Substation	Target	Actual	Remarks
Doon Street	AAA	AAA	After failure of one transformer the substation has been operating on reduced security however a unit borrowed from TPCL of lower rating provides AAA security for most of the year except at peak load time. A larger replacement unit will be installed in March 2012 to reinstate full AAA security.
Leven Street	AAA	AAA	Due to the alternative supply being from another GXP the 33kV back-feed cannot remain alive. Hence a short interruption is required.
Racecourse Road	AA	AA	Slow but steady increase in max demand is likely to exceed current security level by 2016.
Southern	AA	AA	Slow but steady increase in max demand is likely to exceed current security level by 2013.
(Bluff)	AA	AAA	

4.2.3 Choosing the Best Option to Meet Demand

Each of the possible approaches to meeting demand that are outlined in section 4.2.1 will contribute to strategic objectives in different ways. EIL uses a number of decision tools to evaluate options depending on their cost as set out in Table 31.

Table 31: Decision Tools Used Based on Option Cost

Cost and nature of option	Decision tools	Organisational level of evaluation
Up to $50,000, commonly recurring, individual projects not tactically significant but collectively they do add up.	EIL standard rules. Industry rules of thumb. Manufacturer's tables and recommendations. Simple spreadsheet model based on a few parameters.	GM Network Operations
Up to $500,000, individual projects of tactical significance.	Spreadsheet model to calculate NPV that might consider 1 or 2 variation scenarios.	Chief Engineer

Up to $2,500,000 occurs maybe once every few years, likely to be strategically significant.	Extensive spreadsheet model to calculate NPV, Payback that will probably consider several variation scenarios. Use of UMS Optimisation tool.	Chief Executive
Over $2,500,000 occurs maybe once in a decade, likely to be strategically significant.	Extensive spreadsheet model to calculate NPV, Payback that will probably consider several variation scenarios. Use of UMS Optimisation tool.	Board approval

4.2.3.1 UMS Optimisation Tool

Figure 38 displays the weightings the Board has assigned to each attribute.

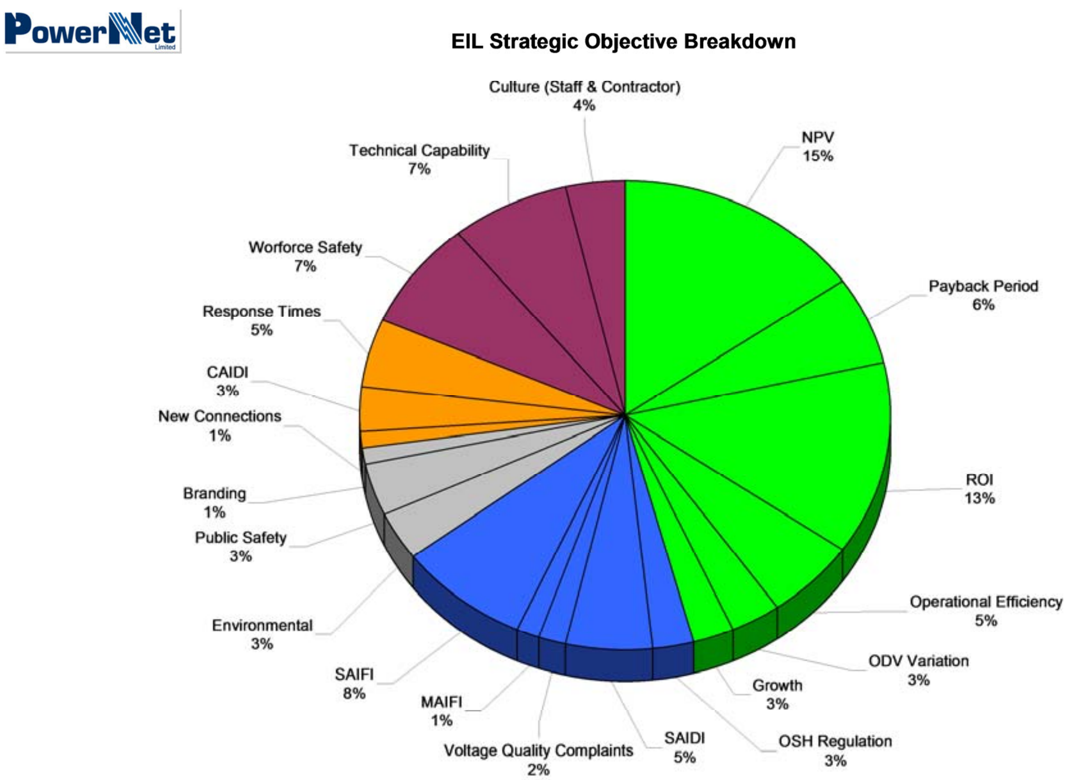

Figure 38: Board Weightings for Optimisation Tool

EIL uses a proprietary evaluation tool to perform two key tasks:

- Capital rationing.
- Option evaluation.

Each category has a score based on defined criteria that is then used to prioritise and select projects which are to be done or deferred. An example of the scoring guide for one of the Public Safety criteria is given in Table 32.

Table 32: UMS Scoring Guide for Public Safety Criteria

Name	Public Safety
Description	Any project which eliminates or significantly reduces any foreseeable safety hazard to the public or easement landowners (and their agents), or enhances general public safety.
Formula	N/A
Issues	▪ Covers projects aimed at meeting the requirements of the Electricity Act & Regulations
Project Characteristics	▪ Refurbishing lines to meet the electrical clearance standards when rating is increased. ▪ Installation of Aircraft Markers and Lights on certain transmission line towers. ▪ Improve the standard of Substation Fencing when refurbishment is required or new fences built. ▪ Removal of 400V lines from poles carrying sub-transmission lines. ▪ Extra barriers/heat shrink in high voltage (HV) distribution transformer kiosks cubicles ▪ Making all LV switchboards finger proof
3	Removes a known or potential class of risk (extreme, severe or major) to many members of the public e.g. at all substations
2	Mitigates a known or potential risk at specific location(s) to members of the public e.g. fence replacement at multiple sites
1	Mitigates a known or potential class of risk to members of the public e.g. at one site
0	No Material Impact
-1	1. Introduces marginal decrease in Public Safety 2. Temporary (less than one year) project introduces additional hazards to the public
-2	Temporary (one to five years) project introduces additional hazards to the public
-3	Introduces permanent additional hazards to the public (Not acceptable)

4.2.4 Application to Projects

Designer and planners use the above tools on projects to enable prioritisation and rationing of our resources. Large projects have differing alternatives scored and the UMS Tool grades each with the Board weightings. Consideration is also given to the Risk Profile of each option and this is also useful in selecting projects.

The Manager in each area prioritises the work based on their needs to meet service standards. Level of budget is adjusted due to trends in service levels; therefore if service levels are steady, expenditure would remain the same. Some abnormal situations[16] do distort results and these are considered in setting targets and expenditure.

[16] Abnormal situations: Major storms, significant planned outages, dry year rationing, external party major equipment failures.

4.3 EIL's Demand Forecast

[Addresses handbook requirement 4.5.5(c)]

4.3.1 EIL's Current Demand

EIL's maximum demand (MD) of 68.63MW did not occur at the same time as the Lower South Island (LSI) peak which occurred at 13:30hrs, 16 August 2011. The EIL Bluff MD of 4.29MW occurred at a different time to both the overall EIL MD and the LSI peak. The EIL contribution at the time of the LSI peak (coincident peak) was 49.69MW with 3.15MW of that load contributed by Bluff EIL. The individual maximum demands are shown in Figure 39.

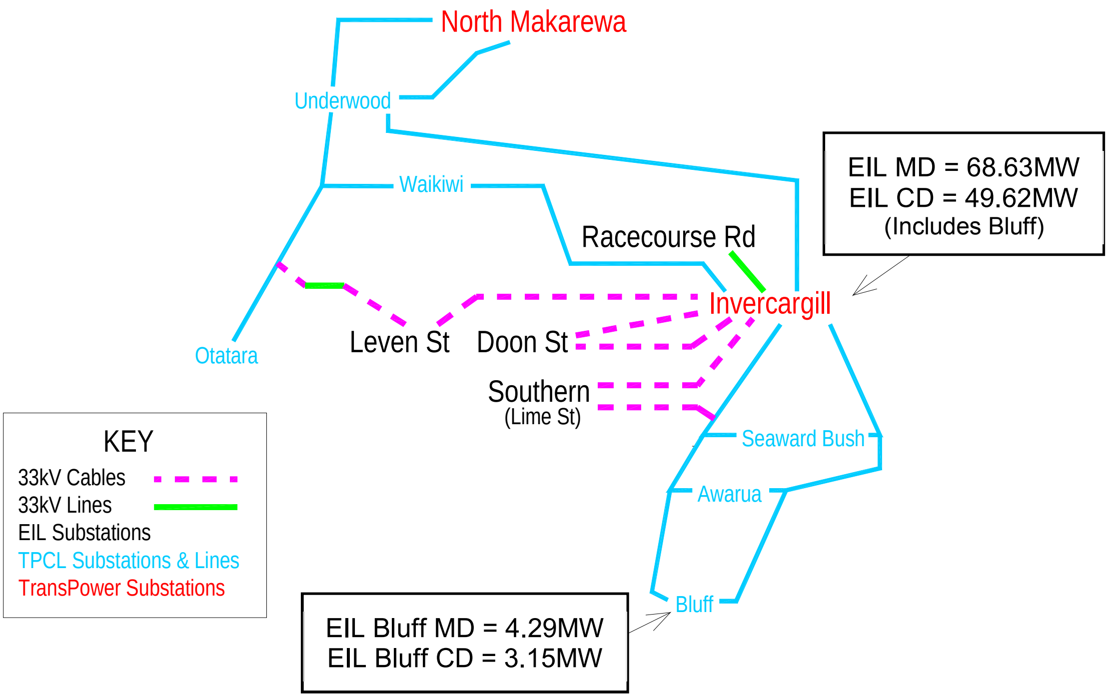

Figure 39: GXP and Generation Demands

Each zone substation recorded the maximum demands as listed in Table 33. The 99.9% Demand is given to remove any short term load transfers and is more indicative of actual area maximum demand.

Table 33: Substation Demand

Zone Substation	Installed Capacity (MVA)	2010/11 Max Demand (MVA)	99.9% 2010/11	99.9% 2009/10	99.9% 2008/09	99.9% 2007/08
Doon St	46	24.7	22.67	22.82	22.01	23.68
Leven St	46	18.8	17.68	18.32	17.66	19.03
Racecourse Rd	23	10.7	9.67	10.11	9.36	10.07
Southern	23	13.4	12.52	12.54	11.72	12.41
Bluff (TPCL)	24	4.6	4.35	4.55	4.60	4.11

Doon St firm capacity is exceeded therefore load transfers will need to be utilised if one power transformer is out of service at peak load times.

4.3.2 Drivers of Future Demand

Key drivers of demand growth (and contraction) are likely to include the issues depicted in

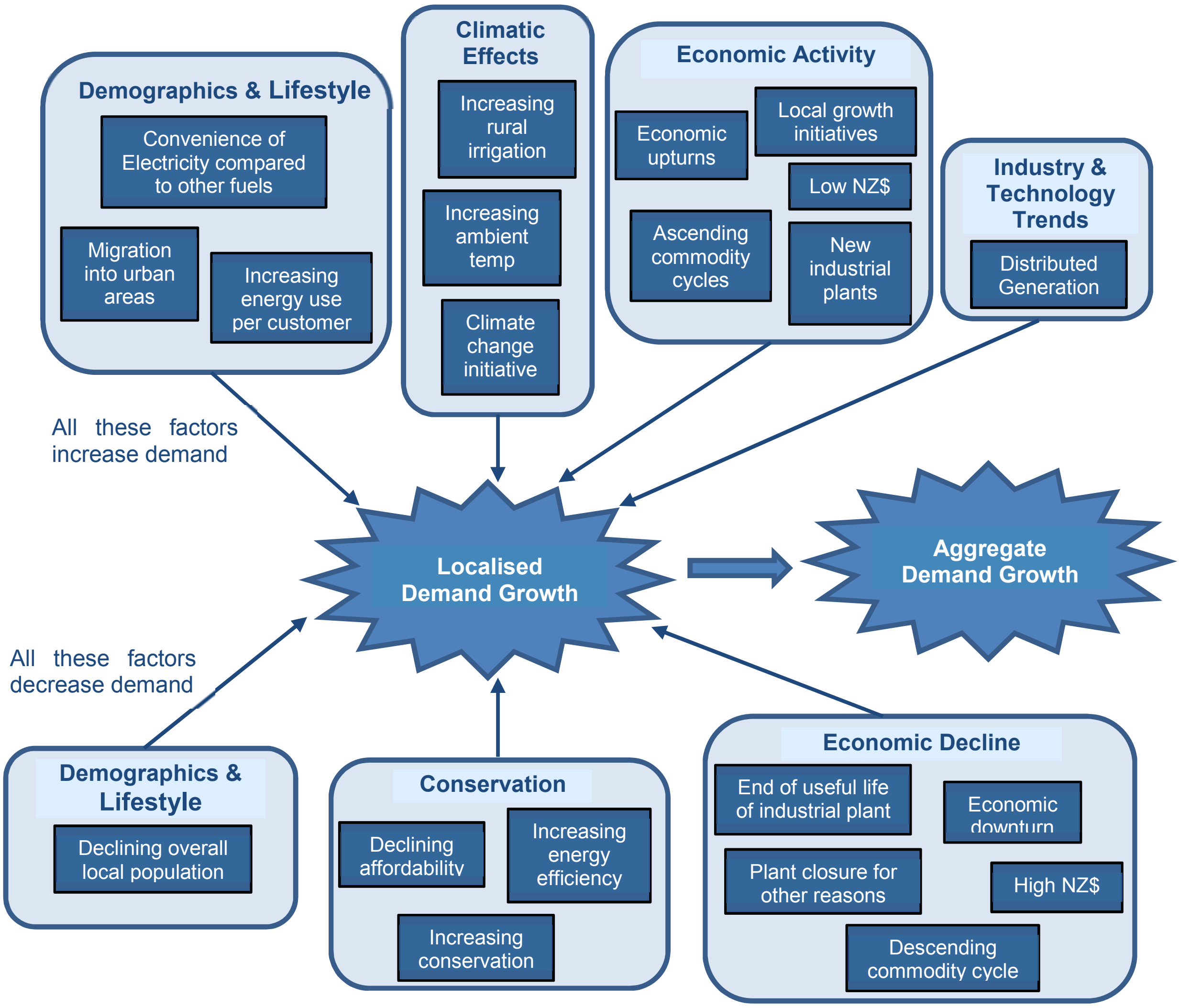

Figure 40: Drivers of Demand

At residential and light commercial feeder level, three or four of these issues may predominate and be predictable and manageable on a statistical basis however experience is that large customers give little if any warning of increases or decreases in demand. The residential and light commercial demand projections can be aggregated into a reasonably reliable zone substation demand forecast but heavy industrial demand will always remain more unpredictable. EIL's estimates of future demand are described in section 4.3.4 below.

Historically, EIL has experienced an average annual demand growth of about 1.3% for the last 10 years. This growth has been distorted with Transpower's introduction of TPM[17] where individual ELB peaks have been replaced by a regional grouping. This has allowed EIL to relax load control during the year due to the increased summer loading due to Dairying (on the TPCL network supplied from the Invercargill GXP). Whilst the company expects this average rate not to continue and to influence the revenue aspects of EIL's business, such as pricing, it must be acknowledged that actual demand growth at localised levels (which will influence costs) can vary anywhere from negative to highly positive. No reductions are foreseen due to the removal of the requirement to supply in 2013, as there is only one lateral that could be considered uneconomic. The following sections examine in detail the most significant drivers of the network demand over the next 10 to 15 years.

4.3.2.1 Rural Money Coming to Town

The impact of farmers retiring to the city increases demand for Townhouses in desirable locations. This is not a new effect and therefore there is no increase in growth expected above trending of previous years.

4.3.2.2 Removal of Coal as a Heating Fuel

Solid Energy had previously advised it would withdraw from supplying coal to the household market by the beginning of 2013, in line with the National Environmental Standards for air quality. The Government has recently announced that it will review the timing for the implementation of the standards and as a result, Solid Energy may alter its deadline for completing its withdrawal.

This is likely to result in an increase in use of alternative sources of heating including heat pumps with resulting growth expected to affect residential areas.

4.3.2.3 Continuance of Major Industries

EIL sees no loss of major industries from the area, due to variation in exchange rates or loss of electricity supply contracts.

4.3.2.4 Discovery of Major Petrochemical Deposit

Exploration in the Great South Basin has been awarded to two companies, with the possible flow on effects if a deposit is developed. The likelihood and level of growth from this effect is unknown and has therefore not been included in forecasted growth.

4.3.2.5 Increased Environmental Concern

Consideration of energy efficiency in consumer appliances is more popular due to government or local council drivers and marketing leading to a reduction in consumption. This is counteracted by conversion to electricity as a 'clean' fuel for heating. The overall effect is predicted to be minimal growth.

4.3.2.6 Economic Crisis Impact

Economic downturn and recovery affects investment by customers and therefore the rate of growth. The recent economic crisis has affected the rate of new connections and therefore a reduction in growth has been seen which is expected to continue over the next few years.

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[17] Transmission Pricing Methodology: Allocation of Transpower costs are based on the share of the average of the top 100 peaks for all loads in the Lower South Island (LSI) region. See http://www.electricitycommission.govt.nz/rulesandregs/rules Part F, Section IV for more details.

4.3.3 Load Forecast Trend

Analysis of historic demand and energy usage over the last 10 years gives demand growth of 1.3% and energy growth of 0.6%. Figure 41 shows the overall EIL data since 1950 and highlights the flattening out since 1989.

The overall effect of drivers of future demand mentioned in section 4.3.2 is not expected to significantly alter these growth trends in future years.

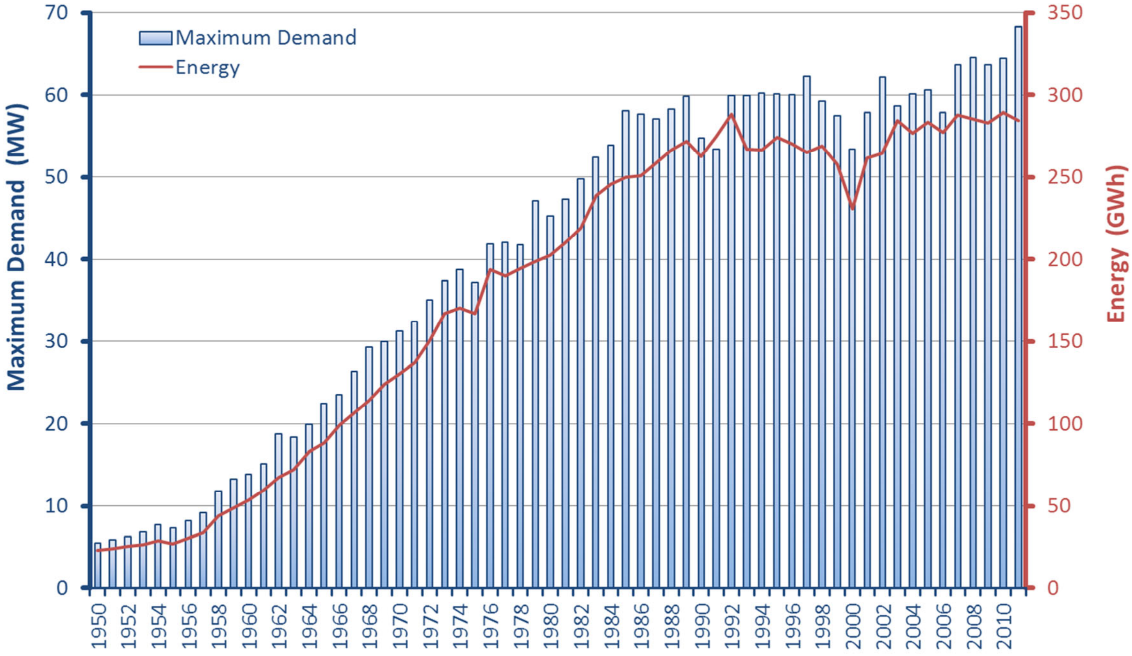


Figure 41: Maximum Demand and Energy Transmitted

4.3.4 Estimated Zone Substation Demands

As outlined in detail in the remainder of Section 4, demand is expected to vary from that described in Section 4.3.1 as follows:

- Expansion of Commercial/Retail/Light Industrial in west Invercargill area impacting Leven and Doon Streets Substations at 2.0% per annum.
- Otherwise standard natural growth in Invercargill of 1.0% per annum, includes some infill of sections.
- Standard natural growth in Bluff of 0.5% per annum.
- Expansion of Commercial/Retail/Light Industrial in Bluff impacting Bluff Substation at 0.5% per annum.
- Load transfers between substations to keep under trigger levels.

Experience strongly indicates that it would be rare to ever get more than a few months confirmation, sufficient to justify significant investment, of definite changes in an existing or a new major customer's demand. This is because most of these customers operate in fast-moving customer markets and often make capital investment decisions quickly themselves and they generally keep such decisions confidential until the latest possible moment. Probably the best that EIL can do is to identify in advance where EIL's network has sufficient surplus capacity to supply a large chunk of load but, as experience shows, industrial siting decisions rarely, if ever, consider the location of energy supply – they tend to be driven more by land-use restrictions, raw material supply and transport infrastructure.

Table 34 identifies the rate of growth projected to zone substation level for a 10 year horizon, along with the provision expected to be made for future growth. This assumes no unforeseen changes in growth rates, as estimated from demand graph trends, or step changes due to connection or loss of large customers. Expanded data is included in Appendix B.

Table 34: Substation Demand Growth Rates

Substation	Rate and nature of growth	2012/13 Demand	2021/22 Demand	Provision for growth to 2022
Doon Street	**2.0%** per annum.	23.0	33.8	The existing 11.5/23MVA transformers are planned to be replaced with 18/36MVA units at the new Queens Park site after one failed in service. This increased capacity will enable load to be able to be transferred away from other subs to avoid exceeding security triggers. The existing 33kV oil filled cables will be paralleled to supply one transformer with a new 33kV XLPE cable being installed to supply the second transformer and maintain security.
Leven Street	**2.0%** per annum, CBD or medium-light industrial. Room for expansion within old show grounds subdivision.	23.0	21.2	Firm capacity is not expected to be exceeded during the planning period as load transfers can be used to delay this security trigger being exceeded.
Racecourse Road	**1.0%** per annum, residential.	11.9	10.0	Load transfers will be used to delay the 12MVA security trigger being exceeded. A second transformer may be required within the planning period but is not likely to be needed for some time due to the increase in capacity provided by the new Queens Park units.
Southern	**1.0%** per annum, residential.	11.8	19.0	Load transfers have been used to delay the 12MVA security trigger being exceeded but a second transformer will be required by 2014. This transformer will provide spare capacity and added security for city growth and will be relocated from Doon St when the units there are replaced.
Bluff (TPCL)	**1.0%** per annum, industrial growth at the Port.	4.7	5.1	New transformers installed recently allow for at least 6MVA of spare capacity allowing growth well beyond the planning period.

4.3.4.1 Demand Model Assumptions

The impact of Distributed Generation (DG) has been ignored due to the estimated low connection rate of DG and the probability that only a small percentage of the capacity will be available during peaks, e.g. White Hill (connected to the TPCL network) has 58MW generation capacity but only contributed 5.89MW during the LSI peak.

Load Management is used when substation equipment is nearing overload, and during load transfers for maintenance, and hasn't been considered in the projected demands above. Load shifting can also be done at the Retailer's request or during Dry-year rationing.

Increased monitoring of heavily loaded sites if data indicates capacity will be exceeded.

Annual preparation of this data will highlight sites that vary from the above model and the planned works adapted for each situation, with some upgrades delayed or brought forward.

4.3.5 Estimated Demand Aggregated to GXP Level

Table 35 shows the aggregated effect of substation demand growth for a 10 year horizon at the Invercargill GXP.

Table 35: GXP Demand Growth

GXP	Rate and nature of growth	Provision for growth to 2022
Invercargill	0.0% Maximum Demand Load will be controlled using load management to stay at present levels.	Transpower have recently upgraded the two 220/33kV banks to 120MVA. This will allow over 20MVA of additional load.

4.3.6 Issues Arising from Estimated Demand

The significant issues arising from the estimated demand in section 4.3.4 are the requirements for the replacement and upgrade of transformers at Doon Street and a second transformer at Southern substation within the planning horizon. Also the 33kV oil cables supplying Doon Street will require supplementation with an additional higher rated 33kV cable to allow the additional installed transformer capacity to be utilised.

4.4 Where are EIL Network Constraints

EIL's network includes the constraints as shown in Table 36:

Table 36: EIL Network Constraints and Intended Remedy

Constraint	Description	Intended remedy
Capacity at Racecourse Road and Southern Substations	Demand nearing 12MVA security trigger.	Additional transformers are planned at both sites when security triggers are exceeded.
Doon St 33kV oil cables	Capacity of these cables will not allow utilisation of the added capacity of the new Doon St transformers.	The cables will be supplemented with an additional 33kV XLPE cable to allow full utilisation of transformer capacity.

MV Cables	Some MV cables operate near full capacity and would be unable to supply backup.	Operational measures ensure cables not overloaded. Protect smaller MV cables with fuses.
MV Transformers	Some transformers are near full capacity.	Monitor MDIs and upsize or add additional as required. Relocate under loaded before purchasing new.
LV switching in CBD	Limited locations for above ground equipment.	Utilise underground equipment or cellar.
Overhead Lines	District plan prohibits new overhead lines.	Utilise cables.

4.5 Policies for Distributed Generation

[Addresses handbook requirement 4.5.5(d)]

The value of distributed generation is clearly recognised in the following ways:

- Reduction of peak demand at the Transpower GXP.
- Reducing the effect of existing network constraints.
- Avoiding investment in additional network capacity.
- Making a very minor contribution to supply security where the customers are prepared to accept that local generation is not as secure as network investment.
- Making better use of local primary energy resources thereby avoiding line losses.
- Avoiding the environmental impact associated with large scale power generation.

It is also recognised that distributed generation can have the following undesirable effects:

- Increased fault levels, requiring protection and switchgear upgrades.
- Increased line losses if surplus energy is exported through a network constraint.
- Stranding of assets or, at least, of part of an asset's capacity.

Despite the potential undesirable effects, the development of distributed generation that will benefit both the generator and EIL is actively encouraged.

The key requirements for those wishing to connect distributed generation to the network broadly fall under the following headings, with a guideline and application forms available on the web at http://www.powernet.co.nz/dg-guide.

4.5.1 Connection Terms and Conditions (Commercial)

- Connection of up to 10kW of distributed generation to an existing connection to the network will not incur any additional line charges. Connection of distributed generation greater than 10kW to an existing connection may incur additional costs to reflect network Up-sizing.
- Distributed generation that requires a new connection to the network will be charged a standard connection fee as if it was a standard off-take customer.
- An annual administration fee will be payable by the connecting party.

- Installation of suitable metering (refer to technical standards below) shall be at the expense of the distributed generator and its associated energy retailer.
- Any benefits of distributed generation that arise from reducing EIL's costs, such as transmission costs or deferred investment in the network, and, provided the distributed generation is of sufficient size to provide real benefits, will be recognised and shared.
- Those wishing to connect distributed generation must have a contractual arrangement with a suitable party in place to consume all injected energy – generators will not be allowed to "lose" the energy in the network.

4.5.2 Safety Standards

- A party connecting distributed generation must comply with any and all safety requirements promulgated by EIL.
- EIL reserves the right to physically disconnect any distributed generation that does not comply with such requirements.

4.5.3 Technical Standards

- Metering capable of recording both imported and exported energy must be installed if the owner of the distributed generation wishes to share in any benefits accruing to EIL. Such metering may need to be half-hourly.
- EIL may require a distributed generator of greater than 10kW to demonstrate that operation of the distributed generation will not interfere with operational aspects of the network, particularly such aspects as protection and control.
- All connection assets must be designed and constructed to technical standards not dissimilar to EIL's own prevailing standards.

4.6 Use of Non-Asset Solutions

[Addresses handbook requirement 4.5.5(e)]

As discussed in section 4.2.1 the company routinely considers a range of non-asset solutions and indeed EIL's preference is for solutions that avoid or defer new investment.

Effectiveness of tariff incentives is lessened with Retailers repackaging line charges that sometimes removes the desired incentive. 'Use of System' agreements include lower tariffs for controlled, night-rate and other special channels.

Load control is utilised to control:

- The amount of Transpower charges by controlling the network load during the LSI peaks.
- The load on individual GXP's when they exceed the capacity of that GXP.
- The load on feeders during outage situations.
- Load shedding is used by some customers where they accept a drop of their load instead of investing in additional network assets.

4.7 Network Development Options

[Addresses handbook requirement 4.5.5(f)]

4.7.1 Identifying Options

When faced with increased demand, reliability, security or safety requirements, EIL considers the broad range of options described in Section 4.2.1. The range of options for each issue varies due to:

- Stakeholder interests

Section 1.6 lists stakeholder interests and the engineer considers these areas in planning and ranking an option.

- Size of the project

Different issues have differing resource requirements the level of analysis and the breadth of options varies. A simple issue like connecting a new customer next to an existing low voltage pillar box would only have a single option analysed, whereas a new industrial plant would have multiple options considered.

- Creativity and knowledge of the Engineer

Breadth of options is also dependent on the Engineer undertaking the planning. Options are developed by the Engineer and critiqued by the Chief Engineer. Standard construction and existing designs are mainly used, but there is support for innovation.

- Resource

The other higher priority projects may limit the resources available for each option. This could be a limitation of finances (uneconomic), workforce (to plan, design, manage, build or operate), materials (unavailability or long lead-time of equipment) or legal (need Resource Consent or easements.)

4.7.2 Identifying the Best Option

Once the best broad option has been identified using the principles embodied in **Error! Reference source not found.**. EIL will use a range of analytical approaches to determine which option best meets EIL's investment criteria. As set out in Section 4.2.3, EIL uses increasingly detailed and comprehensive analytical methods for evaluating more expensive options.

- Simple Spreadsheet: Cost calculation with standardised economic benefit values.
- Risk analysis: More comprehensive and complexity for larger projects.
- Net Present Value (NPV) model: Time series model of future costs and benefits.
- Payback calculation: Financial calculation of the time estimated to recover cost of undertaking that option.
- UMS Optimisation Tool: Multiple parameter model use to optimise stakeholder objectives to a set budget.

4.7.3 Implementing the Best Option

Having determined that a fixed asset (CAPEX) solution best meets EIL's requirements and that EIL's investment criteria will be met (and if they won't be met, ensuring that a customer contribution or some other form of subsidy will be forthcoming), a project will proceed through the following broad steps:

- Perform detail costing and re-run cost-benefit analysis if detail costs exceed those used for investment analysis.
- Address resource consent, land owner and any Transpower issues.
- Perform detailed design and prepare drawings, construction specifications and if necessary tender documents.
- Tender out or Assign construction.
- Close out and de-brief project after construction.

- Ensure that contractors pass all necessary information back to EIL including as-builts and commissioning records.
- Ensure that learning experiences are examined, captured and embedded into PowerNet's culture.

4.8 Development Programme

4.8.1 Current Projects

[Addresses handbook requirement 4.5.5(g)(i)]

Projects scheduled for year one (YE 31 March 2013) are as follows. These projects have a high certainty.

4.8.1.1 Doon St Transformer Replacement

One of the two 11.5/23MVA transformers at the Doon Street substation failed while supplying additional load transferred from the other unit which was out of service for maintenance. The cause was found to be an HV winding inter-turn fault and damage was found to be severe.

While the transformer was under higher than normal loading it was at only 80% of its rated loading. Previous dissolved gas analysis of the transformer had not indicated any increased likelihood of failure. Furan analysis done after the fault showed that the transformer appeared to be aged more than expected due to probable operation at high load and temperatures for extended periods in the past. This was unexpected as the two transformers at Doon Street have been operated in parallel with total loading within the rating of a single unit (to provide a firm supply) meaning the units should have been loaded at below half of their rating with only short durations of higher loading below their full rating during maintenance requiring brief outages of a single transformer. Furan results on the remaining transformer which is from the same manufacturer, but three years older, has given similar results and there is therefore reduced confidence in the reliability of this unit which has since been temporarily de-rated to reduce risk.

Several options were considered providing various levels of repair for relative levels of investment. The simplest option was to rewind the damaged HV winding only, with further options to rewind the associated LV winding or to complete a full three phase rewind of the transformer. A rewind of a single phase only would return the unit to service but the other windings would be still aged leaving no improvement in the transformers life and given the unexpected failure of one winding the other windings could fail at any time making this investment too risky. A full three phase rewind would renew the windings effectively to as new condition providing many years of remaining life however other parts of the transformer would not be renewed without further investment making this a risky option. New replacement transformers avoid this risk and provide other benefits for example higher efficiency and less noise. Also new transformers provide the opportunity for increased rating and capacity which is required somewhere on the EIL city network in the short term to provide for new growth with Doon Street being the ideal substation for this increase due to its central location.

The above factors led to a decision that repair of the unit would be too risky an investment given the cost and replacement is the better option allowing for upsizing of the transformers to provide for future growth and give confidence in the reliability of this critical point of supply for EIL. The replacement transformers have been sized as 18/36MVA units after considering growth projections for the network.

The remaining Doon Street unit is planned to be relocated to Southern substation to provide a dual transformer site and a firm supply point as the substation load is expected to reach the 12MVA security trigger. A new transformer was planned for Southern but utilising the remaining life of the spare unit as it becomes available, which matches the existing Southern 11.5/23MVA transformer rating, is a more economic option allowing investment in a new transformer to be deferred for several years. The relocated unit will require a thorough refurbishment and analysis of remaining life.

This project covers the remaining procurement and installation costs for the first new 18/36MVA transformer to be delivered to Doon Street carried over from last year.

Cost $0 - $0.5M 2012/13; CAPEX – System Growth

4.8.1.2 New Queens Park Substation

The existing Doon Street substation is located in very close proximity to the old Invercargill water tower which is a large tall brick structure. A large concrete walled water storage reservoir is also located next to the substation. As highlighted by the recent Christchurch earthquakes, structures of these types may not survive in a large earthquake and brickwork or other parts of the structure falling from the tower or flooding from the water reservoir could cause significant damage to the substation. The substation fence itself and part of the substation building is of an old brick construction and would also be likely to be damaged in a large earthquake. Also access to the Doon Street substation may not be allowed for some time if the surrounding structures are damaged or even suspected of being damaged until they are confirmed safe by inspection, support, strengthening or possibly demolition.

The 11kV switchboard at Doon Street was installed in stages, with the first seven circuit breakers installed in 1964 and the remaining circuit breakers installed over the next few years. Therefore, in 2012 most of these circuit breakers will have reached or be beyond the standard ODV life of 45 years. Due to the impact that failure of switchgear would have on service levels, which are regulated such that the very high reliability of EIL's network must be maintained, and the strategy to "Replace critical assets near to their technical end-of-life" these units are programmed for replacement. EIL conducts regular tendering processes to ensure that the most economic replacement equipment which meets network design requirements is obtained.

An alternative option to replacing switchgear is to retrofit existing circuit breaker trucks with modern units. However this would not renew all components and those remaining would continue to age leaving an increased risk of failure following a significant proportion of the replacement cost. Switchboards may fail explosively and damage may be extensive requiring lengthy repairs which may not be possible depending on damage sustained. Extensive reconfiguration of the 11kV network would be required to restore supply which would take time and if the entire switchboard was affected complete restoration may not be possible with some customers left without supply for a prolonged period. The switchboard continuous capacity rating would also remain the same with a retrofit option while growth on the network requires greater capacity in the near future. Given that Doon Street substation provides a critical supply to a large part of Invercargill city, including parts of the CBD, and the above considerations retrofitting is not considered an appropriate option. The "do nothing" option is to allow the switchboard to operate to failure which means the risks mentioned above would actually occur as well as greatly increase the risk of injury to field staff and is therefore not appropriate.

Other cost saving options such as simplification of the switchboard (reducing number of replaced circuit breakers) would result in decreased service levels with faults affecting a greater number of customers which would not be acceptable. The replacement switchboard however had two spare circuit breakers which will not be replaced and instead room for expansion will be allowed for with the new switchboard.

As mentioned above a decision has been made to replace both transformers after one unit failed in service and it was determined uneconomic to repair and it is timely to take the opportunity to upsize the units to provide capacity for growth in Invercargill. The remaining spare transformer will then be available for use at EIL's Southern substation which due to load growth is exceeding the 12MVA security trigger and therefore requires a second unit. 11kV load transfers can be utilised to avoid the security trigger short term until this spare unit is available.

Protection is provided by old electromechanical type relays which are mounted in the switchgear panels and are of generally the same vintage as the switchgear. These relays are therefore at the end of their intended life and their accuracy and functionality is not up to the modern standard. Modern digital relays are generally far superior in terms of accuracy and flexibility and also provide a lot of additional functionality including safety features such as arc flash. EIL has standardised on manufacturer to realise the benefits of staff familiarisation and training and in retaining spares for equipment across the network, otherwise the most economic option within the range of options is chosen that provides the necessary features.

The substation building which houses the switchgear, protection and other minor auxiliary equipment also requires a major renovation or replacement due to seismic requirements and issues with asbestos.

Given that most of the major substation components are due for immediate renewal and considering the risk of damage posed by the neighbouring structures as well as potential site access issues resulting from a large earthquake, it has been decided that a new substation is to be built in the area but located safely away from large earthquake prone structures as replacement for the existing substation. A site behind the Blind Centre in Queens Park, near the end of St Andrews Street at Queens Drive, has been proposed and a designation has been sought for this location. It is intended that the existing site will be reinstated as necessary for return to the council.

Full replacement of existing equipment as opposed to refurbishment type renewals is further justified as relocation of equipment to a new site would be impractical without unacceptable outage periods or reduction in security.

Planning and design for the new substation is scheduled for the year ending 31 March 2013 after expected confirmation of the new site. Construction of the substation building is scheduled to be completed in this year with installation of substation equipment and any further associated construction work completed over the following two years. Costing has been based on an indoor design which is appropriate for the modern urban situation minimising visual impact and noise.

Cost $0.5M - $2.5M 2012/13; CAPEX – System Growth.

4.8.1.3 New Queens Park 33kV Cable

Reliability of the 33kV oil filled cables supplying Doon St and Southern substations has been investigated over the last year after learning of a possible systemic weakness in the joints of these cables. An increase in the thermal expansion of core conductors which were changed from copper to aluminium are thought not to have been adequately accounted for in the construction of the cable joints and this movement may have caused damage to insulation over years of operation. Other distribution businesses have encountered issues with similar oil filled cables on their networks and have begun remedial actions.

There is also uncertainty around the understood ratings of these oil cables which is dependent on the cable trench backfill material used which is understood to be of poor thermal resistivity. The cables have therefore been de-rated as a temporary measure until this can be clarified. Assuming the lower applied cable ratings, capacity triggers for firm supply are exceeded during periods of peak loading, although in a contingency scenario 11kV transfers could be utilised to manage loading to acceptable levels.

Options available to EIL range from doing nothing to replacement of the cable joints or reinforcement or even complete replacement of the cables with modern XLPE type cables. It has been decided that due to the planned relocation and increase in capacity for the Doon Street substation an equivalent increased capacity in the supply cables will be required and that this can be provided by paralleling the existing oil cables to create a single double capacity feeder supplying one of the new 18/36MVA transformers with a new 800mm^2 aluminium conductor XLPE cable installed as the second feeder supplying the other new transformer. With the anticipated Queens Park site redirection of the oil filled cables to the new site will be required and it is planned that the cable sections which divert from St Andrews Street down Mary and McMaster Streets to the existing Doon Street site will be redundant with the cable ends paralleled be paralleled at a common location on St Andrews Street and extended to the new Queens Park site with new XLPE cable as used for the new feeder cable.

This option provides the necessary increase in capacity to the new substation as well as one new cable able to supply the full substation load giving confidence in supply reliability. Separation of the cable routes also reduces the risk of both cables being damaged by a single localised event.

Once completed the redundant oil cable sections and joints can be examined and their condition assessed as a good indication of condition for the remaining in service cables. These would be invasive tests that could not be done on in service cables without disturbance creating a significant risk of affecting cable life. Results of this testing should help provide increased confidence in the remaining life of the cables or otherwise direct any remedial actions required. Thermal probes may also be installed to more accurately predict the oil cable capacity ratings.

The above tests will also help understand the condition of the Southern substation supply oil cable however this cable is backed up by an XLPE cable from the TPCL network and therefore carries less risk.

This budget covers the design cost and most of the installation costs for the new XLPE cable with a small amount of work expected to be carried over to the following year. Design can commence once the new substation site designation is confirmed.

Cost $0.5M - $2.5M 2012/13; CAPEX – System Growth

4.8.1.4 Asset Relocation Projects

The Invercargill City Council is undertaking a realignment of Queens Drive which includes reconfiguration of the curbing and footpath locations and resurfacing of the road. This means significant work including excavation around the MV cables which run down both sides of Queens Park in this area. In some areas the realignment will result in MV cables being located under the road which is undesirable due to access issues.

EIL is therefore relocating cables to avoid any damage that would likely be sustained if left in their current position and to move cables out from under the roadway so that they are more accessible for repair of any faults that may occur in future. The opportunity to upsize some cables is also being taken to provide future proofing for expected load growth in the future.

The alternative option is to not complete this work however the risk of damage to existing cables is high and the effect on service levels could be quite major. Any damaged cables may take additional time to repair as gaining access to the work site will be required or realignment crews would be delayed for repairs. A planned approach is considered to be the more appropriate option. Relocation out of the roadway is also allows faster repair of any future faults allowing current service levels to be maintained. Upsizing cables during this project is more economic than waiting until capacity is reached as the trenching and reinstatement costs are a very significant proportion of cable installation costs but can be substantially avoided if tied in with the realignment works.

This work is to be completed in line with the Councils realignment schedule which is expected to be completed within the following year. In future years this budget covers minor asset relocation work that may be required from time to time.

Under $0.5M 2012/13 per annum on-going; CAPEX – Asset Relocation

4.8.1.5 New Connections

This budget provides allowance for new connections to the network including subdivisions. Each specific solution will depend on location and customer requirements.

Planning for new connections is based on historical trending and local knowledge however customer requirements are generally unpredictable. Larger customers especially, which have the greatest effect on the network, tend not to disclose their intentions until connection is required perhaps trying to avoid alerting competitors, so cannot be easily planned for in advance.

Various options are considered generally to determine the least cost option for providing the new connection. Work required depends on the customer's location relative to the network and the capacity of that existing network to supply the additional load. This can range from a simple LV connection to a fuse in a distribution pillar box at the customers property boundary to upgrade of LV cables or replacement of overhead lines with cables of greater rating up to requirement for a new transformer site with associated 11kV extension if required. Even small customers can require a large investment to increase network capacity where existing capacity is already fully utilised.

The district plan requires all new network to be underground in Invercargill however Bluff may utilise overhead construction which tends to be a less cost option.

Distributed generation as a network alternative tends to be less reliable or more expensive, especially upfront, depending on the type installed and a connection to the network is generally still desired as backup and supplementation and may enable customers to sell surplus generation.

Under $0.5M per annum on-going; CAPEX - Customer Connections.

4.8.1.6 Supply Quality Upgrades

On the LV network operation beyond capacity manifests as low voltage experienced by customers during periods of peak loading. This may occasionally require a new transformer site with associated 11kV extension if required however in most cases replacing LV cables with larger cables will be a more economic option to maintain acceptable voltage for all customers. The minimum cable size which provides the existing and spare capacity for expected growth will be used.

An alternative to network upgrade is demand side management however cost incentives to reduce demand are proving ineffective due to the retailers repackaging of line charges into their billing.

Under $0.5M per annum on-going; CAPEX – System Growth.

4.8.1.7 Earth Upgrades

Ineffective earthing may create or fail to control hazardous voltage which may occur on and around network equipment affecting safety for the public and for staff. Also other functional requirements may not be met preventing protection systems from operating correctly affecting which may affect safety and reliability of the network. Routine earth site inspection and testing identifies any sites that require upgrades.

Compliance with the new EEA Guide to Power System Earthing Practice 2009 will be required by the end of March 2012 when the Safety Management System (SMS) comes into force. This requires an assessment of the risk of exposure to any hazards that may be created at earth sites and hazard mitigation measures appropriate to the risk to be carried out.

The analysis to determine what upgrade options are appropriate can be quite complex but essentially look to find the best trade-off between cost and risk reduction. Generally in EIL the earthing upgrades required will be minimal with safety being achieved by simple connection to the large urban MEN (multiple earthed neutral) system.

Under $0.5M per annum on-going; CAPEX – Reliability, Safety and Environment.

4.8.1.8 Reactive Reliability Safety & Environment

A budget to allow for reactive measures required to correct issues affecting network reliability, safety and/or environmental issues which may be encountered from time to time. EIL is required to maintain reliability, safety and environmental standards and suitable options will be determined at the time dependant on the nature of the issue found.

Under $0.5M per annum on-going; CAPEX – Reliability, Safety and Environment.

4.8.1.9 Seismic Engineering Remedial Work

Some remedial work is expected to be recommended following inspections of network and substation assets conducted by civil engineering consultants to determine seismic strength. Options for remedial work will be provided and decisions for appropriate actions will be determined considering the assets importance in respect of ensuring continued network serviceability following and safety following a major seismic event.

Under $0.5M per annum until 2016; CAPEX – Reliability, Safety and Environment.

4.8.2 Planned Projects

[Addresses handbook requirement 4.5.5(g)(ii)]

Expected projects for year two to five (1 April 2013 to 31 March 2017) are as follows. These projects have moderate certainty.

Note some projects described above are on-going, these are not repeated in following sections.

4.8.2.1 New Queens Park Substation

The detailed justification for this project was discussed in section 4.8.1.2 above.

Procurement and installation of substation equipment is scheduled to be mostly completed in year two of the planning horizon with a small amount of this work carried over to the following year.

Cost $2.5M - $ 5.0M over years 2013/14 and 2014/15; CAPEX – System Growth

4.8.2.2 New Queens Park 33kV Cable

This project has been detailed in section 4.8.1.3 above. A small amount of completion work is expected to carry over into the 2013/14 year.

Under $0.5M 2013/14; CAPEX – System Growth.

4.8.2.3 33kV Oil Cable Extension

The 33kV oil cable paralleling and extension work was discussed in section 4.8.1.3 above however this work is effectively a separate project to the installation of the new 33kV XLPE cable. The work captured in this budget covers the paralleling of the existing oil cables at both the supply point end at the Transpower GXP substation off Findley Road and at the remote end at a location along St Andrews Street before the cables leave the common route to the existing Doon Street and the new proposed Queens Park site as well as a new XLPE extension installed the rest of the route length to the new Queens Park site. The oil cables beyond this transition point will be abandoned.

The intention at the cable transition location is to terminate the oil cables and XLPE cable ends onto a bus structure which connects these cables ends together but allows relatively easy disconnection to allow a faulted oil cable to be disconnected if necessary. This will allow the remaining oil cable capacity to be used while repairs are carried out.

At the St Andrews street transition between the oil cables and XLPE extension an enclosure will be required suitable to house terminations and bus work and will most likely need additional space for pressure tanks for the oil cables currently located at Doon Street. This work is scheduled for completion after sufficient equipment at the new Queens Park substation and new 33kV XLPE supply feeder is in service and able to take the load transferred from the Doon Street site which is supplied by the oil cables.

This work is scheduled for completion within the year three of the planning period.

Under $0.5M 2013/14; CAPEX – System Growth.

4.8.2.4 Spare 33/11kV Transformer – Southern

The 12MVA security trigger has been reached at Southern substation which means demand is at a point where upgrade to a dual transformer site to provide a firm supply is considered appropriate. As mentioned in section 4.8.1.1 the remaining 11.5/23MVA unit at Doon Street will become spare and can be transferred to Southern Substation as the new 18/36MVA transformers are installed at the new Queens Park site. Load can be transferred onto the other substations to avoid exceeding this trigger until this spare unit becomes available.

An alternative option would be continued operation with a single transformer however as the level of demand increases the impact that a transformer failure would have on network reliability is considered to be unacceptable.

In addition to relocation costs associated with this project cover the refurbishment of the spare transformer which is appropriate while the transformer is not required for service.

Under $0.5M; 2012/13; System Growth.

4.8.2.5 Bond OHUG

The bond street industrial area undergrounding project represents the completion of the EIL overhead to underground conversion programme which has been implemented over the last 40 years. While overhead construction is typically a more cost effective option, this programme has been undertaken at the directive of the Board as it is a District Plan requirement to underground utility services so that old assets are renewed and reliability and aesthetics are improved.

This part of the undergrounding programme is seen as a lower priority than the projects surrounding the upgrade and relocation of the Doon Street substation to a new site proposed in Queens Park and has therefore been delayed until completion of this work so as to manage resources effectively.

$0.5M - $2.5M 2015/16 and 2016/17; CAPEX - Reliability, Safety and Environment.

4.8.2.6 Spare 33/11kV Transformer – Racecourse Road

It is estimated the 12MVA security trigger will be reached by 2016 meaning an additional transformer would be required on the EIL network to provide a firm supply from Racecourse Road so that current service levels are maintained. Racecourse Road will be the final substation to be upgraded to a dual transformer site and will require the purchase of a new 11.5/23MVA transformer. Load transfers on the 11kV network will be utilised to avoid the security trigger being avoided as long as possible.

An alternative option would be continued operation with a single transformer however as the level of demand increases the impact that a transformer failure would have on network reliability is considered to be unacceptable.

Cost $0.5M - $2.5M 2016/17; System growth.

4.8.2.7 Reliability, Environmental and Safety Projects

This is a small project to install temperature monitoring near the remaining sections of the oil cables to provide data to assist with estimating the ratings of these cables which have been de-rated temporarily. As mentioned in section 4.8.1.3 the cable trench backfill material is thought to be a sand of poor thermal characteristics which would affect the otherwise expected rating of these cables.

While the alternatives would be to risk operation at full rating or continue operation with the cables de-rated the cost of this exercise would be minor compared with the benefits of understanding the effective cable capacities.

Under $0.5M 2014/15; CAPEX – System growth.

4.8.3 Considered Projects

[Addresses handbook requirement 4.5.5(g)(iii)]

Projects expected for year six to ten (1 April 2017 to 31 March 2022) which include projects on-going as detailed above.

4.8.3.1 Unspecified Projects

The unspecified projects budget is an estimate of costs for projects that are as yet unknown but from experience are considered likely to arise in the longer term. Certainty for these estimates obviously quite low.

$0.5M - $2.5M 2017 per annum onwards; System Growth.

4.8.4 Contingent Projects

The following projects are contingent on uncertain events. These have been excluded from EIL's spend plans until they become certain.

4.8.4.1 Oil Refineries

Possible major new industry that may require a new substation and subtransmission lines, most likely would be connected onto the Transpower 220kV network.

4.8.5 Proposed Network Configuration

The planned network configuration in 2022 is shown in Figure 42.

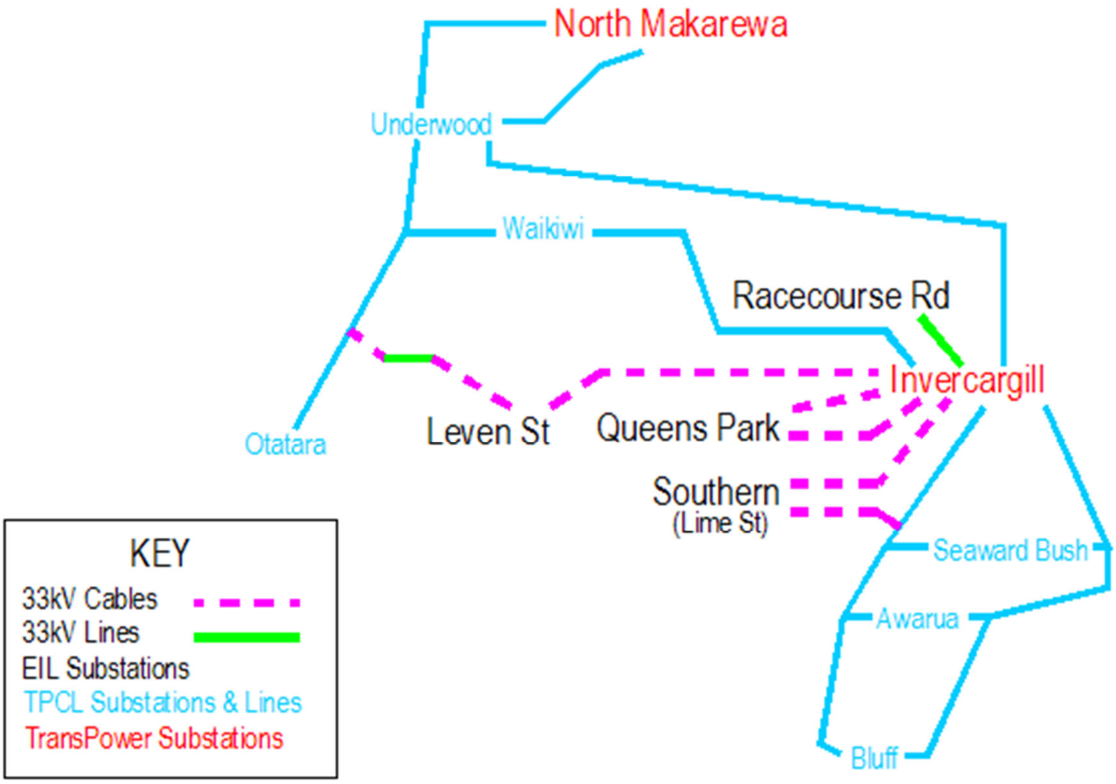


Figure 42: Proposed Network Configuration 2022

4.8.6 Capital Budget

The estimated capital budget for EIL is given below in Figure 43. Note the actual cost per project is not shown so as not to compromise the contractors' estimating and tendering processes.

CAPEX: Reliability, Safety and Environment	2012/13	2013/14	2014/15	2015/16	2016/17	2017/18	2018/19	2019/20	2020/21	2021/22
Earth Upgrades - City	-	-	-	-	-	-	-	-	-	-
Earth Upgrades - Bluff	-	-	-	-	-	-	-	-	-	-
Reactive Reliability Safety & Env	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
Bond OHUG	-	-	-	[redacted]	[redacted]	-	-	-	-	-
Reliability Safety and Env Projects	-	-	[redacted]	-	-	-	-	-	-	-
Siesmic Engineering Remedial Work	[redacted]	[redacted]	[redacted]	[redacted]	-	-	-	-	-	-
	85,800	85,800	91,800	1,012,800	988,800	61,800	61,800	61,800	61,800	61,800

CAPEX: Asset Relocation	2012/13	2013/14	2014/15	2015/16	2016/17	2017/18	2018/19	2019/20	2020/21	2021/22
Asset Relocation Projects	[redacted]	-	-	-	-	-	-	-	-	-
	312,952	-	-	-	-	-	-	-	-	-

CAPEX: Asset Replacement and Renewal	2012/13	2013/14	2014/15	2015/16	2016/17	2017/18	2018/19	2019/20	2020/21	2021/22
General Dist Replacement - City	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
General Dist Replacement - Bluff	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
LV Board Replacement	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
Link Box Replacement	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
Pillar Box Replacement	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
Reactive LV Cable Replacement	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
Zone Substation Minor Replacement	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
Transformer Replacement - City	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
Transformer Replacement - Bluff	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
Reactive 11 kV Cable Replacement	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
General Technical Replacement	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
CBD Switchgear Replacement	-	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	-
SCADA RTU Replacement	-	-	[redacted]	-	-	-	-	-	-	-
Switchboard Replacement - Southern	-	-	[redacted]	-	-	-	-	-	-	-
	1,670,174	1,766,174	2,361,374	2,145,374	1,545,374	1,665,374	1,665,374	1,665,374	1,545,374	1,425,374

CAPEX: System Growth	2012/13	2013/14	2014/15	2015/16	2016/17	2017/18	2018/19	2019/20	2020/21	2021/22
Supply Quality Upgrades - City	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
Supply Quality Upgrades - Bluff	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
Doon St Transformer Replacement	[redacted]	-	-	-	-	-	-	-	-	-
New Queens Park Substation	[redacted]	[redacted]	[redacted]	-	-	-	-	-	-	-
New Queens Park 33kV Cable	[redacted]	[redacted]	-	-	-	-	-	-	-	-
33 kV Oil Cable Extension	-	-	[redacted]	-	-	-	-	-	-	-
Spare 33/11kV TX (Southern)	-	-	[redacted]	-	-	-	-	-	-	-
Spare 33/11kV TX (Racecourse Road)	-	-	-	-	[redacted]	-	-	-	-	-
Unspecified Projects	-	-	-	-	-	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
	2,671,416	3,787,416	997,416	7,416	967,416	727,416	727,416	727,416	1,028,016	1,028,016

CAPEX: Customer Connections	2012/13	2013/14	2014/15	2015/16	2016/17	2017/18	2018/19	2019/20	2020/21	2021/22
Customer Connections - City	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
Customer Connections - Bluff	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
New Subdivisions	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
	192,001	192,001	192,001	192,001	192,001	192,001	192,001	192,001	192,001	192,001

Total Capital Expenditure	4,932,343	5,831,392	3,642,592	3,357,592	3,693,592	2,646,592	2,646,592	2,646,592	2,827,192	2,707,192

Figure 43: Capital Budget

5. Managing the Assets' Lifecycle

All physical assets have a lifecycle. This section describes how EIL manages assets over their entire lifecycle from "commissioning" to "retirement".

5.1 Lifecycle of the Assets

The lifecycle of EIL's existing assets is outlined in Figure 44 below:

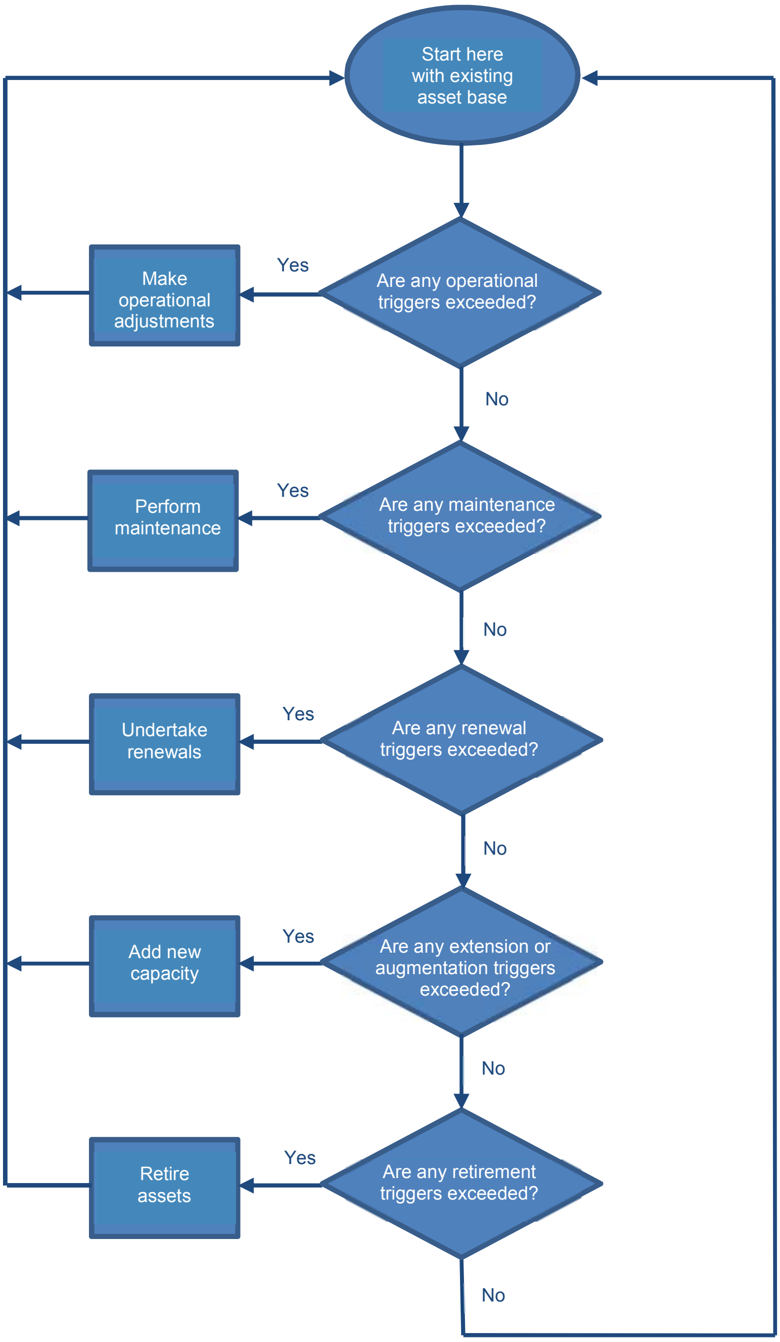


Figure 44: Asset Lifecycle

Table 37 provides some definitions for key lifecycle activities.

Table 37: Definition of key lifecycle activities

Activity	Detailed definition
Operations	Involves altering the operating parameters of an asset such as closing a switch or altering a voltage setting. Doesn't involve any physical change to the asset, simply a change to the assets configuration that it was designed for. In the case of electrical assets it will often involve doing nothing and just letting the electricity flow.
Maintenance	Involves replacing consumable components like the seals in a pump, the oil in a transformer or the contacts in a circuit breaker. Generally these components will be designed to wear out many times over the assets design lifecycle and continued operation of the asset will require such replacement. There may be a significant asymmetry associated with consumables such as lubricants in that replacing a lubricant may not significantly extend the life of an asset but not replacing a lubricant could significantly shorten the assets life.
Renewal	Generally involves replacing a non-consumable item like the housing of a pump with a replacement item of identical functionality (usually capacity). Such replacement is generally regarded as a significant mile-stone in the life of the asset and may significantly extend the life of the asset (a bit like "Grandpa's axe"). Renewal tends to dominate the Capital expenditure in low growth areas (Quadrant 1 of Figure 36) because assets will generally wear out before they become too small. The most typical criteria for renewal will be when the capitalised costs of operations and maintenance exceed the cost of renewal. A key issue with renewal is technological advances that generally make it impossible to replace assets such as SCADA with equivalent functionality.
Up-sizing	Generally involves replacing a non-consumable item like a conductor, busbar or transformer with a similar item of greater capacity but which does not increase the network footprint i.e. restricted to Quadrants 1 and 2 in Figure 36.
Extensions	Involves building a new asset where none previously existed because a location trigger in Table 27 has been exceeded e.g. building several spans of line to connect a new factory to an existing line. This activity falls within Quadrants 3 and 4 of Figure 36. Notwithstanding any surplus capacity in upstream assets, extensions will ultimately require Up-sizing of upstream assets.
Retirement	Generally involves removing an asset from service and disposing of it. Typical guidelines for retirement will be when an asset is no longer required, creates an unacceptable risk exposure or when its costs exceed its revenue.

5.2 Operating EIL's Assets

As outlined in Table 37 operations predominantly involves doing nothing and simply letting the electricity flow from the GXPs to customer's premises year after year with occasional intervention when a trigger point is exceeded (however the workload arising from tens of thousands of trigger points is substantial enough to merit a dedicated control room). As outlined in Figure 44 the first efforts to relieve excursions beyond trigger points are operational activities with typical activities listed in Table 38.

Table 38: Typical responses to operational triggers

Asset class	Trigger event	Response to event	Approach
GXP	Voltage is too high or low on 33kV or 11kV.	Automatic operation of tap changer.	Reactive
	Demand exceeds allocated Transpower limit.	Activate ripple injection plant to switch off load control relays.	Reactive
		Move zone substations between GXPs to relieve load from highly loaded GXP.	Reactive
	Transition from day to night.	Activate ripple injection plant to switch street lights on or off.	Proactive
	On-set of off-peak tariff periods.	Activate ripple injection plant to switch controlled loads on or off.	Proactive
Zone substation transformers	Voltage is too high or low on 11kV.	Automatic operation of tap changer.	Reactive
	Demand exceeds rating.	Move tie points to relieve load from zone sub.	Reactive
Distribution reclosers	Fault current exceeds threshold.	Automatic operation of recloser.	Reactive
Distribution ABSs	Component current rating exceeded.	Open & close ABSs to shift load.	Proactive or reactive
	Fault has occurred.	Open & close ABSs to restore supply.	Reactive
Distribution transformers	Voltage is too high or low on LV.	Manually raise or lower tap where fitted.	Reactive
	Fuses keep blowing.	Shift load to other transformers by cutting and reconnecting LV jumpers.	Reactive
LV distribution	Voltage is too low at customer's board.	Supply from closer transformer if possible by cutting and reconnecting LV jumpers.	Reactive

Table 39 outlines the key operational triggers for each class of EIL's assets. Note that whilst temperature triggers will usually follow demand triggers they may not always. For example an overhead conductor joint might get hot because it is loose or rusty rather than overloaded.

Table 39: Operational triggers

Asset category	Voltage trigger	Demand trigger	Temperature trigger
LV lines and cables	Voltage routinely drops too low to maintain at least 0.94pu at customers switchboards. Voltage routinely rises too high to maintain no more than 1.06pu at customers switchboards.	Customer's pole or pillar fuse blows repeatedly.	Infra-red survey reveals hot joint.
Distribution substations	Voltage routinely drops too low to maintain at least 0.94pu at customers switchboards. Voltage routinely rises too high to maintain no more	Load routinely exceeds rating where MDIs are fitted. LV fuses blow	Infra-red survey reveals hot connections.

	than 1.06pu at customers switchboards.	repeatedly. Short term loading exceeds guidelines in IEC 354.	
Distribution lines and cables		Alarm from SCADA that current has exceeded a setpoint.	Infra-red survey reveals hot joint.
Zone substations	Voltage drops below level at which OLTC can automatically raise or lower taps.	Load exceeds guidelines in IEC 354.	Top oil temperature exceeds manufacturer's recommendations. Core hot-spot temperature exceeds manufacturer's recommendations.
Subtransmission lines and cables	Alarm from SCADA that voltage is outside of allowable setpoints.	Alarm from SCADA that current is over allowable setpoint.	Infra-red survey reveals hot joint.
EIL equipment within GXP	Alarm from SCADA that voltage is outside of allowable setpoints.	Alarm from SCADA that current is over allowable setpoint.	Infra-red survey reveals hot joint.

5.3 Maintaining EIL's Assets

As described in Table 37 maintenance is primarily about replacing consumable components. Examples of the way in which consumable components "wear out" include the oxidation or acidification of insulating oil, pitting or erosion of electrical contacts and wearing of pump seals. Continued operation of such components will eventually lead to failure as indicated in Figure 45 below. Failure of such components is usually based on physical characteristics and exactly what leads to failure may be a complex interaction of parameters such as quality of manufacture, quality of installation, age, operating hours, number of operations, loading cycle, ambient temperature, previous maintenance history and presence of contaminants – note that the horizontal axis in Figure 45 is not simply labelled "time".

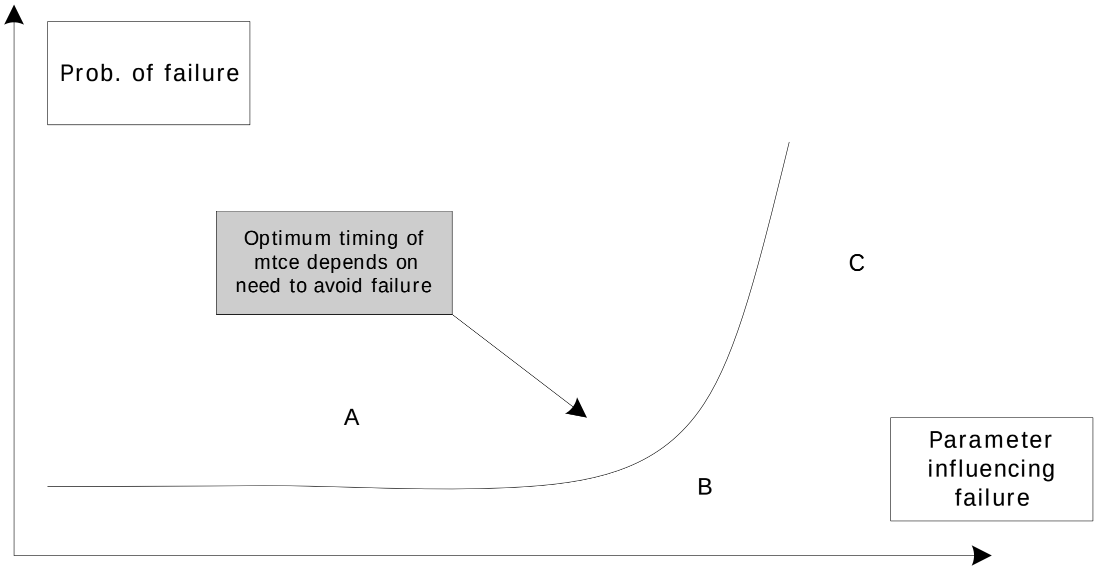


Figure 45: Component Failure

Exactly when maintenance is performed will be determined by the need to avoid failure. For instance the need to avoid failure of a 10kVA transformer supplying a single customer is low; hence it might be operated out to point C in Figure 45 whilst a 66/11kV substation transformer may only be operated to point B due to a higher need to avoid failure. In the extreme case of, say, turbine blades in an aircraft engine it would be desirable to avoid even the slightest probability of failure hence the blades may only be operated to point A. The obvious trade-off with avoiding failure is the increased cost of labour and consumables over the assets lifecycle along with the cost of discarding unused component life.

Like all EIL's other business decisions, maintenance decisions are made on cost-benefit criteria with the principal benefit being avoiding supply interruption. The practical effect of this is that assets supplying large customers or numbers of customers will be extensively condition monitored to avoid supply interruption whilst assets supplying only a few customers such as a 10kVA transformer will more than likely be run to breakdown. The maintenance strategy map in Figure 46 broadly identifies the maintenance strategy adopted for various ratios of costs and benefits.

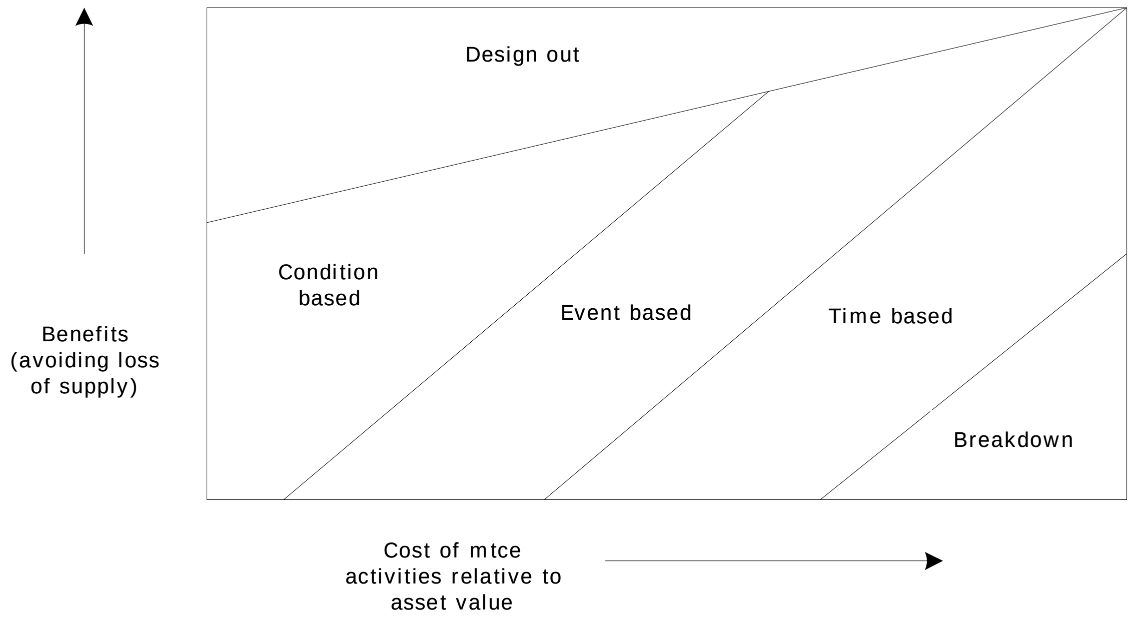


Figure 46: Maintenance Strategy Map

This map indicates that where the benefits are low (principally there is little need to avoid loss of supply) and the costs of maintenance are relatively high, an asset should be run to breakdown. As the value of an asset and the need to avoid loss of supply both increase, the company relies less and less on easily observable proxies for actual condition (such as calendar age, running hours or number of trips) and more and more on actual component condition (through such means as DGA of transformer oil).

Component condition is the key trigger for maintenance; however the precise conditions that trigger maintenance are very broad, ranging from oil acidity to dry rot. Table 40 describes the maintenance triggers adopted:

Table 40: Maintenance Triggers

Asset category	Components	Maintenance trigger
LV lines and cables Five yearly inspection	Poles, arms, stays and bolts	Evidence of dry-rot. Loose bolts, moving stays. Displaced arms.
	Pins, insulators and binders	Obviously loose pins. Visibly chipped or broken insulators. Visibly loose binder.
	Conductor	Visibly splaying or broken conductor.
Distribution substations Five yearly inspection Six monthly for sites >150kVA	Poles, arms and bolts	Evidence of dry-rot. Loose bolts, moving stays. Displaced arms.
	Enclosures	Visible rust. Cracked or broken masonry.
	Transformer	Excessive oil acidity (500kVA or greater). Visible signs of oil leaks. Excessive moisture in breather. Visibly chipped or broken bushings.
	Switches and fuses	Visible rust. Oil colour. Visible signs of oil leak.

Distribution lines and cables Five yearly inspection	Poles, arms, stays and bolts	Evidence of dry-rot. Loose bolts, moving stays. Displaced arms.
	Pins, insulators and binders	Loose tie wire. Chipped or cracked insulator.
	Conductor	Loose or pitted strands. Visible rust.
	Ground-mounted switches	Visible rust. Oil colour. Visible signs of oil leak.
	Regulators	Visible rust. Oil colour. Visible signs of oil leak. Excessive moisture in breather. High Dissolved Gas Analysis results.
Zone substations Monthly checks	Fences and enclosures	Weeds. Visible rust. Gaps in fence.
	Buildings	Flaking paint. Timber rot. Cracked or broken masonry.
	Bus work and conductors	Hot spot detected by Infrared detector. Corrosion of metal or fittings.
	33kV switchgear	Visible rust. Operational count exceeded. Low oil breakdown.
	Transformer	Visible rust. High Dissolved Gas Analysis results (Annual test). Low oil breakdown. High oil acidity.
	11kV switchgear	Visible rust. Operational count exceeded. Low oil breakdown.
	Instrumentation/protection Electromechanical three yearly Electronic five yearly	Maintenance period exceeded. Possible mal-operation of device.
	Batteries Six monthly test	Discharge test or Impedance test.
Substation-transmission lines and cables Five yearly inspection	Poles, arms, stays and bolts	Evidence of dry-rot. Loose bolts, moving stays. Displaced arms.
	Pins, insulators and binders	Loose tie wire. Chipped or cracked insulator.
	Conductor	Loose or pitted strands. Visible rust.
	Cable Annual check	High Partial discharge detected. Sheath insulation short. Oil pressure declining.
Our equipment within GXP Monthly check	Injection plant	Alarm from failure ripple generation. Period exceed for checks.

Typical maintenance policy responses to these trigger points are described in Table 41.

Table 41: Typical responses to maintenance triggers

Asset class	Trigger point	Response to trigger	Approach
Subtransmission lines	Loose or displaced components	Tighten or replace	Condition as revealed by annual inspection
	Rotten or spalled poles	Brace or bandage pole unless renewal is required	Condition as revealed by annual inspection
	Cracked or broken insulator	Replace as required	Breakdown
	Splaying or broken conductor	Repair conductor unless renewal is required	Condition as revealed by annual inspection
GXP and zone substation transformers	Oil acidity	Filter oil	Condition as revealed by annual test
	Excessive moisture in breather	Filter oil	Condition as revealed by monthly inspection
	Weighted number of through faults	Filter oil, possibly de-tank and refurbish	Event driven
	General condition of external components	Repair or replace as required	Condition as revealed by monthly inspection
Distribution lines	Loose or displaced components	Tighten or replace	Condition as revealed by three yearly inspection
	Rotten or spalled poles	Brace or bandage pole unless renewal is required	Condition as revealed by three yearly inspection
	Cracked or broken insulator	Replace as required	Breakdown
	Splaying or broken conductor	Repair conductor unless renewal is required	Condition as revealed by three yearly inspection
Distribution reclosers	Weighted number of light and heavy faults	Repair or replace contacts, filter oil if applicable	Event driven
Distribution ABS's	Loose or displaced supporting components	Tighten or replace unless renewal is required	Condition as revealed by three yearly inspection
	Seized or tight	Lubricate or replace components as required	Breakdown
Distribution transformers	Loose or displaced supporting components	Tighten or replace unless renewal is required	Condition as revealed by three yearly inspection
	Rusty, broken or cracked enclosure where fitted	Make minor repairs unless renewal is required	Condition as revealed by three yearly inspection
	Oil acidity	Filter oil	Remove from service for full overhaul every 15 years
	Excessive moisture in breather where fitted	Filter oil	Condition as revealed by three yearly inspection
	Visible oil leaks	Remove to workshop for repair or renewal if serious	Condition as revealed by three yearly inspection
	Chipped or broken bushings	Replace	Breakdown or condition as revealed by three

			yearly inspection
LV lines	Loose or displaced components	Tighten or replace	Breakdown unless revealed by five yearly inspection
	Rotten or spalled poles	Brace or bandage pole unless renewal is required	Five yearly inspection
	Cracked or broken insulator	Replace as required	Breakdown unless revealed by five yearly inspection
	Splaying or broken conductor	Repair conductor unless renewal is required	Breakdown unless revealed by five yearly inspection

The frequency and nature of the response to each of the above triggers are embodied in EIL's policies and work plans.

5.3.1.1 Systemic Faults

EIL has been made aware of a potential systemic weakness in the 33kV oil filled cables which supply Doon and Southern substations. Similar cables on other distribution company's networks have been found showing signs of insulation damage due to weakness in the cable joints allowing movement of the cores with thermodynamic expansion and contraction.

The Doon Street relocation project proposes the new site be located in Queens Park after which the parts of the oil cables from St Andrew Street to the existing Doon St site will become redundant. A condition assessment of the redundant cable lengths, including analysis of a sample of the paper insulation for aging and inspection of cable joints for movement damage, can be carried out and used to indicate the condition and remaining life of the remaining cables lengths.

There are no other projects presently investigating systemic failures.

Examples of past investigations and outcomes are shown below. Some of these examples may represent learning's from issues found on other networks managed by PowerNet but which are common to the EIL network.

- Kidney strain insulators: Replaced with new polymer strains.
- DIN LV fuses: Sourced units that can be used outdoor.
- Parallel-groove clamps: Replaced with compression joints.
- Non-UV stabilised insulation: Exposed LV now has sleeve cover, with new cables UV stabilised.
- Opossum faults: Extended opossum guard length.

5.3.2 Inspection, Monitoring and Routine Maintenance

[Addresses handbook requirement 4.5.6(b)]

Each maintenance trigger has a related inspection period listed in Table 40, i.e. zone substations are checked each month.

Monitoring of assets includes the following areas:

- Statistic data collection of loading data on substations and large transformers.
- Protection relay testing / checks.

- Earthing checks.
- DGA of transformer oil.
- Partial discharge and infrared survey of substations and major distribution equipment.
- Injection plant tuning checks.
- Supply quality checks.

The on-going maintenance of assets is also covered by this budget. Items covered include:

- Lubrication of ABS's.
- Cleaning of air insulated switchgear.
- Battery replacements.
- Rust repairs and painting.
- TCOL and CB service.
- Minor customer connections.

OPEX on this is budgeted at $0.94 million per annum.

5.3.3 Fault Restoration and Repairs

Fault and emergency maintenance provides for the provision of staff, plant and resources to be ready for faults and/or emergencies. This resource attends and makes the area safe, then may isolate the faulty section so other customers are restored or undertake quick repairs to restore supply to all customers. Note all repairs after three hours are then covered in the routine maintenance budget.

OPEX on this is budgeted at $0.54 million per annum.

5.4 EIL's Maintenance Policies

[Addresses handbook requirement 4.5.6(c)]

EIL's maintenance policies are embodied in the PowerNet standards PNM-97, PNM-99 and PNM-105 which broadly follow manufacturer's recommendations but tend to be modified by industry experience.

5.5 Renewing EIL's Assets

[Addresses handbook requirement 4.5.6(d) and (e)]

Work is classified as renewal if there is no change (and such change would usually be an increase) in functionality i.e. the output of any asset doesn't change. EIL's key criterion for renewing an asset is when the capitalised operations and maintenance costs exceed the renewal cost and this can occur in a number of ways:

- Operating costs become excessive e.g. addition of inputs to a SCADA system requires an increasing level of manning.
- Maintenance costs begin to accelerate away e.g. a transformer needs more frequent oil changes as the seals and gaskets perish.

- Supply interruptions due to component failure become excessive; what constitutes "excessive" will be a matter of judgment which will include the number and nature of customers affected.
- Renewal costs decline, particular where costs of new technologies for assets like SCADA decrease by several fold.

Table 42 below lists EIL's renewal triggers for key asset classes.

Table 42: Renewal Triggers

Asset category	Components	Renewal trigger
LV lines and cables	Poles	• Fails pole test. • Failure due to external force.
	Pins, insulators and binders	• Done with pole renewal.
	Conductor	• Excessive failures. • Multiple joints in a segment
Distribution substations	Poles	• Failure due to pole test. • Failure due to external force.
	Enclosures	• Uneconomic to maintain.
	Transformer	• Excessive rust. • Old technology, pre-1970 core. • Not economical to maintain.
	Switches and fuses	• Not economical to maintain.
Distribution lines and cables	Poles	• Fails pole test. • Failure due to external force.
	Pins, insulators and binders	• Done with pole renewal.
	Conductor	• Excessive failures. • Multiple joints in a segment.
	Ground-mounted switches	• Not economical to maintain. • No source of spare parts. • If not able to be remote controlled.
	Regulators	• Not economical to maintain. • No spare parts. • Greater than Standard Life and maintenance required.
Zone substations	Fences and enclosures	• Not economical to maintain.
	Buildings	• Not economical to maintain.
	Bus work and conductors	• Not economical to maintain.
	33kV switchgear	• Not economical to maintain. • No spare parts. • Greater than Standard Life and maintenance required.
	Transformer	• Not economical to maintain. • No spare parts. • Greater than 1.2 Standard Life and maintenance required.
	11kV switchgear	• Not economical to maintain. • No spare parts. • Greater than Standard Life and maintenance required.
	Bus work and conductors	• Not economical to maintain.
	Instrumentation/Protection	• Not economical to maintain. • No spare parts. • Greater than Standard Life and maintenance required.
	Batteries	• Prior to manufacturers' stated life.

		• On failure of testing.
Subtransmission lines and cables	Poles,	• Not economical to maintain. • Fails pole test. • Failure due to external force.
	Pins, insulators and binders	• Not economical to maintain.
	Conductor	• Not economical to maintain. • Excessive joints in a segment
	Cables	• Not economical to maintain.
Our equipment within GXP		• Not economical to maintain.

Broad polices for renewing all classes of assets are:

- When an asset is likely to create an operational or public safety hazard.
- When the capitalised operations and maintenance costs exceed the likely renewal costs.
- When continued maintenance is unlikely to result in the required service levels.

5.5.1 Current Renewal Projects

[Addresses handbook requirement 4.5.6(d)(i)]

Renewal projects planned to year end 31 March 2012.

5.5.1.1 General Dist Replacement

On-going replacements of distribution assets other than cables. These are identified through routine inspection.

Cost Under $0.5M 2011/12; CAPEX – Asset Replacement and Renewal

5.5.1.2 LV Board Replacement

Replacement of hazardous old LV distribution boards with modern touch safe boards – on-going for 10 years.

Cost Under $0.5M 2011/12; CAPEX – Asset Replacement and Renewal

5.5.1.3 Link Box Replacement

On-going replacement of link boxes which have deteriorated with age or have been damaged and are unfit for service or unsafe.

Cost Under $0.5M 2011/12; CAPEX – Asset Replacement and Renewal

5.5.1.4 Pillar Box Replacement

On-going replacement of pillar boxes which have deteriorated with age or have been damaged and are unfit for service or unsafe.

Cost Under $0.5M 2011/12; CAPEX – Asset Replacement and Renewal

5.5.1.5 Reactive LV Cable Replacement

On-going replacement of 11kV cables as identified by condition after fault occurrence.

Cost Under $0.5M 2011/12; CAPEX – Asset Replacement and Renewal

5.5.1.6 Zone Substation Minor Replacement

On-going replacement of minor components at zone substations such as LTAC panels and battery banks.

Cost Under $0.5M 2011/12; CAPEX – Asset Replacement and Renewal

5.5.1.7 Transformer Replacement

On-going replacements of distribution transformers which are generally identified during distribution inspections and targeted inspections based on age. Some removed units are refurbished.

Cost Under $0.5M 2011/12; CAPEX – Asset Replacement and Renewal

5.5.1.8 Reactive 11kV Cable Replacement

On-going replacement of 11kV cables as identified by condition after fault occurrence.

Cost Under $0.5M 2011/12; CAPEX – Asset Replacement and Renewal

5.5.1.9 General Technical Replacement

On-going replacement of RMUs and other switchgear as they reach end of life and risk of failure increases at distribution substations outside of the CBD area to maintain reliability of supply and safety in the vicinity of the substation.

Cost Under $0.5M 2011/12; CAPEX – Asset Replacement and Renewal

5.5.1.10 Routine Distribution Inspections, Checks & Maintenance

Five yearly network inspections (20% inspected annually), other routine tests and minor maintenance works on distribution assets.

Cost Under $0.5M 2011/12; OPEX – Routine and Preventative Maintenance

5.5.1.11 Minor Work Distribution Inspections, Checks & Maintenance

Generally reactive work undertaken to correct issues found during the routine distribution inspection. Also a general budget for all minor distribution work.

Cost Under $0.5M 2011/12; OPEX – Routine and Preventative Maintenance

5.5.1.12 Vegetation Control

On-going tree trimming in the vicinity of overhead network to prevent contact with lines maintaining network reliability, mainly in the Bluff area.

Cost Under $0.5M 2011/12; OPEX – Routine and Preventative Maintenance

5.5.1.13 Earth Testing

Routine testing of earthing assets and connections to ensure safety and functional requirements are met.

Cost Under $0.5M 2011/12; OPEX – Routine and Preventative Maintenance

5.5.1.14 Routine Technical Inspections, Checks & Maintenance

Routine inspection and testing of assets at zone substations. Includes such things as oil DGA, breakdown, moisture and acidity, operation counts, protection testing etc. Also covers responses to maintenance triggers, such as oil processing or recalibration of relays.

Cost Under $0.5M 2011/12; OPEX – Routine and Preventative Maintenance

5.5.1.15 Minor Work Technical Inspections, Checks & Maintenance

Generally reactive work undertaken to correct issues found during the routine technical inspection. Also a general budget for all minor technical work.

Cost Under $0.5M 2011/12; OPEX – Routine and Preventative Maintenance

5.5.1.16 Condition and Data Assessment

A thorough assessment of network equipment and sites aimed at capturing more detailed data which will enable greater degrees of planning based on a better understanding of network condition. This is in addition to the routine technical and distribution inspections, checks and maintenance budgets which are essentially reactive and cover items which if neglected could quickly lead to premature equipment failure.

Cost Under $0.5M 2011/12; OPEX – Routine and Preventative Maintenance

5.5.1.17 Partial Discharge Survey

Routine partial discharge condition monitoring surveying of subtransmission cables, terminations and equipment to identify abnormal discharge levels before failure occurs.

Cost Under $0.5M 2011/12; OPEX – Routine and Preventative Maintenance

5.5.1.18 General Substation and RMU Maintenance

Routine maintenance at distribution substation assets including RMUs such as cleaning, paint touch-ups and enclosure repairs.

Cost Under $0.5M 2011/12; OPEX – Routine and Preventative Maintenance

5.5.1.19 General Zone Substation Maintenance

Routine maintenance at zone substations such as grounds, fence and building maintenance, rust repair and paint touch-ups.

Cost Under $0.5M 2011/12; OPEX – Routine and Preventative Maintenance

5.5.1.20 Supply Quality Checks

Investigations into supply quality which are generally customer initiated.

Cost Under $0.5M 2011/12; OPEX – Routine and Preventative Maintenance

5.5.1.21 Spare Checks and Minor Maintenance

A budget for checks to confirm what equipment is kept in spares and perform minor maintenance required to ensure spares are ready for service – on-going but at a reduced budget in future years.

Cost Under $0.5M 2011/12; OPEX – Routine and Preventative Maintenance

5.5.1.22 Seismic Checks

A one off budget to perform checks to determine what remedial strengthening work is required to ensure seismic requirements are met for network equipment.

Cost Under $0.5M 2012/13 – 2015/16; OPEX – Routine and Preventative Maintenance

5.5.1.23 General Distribution Refurbishment

Refurbishment works for plant other than that located at distribution substations which won't impact on the valuation of the distribution asset. Covers items like crossarms, insulators, strains, re-sagging lines, stay guards, straightening poles, pole caps, ABS handle replacements etc.

Cost Under $0.5M 2012/13; OPEX – Refurbishment and Renewal Maintenance

5.5.1.24 Transformer Refurbishment

Refurbishment of distribution transformers such as rust repairs, paint touch-up, oil renewal, replacement of minor parts such as bushings, seals etc.

Cost Under $0.5M 2012/13; OPEX – Refurbishment and Renewal Maintenance

5.5.1.25 Zone Substation Refurbishment

A budget to allow refurbishment works that won't impact on the valuation of the substation assets. Covers items like earth sticks, safety equipment, buildings, battery systems etc.

Cost Under $0.5M 2012/13; OPEX – Refurbishment and Renewal Maintenance

5.5.1.26 General Technical Refurbishment

Refurbishment works at distribution substations that won't impact on the valuation of the asset. Identified through routine inspection.

Cost Under $0.5M 2012/13; OPEX – Refurbishment and Renewal Maintenance

5.5.1.27 Incident Response

Initial response up to three hours for safety, isolation and onsite repairs after fault occurrence.

Cost Under $0.5M 2012/13; OPEX – Fault and Emergency Maintenance

5.5.2 Planned Projects

[Addresses handbook requirement 4.5.6(d)(ii)]

The following projects have been planned for the next two to five year period.

5.5.2.1 CBD Switchgear Replacements

Replacement of switchgear as it reaches end of life and risk of failure increases at distribution substations in the CBD area. This ensures acceptable service levels are maintained. Circuit breakers as well as RMUs are utilised in the CBD for added security.

Space limitations in the CBD have required substations to be often located underground or below buildings meaning an increased public safety risk where, for example, a fire may result from failure of switchgear.

Various manufacturers provide options for replacement which will be assessed for functional requirements and price. As the underground CBD substations are difficult to access for major work requiring opening of the pavement in a busy public area a programme to replace equipment and renew these sites will be initiated in 2013/14 which in addition to switchgear will incorporate transformers and other minor site equipment which are typically of a similar vintage and due for replacement. Review of fire protection requirements and appropriate upgrades will also be undertaken. This programme is expected to be completed toward the end of the ten year planning period.

Cost Under $0.5M 2012/13, Under $0.5M 2013/14; CAPEX – Asset Replacement and Renewal.

5.5.2.2 SCADA RTU Replacement

Present GPT mini RTU units are just beyond expected end of life and are becoming less reliable. Full remote operation is required to meet the service levels which would be affected through loss of control of network equipment and quality of operational data capture would suffer. Replacement of RTU's with modern units would provide greater reliability and added functionality.

Renewal could be brought forward if reliability reduces to unacceptable levels but will otherwise be included in the CBD underground substation renewal programme mentioned in section 5.5.2.1 above.

Under $0.5M 2014/15; Asset Replacement and Renewal.

5.5.2.3 Switchboard Replacements - Southern

Replacement of the 11kV switchboard at Southern substation which has reached expected end of life.

Risk of failure increases as the switchboards reach expected end of life impacting on reliability of supply in parts of the network and on safety within the substation. Consequences of failure are too great to risk the old switchgear remaining in service.

Various manufacturers provide options for replacement which will be assessed against functional requirements and price.

Cost $0.5M - $2.5M 2014/15; CAPEX – Asset Replacement and Renewal

5.5.2.4 Doon Street Site Reinstatement and Oil Cable Clean Up

Reinstatement of the existing Doon Street substation site as required for return to the Council following completion of the substation relocation and upgrade project as detailed in section 4.8. This work will include work to ensure the redundant 33kV oil cable sections are either removed and disposed of appropriately or otherwise drained and cleaned up sufficiently so that abandoning the cables in the ground does not cause an adverse effect on the environment.

Cost Under $0.5M 2014/15; OPEX – Routine and Preventative Maintenance

5.5.2.5 Oil Filled Cable Maintenance

A one off budget aimed at assessing the condition and remaining life of the 33kV oil filled cables which will continue to supply the new substation relocated from Doon Street through inspection and analysis of the redundant cable sections as discussed in section 4.8.1.3.

Cost Under $0.5M 2014/15; OPEX – Routine and Preventative Maintenance

5.5.2.6 Meter Certification

Meter recertification carried out three yearly; next due in 2013/14.

Cost Under $0.5M 2013/14 and 3 yearly thereafter; OPEX – Asset Replacement and Renewal.

5.5.3 Future Projects

No future projects are expected in the six to ten year planning horizon.

5.5.4 Renewal Budget

CAPEX renewals are budgeted in the capital budget, see section 4.8.6.

5.6 Up-sizing or Extending EIL's Assets

If any of the capacity triggers in Table 27 are exceeded consideration is given to either Up-sizing or extending EIL's network. These two modes of investment are however, quite different as described in Table 43 below.

Table 43: Distinguishing Between Up-sizing and Extension

Characteristic	Up-sizing	Extension
Location	Within or close to existing network footprint (within a span or so).	Outside of existing network footprint (more than a couple of spans).
Load	Can involve supply to a new connection within the network	Almost always involves supply to a new connection.

	footprint or increasing the capacity to an existing connection.	
Upstream reinforcement	Generally forms the focus of Up-sizing.	May not be required unless upstream capacity is constrained.
Visible presence	Generally invisible.	Obviously visible.
Quadrant in Figure 36	Either 1 or 2 depending on rate of growth.	Either 3 or 4 depending on rate of growth.
Necessity	Possible to avoid if sufficient surplus capacity exists. Possible to avoid or defer using tactical approaches described in section 4.2.1.	Generally can't be avoided – a physical connection is required.
Impact on revenue	Difficult to attribute revenue from increased connection number or capacity to augmented components.	Generally results in direct contribution to revenue from the new connection at the end of the extension.
Impact on costs	Cost and timing can vary and be staged.	Likely to be significant and over a short time.
Impact on ODV	Could be anywhere from minimal to high.	Could be significant depending on length of extension and any consequent Up-sizing required.
Impact on profit	Could be anywhere from minimal to high.	Could be minimal depending on level of customer contribution.
Means of cost recovery	Most likely to be spread across all customers as part of on-going line charges.	Could be recovered from customers connected to that extension by way of capital contribution.
Nature of work carried out	Replacement of components with greater capacity items.	Construction of new assets.

Despite the different nature of Up-sizing and extension work, similar design and build principles are used as described in sections 5.6.1 and 5.6.2.

5.6.1 Designing New Assets

EIL uses a range of technical and engineering standards to achieve an optimal mix of the following outcomes:

- Meet likely demand growth for a reasonable time horizon including such issues as modularity and scalability.
- Minimise over-investment.
- Minimise risk of long-term stranding.
- Minimise corporate risk exposure commensurate with other goals.
- Maximise operational flexibility.
- Maximise the fit with soft organisational capabilities such as engineering and operational expertise and vendor support.
- Comply with sensible environmental and public safety requirements.

Given the fairly simple nature of EIL's network standardised designs are adopted for all asset classes with minor site-specific alterations. These designs, however, will embody the wisdom and experience of current standards, industry guidelines and manufacturers recommendations.

5.6.2 Building New Assets

EIL uses external contractors to augment or extend assets. As part of the building and commissioning process EIL's information records will be "as-built" and all testing documented.

5.7 Enhancing Reliability

Although enhancing reliability does not neatly fit into the life-cycle model, EIL believes that enhancing reliability is strategically significant enough in reshaping the business platform to merit inclusion in the AMP. As described in Section 3.2.1 customers prefer to receive about the same reliability in return for paying about the same line charges, so it is acknowledged that there is no mandate to go improving reliability just because it can be improved, even if EIL doesn't need to increase line charges to do it. However there are many factors that will lead to a decline in reliability over time:

- Tree re-growth.
- Declining asset condition (especially in coastal marine areas).
- Extensions to the network that increase its exposure to trees and weather.
- Increased customer numbers that increase the lost customer-minutes for a given fault.
- Installation of customer requested asset alterations that can reduce reliability (e.g. needing to lock out reclosers on feeders that have embedded generation).

EIL believes it is necessary to offset these impacts in order to maintain reliability; hence a reliability enhancement program using an approach that embodies the following steps has been developed:

- Identifying the customer-minutes lost for each asset by cause.
- Identifying the scope and likely cost of reducing those lost customer-minutes.
- Estimating the likely reduction in lost customer-minutes if the work scope was to be implemented.
- Calculating the cost per customer-minute of each enhancement opportunity.
- Prioritising the enhancement opportunities from lowest cost to highest. EIL expects the incremental cost of regaining lost customer-minutes will accelerate away at some point which will set an obvious limit to implementing opportunities.

5.8 Converting Overhead to Underground

Conversion of overhead lines to underground cable is also an activity that doesn't fit neatly within the asset life-cycle because it tends to be driven more by the need to beautify areas rather than for asset-related reasons (which doesn't really fit the renewal or up-sizing triggers). As such, conversion tends to rely on other utilities cost sharing or local communities funding the work.

5.9 Retiring of EIL's assets

Retiring assets generally involves doing most or all of the following activities:

- De-energising the asset.
- Physically disconnecting it from other live assets.
- Curtailing the assets revenue stream.
- Removing it from the ODV.
- Either physical removal of the asset from location or abandoning in-situ (typically for underground cables).
- Disposal of the asset in an acceptable manner particularly if it contains SF6, oil, lead or asbestos.

Key criteria for retiring an asset include:

- Its physical presence is no longer required (usually because a customer has reduced or ceased demand).
- It creates an unacceptable risk exposure, either because its inherent risks have increased over time or because emerging trends of safe exposure levels are declining. Assets retired for safety reasons will not be re-deployed or sold for re-use.
- Where better options exist to create similar outcomes (e.g. replacing lubricated bearings with high-impact nylon bushes) and there are no suitable opportunities for re-deployment.
- Where an asset has been augmented and no suitable opportunities exist for re-deployment.

5.10 EIL's Maintenance Budget

Estimated expenditure on maintaining the assets are given in Figure 47. Target is maintaining the ratio of maintenance under 4.0% of the total network replacement cost. This budget covers both Operation and Maintenance areas.

OPEX: Routine and Preventative Maintenance	2012/13	2013/14	2014/15	2015/16	2016/17	2017/18	2018/19	2019/20	2020/21	2021/22
Routine Dist Insp Check & Maint - City	19,750	19,750	19,750	19,750	19,750	19,750	19,750	19,750	19,750	19,750
Minor Work Dist Insp Check & Mtce - City	113,000	113,000	113,000	113,000	113,000	113,000	113,000	113,000	113,000	113,000
Routine Dist Insp, Check & Maint - Bluff	6,000	6,000	6,000	6,000	6,000	6,000	6,000	6,000	6,000	6,000
Minor Work Dist Insp Check & Mtce - Bluff	41,200	41,200	41,200	41,200	41,200	41,200	41,200	41,200	41,200	41,200
Vegetation Control - City	2,000	2,000	2,000	2,000	2,000	2,000	2,000	2,000	2,000	2,000
Vegetation Control - Bluff	1,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000
Earth Testing - City	14,760	14,760	14,760	14,760	14,760	14,760	14,760	14,760	14,760	14,760
Earth Testing - Bluff	5,063	5,063	5,063	5,063	5,063	5,063	5,063	5,063	5,063	5,063
Routine Tech Insp Check & Mtce - City	60,000	60,000	60,000	60,000	60,000	60,000	60,000	60,000	60,000	60,000
Minor Work Tech Insp Check & Mtce - City	203,940	203,940	203,940	203,940	203,940	203,940	203,940	203,940	203,940	203,940
Routine Tech Insp Check & Maint - Bluff	1,030	1,030	1,030	1,030	1,030	1,030	1,030	1,030	1,030	1,030
Minor Work Tec Insp Check & Mtce - Bluff	2,060	2,060	2,060	2,060	2,060	2,060	2,060	2,060	2,060	2,060
Condition and Data Assessment	140,000	140,000	140,000	140,000	140,000	140,000	140,000	140,000	140,000	140,000
Partial Discharge Survey	25,000	25,000	25,000	25,000	25,000	25,000	25,000	25,000	25,000	25,000
General Substation Maintenance	47,380	47,380	47,380	47,380	47,380	47,380	47,380	47,380	47,380	47,380
General RMU Maintenance	181,692	181,692	181,692	181,692	181,692	181,692	181,692	181,692	181,692	181,692
General Zone Substation Maintenance	41,715	41,715	41,715	41,715	41,715	41,715	41,715	41,715	41,715	41,715
Oil Filled Cable Maintenance	-	-	10,000	-	-	-	-	-	-	-
Doon Site Reinstate & Oil cable cleanup	-	-	80,000	-	-	-	-	-	-	-
Meter Certification	-	8,300	-	-	8,300	-	-	8,300	-	-
Supply Quality Checks - City	2,060	2,060	2,060	2,060	2,060	2,060	2,060	2,060	2,060	2,060
Supply Quality Checks - Bluff	1,030	1,030	1,030	1,030	1,030	1,030	1,030	1,030	1,030	1,030
Spares Checks and Minor Maintenance	9,013	3,500	3,500	3,500	3,500	3,500	3,500	3,500	3,500	3,500
Seismic Checks	20,000	20,000	20,000	20,000	-	-	-	-	-	-
Connections Minor Work - City	6,000	6,000	6,000	6,000	6,000	6,000	6,000	6,000	6,000	6,000
Connections Minor Work - Bluff	500	500	500	500	500	500	500	500	500	500
	944,193	**946,980**	**1,028,680**	**938,680**	**926,980**	**918,680**	**918,680**	**926,980**	**918,680**	**918,680**

OPEX: Refurbishment and Renewal Maintenance	2012/13	2013/14	2014/15	2015/16	2016/17	2017/18	2018/19	2019/20	2020/21	2021/22
General Dist Refurbishment - City	30,900	30,900	30,900	30,900	30,900	30,900	30,900	30,900	30,900	30,900
General Dist Refurbishment - Bluff	16,480	16,480	16,480	16,480	16,480	16,480	16,480	16,480	16,480	16,480
Transformer Refurbishment	64,890	64,890	64,890	64,890	64,890	64,890	64,890	64,890	64,890	64,890
Zone Substation Refurbishment	15,000	15,000	15,000	15,000	15,000	15,000	15,000	15,000	15,000	15,000
General Technical Refurbishment - City	63,000	63,000	63,000	63,000	63,000	63,000	63,000	63,000	63,000	63,000
General Technical Refurbishment - Bluff	12,360	12,360	12,360	12,360	12,360	12,360	12,360	12,360	12,360	12,360
	202,630	**202,630**	**202,630**	**202,630**	**202,630**	**202,630**	**202,630**	**202,630**	**202,630**	**202,630**

OPEX: Fault and Emergency Maintenance	2012/13	2013/14	2014/15	2015/16	2016/17	2017/18	2018/19	2019/20	2020/21	2021/22
Incident Response Dist - City	213,424	213,424	213,424	213,424	213,424	213,424	213,424	213,424	213,424	213,424
Incident Additional Time Dist - City	12,360	12,360	12,360	12,360	12,360	12,360	12,360	12,360	12,360	12,360
Incident Response Dist - Bluff	106,712	106,712	106,712	106,712	106,712	106,712	106,712	106,712	106,712	106,712
Incident Additional Time Dist - Bluff	4,120	4,120	4,120	4,120	4,120	4,120	4,120	4,120	4,120	4,120
Incident Response Tech - City	36,464	36,464	36,464	36,464	36,464	36,464	36,464	36,464	36,464	36,464
Incident Additional Time Tech - City	152,440	152,440	152,440	152,440	152,440	152,440	152,440	152,440	152,440	152,440
Incident Response Tech - Bluff	10,300	10,300	10,300	10,300	10,300	10,300	10,300	10,300	10,300	10,300
Incident Additional Time Tech - Bluff	2,060	2,060	2,060	2,060	2,060	2,060	2,060	2,060	2,060	2,060
	537,880	**537,880**	**537,880**	**537,880**	**537,880**	**537,880**	**537,880**	**537,880**	**537,880**	**537,880**

Operational Expenditure Total	**1,684,703**	**1,687,490**	**1,769,190**	**1,679,190**	**1,667,490**	**1,659,190**	**1,659,190**	**1,667,490**	**1,659,190**	**1,659,190**
System Management and Operations	1,101,558	1,133,467	1,165,684	1,182,180	1,200,933	1,000,000	1,000,000	1,000,000	1,000,000	1,000,000
Direct OPEX	**2,786,261**	**2,820,957**	**2,934,874**	**2,861,370**	**2,868,423**	**2,659,190**	**2,659,190**	**2,667,490**	**2,659,190**	**2,659,190**

Figure 47: EIL Maintenance Budget

Costs include PowerNet and Contractor's costs directly related to operation and maintenance management.

6. Risk Management

The business is exposed to a wide range of risks. This section examines EIL's risk exposures, describes what it has done and will do about these exposures and what it will do when disaster strikes.

Risk management is used to bring risk within acceptable levels.

6.1 Risk Methods

The risk management process as it applies to the electricity network business is intended to assess exposure and prioritise mitigating actions.

The risk on the network is analysed at the high level, reviewing major network components and systems to see if possible events could lead to undesirable situations.

6.1.1 Guiding Principles

EIL's behaviour and decision making is guided by the following principles:

- Safety of the public and staff is paramount.
- Essential services are the second priority.
- Large impact work takes priority over smaller impact work.
- Switching to restore supplies prior to repair work.
- Plans will generally only handle one major event at a time.
- Risks will be removed, mitigated, or lessened, depending on the economics.

6.1.2 Risk Categories

Risks are classified against the following categories:

Weather

- Wind – strong winds that cause either pole failures or blow debris into lines.
- Snow – impact can be by causing failure of lines or limiting access around the network.
- Flood – experience of 1984 floods has caused Regional Council to install flood protection works, but still need to consider if similar water levels do occur again.

Physical

- Earthquake – no recent history of major damage. The November 2004 7.2 Richter scale quake 240 km south-west of Te Anau, caused no damage to the network. Although recent earthquakes in Christchurch have proven that large and unexpected events may occur and have significant impact on the network.
- Liquefaction – post Christchurch's 22 February 2011 6.3 quake, the hazard of liquefaction has become a risk to be considered.
- Fire – transformers are insulated with mineral oil that is flammable and buildings have flammable materials so fire will affect the supply of electricity. Source of fire could be internal or from external sources.
- Terrorism – malicious damage to equipment can interrupt supply.
- Asset Failures – equipment failures can interrupt supply or negate systems from operating correctly. i.e. failure of a padlock could allow public access to restricted areas.

Human

- Pandemic – impact depends on the virility of the disease. Could impact on staff productivity as they try to avoid infection or become unable to work.
- Car versus pole – damage to the driver/passengers and the network could be significant.
- Vandalism – range varies from malicious damage to 'tagging' of buildings or equipment.

Corporate

- Investment – providing business processes that ensure appropriate contracts and guarantees are agreed prior to undertaking large investments.
- Loss of revenue – loss of customers through by-pass or economic downturn could reduce revenue.
- Management contract – failure of PowerNet as EIL's asset manager.
- Regulatory – failure to meet regulatory requirements.
- Resource – field staff to undertake operation, maintenance, renewal, Up-sizing, expansion and retirement of network assets.

6.2 Risk Tactics

The following tactics are used to manage risk under the following broad categories:

- Operate a 24hr control centre.
- Provide redundancy of supply to large customer groups.
- Remove assets from risk zone.
- Involvement with the local Civil Defence.

6.3 Risk Details

6.3.1 Weather

Table 44: Risk Associated with Weather Events and Responses

Event	Likelihood	Consequence	Responses
Wind	Medium	Low	Impact is reduced by undergrounding of lines. Network design standard specifies level for design. If damage occurs on lines this is remedied by repairing the failed equipment.
Snow	Low	Low	Impact is reduced by undergrounding of lines. If damage occurs on lines this is remedied by repairing the failed equipment. If access is limited then external plant is hired to clear access or substitute.
Flood	Very Low	Low	Impact is reduced by undergrounding of lines. Transformers and switchgear in high risk areas to be mounted above the flood level. Zone substations to be sited in areas of very low flood risk.

6.3.2 Physical

Table 45: Risk Associated with Physical Events and Responses

Event	Likelihood	Consequence	Responses
Earthquake (>8)	Extremely Low	Major	Disaster recovery event. Need to determine actual likely level of survivability of existing assets.
Earthquake (6 to 7)	Very Low	Low to High	Specify so buildings and equipment will survive. Review existing buildings and equipment and reinforce if necessary.
Liquefaction	Very Low	Low to Medium	Specify buildings and equipment foundations to minimise impact.
Fire	Very Low	High	Supply customers from neighbouring substations. Maintain fire alarms in buildings.
Terrorism	Very Low	High	Ensure security of restricted sites. Use alternative routes and equipment to restore supply, similar to equipment failures below.

6.3.3 Equipment Failures

As the impact of this is variable, a central control room is provided, which is manned 24 hours a day by PowerNet staff. Engineering staff are on standby at any time to provide backup assistance for network issues. Faults contractors provide onsite action and minor failure repairs with contractors 'on-call' for medium to large failures or storms.

Table 46: Risk Associated with Equipment Failures and Responses

Event	Likelihood	Consequence	Responses
33kV & 66kV Lines and Cables	Low	Low	Regular inspections and maintain contacts with experienced faults contractors. Provide alternative supply by ringed subtransmission or through the distribution network. All new works to Southern Power Contractors Line Design Standard.
Power Transformer	Very Low	Low to medium	Dual power transformers sites can be removed from service due to fault or maintenance. Continue to undertake annual DGA to allow early detection of failures. Relocate spare power transformer to site while damage unit is repaired or replaced.
11kV Switchboard	Low	Medium	Annual testing including PD[18] and IR[19]. Replacement at end of life and continue to

[18] PD = Partial Discharge, indication of discharges occurring within insulation.

[19] IR = Infrared, detection of heat of equipment that highlights hot spots.

			provide sectionalised boards. Able to reconfigure network to bypass each switchboard with use of mobile regulators.
11kV & 400V Lines and Cables	Medium	Low	Regular inspections and maintain contacts with experienced faults contractors. Provide alternative supply by meshed distribution network.
Oil Spill	Very Low	Medium	Oil spill kits located at a few substations for the faults contractor to use in event of an oil leak or spill. Most zone substations have oil bunding and regular checks that the separator system is functioning correctly.
Security measures	Very Low	Medium	Monthly checks of each restricted site. Remote monitoring of access doors by SCADA.
Batteries	Low	Medium	Continue monthly check and six monthly testing.
Circuit breaker Protection	Very low	Medium	Continue regular operational checks. Mal-operations investigated.
Circuit Breakers	Very low	Low	Backup provided by incomer circuit breaker. Continue regular maintenance and testing.
SCADA RTU	Low	Low	Monitor response of each RTU at the master station and alarm if no response after five minutes. If failure then send faults contractor to restore, if critical events then roster a contractor onsite.
SCADA Masterstation	Very low	Low	Continue to operate as a Dual Redundant configuration, with two operator stations. This requires both Servers to fail before service is lost. Continue to have a support agreement with the software supplier and technical faults contractor to maintain the equipment.
Load Control	Low	Medium	Provide backup to and from EIL Invercargill 2 Ripple Injection Plant for Invercargill, Winton backs up North Makarewa and Gore and Edendale backup each other. Manually operate plant with test set if SCADA controller fails.

6.3.4 Human

Table 47: Human Event Risks and Responses

Event	Likelihood	Consequence	Responses
Pandemic	Low	Low to High	Work to the PowerNet pandemic plan. Includes details such as working from home, only critical faults work and provide emergency kits for offices etc.
Car versus pole	Low	Low	Have resource to bypass and repair.
Vandalism	Medium	Low to High	Six monthly checks of all ground-mounted

			equipment. Faults contractor to report all vandalism and repair depending on safety then economics. i.e. Tagging/graffiti would depend on the location and content. Any safety problems will be made safe as soon as they are discovered.

6.3.5 Corporate

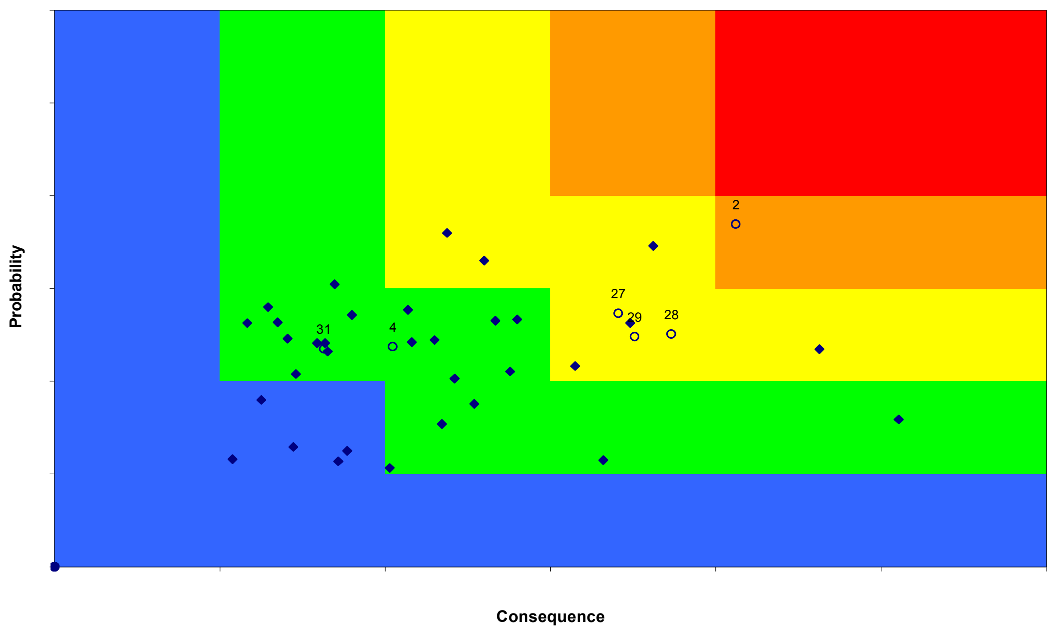
Table 48: Corporate Risks and Responses

Event	Likelihood	Consequence	Responses
Investment	Low	Low	Very little new investment occurring, new larger contracts require Shareholder Guarantee before supply is provided.
Loss of Revenue	Very Low	High	Continue to have Use of System Agreements with retailers. New large investments for individual customers to have a guarantee.
Management Contract	Extremely low	High	Maintain a contract with PowerNet. Ensure PowerNet has and operates to a Business Continuity Plan.
Regulatory	Extremely low	High	Continue to contract PowerNet to meet regulatory requirements. Ensure PowerNet has and operates to a Business Continuity Plan.
Resource	Low	High	Continue to enhance Alliance contractor relationship with present contractors. Provide a long term commitment and support, for the contractor to be sufficiently resourced to achieve the contract service levels on the network.

6.3.6 Projects

Current year major projects are evaluated by the UMS Optimisation Tool. Part of the analysis is a risk assessment of the project. The 2007/08 output is shown below.

Risk Matrix-Overall



The two axes relate to the probability of failure, the higher up the "Y" axis the more certainty that this may occur and the "X" axis representing the consequence or impact of failure from minimal to catastrophic.

The coloured regions group the common risk levels with the blue representing very minor risks through to the red zone representing an unacceptable extreme risk.

This shows the risk analysis of the selected projects. The unselected projects are shown as unfilled points with these generally relating to the other options for major projects.

6.4 Contingency Plans

EIL has the following contingency plans through its management company PowerNet:

6.4.1 PowerNet Business Continuity Plan

PowerNet must be able to continue in the event of any serious business interruption. Events causing interruption can range from malicious acts through damaging events, to a major natural disaster such as an earthquake.

The principle objectives of the Business Continuity Plan are to:

- Eliminate or reduce damage to facilities, and loss of assets and records.
- Minimise financial loss.
- Provide for a timely resumption of operations in the event of a disaster.
- Reduce or limit exposure to potential liability claims filed against the Company, its Directors and Staff.

6.4.2 PowerNet Pandemic Action Plan

PowerNet must be able to continue in the event of a breakout of any highly infectious illness which could cause staff to be unable to function in their job.

The plan aims to manage the impact of an influenza pandemic on PowerNet's staff, the business and services through two main strategies:

1. Containment of the disease by reducing spread within PowerNet. This is achieved by such measures as; reducing risk of infected persons entering PowerNet's premises, social distancing, cleaning of the work environment, managing fear, management of cases at work and travel advice.
2. Maintenance of essential services if containment is not possible. This is achieved through identification of the essential activities and functions of the business, the staff required to carry out these tasks and special measures required to continue these tasks under a pandemic scenario.

6.4.3 Network Operating Plans

As contingency for major outages on the EIL network PowerNet holds network operating plans for safe and efficient restoration of services where possible. For example, an operating order detailing operational steps required to restore supply after loss of a zone substation.

6.5 Insurance

EIL holds Public Liability insurance and insurance on zone substations, repeaters and buildings but not any lines or distribution assets.

Contractors working on the network hold their own Liability and Works Insurance.

7. Funding the Business

Everything discussed in EIL's AMP so far has been (indirectly) about costs. This section discusses how EIL's business is funded.

7.1 Business Model

EIL's business model is based around the right-hand side of

Figure 48.

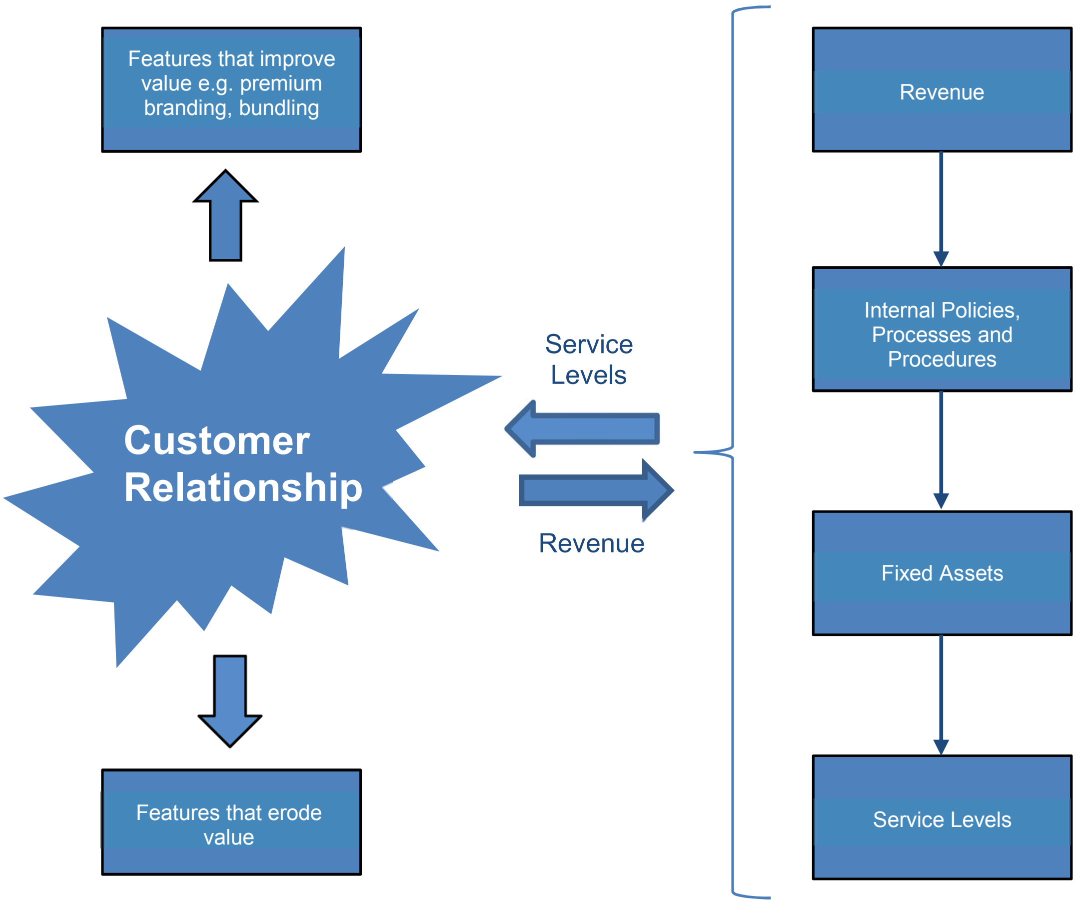


Figure 48: Customer Interface Model

This model clearly shows that the company receives cash from EIL's customers (via the retailers who operate on EIL's network) and then, through a wide range of internal processes, policies and plans, the company converts that cash into fixed assets. These fixed assets in turn create the service levels such as capacity, reliability, security and voltage stability that customers want.

7.2 Revenue

EIL's money comes primarily from the retailers who pay EIL for conveying energy over EIL's network or by customer contributions for the uneconomic part of works. In regard to funding new assets (i.e. beyond the immediate financial year) EIL has considered the following approaches:

- Funding from revenue within the year concerned.
- Funding from after-tax earnings retained from previous years.
- Raising new equity (very unlikely given the current shareholding arrangement).
- Raising debt (which has a cost, and is also subject to interest cover ratios).
- Allowing Transpower to build and own assets which allows EIL to avoid new capital on its ODV and its balance sheet, but perhaps more importantly also allows EIL to treat any increased Transpower charges as a pass-through cost.

7.3 Expenditure

Work is done to maintain the asset value of the network and to expand or augment to meet customer demands.

7.4 Changes in the Value of Assets

Given the preferences expressed by EIL's customers for the following price-quality trade-offs in the 'Customer engagement telephone survey' undertaken by Gary Nicol Associates in January – February 2011:

- 86% are not willing to pay $10 per month more in order to reduce interruptions.
- 10% are willing to pay $10 per month more in order to reduce interruptions
- 4% don't know or are unsure of price-quality trade-offs.

EIL's asset value should either remain about the same or be allowed to decline in a controlled manner (and knowing how to do this is obviously a complex issue). However this presents EIL with the dilemma of responding to customers wishes for lower supply quality in the face of a "no material decline in SAIDI requirement". Factors that will influence EIL's asset value are shown in Table 49 below:

Table 49: Factors influencing EIL's asset value

Factors that increase EIL's asset value	Factors that decrease EIL's asset value
Addition of new assets to the network. Need to confirm exactly when asset value can be added to valuation base under ODV rules.	Removal of assets from the network. Need to confirm when asset value can be removed from valuation base under ODV rules.
Renewal of existing assets. Note definition of renewal as being restoration of original functionality – no increase in service potential beyond original functionality.	On-going depreciation of assets.
Increase of standard component values implicit in the ODV methodology.	Reduction of standard component values implicit in the ODV methodology.

At a practical level EIL's asset valuation will vary even in the absence of component revaluations. This is principally because the accounting treatment of depreciation models the decline in service potential as a straight line (when in most cases it is more closely reflected by an inverted bath-tub curve) whilst the restoration of service potential is very "lumpy". However the aggregation of many depreciating assets and many restoration projects tends to smooth short-term variations in asset value.

7.5 Depreciating the Assets

As outlined in section 7.4 above, the accounting treatment of depreciation doesn't strictly model the decline in service potential of an asset - sure it probably does quite accurately model the underlying physical processes of rust, rot, acidification, erosion etc. – but an asset often tends to remain serviceable until it has rusted, rotted, acidified, or eroded substantially and then fails quickly.

Straight-line depreciation does, however, provide a smooth and reasonably painless means of gathering funds to renew worn out assets. This will be particularly important as the "bow wave" of asset renewals approaches.

8. Processes and Systems

The core of EIL's asset management activities lie with the detailed processes and systems that reflect EIL's thinking, manifest in EIL's policies, strategies and processes and ultimately shape the nature and configuration of EIL's fixed assets. The hierarchy of data model shown in Figure 49 describes the typical sorts of information residing within EIL's business (including in EIL's employees brains).

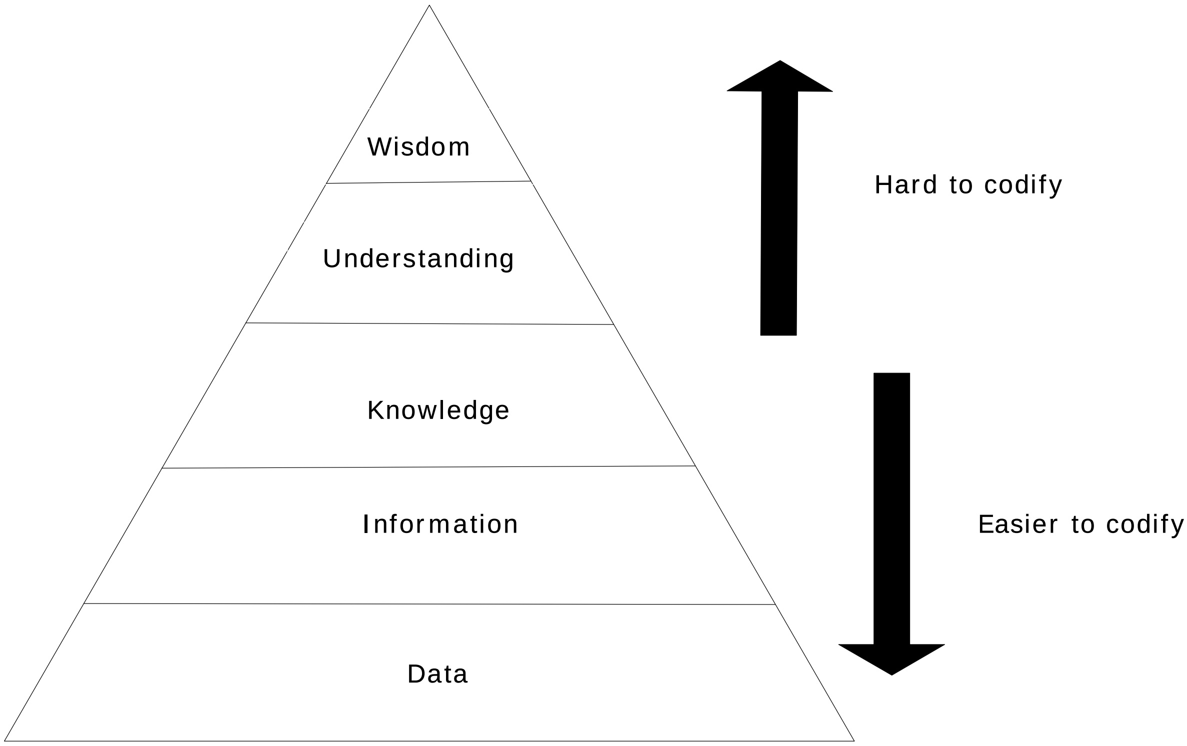


Figure 49: Hierarchy of Data

The bottom two layers of the hierarchy tend to relate strongly to EIL's asset and operational data which reside in the GIS and SCADA respectively and the summaries of this data that form one part of EIL's decision making.

The third layer – knowledge – tends to be more broad and general in nature and may include such things as technical standards that codify accumulated knowledge into a single useful document.

The top two layers tend to be very broad and often quite fuzzy. It is at this level that key organisational strategies and processes reside at. As indicated in Figure 49 it is generally hard to codify these things, hence correct application is heavily dependent on skilled people.

8.1 Asset Knowledge

EIL knows a great deal about almost all of the assets – their location, what they are made of, generally how old they are and how well they can perform.

EIL's asset data resides in two key locations:

- Asset description, location, age and condition information of line, cables and field devices resides in the Geographical Information System (GIS).

- Asset descriptions, details, age and condition information of serial numbered components resides in the Asset Management System (AMS).
- Asset operational data such as loadings, voltages, temperatures and switch positions reside in the Supervisory Control and Data Acquisition (SCADA) system.

An additional class of data (essentially commercial in nature) includes such data as customer details, consumption and billing history.

Table 50: Knowledge Accuracy

System	Parameter	Completeness	Notes
GIS	Description	Excellent	Some delays between job completion and updating into the GIS
GIS	Location	Excellent	
GIS	Age	Poor	Pole ages not available for 63%
GIS	Condition	Poor	No recent information
WASP	Description	Okay	Some delays between job completion and updating into WASP
WASP	Details	Okay	
WASP	Age	Okay	Missing age on old components
WASP	Condition	Poor	Some condition monitoring data (DGA)
SCADA	Zone Substations	Excellent	All monitored
SCADA	Field Devices	Okay	A few sites monitored

8.2 Improving the Quality of the Data

[Addresses handbook requirement 4.4.6(c)]

8.2.1 GIS Data Improvement

EIL's original data capture emphasised asset location and configuration and was used to populate the GIS, but didn't include a high level of asset condition. As part of this original data capture the company developed a field manual of drawings and photo's to minimise subjectivity. Records and drawings have been used to apply an age but 63% of poles had no supporting information. Due to old poles not having a manufacture date affixed, it is very difficult to obtain the actual age to update GIS. We are considering options to get ages measured, for the un-dated poles, but no economic methodology has been found.

About 20% of the network (by length) each year is condition assessed to update asset condition data (noting that asset condition is continually varying), and any discovered details are updated.

Key process improvements will include more timely as-builts with PowerNet staff GPS-ing[20] poles and use of scan-able forms for data input (Teleform system).

8.2.2 AMS Data Improvement

Data for the AMS is collected by the Network Movement Notice that records every movement of serial numbered assets. Some updating of data is obtained when sites

[20] GPS = Global Positioning System, a device that uses satellites and accurate clocks, to measure the location of a point.

are checked with a barcode label put on equipment to confirm data capture, and highlight missed assets.

8.3 Use of the Data

All data will be used for either making decisions within EIL's own business or assisting external entities to make decisions. This data is almost always aggregated into information (the second level of the pyramid) in order to make decisions e.g. a decision to replace a zone substation transformer will be based on an aggregation of loading data.

8.4 Decision Making

The decision making process also involves the top two levels of the hierarchy – understanding and wisdom – which tend to be broad and enduring in nature. Although true understanding and wisdom are difficult to codify, it is possible to capture discrete pieces of understanding and wisdom and then codify them into such documents as technical standards, policies, processes, operating instructions, spreadsheet models etc. This is called knowledge and probably represents the upper limit of what can be reasonably codified.

Accurate decision making therefore requires the convergence of both information and (a lot of) knowledge to yield a correct answer – deficiencies in either area (incorrect data, or a failure to correctly understand issues) will lead to wrong outcomes. The source, roles and interaction of each component of the hierarchy are shown below in

Figure 50.

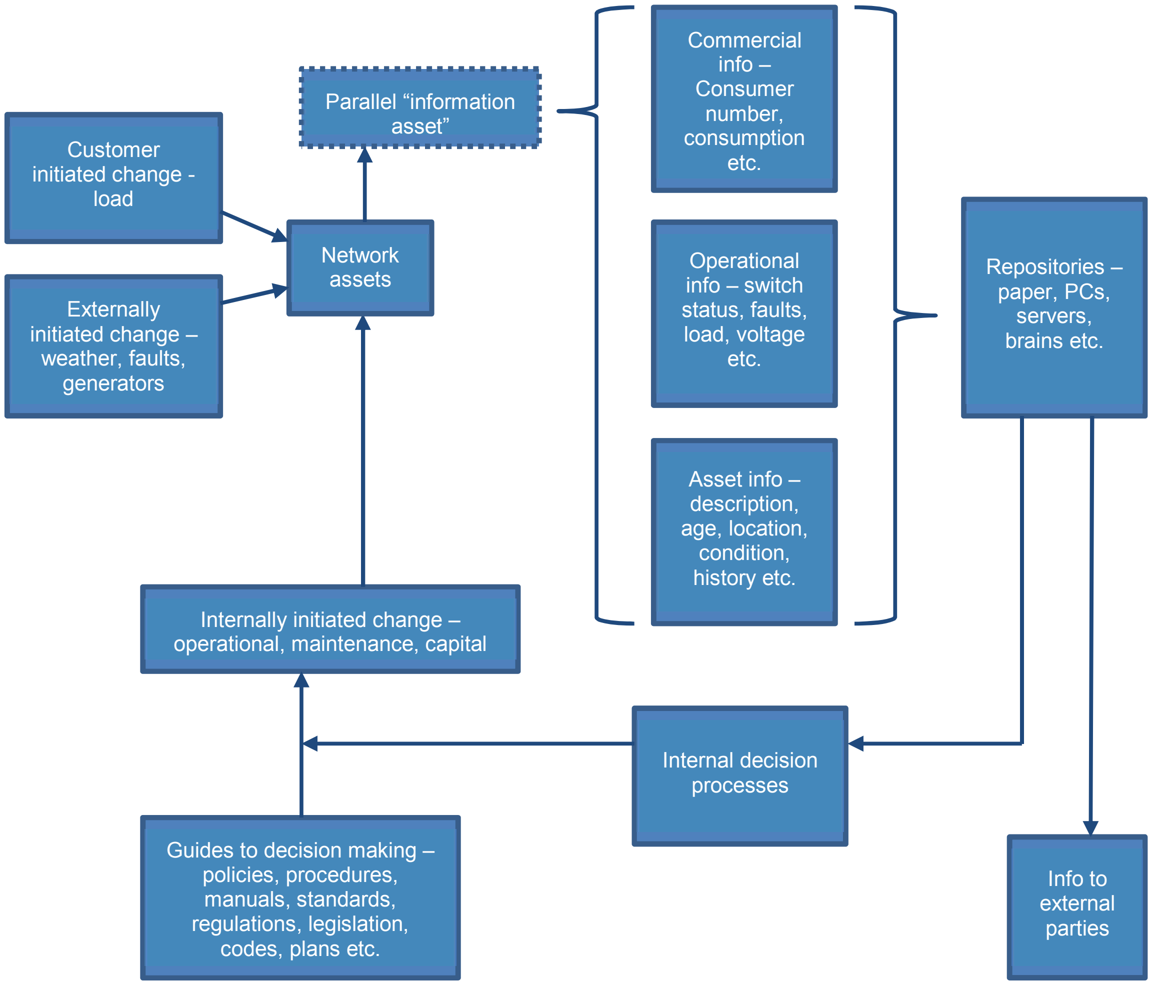


Figure 50: Key information systems and processes

8.5 Key Processes and Systems

EIL's key processes and systems are based around the key lifecycle activities defined in Figure 44, which are based around the AS/NZS9001:2001 Quality System and are described in the following sections. These processes are not intended to be bureaucratic or burdensome, but are rather intended to guide EIL's decisions toward ways that have proved successful in the past (apart from safety related procedures which do contain mandatory instructions). Accordingly these processes are open to modification or amendment if a better way becomes obvious.

8.5.1 Operating Processes and Systems

Commissioning Network Equipment	PNM-61
Network Equipment Movements	PNM-63
Planned Outages	PNM-65
Network Faults, Defects and Supply Complaints	PNM-67
Major Network Disruptions	PNM-69
Use of Operating Orders (O/O)	PNM-71
Control of Tags	PNM-73
Access to substations and Switchyards	PNM-75

Operational Requirements for Confined Space Entry	PNM-76
Operating Authorisations	PNM-77
Radio Telephone Communications	PNM-79
Operational Requirements for Live Line Work	PNM-81
Control of SCADA Computers	PNM-83
Machinery Near Electrical Works	PNM-85
Customer Fault Calls/Retail Matters	PNM-87
Site Safety Management Audits	PNM-88
Meter/Ripple Receiver Control	PNM-121

8.5.2 Maintenance Processes and Systems

Transformer Maintenance	PNM-99
Maintenance Planning	PNM-105
Control of Network Spares	PNM-97

Other maintenance is to manufacturers' recommendations or updated industry practise.

8.5.3 Renewal Processes and Systems

Network Development	PNM-113
Design and Development	PNM-114

8.5.4 Up-sizing or Extension Processes and Systems

Processing Installation Connection Applications	PNM-123
Network Development	PNM-113
Design and Development	PNM-114
Easements	PNM-131

8.5.5 Retirement Processes and Systems

Disconnected And/Or Discontinued Supplies	PNM-125

8.5.6 Performance Measuring Processes and Systems

[Addresses handbook requirement 4.5.2(f)(iii)]

8.5.6.1 Faults

All faults are entered into the 'Faults' database and reported monthly to the board, together with details of all the planned outages.

8.5.6.2 Financial

Monthly reports out of the Finance One (F1) financial system provide measurement of revenues and expenses for the EIL line business unit. Project costs are managed in PowerNet with project managers managing costs through the WASP system. Interfaces between F1 and WASP track estimates and costs against assets.

8.5.6.3 Customer

Customer statistics are monitored by a Customer Database system developed by ACE computers, this interfaces with the National Registry to provide and obtain updates on customer connections and movements. Customer consumption is monitored by another ACE Computers system 'BILL'. BILL receives monthly details from retailers and links this to the customer database.

8.5.6.4 Service Levels

Customers that have had work done are sent a survey form at the end of the job. Results are monitored and any comments given are reviewed and responded to.

8.5.7 Other Business Processes

In addition to the above processes that are specific to life cycle activities, EIL has a range of general business processes that guide activities such as evaluating tenders and closing out contracts:

Setting Up the Contract	PNM-10
Tender Evaluation	PNM-15
Contract Formation	PNM-20
Construction Approval	PNM-25
Materials Management	PNM-30
Contract Control	PNM-35
Contract Close Out	PNM-40
Customer Satisfaction	PNM-50
External Contracting	PNM-60
Drawing Control	PNM-89
Network Operational Diagram/GIS Control	PNM-91
Control of Operating and Maintenance Manuals	PNM-93
Control of External Standards	PNM-95
Control of Power Quality Recorders	PNM-103
Quality Plans	PNM-107
Health and Safety	PNM-109
Accidents and Incidents	PNM-111
Design and Development	PNM-114
Network Purchasing	PNM-115
Network Pricing	PNM-117
Customer Service Performance	PNM-119
Incoming and Outgoing Mail Correspondence	PNM-129

8.6 Asset Management Tools

A variety of tools and procedures are utilised by PowerNet to best manage the assets of the various networks. GIS and WASP software packages are used to store and evaluate assets data. Quality system procedures are in place to highlight and focus on various management techniques. The outputs of these systems produce 1 year and 10 year AMP's, together with data for on-going day to day planning and control.

8.6.1 GIS

An Intergraph based Geographic Information System is utilised to store and map data on individual components of distributed networks. This focuses primarily on cables, conductors, poles, transformers, switches, fuses and similar items. Large composite items such as substations are managed by more traditional techniques such as drawings and individual test reports.

Equipment capacity, age and condition are listed by segment. The data is used to provide base maps of existing equipment, for extensions to the network, for maintenance scheduling and similar functions.

8.6.2 AMS

Our present Asset Management System is WASP (Works, Assets, Scheduling, Purchasing) which provides work scheduling and asset management tool. It is intricately linked to the financial management system. This package tracks major assets and is the focus for work packaging and scheduling.

Most day to day operations are managed using WASP. Maintenance regimes, field inspections and customers produce tasks and/or estimates that are sometimes grouped and a 'work pack' issued from WASP.

A change from WASP has been approved in favour of the Asset Management System package Maximo. This new package is more up to date and better suited to EIL's needs. It will provide greater functionality and help streamline administration of EIL's maintenance practices. As part of the transfer of data to the new system data will be checked for accuracy and completeness and updated where possible to provide better information about EIL's assets which should facilitate better maintenance management decisions.

8.6.3 Faults Database

All outages are logged into a database which is used to provide regulatory information and statistics on networks performance. Reports from this system are used to highlight poorly performing feeders, these are then analysed to determine if it is a maintenance issue or if reliability may be enhanced by other methods. A display of recent faults is shown in Figure 51, and indicates no areas of concern.

Figure 51: EIL Faults April 2010 to March 2011

8.6.4 PNM-105 Maintenance Planning

The quality system procedure PNM-105 drives maintenance planning. It is the procedure used to drive this document to completion. Flowchart from this quality system document is shown to the right.

Relevant inputs into the plan include:

- WASP Records
- Surveys (field, CDM)
- Analysis of faults database
- GIS database
- System network loading data
- Major customers

- Growth (domestic, commercial, industrial) in geographic areas
- Legislation
- Cyclic maintenance on major plant items
- Current AMP.

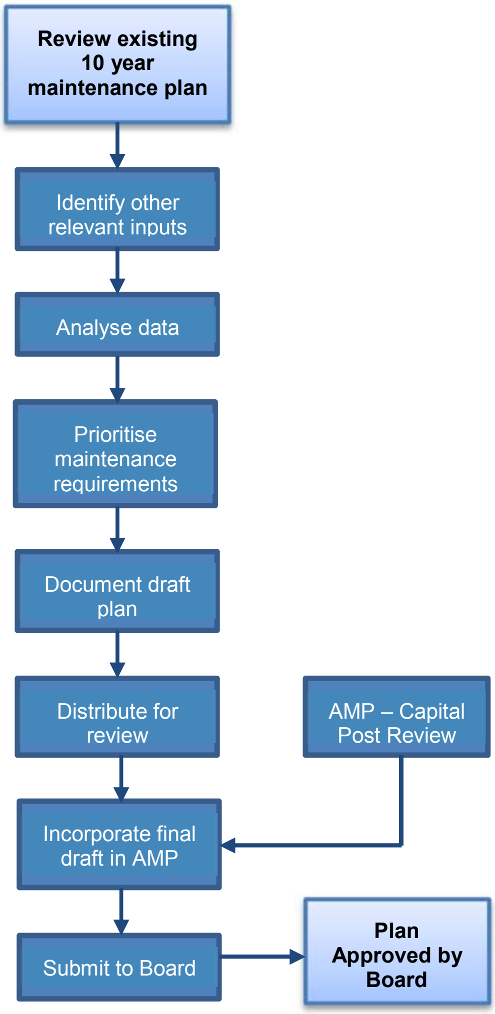


Figure 52: PNM-105 Maintenance Planning Flowchart

9. Performance and Improvement

9.1 Outcomes Against Plans

9.1.1 Maintenance

Table 51: Variance between Previous Operational Expenditure Forecast and Actual Expenditure

Operational Expenditure	Previous Forecast for 2010/11 ($k)	Actual for 2010/11 ($k)	Percentage Variance
Routine and Preventative Maintenance	559	565	1.1%
Refurbishment and Renewal Maintenance	240	253	5.4%
Fault and Emergency Maintenance	674	464	-31.2%
Operational Expenditure on Asset Management	**1,473**	**1,282**	**-13.0%**

Maintenance was below budget due to;

- Fault and Emergency Maintenance – Lower Reactive Costs

9.1.2 Capital

Table 52: Variance between Previous Capital Expenditure Forecast and Actual Expenditure

Capital Expenditure	Previous Forecast for 2010/11 ($k)	Actual for 2010/11 ($k)	Percentage Variance
Customer Connection	559	378	-32.4%
System Growth	216	78	-63.9%
Reliability, Safety and Environment	1,199	1,523	27.0%
Asset Replacement and Renewal	1,970	1,393	-29.3%
Asset Relocations	8	4	-50.0%
Capital Expenditure on Asset Management	**3,952**	**3,376**	**-14.6%**

Capital works was under budget due to;

- Customer Connections – Less activity due to the economic downturn
- System Growth – Less LV Cable Work Done
- Reliability, Safety and Environment – Budgets were underestimated for two undergrounding projects
- Asset Relocations – Immaterial

9.2 Performance Against Targets

9.2.1 Primary Service Levels

Table 53 displays the target versus actual reliability performance on the network. For the 2010/11 year the overall network performance was poor, with SAIDI over target by 13.23 customer-minutes and SAIFI also over target by 0.38.

Table 53: Performance against Primary Service Targets

	2010/11 AMP Target	12 Month Actual
SAIFI	0.80	1.18
SAIDI	31.54	44.77

Targets are based on averages over the previous few years and due to the reliability of the network have been set very low. This, however, means single events have the potential to have a significant impact on reliability performance as was the case in the 2010/11 year when one of the Doon Street transformers failed unexpectedly while the other transformer was out of service and isolated for maintenance. This is considered a very low probability event which unfortunately caused a wide spread loss of supply and had a dramatic effect on the overall performance measures of the otherwise very well performing network.

9.2.2 Secondary Service Levels

Results for 2010/11 are shown in Table 54:

Table 54: Performance against Secondary Service Targets

Attribute	Measure	Target 2010/11	Actual 2010/11
Customer Satisfaction: Inquiries	Percentage satisfied with PowerNet staff. {CES: Q9(b)}[21]	>80%	67%
Customer Satisfaction: New Connections	Phone: Friendliness and courtesy. {CSS: Q3(c)}[22]	>3.5[23]	4.5
	Phone: Time taken to answer call. {CSS: Q3(a)}	>3.5	4.0
	Overall level of service. {CSS: Q5}	>3.5	4.0
	Work done to a standard which meet your expectations. {CSS: Q4(b)}	>3.5	4.0
Customer	Power restored in a reasonable amount of	>90%	88%

[21] CES = Customer Engagement Survey of 200 customers, undertaken by phone annually.

[22] CSS = Customer Satisfaction Survey undertaken by sending questionnaire to customers with invoices.

[23] Where 1 = poor and 5 = excellent

Satisfaction: Faults	time. {CES: Q4(b)}		
	Information supplied was satisfactory. {CES: Q8(b)}	>90%	88%
	PowerNet first choice to contact for faults. {CES: Q6}	>25%	12%
Voltage Complaints	Number of customers who have made voltage complaints	<12	2
	Number of customers who have justified voltage complaints regarding power quality	<4	0
	Average days to complete investigation	<30	10
	Period taken to remedy justified complaints	<60	N/A
Planned Outages	Provide sufficient information	>75%	80%
	Satisfaction regarding amount of notice	>75%	100%
	Acceptance of maximum of one planned outages every two years.	>50%	93%
	Acceptance of planned outages lasing two hours on average	>25%	86%

The percentage of customers who were satisfied with PowerNet staff when making inquiries was 67% which was below the target of 80% however the sample size was only three and the one customer who did not indicate satisfaction was unsure. This would most likely indicate that they were reasonably satisfied as most people might recall a negative experience.

The percentage of customers that perceived their power to be restored in a reasonable amount of time following a fault was 88% which is slightly below the target of 90%. Only 3% however, indicated that they were not happy with the time taken to restore power with the remaining 9% unable to recall the experience. From those people who were able to provide an answer 97% were happy with the restoration time.

The percentage of customers that perceived that the information supplied to them following a fault was satisfactory was 88% which is slightly below the target of 90%. However the remaining 9% were unable to recall the experience so nobody expressed dissatisfaction and of those people who were able to provide an answer 100% were happy with the restoration time.

The percentage of customers that contacted PowerNet as their first choice following a fault was 12% which is below the target of 25%. Alternative choices were often the customer's electricity retailer however 55% indicated "other" as their first choice which in most cases indicated they would call friends or neighbours or simply would not call. Of the 45% that attempted contact 27% called PowerNet as their first choice. This measure is expected to improve due to sponsorships, company presence at public events and targeted marketing such as fridge magnets.

Performance against all other secondary service levels matched or performed better than the targets set for 2010/11.

9.2.3 Other Service Levels

9.2.3.1 Efficiency

Table 55: Performance against Efficiency Targets

Measure	2010/11 Target	2010/11 Actual	Comment
Load factor	> 50%	48%	No load control required
Loss ratio	< 6.5%	3.8%	Variable - dependant on Retailer accruals
Capacity utilisation	> 41%	46.4%	Influenced by load factor

The growth seen at the GXP level has been distorted with Transpower's introduction of the TPM[24] where individual ELB peaks have been replaced by a regional grouping. This has allowed EIL to relax load control during the year but has had a negative impact on load factor.

Losses tend to vary from year to year more than would be expected due to changes in operation and network assets. This variation can mostly be attributed to the retailer accrual process. Therefore a longer term average is more likely to be indicative of actual loss ratio.

While it is desirable to have a capacity utilisation factor as high as possible, standardisation of transformer sizing, allowance for growth and the unpredictable consumption patterns of some customers means there is a practical and economic limit to how much this factor can be improved.

9.2.3.2 Financial

Table 56: Performance against Financial Targets

Measure	2010/11 Target	2010/11 Actual	Comment
Direct costs	$3,384.18	$3613.15	Cost per km of line
Indirect costs	$109.91	$115.95	Cost per customer

Direct and indirect costs were only slightly above target for 2010/11.

9.3 Improvement Areas

9.3.1 Maintenance and Capital Works

Need to increase productivity or resource to complete more of the planned projects.

9.3.2 Reliability

On the whole reliability of the EIL network is very good but last year reliability measures were affected by a single large outage caused by a very low probability fault event.

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[24] Transmission Pricing Methodology: Allocation of Transpower costs are based on the share of the average of the top 100 peaks for all loads in the Lower South Island (LSI) region. See http://www.electricitycommission.govt.nz/rulesandregs/rules Part F, Section IV for more details.

9.3.3 Efficiency

Capacity utilisation could be improved.

9.3.4 Data

EIL holds some good data about assets but could be improved.

9.4 Improvement Strategies

9.4.1 Maintenance and Capital Works

Improvement of short and long term project and maintenance planning processes should lead to better scheduling of resources and improved budget estimations.

Long term relationships with contractors are being maintained so they can more confidently build their resources and personnel. This will allow more work to be completed and ensure a resource for future years.

9.4.2 Reliability

Long term relationships with contractors are being maintained so they can build their resources, personnel and familiarity with the network, so that the restoration of supply is done efficiently.

Continue regular network inspections and action critical items as they are identified. Also increase data capture and condition assessment above reactive maintenance practices to allow better planning based on more accurate and complete asset data.

Increase number of remotely controlled devices to speed isolation of faulty sections and restoration of supply to healthy sections.

Consideration is being given to purchasing additional equipment that could provide additional condition monitoring and may help to better predict when critical network equipment failures, as happened last year, might occur in future however it is not known whether this equipment would have been able to predict the fault. Current condition monitoring practices which would often detect a concerning trend toward failure were completed but did not give any indication of imminent failure.

9.4.3 Efficiency

As new transformers are added to the network, a rationalisation of capacities will be done, with underutilised units relocated to match loads. Overloaded transformers may also need to be rationalised which would have a negative impact on this indicator.

The desire to improve capacity factor will be considered when installing new distribution transformers however installing smaller transformers may result in overloading which will shorten the life of these assets so there is a limit to how much this can be improved without affecting financial efficiency.

9.4.4 Data

Data is continually being improved as records are updated when assets are renewed or upgraded. A specific budget has been added to the works plan to increase field data captured about installed assets. Other field survey projects may be undertaken where gap analysis reveals insufficiencies in data.

Asset Management System software is being updated to assist with better capture and use of asset data.

A. Appendix – PowerNet Customer Survey

PowerNet Consumer Engagement Telephone Survey: EIL

Phone	Date	Interviewer
Good afternoon/evening my name is ______. I am conducting a brief customer survey on behalf of PowerNet. May I please speak to a person in your home who is responsible for paying the electricity account? *(Reintroduce if necessary)* May I trouble you for a few minutes of your time?		

A1: Do you know who PowerNet is?	Yes **1** *Go to A2*	
	No **2** *Go to A3*	
A2: Using a 1 to 5 rating scale where 1 is Poor and 5 is Excellent can you rate the performance of PowerNet over the last 12 months for:	Caring for customers	**1 2 3 4 5 X**
	Sensitive to the environment	**1 2 3 4 5 X**
	Supporting the community	**1 2 3 4 5 X**
	Safety conscious	**1 2 3 4 5 X**
Go to D1	Efficient	**1 2 3 4 5 X**

A3: PowerNet maintains the local electricity lines and substations that supply power to your premises.

D1: Are you a commercial or residential customer?	Commercial	**1**
	Residential	**2**

Question 1: PowerNet is proposing a maximum of one planned interruption to your power supply, on average, every two years in order to carry out maintenance or upgrade work on its electricity network. Do you consider this number of planned interruptions to be reasonable?	Yes	**1**	*Go to Q 2*
	No	**2**	*Go to Q 1(a)*
	Don't know/unsure	**3**	*Go to Q 2*

Question 1(a): How many years between planned interruptions do you consider to be more reasonable?	3 years	**1**
	4 years	**2**
	5 years	**3**

Question 2: PowerNet expects such planned interruptions will on average last up to two hours each. Do you consider this amount of time to be reasonable?	Yes	**1**	*Go to Q 3*
	No	**2**	*Go to Q 2(a)*
	Don't know/unsure	**3**	*Go to Q 3*

Question 2(a): What length of time would you consider to be more reasonable? *(Specify hours)*	30 min	**1**
	1 hours	**2**
	$1^1/_2$ hours	**3**

Question 3: Have you received advice of a planned electricity interruption during the last 6 months?	Yes	**1**	*Go to Q 3(a)*
	No	**2**	*Go to Q 3(e)*
	Don't know/unsure	**3**	*Go to Q 3(e)*

Question 3(a): Were you satisfied with the amount of information given to you about this planned interruption?	Yes	**1**	*Go to Q 3(c)*
	No	**2**	*Go to Q 3(b)*
	Unable to recall	**3**	*Go to Q 3(c)*
Question 3 (b): What additional information would you have liked?			

Question 3(c): Do you feel that you were given enough notice of this planned interruption?	Yes	**1**	*Go to Q 3(e)*
	No	**2**	*Go to Q 3(d)*
	Don't know/unsure	**3**	*Go to Q 3(e)*

Question 3(d): How much notice of planned interruptions would you prefer to be given? *(Specify days/weeks)* *(Do not prompt)*	1 day	**1**	1 week	**4**
	3 days	**2**	2 weeks	**5**
	5 days	**3**	Other	**6**

Question 3(e): Do you have a preferred day and time(s) for a planned interruptions?	Yes	**1**	*Go to Q 3(f)*
	No	**2**	*Go to Q 4*

Question 3 (f): What is your preferred day and time(s)?

Question 4: Have you had an unexpected	Yes	**1**	*Go to Q 4(a)*

interruption to your power supply during the last 6 months?	No	**2**	*Go to Q 5*	
	Unable to recall	**3**	*Go to Q 5*	

Question 4(a): Thinking about the most recent unexpected interruption to your electricity supply, how long did it take for your supply to be restored? *(Specify hours/days)* *(Do not prompt)*	Within 45 min	**1**	3 hours	**5**
	1 hour	**2**	4 hours	**6**
	$1^1/_2$ hours	**3**	12 hours	**7**
	2 hours	**4**	Don't know	**8**
			Other	**9**

Question 4(b): Do you consider your electricity supply was restored within a reasonable amount of time?	Yes	**1**	*Go to Q 5*
	No	**2**	*Go to Q 4(c)*
	Unable to recall	**3**	*Go to Q 5*

Question 4(c): What do you consider would have been a more reasonable amount of time? *(Specify hours/days)* *(Do not prompt)* ***Go to Q5(a)***	30 minutes	**1**	$1^1/_2$ hours	**4**
	45 minutes	**2**	2 hours	**5**
	1 hour	**3**	Other	**6**

Question 5: In the event of an unexpected interruption to your electricity supply, what do you consider would be a reasonable amount of time before electricity supply is restored to your home? *(Specify hours/days)* *(Do not prompt)*	5 minutes	**1**	2 hours	**10**
	10 minutes	**2**	3 hours	**11**
	15 minutes	**3**	4 hours	**12**
	20 minutes	**4**	5 hours	**13**
	30 minutes	**5**	6 hours	**14**
	40 minutes	**6**	12 hours	**15**
	45 minutes	**7**	1 day	**16**
	1 hour	**8**	Unsure	**17**
	$1^1/_2$ hours	**9**	Other	**18**

Question 5(a): PowerNet is reviewing the level of service provided to its customers and options include increasing spending. Presently there is an average of one interruptions every two years. If this was reduced to one interruption every three years would you be happy to pay an additional $10 per month on your electricity bill?	Yes	**1**
	No	**2**
	Don't know/unsure	**3**

Question 6: Who would you contact in the event of the power supply to your home being unexpectedly interrupted? *(Do not prompt)*	Meridian Energy	**1**
	Contact Energy	**2**
	Mighty River Power	**3**
	TrustPower	**4**

	PowerNet	5	
	Other	6	
Question 7: Have you made such a call within the last 6 months?	Yes	**1**	*Go to Q 8*
	No	**2**	*Go to Q 8(d)*
	Unable to recall	**3**	*Go to Q 8(d)*
Question 8: Were you satisfied that the system worked in getting you enough information about the supply interruption?	Yes	**1**	*Go to Q 8(b)*
	No	**2**	*Go to Q 8(a)*
	Don't know/unsure	**3**	*Go to Q 8(b)*
Question 8 (a): What, if anything, do you feel could be done to improve this system?			
Question 8 (b): Were you satisfied with the information that you received?	Yes	**1**	*Go to Q 8(d)*
	No	**2**	*Go to Q 8(c)*
	Don't know/unsure	**3**	*Go to Q 8(d)*
Question 8 (c): What, if anything, do you feel could be done to improve this information or the way in which it is delivered?			
Question 8 (d): What is the most important information you wish to receive when you experience an unplanned supply interruption? *(Do not prompt)*	Accurate time when power will be restored	**1**	
	Reason for fault	**2**	
	Other	**3**	
Question 8(e): Are you aware of PowerNet's 0800 faults number?	Yes **1**	No **2**	
Question 9: Have you contacted PowerNet regarding any other issues relating to your electricity supply during the last 6 months?	Yes	**1**	*Go to Q 9(a)*
	No	**2**	*Go to Q 9(e)*
	Unable to recall	**3**	*Go to Q 9(e)*
Question 9(a): What did your enquiry relate to? *(Do not prompt)*	Voltage complaints	**1**	
	Safety disconnections	**2**	
	New or altered supply	**3**	
	Trees near lines	**4**	
	Other	**5**	
Question 9 (b): Were you satisfied with	Yes	**1**	*Go to Q 9(d)*

the performance of the PowerNet staff member(s) who handled your enquiry?	No	**2**	*Go to Q 9(c)*
	Don't know/unsure	**3**	*Go to Q 9(e)*

Question 9 (c): Specifically what were you dissatisfied with?

Question 9 (d): Was there anything that PowerNet did well?

Question 9 (e): What if anything do you feel could be done to improve the service provided by PowerNet staff?

This concludes our survey - Thank you for your time

B. Appendix – Expanded Data Tables

Table 57: Existing Substations Growth Projection

Substation	2011/12	2012/13	2013/14	2014/15	2015/16	2016/17	2017/18	2018/19	2019/20	2020/21	2021/22
Doon Street	25.2	25.7	26.2	26.7	27.2	27.8	28.3	28.9	29.5	30.1	30.7
Leven Street	19.1	19.5	19.9	20.3	20.7	21.1	21.6	22.0	22.4	22.9	23.3
Racecourse Road	10.9	11.0	11.1	11.2	11.3	11.5	11.6	11.7	11.8	11.9	12.0
Southern	13.7	13.8	13.9	14.1	14.2	14.4	14.5	14.6	14.8	14.9	15.1
Bluff	4.7	4.7	4.8	4.8	4.9	4.9	5.0	5.0	5.1	5.1	5.2

Table 58: Substation Demands with Proposed Developments 2011 - 2015

Zone Substation	Δ '11/12	2011/12 MD	Δ '12/13	2012/13 MD	Δ '13/14	2013/14 MD	Δ '14/15	2014/15 MD	Δ '15/16	2015/16 MD	Δ '16/17	2016/17 MD
Doon Street	-2.6	22.6		23.0	-11.7	11.7	-12.0					
Queens Park					12.2	12.2	17.0	29.5		30.0		30.6
Leven Street	3.4	22.6		23.0	-0.5	23.0	-5.0	18.4		18.8		19.2
Racecourse Road	1.0	11.8		11.9		12.0	-2.8	9.3		9.4		9.5
Racecourse Road (Dual Transformer)												
Southern	-1.8	11.7		11.8		12.0	-12.1					
Southern (Dual Transformer)							17.7	17.7		17.9		18.0
Bluff		4.7		4.7		4.7		4.8		4.8		4.9

Table 59: Substation Demands with Proposed Developments 2016 - 2022

Zone Substation	Δ '17/18	2017/18 MD	Δ '18/19	2018/19 MD	Δ '19/20	2019/20 MD	Δ '20/21	2020/21 MD	Δ '21/22	2021/22 MD
Doon Street										
Queens Park		31.3		31.9		32.5		33.2		33.8
Leven Street		19.5		19.9		20.3		20.7		21.2
Racecourse Road		9.6		9.7		9.8		9.9		10.0
Racecourse Road (Dual Transformer)										
Southern										
Southern (Dual Transformer)		18.2		18.4		18.6		18.8		19.0
Bluff		4.9		5.0		5.0		5.1		5.1

C. Appendix – Assumptions

When developing this plan we have made the following assumptions:

- No major developments in the region, unless specifically listed.
- Growth trends will be similar to historic trends.
- No change in present regulation.
- Distributed generation will develop slowly with little impact within the next ten years.
- The life of assets is based on the ODV asset life.
- Population for sizing of equipment is based on the high projection.
- No decline in meat and wool markets.
- Increase in dairy markets.
- No major development in coal extraction and/or processing.
- No major development in mineral extraction and/or processing.
- Material and Labour costs only increasing by CPI.

10. Approval by Board of Directors

Form 2 – Certificate for Asset Management Plans

We, Neil Douglas Boniface and, Philip James Mulvey being Directors of Electricity Invercargill Limited certify that, having made all reasonable enquiry, to the best of our knowledge, the attached asset management plan of Electricity Invercargill Limited prepared for the purposes of requirement 7(1) of the Commerce Commission's Electricity Distribution (Information Disclosure) Requirements 2008 complies with those Requirements.

N D Boniface

P J Mulvey

28 March 2012