Asset Management Plan 2006 - 2016

Electricity Invercargill Limited

Publicly disclosed in August 2006

Contents

1. Summary of the plan

This Asset Management Plan provides a systematic view of managing the assets of the company. The undergrounding programme over the last thirty years has renewed most parts of the city network with a likely lull in required works for the next ten to fifteen years. The possibility of a new area for commercial and light industrial development allows some additional growth on the network. This was due to the 'The Power Company Limited' network completely surrounding EIL's network.

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

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

The age of the network is relatively young, 57% of standard life remaining, with most assets in good condition.

Growth on the network is low with demand increasing only 0.1% per annum over the last 20 years, with energy increasing 0.6% per annum.

Focus for the next ten years is to maintain the performance as one of most reliable networks in New Zealand.

Safety issue of exposed live busbars on J-type LV fuses boards will be removed by renewing all of these boards.

Renewals of transformers, ring main units and pillar boxes are expected to have a significant ongoing cost. Renewal of zone substation switchboards will have an impact in 2010 to 2014. Renewal of the switchgear in the CBD[1] is planned over five years from 2008.

Renewal and upsizing of the early 1970 low voltage (LV) cables is programmed to begin in 2008.

Upsizing by the addition of a seventh power transformer is budgeted for in 2011.

The city undergrounding programme to be completed by 2010, with the likely western heavy traffic by-pass route planned to be undergrounded by 2012. No undergrounding is planned for Bluff due to the rocky subsurface.

Comment on this plan is welcome and should be addressed to the Engineering Manager, PowerNet Ltd, PO Box 1642, Invercargill or email amp@powernet.co.nz. The next review of this Asset Management Plan is planned for publishing in August 2007.

[1] CBD = Central Business District

2. Background and objectives

2.1 Purpose of the Asset Management Plan

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

- Sets service levels for its electricity network that will meet consumer, 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 retirement.
- Has adequately considered the classes of risk the 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 its asset locations, ages, conditions and the assets likely future behaviour as they age and may be required to perform at different levels.

Disclosure of the Asset Management Plan in this format will also assist in meeting the requirements of Section 24 and Schedule 2 of the Electricity Information Disclosure Requirements 2004.

2.2 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, the prevailing regulatory environment, government policy objectives, commercial and competitive pressures and technology trends. Asset selection is also influenced by technical regulations, asset deterioration, the laws of physics and risk exposures independent of the strategic context and indeed, these issues may constrain the strategic plan.

2.2.1 Strategic context

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

- Consideration of 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.
- EIL's commercial goal which is primarily to deliver a sustainable earnings stream to its owner that is the best use of the latter's funds.
- Competitive pressures from other lines companies which might try to supply new consumers/subdivisions that could be connected to EIL's network.
- Pressure from substitute fuels both at end-user level (such as substituting for electricity, 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.
- Interest rates which can influence the rate at which new consumers connect to the network.
- Ensuring sufficient resources are available long term to satisfy EIL's service requirements.

2.2.2 Independence from strategic context

It is also important to recognise that although assets must be shaped by the strategic issues identified in section 2.2.1, they will also be influenced (and even constrained) by issues that are independent of the strategic context. For example, the rate at which wooden poles rot is independent of the price threshold regime – the price threshold regime could theoretically constrain the rate at which the company replaces rotten poles but it does not influence the rate of rot.

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 85km of lines, 593km of cables and 440 transformers to fit ever-changing strategic goals.
- The laws of physics which govern such fundamental issues as power flows, insulation failure and faults.
- Physical risk exposures. Exposure to events such as wind, snow, earthquakes and vehicle impacts are generally independent of the strategic context. Issues in which 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.

2.2.3 Annual Business Plan and works plans

Each year the first year of the Asset Management Plan is consolidated with any recent strategic, commercial, asset or operational issues into the annual Business Plan which defines the priorities and actions for the year ahead and which will contribute to the long-term alignment with the strategic context.

An important component of the annual Business Plan is the annual works program which scopes and costs each individual activity or project that is expected to be undertaken 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 Asset Management Plan and secondly ensure that each project is implemented according to the scope prescribed in the works program.

2.2.4 Interaction of key planning documents

Interactions of the key planning issues, processes and documents are shown in Figure 1 below:

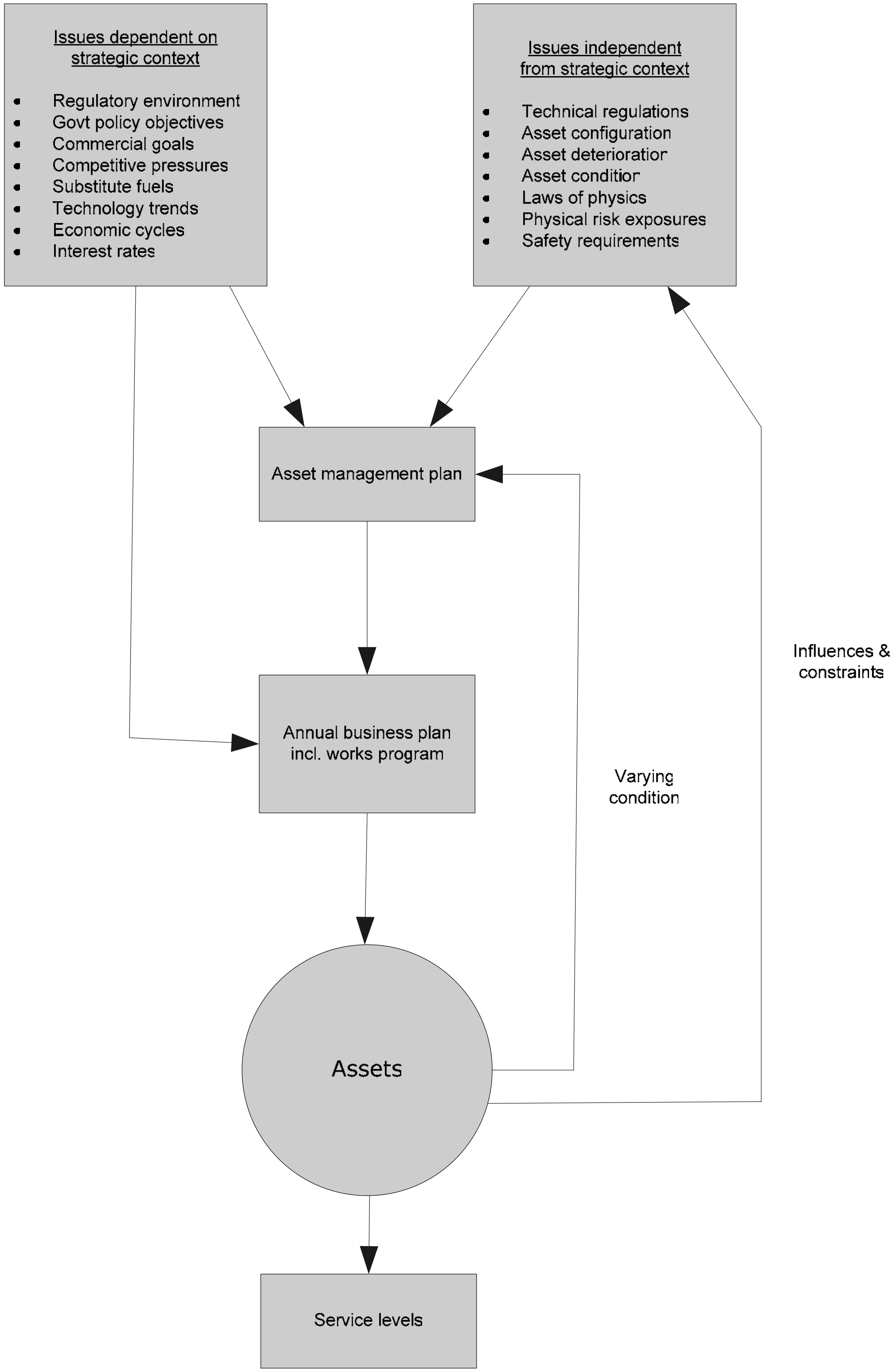


Figure 1- Interaction of key plans

2.3 Period covered by the Asset Management Plan

This Asset Management Plan covers the period 1 April 2006 to 31 March 2016. This Asset Management Plan was prepared during June and July 2006, approved by the EIL Board in early August 2006 and publicly disclosed at the end of August 2006 in accordance with clause 4.1.4 of the Handbook.

2.4 Stakeholder Interests

2.4.1 Stakeholders

Stakeholders include 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).
- Is physically connected to the network.
- Uses the network for conveying electricity.
- Supplies EIL with goods or services.
- 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 network's existence (such as requesting disclosure data or regulating prices).

2.4.2 Stakeholder Interests

The interests of the stakeholders are defined in Table 1 below:

Table 1 - Key stakeholder interests

	Interests			
	Viability	**Supply quality**	**Safety**	**Compliance**
Shareholder	✓	✓	✓	✓
Bankers	✓			
Connected consumers	✓	✓	✓	
Contracted manager (PowerNet)	✓	✓	✓	✓
Energy retailers	✓	✓		
Mass-market representative groups	✓	✓		
Industry representative groups	✓	✓		
Staff and contractors	✓		✓	✓
Suppliers of goods and services	✓			
Public			✓	
Councils (excluding as a consumer)			✓	
Land Transport			✓	✓
Ministry of Economic Development		✓	✓	✓
Commerce Commission	✓	✓		✓
Electricity Commission				✓

2.4.3 Meeting stakeholder interests

Table 2 provides a broad indication of how stakeholder interests are met:

Table 2 - Accommodating stakeholder interests

Interest	Description	Accommodate the interests of Stakeholders
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.	• Stakeholders' 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.
Supply quality	Emphasis on continuity, restoration and reducing flicker is essential to minimising interruptions to consumers' businesses.	• Stakeholders' needs for supply quality will be accommodated by focusing resources on continuity and restoration. The most recent mass-market survey indicated a general satisfaction with the present supply quality but also with many consumers 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 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. • Prices will be restrained to within the limits prescribed by the price path threshold, unless it comprises safety or viability.

2.4.4 Managing conflicting interests

Priorities for managing conflicting interests are:

- Safety. Top priority is 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).
- Supply quality is third priority. Supply quality makes consumers successful.
- Compliance. A lower priority is given to compliance that is not safety and supply quality related.

2.4.5 Consumer consultation

Consultation was undertaken by three methods, firstly a random sample of consumers were invited to a forum to discuss price/quality trade-offs. Of the five percent that said they'd attend only three percent attended. No change in the current levels of quality was desired.

The second method was a phone survey of 200 consumers undertaken by external consultants. A copy of the questionnaire used is attached in appendix A. Only 4% suggested a decrease in the electricity bill for a decrease in reliability with 41% willing to pay a very small increase in the electricity bill to improve reliability. This plan therefore will attempt to increase reliability at as low of a cost as possible.

Lastly, individual consumers are consulted as they undertake connection to the network. For example, the extensions of Stadium Southland, with the new cycle track, staff raised options to supply the new load and highlighted the impact should the transformer fail.

2.5 Accountabilities for asset management

EIL's ownership, governance and management structure is depicted below in Figure 2.

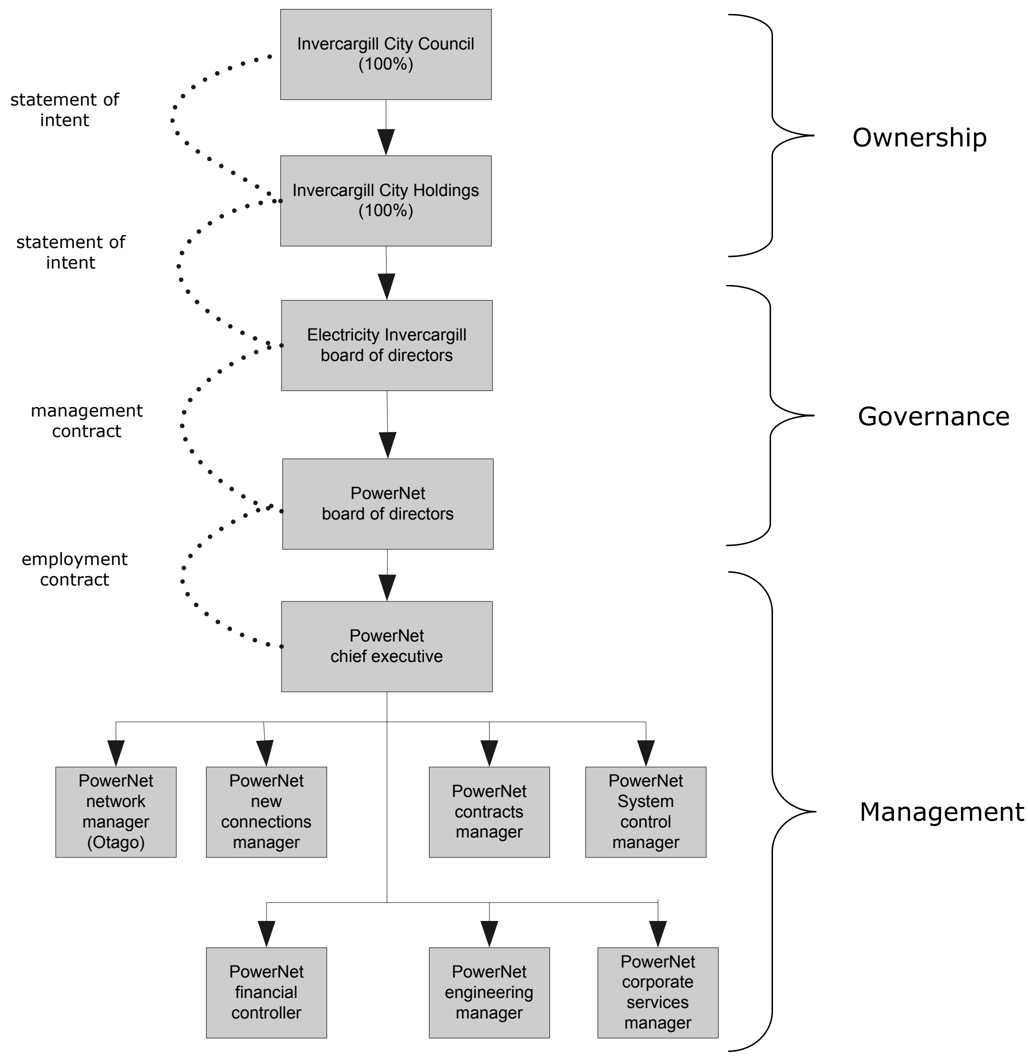


Figure 2 - Governance and Management Accountabilities

2.5.1 Accountability at governance level

As EIL uses a contracted management company (PowerNet Ltd) to manage its assets and its ultimate shareholder (Invercargill City Council) includes a wholly-owned holding company, there is effectively a three-tier governance structure as follows:

- The first tier of governance accountability is between the Board of Invercargill City Holdings and the Invercargill City Council. The governance mechanism is a Statement of Intent (although in this instance it does not need to comply with s39 of the Energy Companies Act 1992).
- The second tier of governance accountability is between the EIL Board and the Board of Invercargill City Holdings with the principal mechanism being the Statement of Intent (which does need to comply with s39 of the Energy Companies Act 1992). Inclusion of SAIDI and SAIFI targets in this Statement makes the Board intimately accountable to its shareholder for these important asset management outcomes whilst the inclusion of financial targets in the Statement makes the Board additionally accountable for overseeing the price-quality trade-off inherent in projecting revenue and SAIDI.
- The third tier of governance accountability is between the EIL Board and the PowerNet Board with the principal mechanism being the Network Asset Management Agreement that specifies a range of strategic and operational outcomes to be achieved.

2.5.2 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 contract with the PowerNet Board which reflects the outcomes specified in the management contract between the EIL Board and the PowerNet Board.

2.5.3 Accountability at operational level

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

The individual manager who has the most influence over the long-term asset management outcomes will be the Engineering Manager through his preparation of the Asset Management Plan which will guide the nature and direction of the other managers' work.

2.5.4 Accountability at work-face level

There are two alliance contractors with long term contracts with PowerNet. The principal accountability mechanism is through a performance contract that reflects the outcomes PowerNet must create for EIL.

2.6 Systems and processes

EIL's systems and processes are described in detail in Section 9 of the Asset Management Plan.

3. Details of the assets

3.1 Distribution area

3.1.1 Geographical coverage

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.
- The borough of Bluff extending as far west as the former Ocean Beach freezing works.

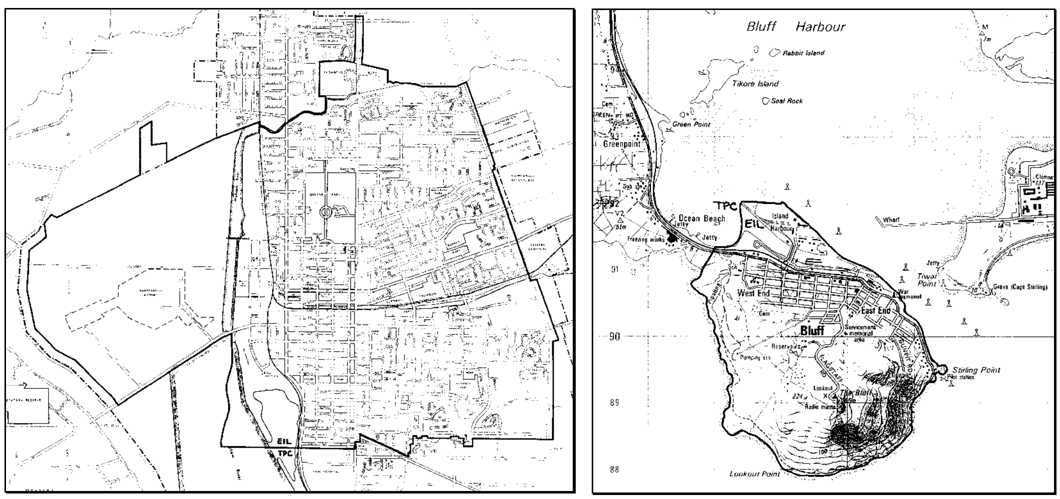


Figure 3 - EIL Distribution Area

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.

There are no large consumers that have significant impact on the network operations or asset management priorities.

3.1.2 Demographics

The population of the EIL distribution area is approximately 34,800. Classification of areas within the distribution area is as follows:

Description	Includes
Invercargill CBD	The area broadly bounded by Tyne Street to the south, the railway line to the west, Gala Street to the north and Jed Street to the east.
All other parts of Invercargill	Everywhere in Invercargill supplied by EIL but not within the CBD area.
Bluff	All of the Bluff distribution area.

3.1.3 Key industries

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. The Bluff distribution area includes a large port along with associated heavy industries as well as residential and commercial consumers.

3.1.4 Energy and demand characteristics

Key energy and demand figures for the YE 30 June 2006 are as follows:

Parameter	Value	Long-term trend
Energy conveyed	277GWh	Steady
Max demand	57.9MVA	Steady
Load factor	55%	Steady

3.2 Network configuration

To supply the 16,889 consumers 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 The Power Company's zone substation situated just west of Bluff Township. EIL also owns interconnectors to The Power Company's Otatara and Seaward Bush 33kV lines that provide alternative supplies to the Leven Street and Southern zone substations respectively.

3.2.1 Bulk supply assets

3.2.1.1 Invercargill GXP

Invercargill GXP comprises a strong point in the 220kV grid which is tied to Roxburgh power station 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 outdoor A and B bus arrangement that is energised by two banks of three 1-phase 16.67MVA 220/33kV transformers. EIL has five 33kV feeders each supplied by its own bulk oil breaker.

EIL owns the segments of 33kV line and cable (but not the circuit breakers or busbars) that run within the GXP land area and it also operates and jointly owns a control room that oversees the network. EIL also owns one of the two 33kV 217Hz ripple injection plants on the west side of the GXP site. The second plant is owned by The Power Company, each plant providing backup capability to the other.

3.2.2 Sub-transmission network

EIL's sub-transmission 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 The Power Company's 33kV network as depicted in Figure 4.

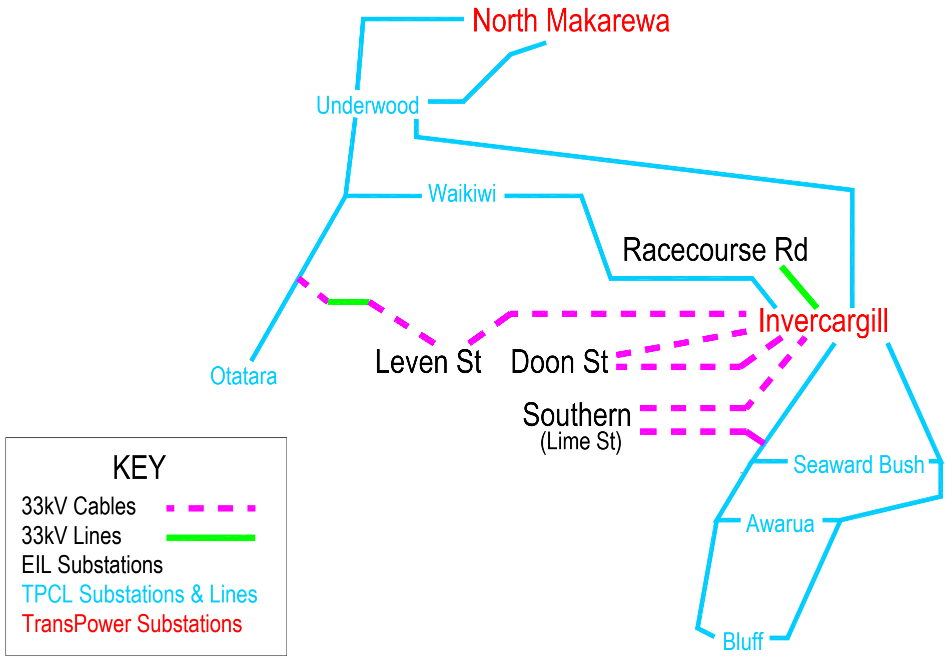


Figure 4 - Sub-transmission Network

Note that EIL's two Bluff 11kV feeders are supplied from The Power Company's 33kV sub-transmission network. EIL's sub-transmission network comprises 1.4km of 33kV line and 24.9km of 33kV cable and has the following characteristics:

- Two points of interconnection with The Power Company'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 The Power Company's Otatara 33kV feeder.
- It is predominately a ring topology except for Racecourse Road which is a spur.

3.2.3 Zone substations

EIL currently owns and operates the following 4 zone 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 The Power Company'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 The Power Company's Seaward Bush 33kV feeder.

3.2.4 11kV Distribution network

3.2.4.1 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.

3.2.4.2 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 38 years and has only 19.8km 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. One 3.3kV feeder is still in operation supplying the loads up Bluff hill.

3.2.4.3 Per substation basis

The split of the 11kV distribution network on a per substation basis is presented below. Safety and reliability are the strongest drivers of allocation of resources with consumer density providing an indication of priority of other works.

Substation	Length	Consumers	Consumer density
Doon Street	77.3km	7,834	101.3 /km
Leven Street	36.9km	1,535	41.3 /km
Racecourse Road	27.4km	2,720	99.3 /km
Southern	35.6km	3,809	107.0 /km
TPCL Bluff – EIL feeders	18.5km	991	53.6 /km
Total/average	**195.7km**	**16,889**	**86.3 /km**

3.2.5 Distribution substations

Just as zone substation transformers form the interface between the sub-transmission 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 consumers or special consumers, 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.

Rating	Pole	Ground
1-phase 15kVA	2	2
3-phase 30kVA	2	3
3-phase 50kVA	3	2
3-phase 75kVA	1	0
3-phase 100kVA	7	19
3-phase 200kVA	11	54
3-phase 300kVA	14	235
3-phase 500kVA	[redacted]	42
3-phase 750kVA	[redacted]	34
3-phase 1,000kVA	[redacted]	9
Total	**40**	**400**

3.2.6 400V Distribution network

3.2.6.1 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.

3.2.6.2 Configuration

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

3.2.6.3 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 underground has occurred in a few locations using XPLE cable.

3.2.6.4 Per substation basis

On a per substation basis the split of LV network is as follows. Data has been captured but tracing to separate it into each substation requires inputting and updating of the tie points.

Substation	Length	Consumers	Consumer density
Doon Street	*	7,834	*
Leven Street	*	1,535	*
Racecourse Road	*	2,720	*
Southern	*	3,809	*
(Bluff)	*	991	*
Total / average	**455.4km**	**16,889**	**37.1 /km**

3.2.7 Consumer connection assets

The sharp end of the business is the 16,889 consumer connections - for which revenue is earned for providing a connection to the network (via the five retailers which convey electricity over the network). All of the "other assets" convey energy to these consumer connections and essentially are a cost to EIL that has to be matched by the revenue derived from the consumer connections. These consumer 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 consumers.

Connection type	Total	Cumulative	Percent	Percent cumulative
20kW 1-phase	14,328	14,328	84.8%	84.8%
10% fixed option	724	15,052	4.3%	89.1%
30kW 3-phase	668	15,720	3.9%	93.0%
8kW 1-phase	379	16,099	2.2%	95.2%
50kW 3-phase	373	16,472	2.2%	97.4%
Total	**16,472**	**16,472**	[redacted]	**97.4%**

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

3.2.8 Load control assets

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

- One main 33kV 217Hz 125kVA injection plant at Invercargill, with backup provided from the adjacent TPCL plant.

3.2.9 Protection and control

3.2.9.1 Key protection systems

The network protection includes the following broad classifications of systems:

Circuit Breakers (CB)

- CB's provide powered switching (usually charged springs or DC coil) enabling operational control of isolation and fault interruption of all faults.
- CB protection relays which have always included over-current and earth-fault functions. More recent equipment also includes voltage, frequency, directional and CB 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.

3.2.9.2 DC power supplies

Batteries, battery chargers, and battery monitors provide the DC supply systems for CB control and protection functions. This allows continued operation of plant throughout any power outage.

3.2.9.3 Tap changer controls

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

3.2.10 SCADA and communications

EIL uses SCADA for control and monitoring of zone substations and remote switching devices and for activating load control plant.

3.2.10.1 Master station

The SCADA master station is located at the 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 to provide full Power Industry functions.

3.2.10.2 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 CB
  - Surrey Park RMU
  - Doon Street Substation
  - Racecourse Road Substation
  - Southern Substation.

3.2.10.3 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.

3.2.11 Other assets

3.2.11.1 Mobile generation

None.

3.2.11.2 Stand-by generators

None.

3.2.11.3 Power factor correction

None.

3.2.11.4 Mobile substations

None.

3.2.11.5 Metering

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

3.3 Age and condition of the assets by category

3.3.1 Bulk supply assets and embedded generation

The company owns the following assets within the GXP.

Injection Plants

Voltage	Location	Quantity	Manufactured	Valuation	Condition
33kV	Invercargill 2	1	1988	$93k	Good, all gear is indoor.

Remaining life of this plant according to ODV standard life is three years, but due to the condition and minor replacements the expected remaining life of this plant is at least 13 years.

3.3.2 Sub-transmission network

Voltage	Location	Quantity	Manufactured	Valuation[2]	Condition
33kV	Invercargill 122 to Southern	Cable 5.0 km	1968 RL = 32yrs	RC $940.0k DRC $174.0k	Good, only lightly loaded.
33kV	Invercargill 152 to Doon Street	Cable 3.5 km	1970 RL = 34yrs	RC $1,089.6k DRC $248.2k	Good, only lightly loaded.
33kV	Invercargill 272 to Doon Street	Cable 3.5 km	1975 RL = 39yrs	RC $656.7k DRC $222.5k	Good, only lightly loaded.
33kV	Invercargill 252 to Leven Street	Cable 5.2 km	1983 RL = 22yrs	RC $919.8k DRC $584.7k	Good, only lightly loaded.
33kV	Bluff Line to Southern	Cable 1.5 km	1999 RL = 38yrs	RC $255.6k DRC $222.9k	Good, not loaded.
33kV	Otatara Line to Leven	Cable 3.7 km Line 1.1 km	2000 RL = 39yrs	RC $718.6k DRC $642.8k	Good, not loaded.
33kV	Invercargill 162 to Racecourse Road	Line 0.3 km	1975 RL = 14yrs	RC $16.4k DRC $8.9k	Good, short cross country, concrete poles.

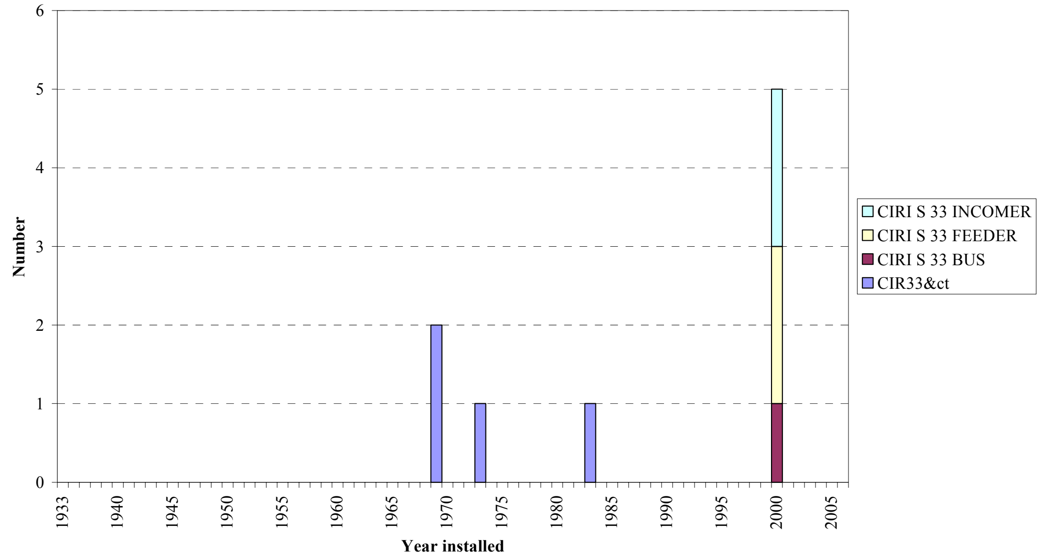
All circuits are within their rating with no known problems.

3.3.3 Zone substations

Age profiles for the three major components of Zone Substations are shown below:

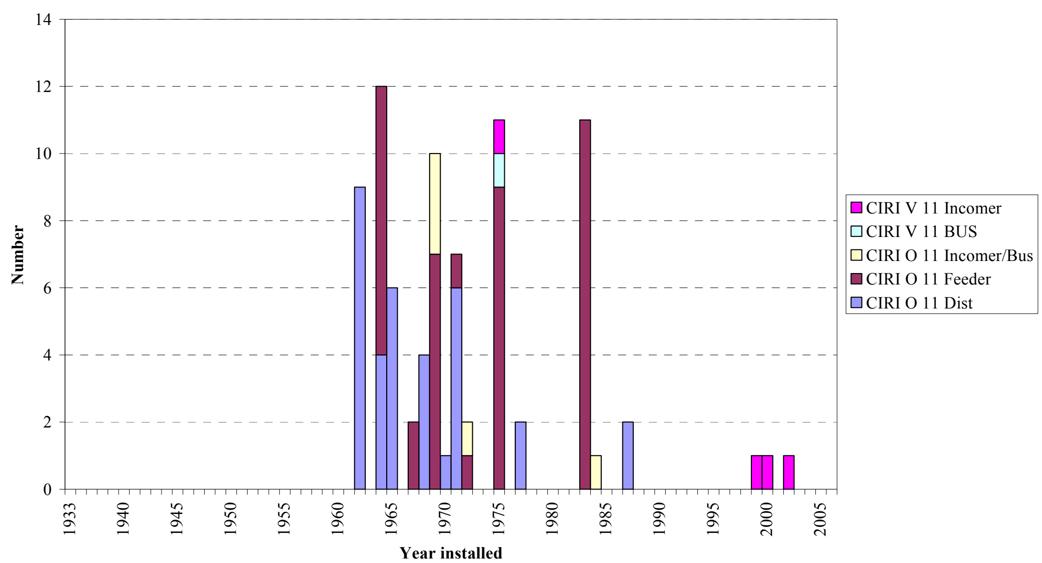
[2] Estimated based on 2004 ODV Handbook but calculated for 2006. RC = Replacement Cost, DRC = Depreciated RC.

HV Circuit Breakers

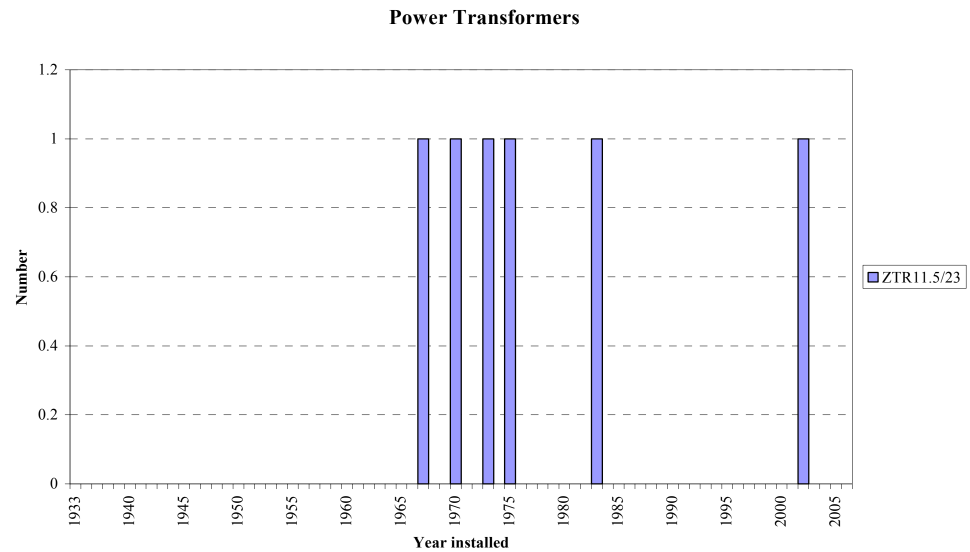


Corrosion is affecting the 33kV bushing gaskets at Doon Street Substation. The latest switchboard at Leven Street Substation is indoor and in good condition. The outdoor equipment at Southern Substation has been damaged by vandalism requiring the installation of protective barriers around critical equipment.

MV Circuit Breakers



All the 11kV circuit breakers are indoor, with some units in underground substations. Condition of the gear is good.

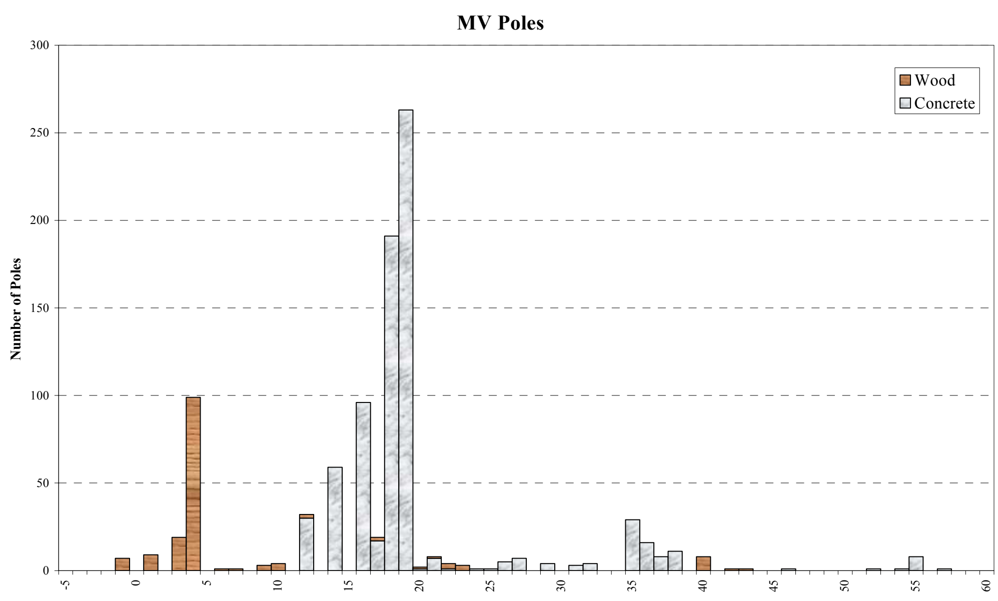


The Power Transformers on the network are of emergency rating design permitting loading up to 23MVA, if the ambient temperature is less than 5ºC. Each unit is under the ONAN rating and Dissolved Gas Analysis monitoring shows each is in good condition.

3.3.4 Distribution network

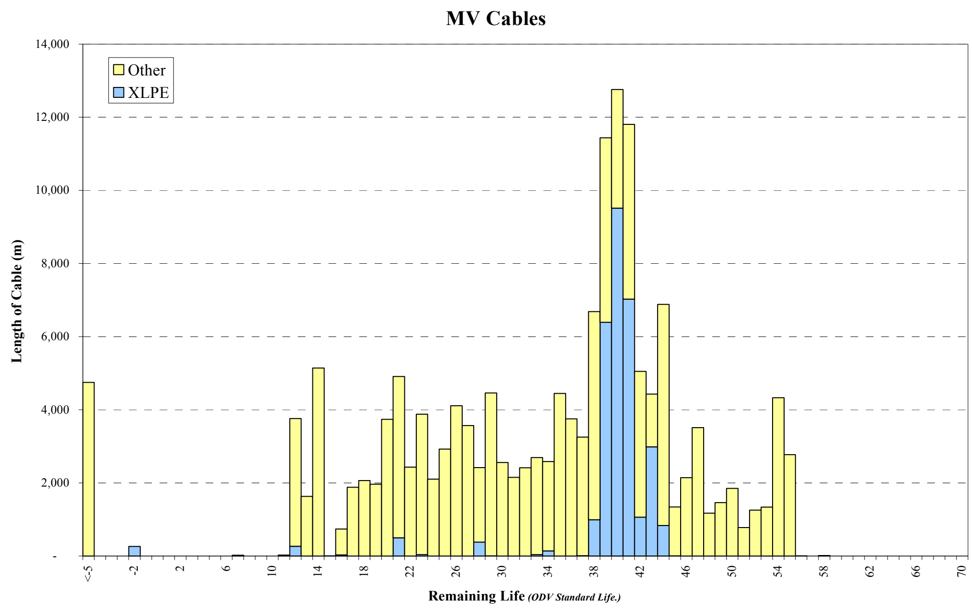
3.3.4.1 Poles

The below chart displays the estimated 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 removed as part of the undergrounding programme.



3.3.4.2 Cables

The chart below displays the remaining life of the MV cables on the network. Data on the exact material is not recorded and it is uneconomic to collect.

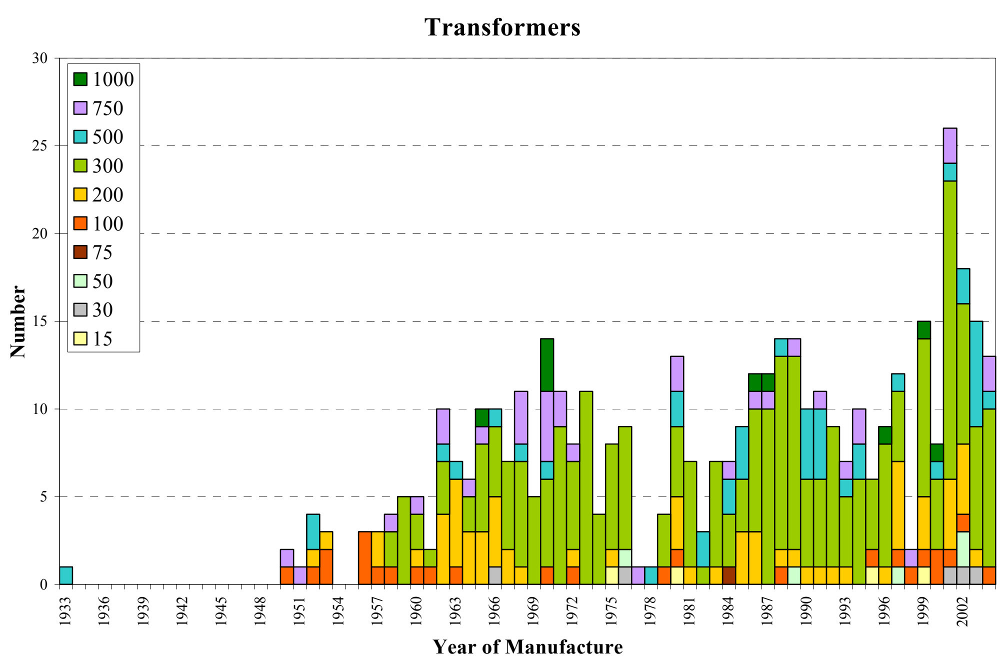


Most cables are lightly loaded but there have been termination failures.

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

3.3.5 Distribution substations

The chart below displays the age profile of the distribution transformers on the network. As a number of sites are enclosed, the weather impact is reduced and the condition of these transformers is very good.

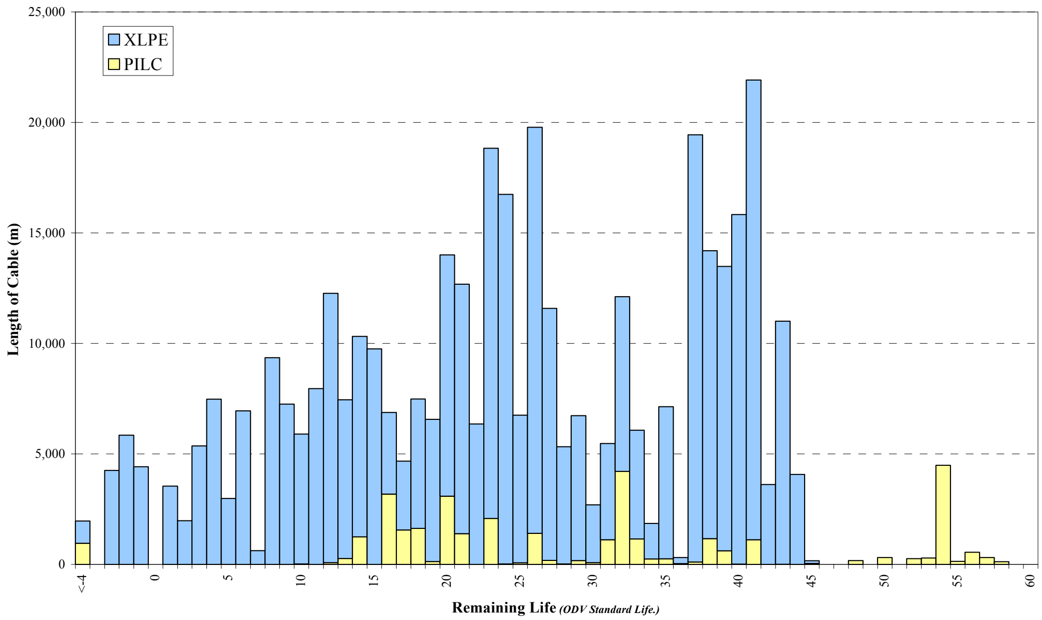


The ongoing undergrounding programme also causes the renewal of pole mounted transformers with some of the newer units refurnished and converted to ground mounting.

3.3.6 LV network

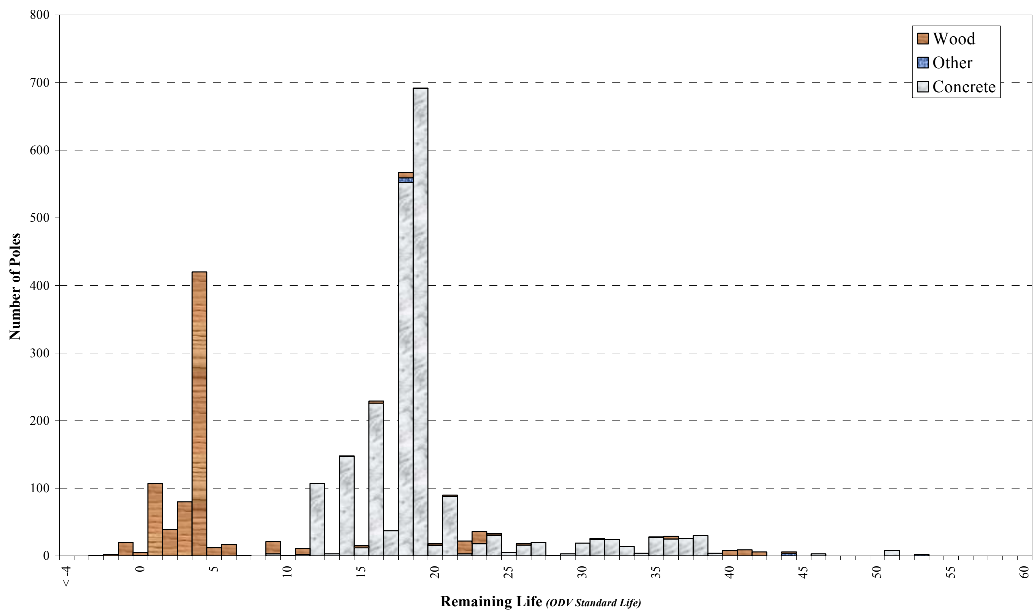
Age profiles are shown below and highlight that based on age, a number of assets should be renewed. In practice, cables are left in service until performance deteriorates impacting on service levels.

LV Cables



The 400V cables installed in the early 1970's are now becoming overloaded due to greater demand per household which is being seen as increased voltage complaints.

LV Poles



Almost all LV (400V) poles in the city will be removed as part of the undergrounding programme, with poles in Bluff renewed, as required, out of the regular inspections of the network.

3.3.7 Consumer connection assets

No accurate age data exists for consumer connection assets and generally these are renewed as they fail or are up-sized for increased consumer requirements.

3.3.8 Load control assets

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.

3.3.9 Protection and control

3.3.9.1 Key protection systems

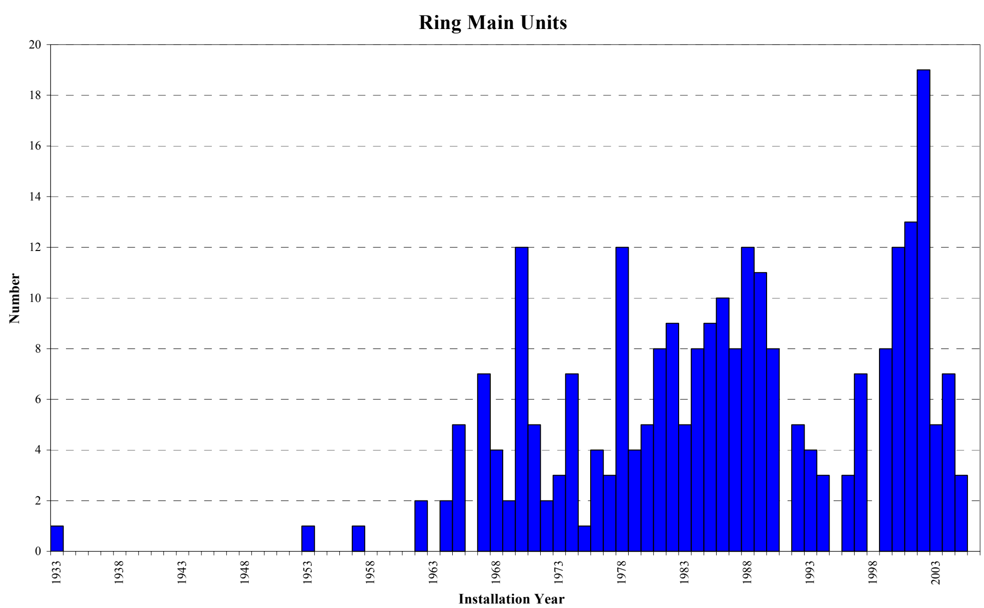
CB's

Voltage	Location	Quantity	Manufactured	Valuation[3]	Condition
11kV	Gore Street	Nulec N24	1997	DRC $18k	Average
11kV	Shannon Street	Cooper KFE	1995	DRC $17k	Average

Switches

There are 76 Air Break Switches (ABS) and 260 Ring Main Units (RMU) on the network. Details on the age of ABS's are limited but most are being removed as part of the undergrounding programme.

The age profile of RMU's below shows three units older than the standard life of 45 years, but these units are enclosed and are still providing good service.



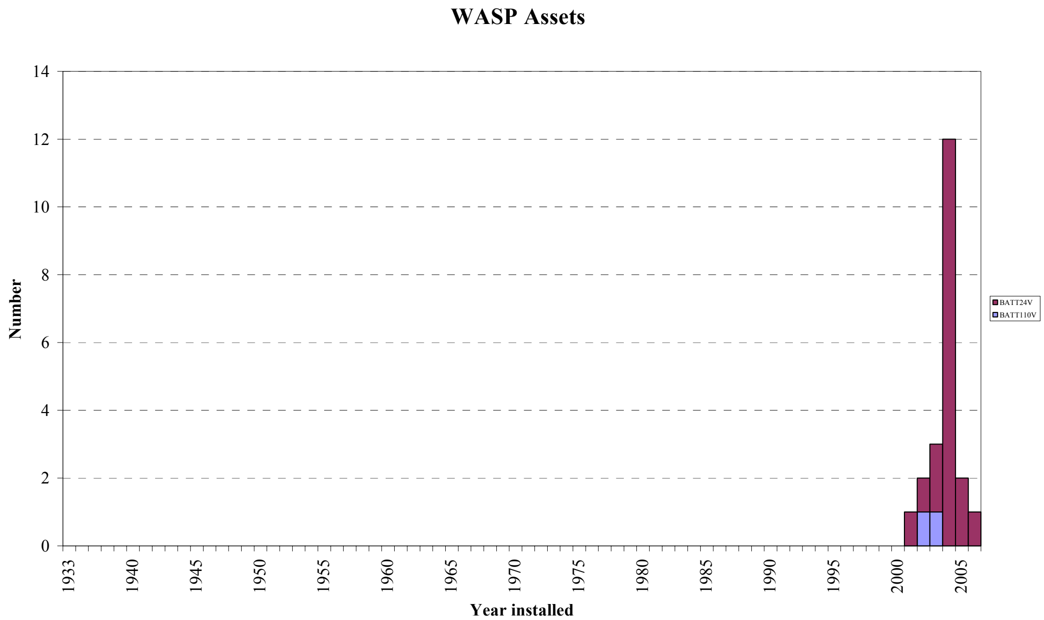
Fuses

[3] Estimated based on 2004 ODV Handbook but calculated for 2006. RC = Replacement Cost, DRC = Depreciated RC.

There are 130 drop out fuses on the network. Most of these are in the city and will be removed due to the undergrounding programme.

3.3.9.2 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.



The chart shows all batteries are less than five years old.

3.3.9.3 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.

3.3.10 SCADA and Communications

3.3.10.1 Master station

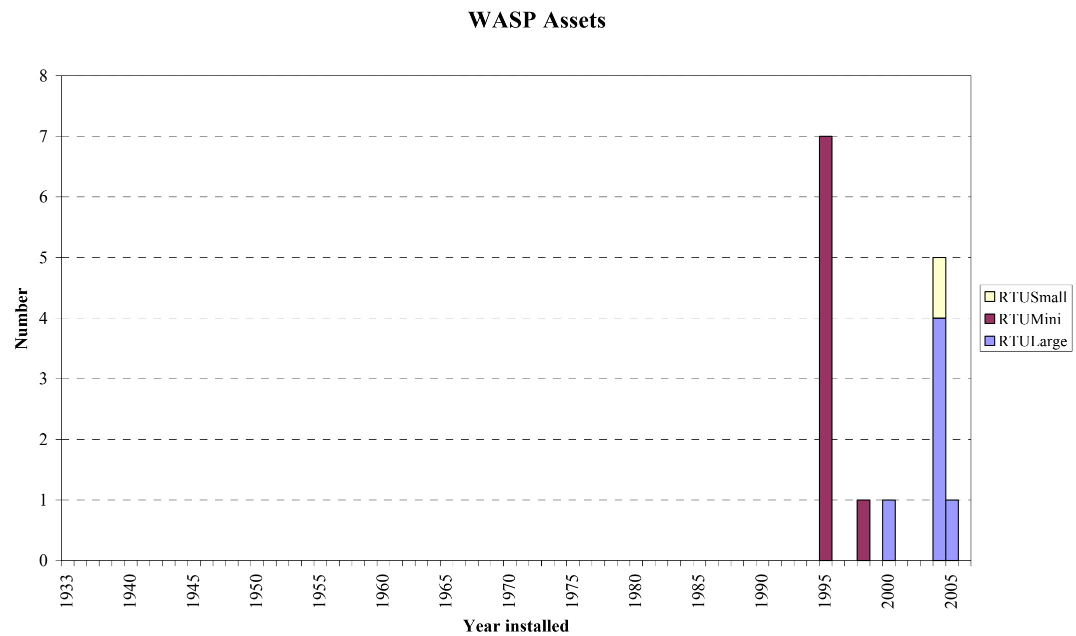
The initial system was commissioned in 1999, with a recent upgrade of the Server PC's in 2005. The software has developed with the latest version being implemented with the new servers in 2005. One operator PC is still operating but the original CRT screens have burnt due to continuous operation. The other has had the screen renewed with LCD screens.

3.3.10.2 Communications links

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

3.3.10.3 Remote stations

The RTU age profile shows that most units are modern. The early GPT miniRTU were installed in 1995, and continue to provide patchy service - generally failing at the time of faults.



3.3.11 Other assets

3.3.11.1 Mobile generation

None.

3.3.11.2 Stand-by generators

None.

3.3.11.3 Power factor correction

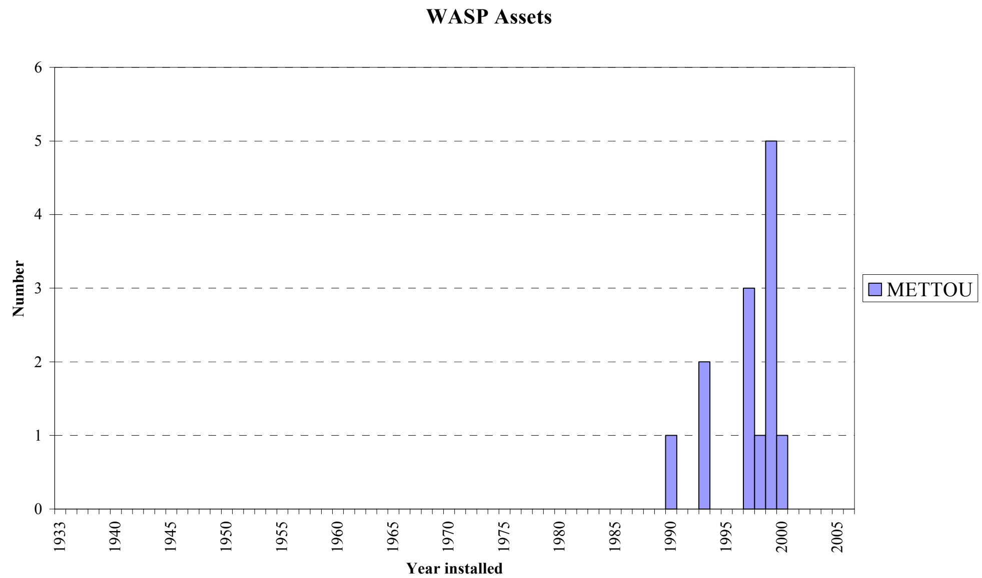
None.

3.3.11.4 Mobile substations

None.

3.3.11.5 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 given below:



3.3.12 Summary

The assets are summarised in Table 3.

Table 3 - Summary of assets by category

Asset description	Quantity	Unit	Average remaining life as a percent of ODV standard life	Condition summary	ORC ($000)	Percent of ORC
Ripple Injection	1	total	20%	Good	307	0.4%
33kV line	1	km	85%	Good	84	0.1%
33kV cable	24	km	63%	Good	4,611	5.8%
Other zone substation assets		total	58%	Average	426	0.5%
33kV switchgear in Zone substations	11	each	90%	Average	100	0.1%
11kV switchgear in Zone substations	231	each	35%	Average	3,865	4.9%
Power transformers	6	each	57%	Average	3,660	4.6%
Spares		each	57%	Average	422	0.5%
11kV line	36	km	33%	Average	1,817	2.3%
11kV cable	163	km	69%	Good	14,258	17.9%
Distribution transformers and site	869	each	60%	Good	12,571	15.8%
11kV switchgear	611	each	50%	Average	5,786	7.3%
400V lines	85	km	28%	Average	1,586	2.0%
400V cable	397	km	57%	Good	21,865	27.5%
400V switches, links etc	130	each	92%	Good	520	0.7%
Street lighting circuits	74	km	59%	Good	1,591	2.0%
SCADA and system control	29	each	49%	Good	570	0.7%
Land and buildings	16	each	56%	Good	1,365	1.7%
Connection assets incl street lights	16,891	each	57%	Good	4,188	5.3%
Total					79,592	

3.4 Justifying the assets

EIL creates stakeholder service levels by carrying out a number of activities (described in Section 6) on the assets, including the initial step of actually building assets such as lines and substations. Some of these assets obviously need to deliver greater service levels than others eg 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:

- An intimate understanding of how asset ratings and configurations create service levels such as capacity, security, reliability and voltage stability.
- The asymmetric nature of under-investment and over-investment to be clearly understood ie over-investing creates service levels before they are needed, but under-investing can lead to service interruptions (which typically costs about 10x to 100x, as much as over-investing as was discovered in Auckland in June 2006).
- The discrete "sizes" of many classes of components to be recognised eg 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 the 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 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 an asset will 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 ODRC to DRC which is 0.9876, with a ratio close to 1, indicating a high level of justification.

4. Proposed service levels

4.1 Consumer-oriented service levels

This section firstly describes the service levels expected to be created for consumers (which is what they pay for) and secondly the service levels expected to be created for other key stakeholder groups (which consumers are expected to subsidise).

Research indicates that consumers value continuity and restoration of supply more highly than other attributes such as answering the phone quickly, quick processing of new connection applications etc. What has also become apparent from research is the increasing value consumers place on the absence of flicker, sags, surges and brown-outs. Other research however indicates that flicker is probably noticed more often than when it is a problem.

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

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

4.1.1 Primary service levels

EIL's primary service levels are continuity and restoration. To measure performance in this area 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 consumer connected to the network.
- SAIFI – system average interruption frequency index. This is a measure of how many system interruptions occur per year per consumer connected to the network.

Projections of these measures for the next five years ending 31 March are set out in Table 4 below.

Table 4 - Primary service levels - reliability

Measure	YE 31/3/07	YE 31/3/08	YE 31/3/09	YE 31/3/10	YE 31/3/11
SAIFI	1.00	1.00	0.95	0.95	0.90
SAIDI	35.0	35.0	35.0	34.5	34.0

In practical terms this means consumers can broadly expect the reliability stated in Table 5 below.

Table 5 - Expected reliability by location

General location	Expected reliability	
Invercargill CBD • 33kV Fault • 11kV Fault	Frequency of faults • One every 20 years • One every 1.4 years	Estimated restoration[4]: • 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[4]: • 15 min • 30 min
Bluff • 33kV Fault • 11kV Fault	Frequency of faults • 3 every year • 2.9 every year	Estimated restoration[4]: • 1 min • 45 min

4.1.2 Secondary service levels

Secondary service levels are the attributes of service that EIL's consumers 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 eg someone could work a few hours overtime to process a back log of new connection applications, an over-loaded phone could be diverted or the shut-down notification process could be improved.
- They are heterogeneous in nature ie they can be provided exclusively to consumers who are willing to pay more in contrast to fixed asset solutions which will equally benefit all consumers connected to an asset regardless of whether they pay.

These attributes include:

- How satisfied consumers are after communication regarding:
    - Tree trimming
    - Connections
    - Faults
- Time taken to respond to voltage complaints and time to remedy justified voltage complaints.
- Are consumers given sufficient notice of planned shutdowns?

Table 6 below sets out projections of these service levels for the next three years.

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

Table 6 - Secondary service levels

Attribute	Measure	YE 31/3/06	YE 31/3/07	YE 31/3/08	YE 31/3/09
Consumer Satisfaction: Trees	Written: Amount of information	4.6[5]	>3.5	>3.5	>3.5
	Phone: Friendliness and courtesy	4.7[5]	>3.5	>3.5	>3.5
	Phone: Time taken to answer call	4.6[5]	>3.5	>3.5	>3.5
	Overall level of service	4.5[5]	>3.5	>3.5	>3.5
	Contractor service	4.8[5]	>3.5	>3.5	>3.5
Consumer Satisfaction: Connections	Written: Amount of information	3.9[5]	>3.5	>3.5	>3.5
	Phone: Friendliness and courtesy	4.3[5]	>3.5	>3.5	>3.5
	Phone: Time taken to answer call	4.3[5]	>3.5	>3.5	>3.5
	Overall level of service	3.3[5]	>3.5	>3.5	>3.5
	Contractor service	4.2[5]	>3.5	>3.5	>3.5
Consumer Satisfaction: Faults Repair	Overall level of service	4.3[5]	>3.5	>3.5	>3.5
	Phone: Friendliness and courtesy	4.3[5]	>3.5	>3.5	>3.5
	Phone: Time taken to answer call	4.1[5]	>3.5	>3.5	>3.5
	Contractor service	4.5[5]	>3.5	>3.5	>3.5
	PowerNet Service	4.4[5]	>3.5	>3.5	>3.5
Voltage Complaints	Number of consumers who have made voltage complaints	6	<12	<12	<12
	Number of consumers who have justified voltage complaints regarding power quality	2	<4	<4	<4
	Average days to complete investigation	19	<30	<30	<30
	Period taken to remedy justified complaints	106	<90	<90	<90
Planned Outages	Provide sufficient information	#[6]	>75%	>75%	>75%
	Satisfaction regarding amount of notice	#[6]	>75%	>75%	>75%
	Acceptance of maximum of three planned outages per year	59%[6]	>50%	>50%	>50%
	Acceptance of planned outages lasing five hours on average	37%[6]	>25%	>25%	>25%

[5] May 2006 PowerNet Phone Survey; Scale 1- 5 where 1 = Very Poor and 5 = Excellent, - = no responses from 200 interviewees, x% = percentage of respondents.

[6] March 2006 Consumer Engagement Telephone Survey; results are percentage of the 200 respondents. # means no outage recalled.

4.1.3 Other service levels

In addition to the service levels that are of primary and secondary importance to consumers 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 public goods necessary for the proper functioning of a safe and orderly community EIL is expected to absorb the associated costs into its overall cost base.

4.1.3.1 Public safety

Various legal requirements require EIL's assets (and consumers' 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 (Hazards From Trees) Regulations 2003.
- Maintaining safe clearances from live conductors (NZECP34:2001).
- Power system earthing (NZECP35:1993).

4.1.3.2 Amenity value

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

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

In general, EIL will need to place all new assets underground which is obviously significantly more expensive and also creates reliability levels beyond those which consumers generally expect and are prepared to pay for.

4.1.3.3 Industry performance

Various statutes and regulations require EIL to compile and disclose prescribed information to specified standards. These include:

- Electricity Information Disclosure Requirements 2004 and subsequent amendments.
- Commerce Act (Electricity Distribution Thresholds) Notice 2004.

4.1.3.4 Electrical interference

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

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

4.2 Business performance targets

In addition to complying with the price path thresholds regime established under Part 4A of the Commerce Act 1986 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 2006.

4.2.1 Financial efficiency measures

EIL's projected financial efficiency measures are shown below. These measures are:

- Direct costs per km of line – [direct expenditure as defined in the disclosure requirements] / [system length at year end].
- Indirect costs per ICP – [indirect expenditure as defined in the disclosure requirements] / [number of ICP's at year end].

Measure	YE 31/3/07	YE 31/3/08	YE 31/3/09	YE 31/3/10	YE 31/3/11
Direct costs	$2,476.55	$2,470.72	$2,448.18	$2,429.49	$2,410.85
Indirect costs	$79.66	$79.26	$79.21	$78.82	$78.43

4.2.2 Energy delivery efficiency measures

EIL's projected energy efficiency measures are shown below. These measures are:

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

Measure	YE 31/3/07	YE 31/3/08	YE 31/3/09	YE 31/3/10	YE 31/3/11
Load factor	55%	55%	56%	56%	56%
Loss ratio	6.5%	6.5%	6.5%	6.5%	6.5%
Capacity utilisation	40%	40%	41%	41%	42%

4.3 Justifying the service levels

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

- Positive cost benefit within revenue capability.
- By the physical characteristics and configuration of the assets which are expensive to significantly alter (but which can be altered if a consumer or group of consumers agrees to pay for the alteration).
- By a consumers' 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 maintain clearances).

5. Development plans

EIL's development plans are driven primarily by demand but on occasions may be influenced by other drivers such as security of supply, safety, or environmental compliance.

At its most fundamental level, demand is created by each individual consumer drawing energy across their individual connection. The demand at each connection aggregates "up the network" to the distribution transformer, then to the distribution network, the zone substation, the sub-transmission network back to the GXP and ultimately through the grid to a power station.

5.1 Planning approach and criteria

5.1.1 Planning unit

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

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

` Physically this planning unit will usually be based around the lines or cables emanating from an 11kV board.

5.1.2 Planning approaches

EIL plans its assets in three different ways (strategically, tactically and operationally) as shown in Table 7 below:

Table 7 - Planning approaches

Attribute	Strategic	Tactical	Operational
Asset description	• Assets within GXP. • Sub-transmission lines and cables. • Major zone substation assets. • Load control injection plant. • Central SCADA and telemetry. • Distribution configuration eg 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 consumer connections.	• All 400V lines and cables. • All 400V consumer connections. • All consumer metering and load control assets.
Number of consumers supplied	• Anywhere from 500 upwards.	• Anywhere from 1 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 principal in annual business plan. • Individual approval by board and possibly shareholder.	• Approved in principal in annual business plan. • Individual approval by Chief Executive.	• Approved in principal in annual business plan. • Individual approval by Engineering Manager.
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 5 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	Lo	Hi
Outside of existing network footprint	**Quadrant 3** • 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. • 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 thru' put as well as additional connections may be difficult. • Likely to involve tactical upgrades of many assets

Prevailing load growth

Figure 5 - Investment strategy matrix

As the network covers all of the network area the load growth sits in Quadrants 1 and 2 by definition ie EIL is either connecting additional consumers or increasing the capacity of existing connections within or close to the existing network footprint. The key characteristic of this mode of investment is "upsizing" rather than "extension" ie capacity, security, reliability or voltage triggers new investment (as opposed to location).

5.1.3 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.

The first step in meeting future demand is to determine if the projected demand will exceed any of the defined trigger points for asset location, capacity, reliability, security or voltage. These points are outlined for each asset class in Table 8.

If a trigger point is exceeded EIL will then move to identify a range of options to bring the assets' operating parameters back to within the acceptable range of trigger points. These options are described in section 5.2 which also embodies an overall preference for avoiding new capital expenditure.

Table 8 - Summary of capacity "trigger points"

Asset category	Extension	Upsizing			
	Location trigger	Capacity trigger	Reliability trigger	Security trigger	Voltage trigger
LV lines and cables	• Existing LV lines and cables don't reach the required location.	• Tends to manifest as fuse blowing when current exceeds circuit rating.	• Not applicable. Normally a Maintenance or Operational trigger, as no requirement for Upsizing.	• Excursion beyond triggers specified in section 4.2.2.	• Voltage at consumers' boundary consistently drops below 0.94pu.
Distribution substations	• Load cannot be reasonably supplied by LV configuration therefore requires new distribution lines or cables and substation.	• Where fitted, MDI reading exceeds 90% of nameplate rating.			• Voltage at consumers' boundary consistently drops below 0.94pu, that cannot be remedied by LV upsizing.
Distribution lines and cables	• Load cannot be reasonably supplied by LV configuration therefore requires new distribution lines or cables and substation.	• Analysis calculates that the peak current exceeds the thermal rating of the circuit segment.			• Voltage at MV terminals of transformer consistently drops below 10.45kV and cannot be compensated by local tap setting.
Zone substations	• Load cannot be reasonably supplied by distribution configuration therefore requires new sub-trans lines or cables and zone substation.	• Max demand consistently exceeds 100% of nameplate rating.			• Voltage at MV terminals of transformer consistently drops below 10.45kV and cannot be compensated by OLTC.
Sub-transmission lines and cables	• Load cannot be reasonably supplied by distribution configuration therefore requires new sub-trans lines or cables and zone substation.	• Analysis calculates that the peak current exceeds the thermal rating of the circuit segment.			• Voltage at HV terminals of transformer consistently drops below 28.7kV and cannot be compensated by OLTC.
EIL Network equipment within GXP	• Load cannot be reasonably supplied by new or extended Sub-transmission or Substation therefore requires new GXP equipment.	• Max demand consistently exceeds 80% of nameplate rating.			• Not applicable.

5.2 Prioritisation methodology

5.2.1 Options for meeting demand

Table 8 defines the trigger points at which the capacity of each class of assets needs to be increased. Increasing the capacity of individual assets within these classes can take the following forms (in a broad order of preference):

- Accept that one or more parameters have exceeded a trigger point and take no action. This option would only be adopted if the benefit-cost ratio of all other reasonable options was unacceptably low and if assurance was provided to the Chief Executive that this option did not represent an unacceptable increase in risk to EIL. An example of where this option might be adopted is where the voltage at the far end of an 11kV overhead line earmarked for OHUG[7] falls marginally below the threshold – the benefits of correcting such a constraint are simply too low.
- Operational activities, in particular switching 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 limit protection settings.
- Influence consumers to alter their consumption patterns so that asset's perform at levels below the trigger points. Examples might be to shift demand to different time zones, negotiate interruptible tariffs with certain consumers so that overloaded assets can be relieved, or assist a consumer to adopt a substitute energy source to avoid new capacity.
- Construct distributed generation so that an adjacent asset's performance is restored to a level below its trigger point. Distributed generation would be particularly useful where additional capacity could eventually be stranded or where primary energy is going to waste eg waste steam from a process.
- Modify an asset so that the asset's trigger point will move to a level that is not exceeded eg by adding forced cooling. This is essentially a sub-set of the above approach but will generally involve less expenditure. This approach is more suited to larger classes of assets such as 33/11kV transformers.
- Retrofitting high-technology devices that can exploit the features of existing assets (including the generous design margins of a bygone era) . Examples might be using remotely switched air-breaks to improve reliability, or using advanced software to thermally re-rate heavily-loaded lines.
- 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 voltage options are considered 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. The model in Figure 6 is used to broadly guide the adoption of various approaches:

[7] Overhead to Underground Conversion.

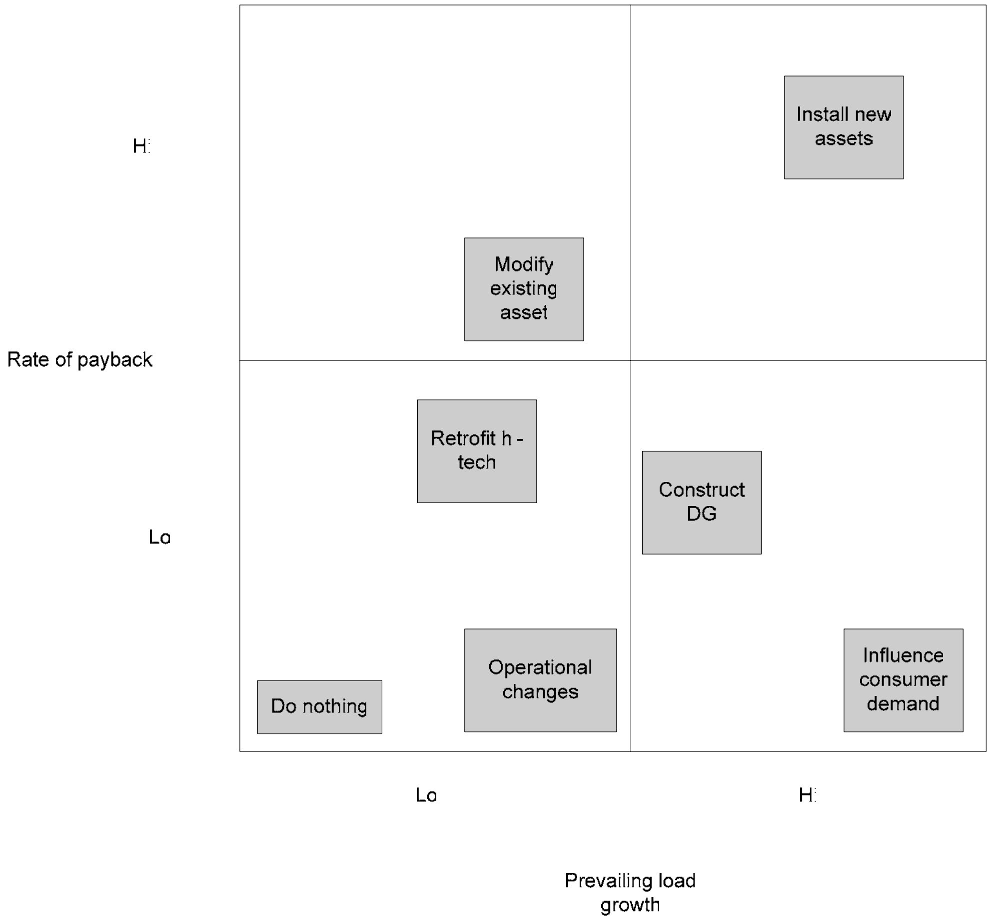


Figure 6 - Options for meeting demand

5.2.2 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 (the "spare tyre" philosophy). Typical approaches to providing security to a zone substation include:

- Provision of an alternative sub-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 maximum rating.
- Use of local generation.

The most pressing issue with security is that it involves a level of investment beyond that which is obviously required to meet demand and it can be easy to let demand growth erode this surplus capacity as Energex did over the last 15 years (which only became apparent with the air-con load and big storms in 2004).

5.2.2.1 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 1970s. P2/5 is a strictly deterministic standard ie 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.

5.2.2.2 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.

5.2.2.3 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.

5.2.2.4 EIL security standards

Table 9 describes the security standards adopted by EIL and Table 10 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 consumer, its security requirements will over-ride prevailing industry guidelines.
- The preferred means of providing security to urban zone substations will be by secondary sub-transmission assets with any available back-feeding on the 11kV providing a third tier of security.

Table 9 - Target security levels

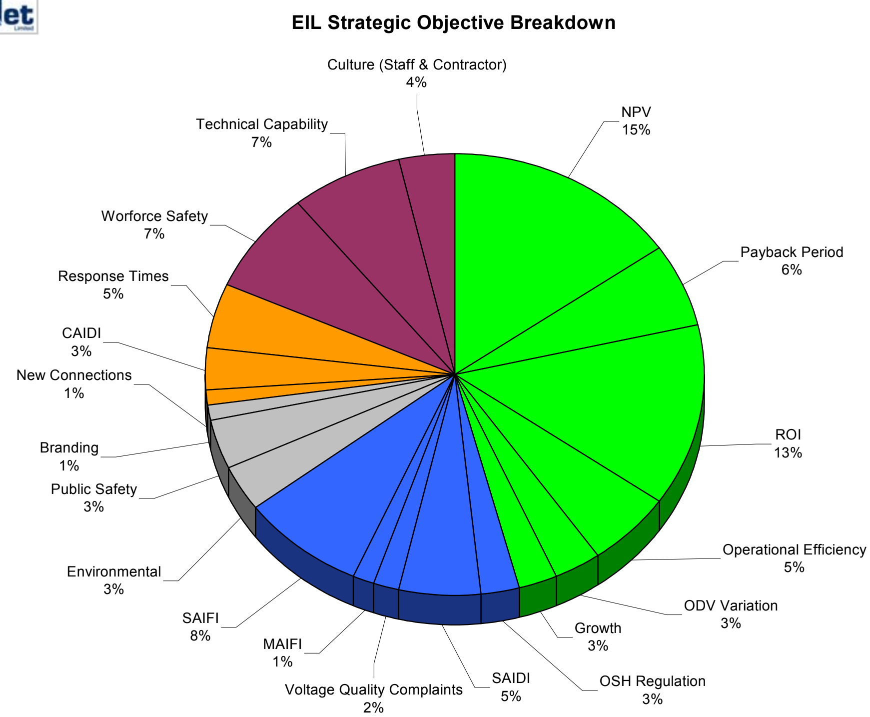
Description	Load type	Security level
AAA	Greater than 12MW or 6,000 consumers	No loss of supply after the first contingent event
AA	Between 4 and 12MW or 2,000 to 6,000 consumers	All load restored within 15 minutes of the first contingent event
A(i)	Between 1 and 4MW	All load restored within 2 hours 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 10 - Substation security levels

Substation	Target	Actual	Remarks
Doon Street	AAA	AAA	
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 2015
Southern	AA	AA	
(Bluff)	AA	AAA	

5.2.3 Choosing the best option to meet demand

Each of the possible approaches to meeting demand that are outlined in Section 5.2.1 will contribute to strategic objectives in different ways. The pie chart below defines the weightings the Board has assigned to each attribute.



A proprietary evaluation tool is used to perform two key tasks:

- Capital rationing.
- Option evaluation.

5.3 Demand forecast

5.3.1 Current demand

The current after-diversity max demand (ADMD) of 57.9MW is depicted in Figure 7 below.

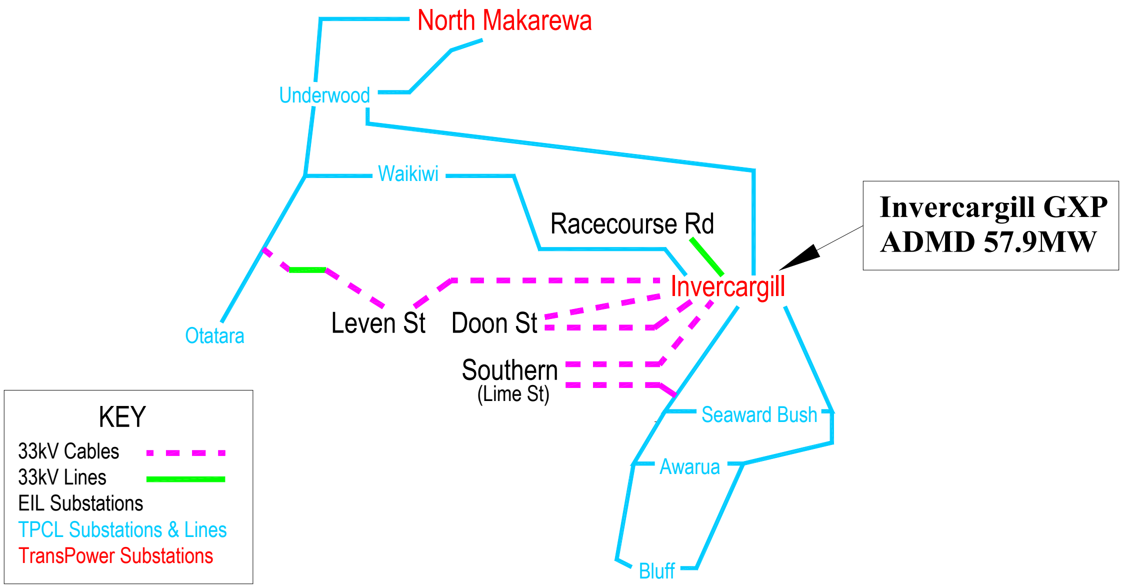


Figure 7 – Network Maximum Demands

5.3.2 Drivers of future demand

Key drivers of demand growth (and contraction) are likely to include the issues depicted in Figure 8 below.

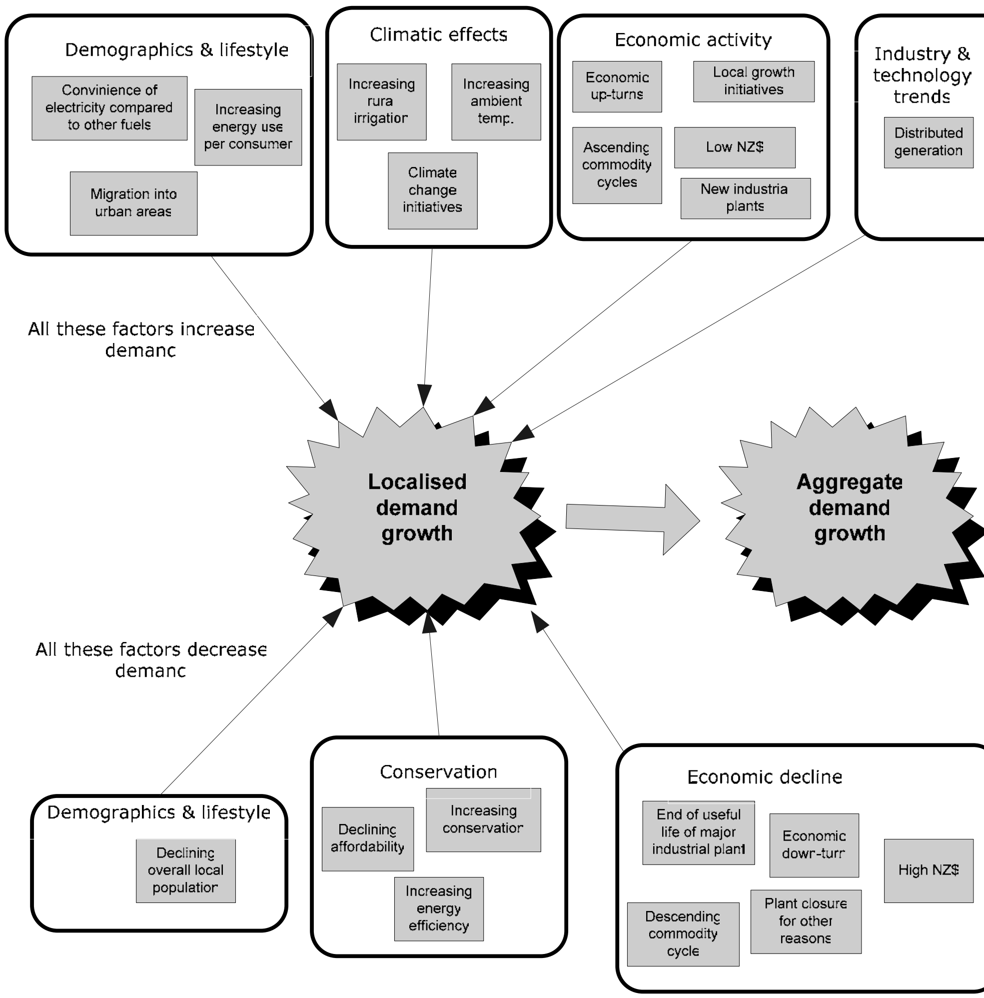


Figure 8 - Drivers of demand

At residential and light commercial feeder level 3 or 4 of the above issues may predominate and be predictable and manageable on a statistical basis however experience indicates that large consumers 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. Estimates of future demand are described in section 5.3.3 below.

EIL is expecting an average demand growth of about 0.25% per year for the next 10 years for all zone substations except Leven Street for which about 1.5% per year is predicted. The following sections examine in detail the most significant drivers of the network demand over the next 10 to 15 years.

No reductions due to the removal of the requirement to supply in 2013, as there is only one lateral that could be considered uneconomic.

5.3.2.1 Rural money coming to town

The impact of farmers retiring to the city increases demand for Townhouses in desirable locations.

5.3.2.2 Removal of Coal as a heating fuel

Solid Energy has stated that it will not continue to supply coal to the domestic market by 2012.[8]

5.3.2.3 Continuance of Major Industries

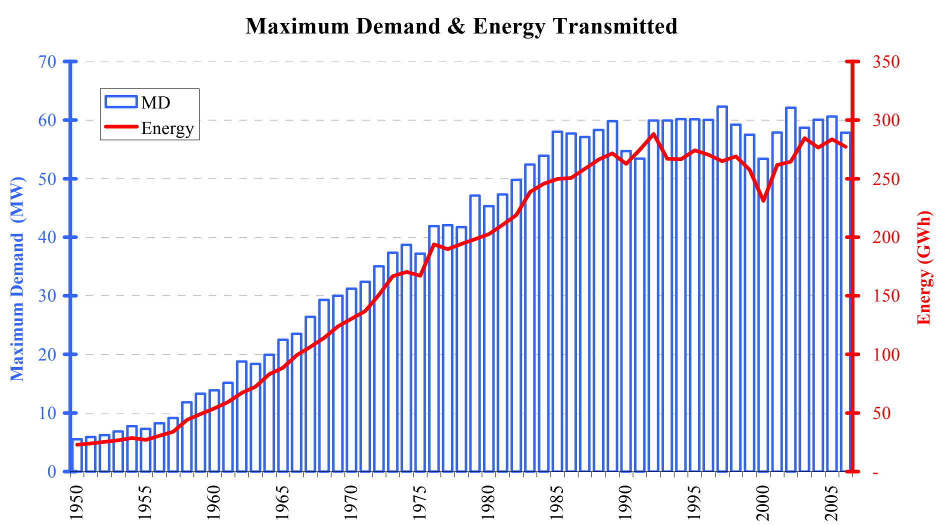
EIL sees no loss of major industries from the area, due to variation in exchange rates or loss of electricity supply contracts.

5.3.2.4 Increased environmental concern

Increase in energy efficiency counteracted by conversion to electricity for heating.

5.3.3 Load forecast Trend

Analysis of historic demand and energy usage over the last 20 years gives demand growth of 0.1% and energy growth of 0.6%. The chart below shows the data since 1950, and highlights the flattening out since 1989.



5.3.4 Estimated zone substation demands

As outlined in detail in the remainder of section 5, demand is expected to increase from that described in section 5.3.1 as follows:

- Standard natural growth in Invercargill of 0.25% per annum, includes some infill of sections in desirable locations.
- Expansion of Commercial/Retail/Light Industrial in west Invercargill area impacting Leven Street Substation at 1.35% per annum.
- Standard natural growth in Bluff of 0.05% per annum.
- Expansion of Commercial/Retail/Light Industrial in Bluff impacting Bluff Substation at 0.20% per annum.
- Load transfers between substations to keep under trigger levels.

[8] http://www.solidenergy.co.nz/nzcoal-withdrawal.htm accessed 24 July 2006.

Experience strongly indicates that it would be rare to ever get more than a few months confirmation of definite changes in an existing or new major consumers demand. This is because most of these consumer's operate in fast-moving consumer markets and often make capital investment decisions quickly themselves and they generally keep such decisions confidential until the last possible moment. Locations where the network has sufficient surplus capacity to supply a large chunk of load can be identified in advance but experience shows that 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 11 below identifies the rate and nature of growth aggregated to zone substation level for a 10 year horizon, along with the provision EIL expects to have to make for future growth. Appendix B shows the feeder growth rates from which the Table 11 has been compiled.

Table 11 - Substation demand growth rates

Substation	Rate and nature of growth	Provision for growth to 2016
Doon Street	About 0.25% per year	Transferred load to Leven Street and Racecourse Road during 2005, this allows 1.2MVA of spare capacity up to the firm capacity of 23MVA
Leven Street	About 1.6% per year, almost all CBD or medium and light industrial load. Only location with room for expansion within network boundary, is the old Showgrounds, northwest of the substation	Expect firm capacity to be full utilised. Any additional load would be provided by transferring loads to other substations
Racecourse Road	About 0.25% per year, all residential	Exceeds ONAN[9] and security trigger now. A second transformer here or at Southern will provide spare 9.6MVA capacity for city growth
Southern	About 0.25% per year, all residential	Exceeds ONAN[9] now, and will exceed security trigger in 2013. The second transformer here or at Racecourse Road will provide spare capacity for city growth and load transfer to keep under triggers
Bluff (TPCL)	About 0.25% per year, mainly industrial growth at the Port	Load on TPCL Bluff substation exceeds firm capacity and TPCL are planning to upgrade capacity in 2006/07 that will allow at least 6MVA of spare capacity

[9] ONAN = Oil Natural Air Natural. Rating of transformer with no fans or pumps operating.

5.3.5 Estimated demand aggregated to GXP level

Table 12 shows the aggregated effect of substation demand growth for a 10 year horizon at the GXP.

Table 12 - GXP demand growth

GXP	Rate and nature of growth	Provision for growth to 2016
Invercargill	0.0% Maximum Demand Load will be controlled using load management to stay at present levels.	Transpower are presently planning the upgrade of the two 220/33kV 50MVA banks to 120MVA for 2006/07. This will restore firm capacity to Invercargill GXP and allow over 20MVA of additional load.

5.3.6 Issues arising from estimated demand

The significant issues arising from the estimated demand in section 5.3.4 are the requirement for a second transformer at either Racecourse Road or Southern substations and the required increased capacity at Invercargill GXP.

5.3.7 Where are the EIL network capacity constraints

The network includes the following constraints:

Constraint	Description	Intended remedy
Invercargill GXP	Firm capacity of 63MVA	Upsized transformers by Transpower.
Bluff (TPCL) Substation	Firm capacity of 5MVA	Upsized transformers by TPCL.
Capacity at Racecourse Road	Demand exceeds security trigger of 12MVA	Add additional transformer at site or at Southern Substation and transfer some load.
MV Cables	Some MV cables operate near full capacity and would be unable to supply backup.	Operational ensure cables not overloaded. Protect smaller MV cables with fuses.
MV Transformers	Some transformers are near full capacity.	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.

5.4 Policies for distributed generation

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

- Reduction of peak demand at Transpower GXP's.
- Reducing the effect of existing network constraints.
- Avoiding investment in additional network capacity.
- Making a very minor contribution to supply security where the consumers 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.

However 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.

5.4.1 Connection terms and conditions (commercial)

- Connection of distributed generation up to 10kW to an existing connection 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 which can be either on a full, up-front basis or over time.
- Distributed generation that requires a new connection to the network will be charged a standard connection fee, as if they were a standard off-take consumer.
- An annual administration fee will be payable by the connecting party to us.
- 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.

5.4.2 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.

5.4.3 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 will need to be half-hourly.
- A distributed generator of greater than 10kW may be required 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.

5.5 Use of non-asset solutions

As discussed in section 5.2.1 EIL routinely considers a range of non-asset solutions and indeed the preference is for solutions that avoid or defer new investment.

5.6 Network development options

There have been few projects that have many options, recent consumer connections have been to meet consumer requirements and have minor impact on network constraints. Generally the decision is between reinforcement of the 400V distribution network or a new transformer.

A major project that arose after the Auckland 110kV cable failures was the improvement of security to the CBD. The options considered included:

- An additional 33kV cable from the Invercargill GXP.
- 33kV cable from the Doon Street substation.
- 33kV connection to the TPCL 33kV.
- Allow a CBD outage.

The selected option was the connection to the TPCL 33kV network because of the additional security of being able to be supplied off Transpower's North Makarewa GXP and not needing to install a long length of cable through the CBD.

In the past EIL has had a special interruptible load control channel where consumers have received lower charges but these have reduced in effectiveness with decreased consumer flexibility in their energy usage. The usefulness of the off-peak general tariff has been used in the past to reduce peak demand but repackaging of Line Charges by retailers has reduced its effectiveness because of the reduction of cost difference to the end user between controlled and uncontrolled load. The difference in charges from Contact Energy Limited for a 20kVA supply is approximately $6/month with off peak, or reduction of 4%.

A recent situation was the supply up Bluff Hill, the 3.3kV line passes through a bush area that has difficult access. Alternatives considered included:

- Rebuild on the existing route and clear the bush.
- Reroute the line to the roadside and clear trees.
- Reroute to roadside by cable.
- Disconnect and get consumers to install RAPS[10].
- Convert to 11kV.

Due to this being a tourist landmark, the number of consumers and to the ongoing cost of trimming the trees, the selected option was an 11kV cable along the roadside. This became more favoured because another network operator was installing a cable along the same route and costs could be shared.

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[10] Remote Area Power Supply, an energy source not connected to the network, provided by alternative energy sources including; Wind, Solar, Diesel, LPG etc.

5.7 Development program

5.7.1 Current Projects

5.7.1.1 Bluff Capacity

This project is being undertaken by The Power Company Limited with EIL as its consumer. Impact to EIL will be increased Line Charges for the Bluff connection.

5.7.1.2 Invercargill GXP capacity

Presently the maximum demand on Invercargill GXP from EIL and TPCL loads is 78MVA with the winter rating of one 220/33kV transformer at 61MVA, therefore if one transformer failed at a high load time, all supply would be lost.

Options considered included:

- Load transfer scheme to supply part load from North Makarewa GXP.
- Load reduction, use of tariff to reduce maximum demand.
- GXP supplement by generation to reduce GXP peak.
- Transfer load onto another GXP.
- Upsize by Transpower of transformer capacity.

It was found that limitations on future growth, the consumers' desire for high reliability, ineffectiveness of tariffs and limitation of the neighbouring GXP, highlighted the upsizing option as the best option.

While there is no direct investment by EIL, the change in assets at Transpower required a New Investment Agreement with its associated annual charges.

5.7.1.3 Doon Street Substation 33kV Circuit Breakers

Renewal of the two 33kV outdoor circuit breakers (CBs) with new outdoor units.

This was chosen because this was estimated to have the least cost and still provide full protection across both the cable and the transformer. The installation next to the existing Oil Cable terminations does not require changes to the Oil cables and can lead to removal of the 33kV structure to gain access to the southern transformer.

5.7.1.4 SCADA RTU Renewal

Renewal of the GPT mini RTU's at five CBD switching stations. This project will continue next year with five more CBD site RTU's renewed.

This was chosen as the present units are becoming unreliable and full remote operation is required to meet the service levels for the CBD.

5.7.1.5 Undergrounding Programme

Undergrounding of lines and services in the following areas:

- Lamond, Kowhai, Salford, Chelmsford, and Helmsdale Streets.
- Tyne, Eye, Kelvin, Deveron, and Jed Streets.
- John, Saturn, and Murphy Streets.

These projects are being undertaken at the directive of the Board to renew old assets and to improve reliability and aesthetics.

5.7.1.6 New Connections

Allowance for new connections to the network. Each specific solution will depend on location and consumer requirements.

5.7.1.7 Whole Category Projects

These are ongoing projects that operate and maintain specific asset categories within their normal lifecycle to maintain required service levels.

- Air Break Switches; operation, maintenance, and renewal of overhead ABS's.
- Faults Service; provision of staff to operate and repair the network.
- Transformers; operation, maintenance, renewal and upsizing.
- Power Quality; investigation of network problems and upsizing projects to remedy.
- Earthing; maintenance, renewal and upsizing of earthing systems.
- Distribution Line and Cables; operation, maintenance, renewal and upsizing.
- Distribution Pillar Boxes; operation, maintenance, renewal and upsizing.
- Distribution Switchgear; operation, maintenance, renewal and upsizing.
- Subtransmission; operation, maintenance, renewal and upsizing.
- Substation; operation, maintenance, renewal and upsizing.
- Miscellaneous Undergrounding; opportunity taking when other works are occurring.

5.7.2 Planned Projects

5.7.2.1 Doon Street Substation Switchboard Renewal

The 11kV switchboard at Doon Street was installed in various stages, with the first seven circuit breakers installed in 1964. Therefore, in 2009 these circuit breakers will be 45 years old and at the standard ODV life. Options are:

- Retrofit existing CB trucks with modern units.
    - Does not renew other fittings on switchboard, eg bus supports, metalwork, CT's, bushings, cable terminations.
    - Very little interruption to implement.
    - Lower cost.
- Replace half the board with modern 11kV switchboard.
    - Renews all parts of switchboard, with modern protection and control.
    - Requires substantial outage of half the switchboard.
    - Higher cost.
- Do nothing and wait until switchboard fails.
    - May not be able to repair when fails.
    - Failure could destroy or damage whole switchboard.
    - Lowest cost?
- Mass install individual generation so no need for network.

5.7.2.2 Distribution Substation Switch Renewal

Replace old switchgear in CBD distribution stations due to age and reliability. Options include:

- Modern switchgear.
- Refit with modern CB in existing panel.
- Do nothing.

The location of some sites make access difficult and expensive, with traffic management required and the closing of one lane of state highway one for four sites. Budget has been made to replace with modern switchgear, so that extended lives can be achieved.

5.7.2.3 LV Cable Renewal and Resizing

Renew or Upsize old PVC LV cables that have reached their standard lives, and are not sufficient to provide voltage within limits.

5.7.2.4 LV Fuse Board Renewal

Renew old Type J fuse boards with modern DIN standard fuse boards, due to the safety risk of the exposed live busbars.

5.7.2.5 Undergrounding Programme

Undergrounding of lines and services in the following areas:

- Continue John, Saturn, and Murphy Streets.
- Moulson and Brown Streets.
- Nith, Liddel, Ettrick, Conon, Clyde, Crinan and Annan Streets.
- Ethel and Ash Streets.
- Tramway, Coronation and York Streets.
- West, Purdue, Fairview, Marjorie and Stuart Streets.

These projects are being undertaken at the directive of the Board to renew old assets and to improve reliability and aesthetics.

5.7.3 Future Projects

5.7.3.1 Racecourse Road Capacity

The addition of a seventh power transformer on the network is required sometime before 2013 due to security trigger on either Racecourse Road or Southern Substations.

As load transfers can occur between these sites the location of the extra unit is flexible and study is required to finalise the location.

5.7.3.2 Undergrounding Industrial Area

Undergrounding of lines and services in the following areas:

- Bond Street

These projects are being undertaken at the directive of the Board to renew old assets and to improve reliability, aesthetics and provide clearance along the western heavy traffic by-pass route.

5.7.3.3 Southern Substation Switchboard Renewal

The 11kV switchboard at Southern was installed in 1968. Therefore, in 2013 these circuit breakers will be 45 years old and at the standard ODV life. Options are the similar to the Doon Street switchboard renewal project in section 5.7.2.1.

5.7.4 Capital Budget

The capital budget for the next ten year is given below.

Expansion	2006/07	2007/08	2008/09	2009/10	2010/11	2011/12	2012/13	2013/14	2014/15	2015/16
New Connections	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
Major New Connections	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
Subdivisions	-	-	-	-	-	-	-	-	-	-
	158,550	158,550	158,550	158,550	101,925	101,925	101,925	101,925	101,925	101,925

Operations & Maintenance	2006/07	2007/08	2008/09	2009/10	2010/11	2011/12	2012/13	2013/14	2014/15	2015/16
Distribution Faults	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
Substation Maintenance	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
	12,911	14,156	16,421	16,421	16,421	16,421	18,686	18,686	18,686	18,686

Renewals	2006/07	2007/08	2008/09	2009/10	2010/11	2011/12	2012/13	2013/14	2014/15	2015/16
ABS Maintenance & Renewals	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
Transformer Renewals	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
Earth Upgrades & Renewals	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
Distribution Renewals	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
Distribution Link & Pillar Boxes	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
Distribution LV board renewals	-	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
Distribution RMU Renewals	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
CBD Switchgear Renewals	-	-	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	-	-	-
Subtransmission Renewals	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
SCADA RTU Renewals	[redacted]	[redacted]	-	-	-	-	-	-	-	-
Switchboard Renewal - Doon St	-	-	-	[redacted]	-	-	[redacted]	-	-	-
Switchboard Renewal - Southern	-	-	-	-	-	-	-	[redacted]	-	-
33kV CB Renewal	[redacted]	-	-	-	-	-	-	-	-	-
	528,878	488,674	492,071	872,591	541,335	576,443	918,458	814,834	475,084	475,084

Upsizing	2006/07	2007/08	2008/09	2009/10	2010/11	2011/12	2012/13	2013/14	2014/15	2015/16
Supply Quality Upgrades	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
LV Cable Replacement	-	-	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
Spare 33/11kV Transformer (Southern)	-	-	-	-	[redacted]	-	-	-	-	-
Spare 33/11kV TX (Racecourse Road)	-	-	-	-	-	-	-	-	-	-
Unspecified Projects	-	-	-	-	-	-	[redacted]	[redacted]	[redacted]	[redacted]
	18,120	18,120	472,253	585,503	1,605,885	699,885	984,143	1,040,768	1,210,643	1,210,643

Undergrounding	2006/07	2007/08	2008/09	2009/10	2010/11	2011/12	2012/13	2013/14	2014/15	2015/16
Lamond/Kohai/Salford/Chelmsford/Helmsdale	[redacted]	-	-	-	-	-	-	-	-	-
Tyne/Eye/Kelvin/Deveron/Jed	[redacted]	-	-	-	-	-	-	-	-	-
John/Saturn/Murphy	[redacted]	[redacted]	-	-	-	-	-	-	-	-
Moulson/Brown	-	[redacted]	-	-	-	-	-	-	-	-
Nith/Liddel/Ettrick/Conon/Clyde/Crinan/Annan	-	[redacted]	-	-	-	-	-	-	-	-
Ethel/Ash	-	[redacted]	-	-	-	-	-	-	-	-
Tramway/Coronation/York	-	-	[redacted]	-	-	-	-	-	-	-
West/Purdue/Fairview/Marjorie/Stuart	-	-	-	[redacted]	-	-	-	-	-	-
Miscellaneous Undergrounding	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
Miscellaneous Industrial Area	-	-	-	-	-	[redacted]	-	-	-	-
	1,823,325	1,780,913	1,196,713	667,609	11,325	685,163	5,663	5,663	5,663	5,663

TOTAL	2,541,783	2,460,413	2,336,008	2,300,674	2,276,891	2,079,836	2,028,874	1,981,875	1,812,000	1,812,000

6. Managing the assets' lifecycle

All EIL's electricity assets have a lifecycle and this section describes how EIL manages its assets over the entire lifecycle from "commissioning" to "retirement".

6.1 Lifecycle of the assets

The lifecycle of EIL's existing assets is outlined in Figure 9 below:

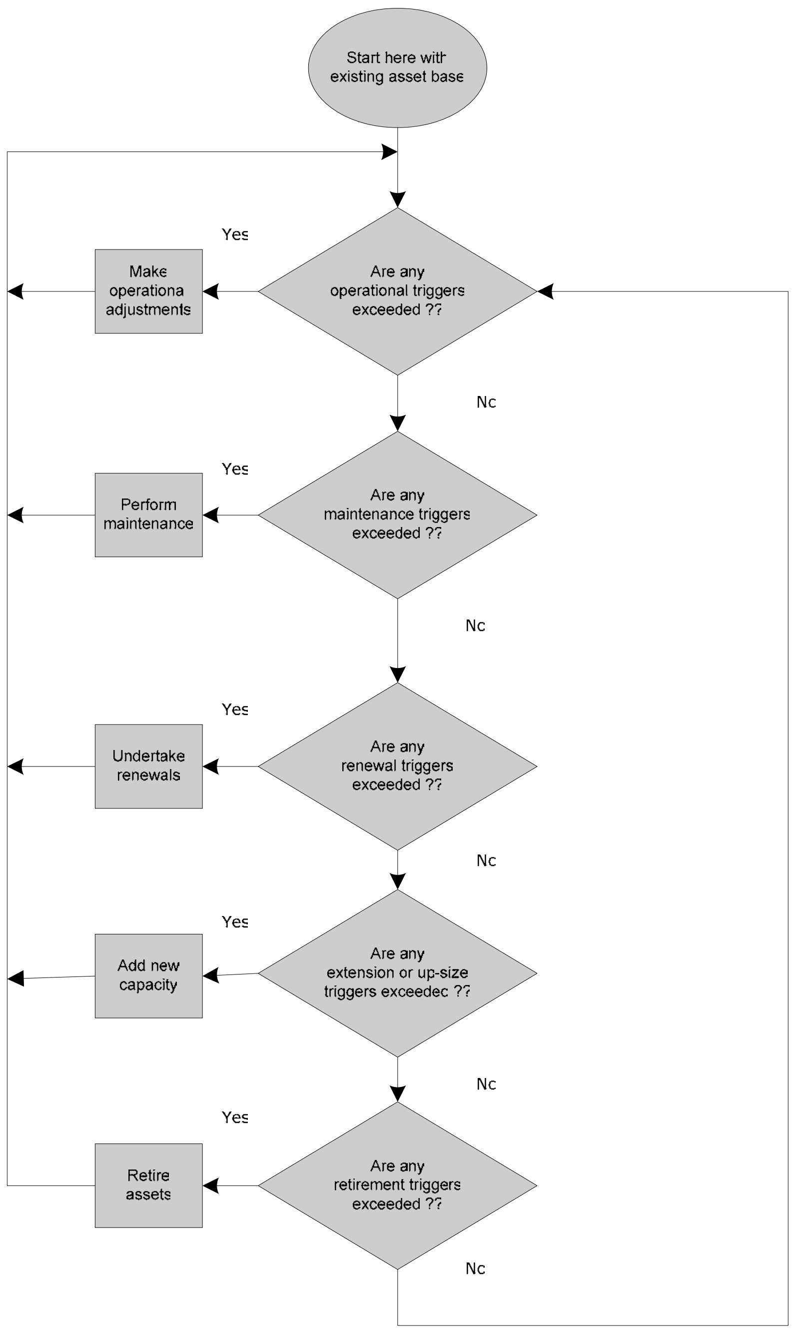


Figure 9 - Asset lifecycle

Table 13 below provides some definitions for key lifecycle activities:

Table 13 - 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 CB. 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 4.1.2(b)) 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 ie restricted to Quadrants 1 and 2 in Figure 4.1.2(b).
Extensions	Involves building a new asset where none previously existed because a location trigger in Table 4.1.3(a) has been exceeded eg building several spans of line to connect a new factory to an existing line. This activity falls within Quadrants 3 and 4 of Figure 4.1.2(b). 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.

6.2 Operating the assets

As outlined in Table 13 operations predominantly involves letting the electricity flow from the GXP's to consumers' 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 9 the first efforts to relieve excursions beyond trigger points are operational activities and may include:

- Operating a tap-changer to correct voltage excursions (which generally occurs automatically).
- Opening and closing ABS's or RMU's to relieve an over-loaded asset.
- Opening and closing ABS's or RMU's to shutdown or restore power (which can be either planned or fault related).
- Operating load control plant to reduce demand.
- Activating fans or pumps on transformers to increase the cooling rate.

Table 14 outlines the key operational triggers for each class of asset. Note that whilst temperature triggers will usually follow demand triggers, they may not always eg an overhead conductor joint might get hot because it is loose or rusty rather than overloaded.

Table 14 - 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 consumers switchboards. • Voltage routinely rises too high to maintain no more than 1.06pu at consumers switchboards.	• Consumers' 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 consumers switchboards. • Voltage routinely rises too high to maintain no more than 1.06pu at consumers switchboards.	• Load routinely exceeds rating where MDI's are fitted. • LV fuse blows repeatedly. • Short term loading exceeds guidelines in IEC 354.	• Infra-red survey reveals hot connections.
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 manufacturers' recommendations. • Core hot-spot temperature exceeds manufacturers' recommendations.
Sub-transmission 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

6.3 Maintaining the assets

As described in Table 13 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 10 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 10 is not simply labelled "time".

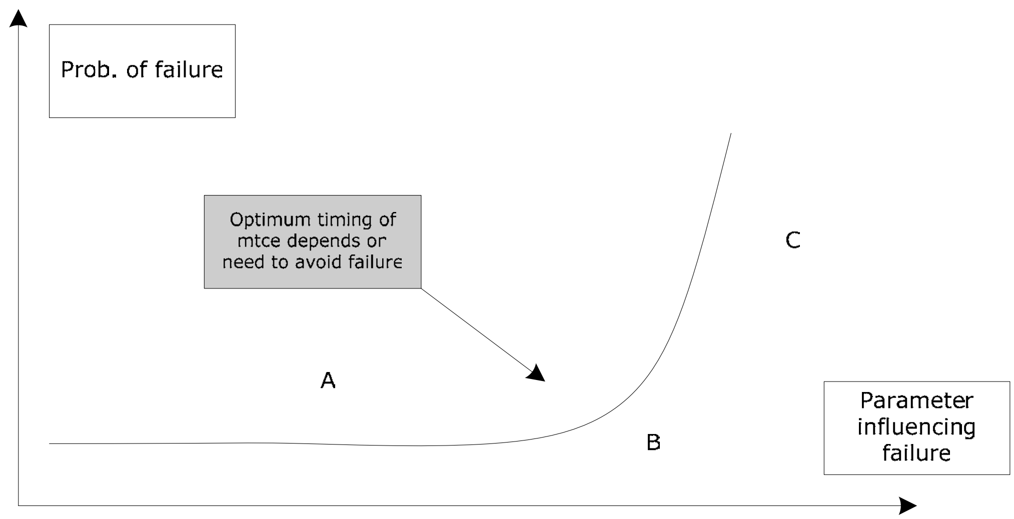


Figure 10 - Component failure

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 consumer is low; hence it might be operated out to point C in Figure 10 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.

EIL makes maintenance decisions on cost-benefit criteria with the principal benefit being avoiding supply interruption. The practical effect of this is that assets supplying large consumers or numbers of consumers will be extensively condition monitored to avoid supply interruption whilst assets supplying only a few consumers such as a 10kVA transformer will more than likely be run to breakdown. The maintenance strategy map in Figure 11 broadly identifies the maintenance strategy adopted for various ratios of costs and benefits.

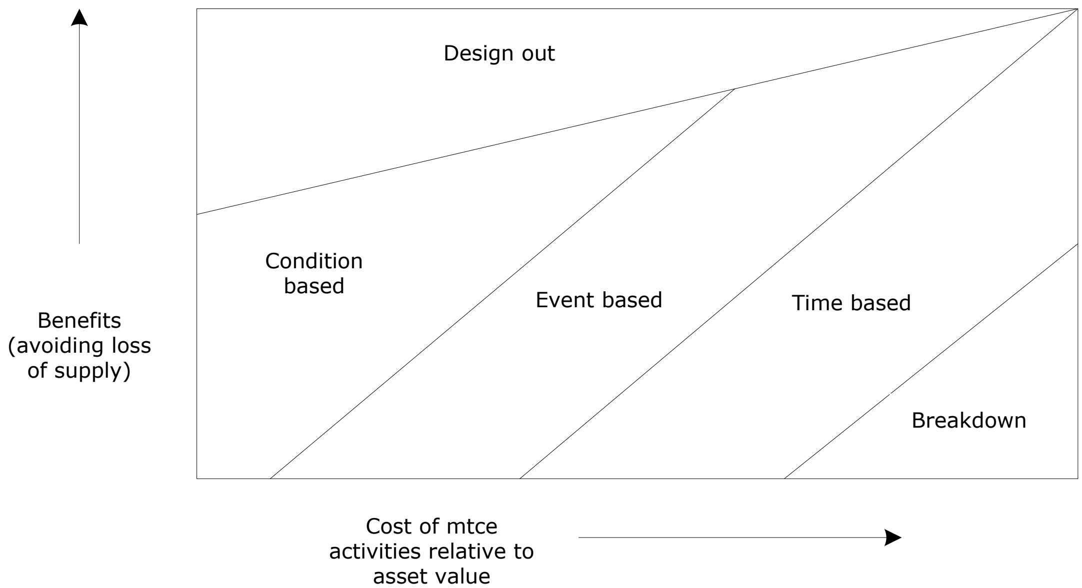


Figure 11 - Maintenance strategy map

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 EIL 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 Dissolved Gas Analysis for 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 15 describes the maintenance triggers EIL has adopted:

Table 15 - 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

Asset category	Components	Maintenance trigger
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
Sub-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.

6.3.1 EIL maintenance policies

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

6.4 EIL Maintenance Budget

Estimated expenditure on maintaining the assets are given below, with estimated 1% efficiency and productivity gain. This budget covers both Operation and Maintenance areas.

($000)	06/07	07/08	08/09	09/10	10/11	11/12	12/13	13/14	14/15	15/16
33kV Lines	2.0	2.0	2.0	1.9	1.9	1.9	1.9	1.9	1.8	1.8
11kV Lines	45.0	44.6	44.1	43.7	43.2	42.8	42.4	41.9	41.5	41.1
11kV Switchgear	130.0	128.7	127.4	126.1	124.9	123.6	122.4	121.2	120.0	118.8
400V Lines	36.0	35.6	35.3	34.9	34.6	34.2	33.9	33.6	33.2	32.9
33kV Cables	90.0	89.1	88.2	87.3	86.5	85.6	84.7	83.9	83.0	82.2
11kV Cables	304.0	301.0	298.0	295.0	292.0	289.1	286.2	283.3	280.5	277.7
400V Cables	565.0	559.4	553.8	548.2	542.7	537.3	531.9	526.6	521.4	516.1
Buildings and Structures	45.0	44.6	44.1	43.7	43.2	42.8	42.4	41.9	41.5	41.1
SCADA and Communications	25.0	24.8	24.5	24.3	24.0	23.8	23.5	23.3	23.1	22.8
Power Transformers	80.0	79.2	78.4	77.6	76.8	76.1	75.3	74.6	73.8	73.1
Circuit Breakers (including Protection)	90.0	89.1	88.2	87.3	86.5	85.6	84.7	83.9	83.0	82.2
Distribution Transformers	260.0	257.4	254.8	252.3	249.8	247.3	244.8	242.3	239.9	237.5
Ripple Plant	10.0	9.9	9.8	9.7	9.6	9.5	9.4	9.3	9.2	9.1
	1,682	**1,665**	**1,649**	**1,632**	**1,616**	**1,600**	**1,584**	**1,568**	**1,552**	**1,537**

Costs include PowerNet and Contractors' overheads related to maintenance management.

6.5 Renewing the assets

EIL classifies work as renewal if there is no change (usually an increase) in functionality ie the output of any asset doesn't change. The key criteria for renewing an asset is when the capitalised ops and maintenance costs exceed the renewal cost, and this can occur in a number of ways:

- Operating costs become excessive eg addition of inputs to a SCADA system requires an increasing level of manning.
- Maintenance costs begin to accelerate away eg a transformer needs more frequent oil changes as the seals and gaskets perish.
- Supply interruptions due to component failure become excessive (and what constitutes "excessive" will be a matter of judgment which will include the number and nature of consumers affected).
- Renewal costs decline, particular where costs of new technologies for assets like SCADA decrease by several fold.

Table 16 below lists the renewal triggers for key asset classes.

Table 16 - 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
Sub-transmission 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

6.5.1 Renewal Budget

All renewals are budgeted in the capital budget, see section 5.7.4.

6.6 Up-sizing or extending the assets

If any of the capacity triggers in Table 8 are exceeded either up-sizing or extending the network will be considered. These two modes of investment are, however, quite different as described in Table 17 below.

Table 17 - 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.
Load	Can involve supply to a new connection within the network footprint or increasing the capacity to an existing connection.	Almost always involves supply to a new 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 5	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 up-sized 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 consumer contribution.
Means of cost recovery	Most likely to be spread across all consumers as part of on-going line charges.	Could be recovered from consumers 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 6.6.1 and 6.6.2 below.

6.6.1 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 for all asset classes with minor site-specific alterations tend to be adopted. These designs, however, will embody the wisdom and experience of current standards, industry guidelines and manufacturers recommendations.

6.6.2 Building new assets

External contractors are used to up-size or extend assets. As part of the building and commissioning process the information records are updated as constructed and all testing documented.

6.7 Retiring the 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 asset systems.
- 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 SF_6, oil, lead or asbestos.

Key criteria for retiring an asset include:

- Its physical presence is no longer required (usually because a consumer 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 (eg replacing lubricated bearings with high-impact nylon bushes) and there are no suitable opportunities for re-deployment.
- Where an asset has been up-sized and no suitable opportunities exist for re-deployment.

7. 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.

7.1 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.

7.1.1 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.

7.1.2 Risk Categories

Risks are classified against the following categories:

- Weather
    - Wind – strong winds that cause either pole failures or blow debris into lines. More impact for Bluff than City network.
    - 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. Large events may occur and impact the network. The November 2004 7.2 Richter scale quake 240 km south-west of Te Anau, caused no damage to the network.
    - Fire – transformers are insulated with mineral oil that is flammable, and buildings have flammable materials so fire will affect the supply of electricity. Sou4rce 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. ie. 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 work 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 insure appropriate contracts and guarantees are agreed prior to undertaking large investments.
  - Loss of revenue – loss of consumers 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, upsizing, expansion and retirement of network assets.

7.1.3 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 consumer groups.
- Remove assets from risk zone.
- Involvement with the local Civil Defence.

7.2 Risk Details

7.2.1 Weather

Event	Likelihood	Consequence	Responses
Wind	Low	Low	Impact to the City is reduced by undergrounding of lines. If damage occurs on lines this is remedied by repairing the failed equipment.
Snow	Very Low	Low	Impact to the City 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 to the City 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. Underground substations to have pumps to remove any water and regular checks of water-tightness of each site.

7.2.2 Physical

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 buildings and equipment to survive. Review existing buildings and equipment and reinforce if necessary.
Fire	Very Low	High	Supply consumers from neighbouring LV cables and transformers. Continue to operate or install fire sprinklers or suppression systems in basement housed sites. Continue to maintain fire detection and alarm systems.
Terrorism	Very Low	High	Ensure security of restricted sites. Use alternative routes and equipment to restore supply, similar to equipment failures below.

<u>Equipment Failures</u>

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.

Event	Likelihood	Consequence	Responses
33kV oil cable	Low	Low	Continue to undertake annual sheath tests. Repair any damage in sheath insulation. Each cable has an alternative 33kV cable along a different route. Continue to monitor pressure alarms on each cable. Continue to maintain spare pressure tanks and the 'double stage oil degasifier unit', with an experienced contractor to operate. Maintain contacts with experienced oil cable jointers and/or contractors.
Power Transformer	Very Low	Low	Each power transformer can be removed from service due to fault or maintenance. Continue to undertaken annual DGA to allow early detection of failures. If prolonged lost of one unit then spare power transformer from TPCL can be installed. Less restriction once seventh unit installed.

Event	Likelihood	Consequence	Responses
11kV Switchboard	Low	Medium	Annual testing including PD[11] and IR[12]. Replacement at end of life and continue to provide sectionalised boards. Able to reconfigure network to bypass each switchboard at most times.
Oil Spill	Very Low	Medium	Oil spill kits located at Southern and Leven St Substations for the Faults contractor to use in event of an oil leak or spill. 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.
CB Protection	Very low	Medium	Continue regular operational checks. Mal-operations investigated.
Circuit Breakers	Very low	Low	Backup provided by incomer CB. 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 TPCL Invercargill 1 Ripple Injection Plant. Manually operate plant with test set if SCADA controller fails.

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

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

7.2.3 Human

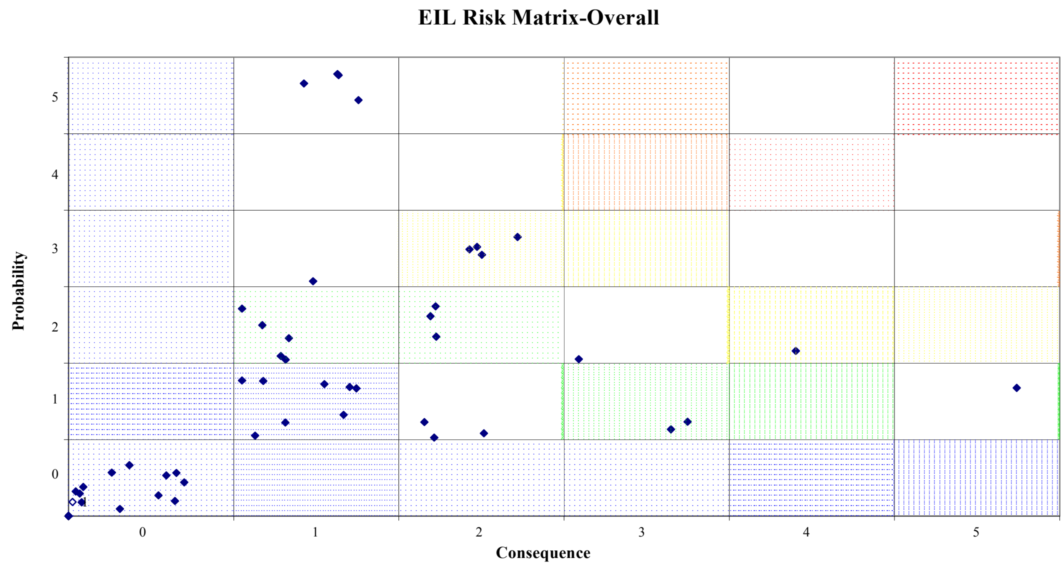
Event	Likelihood	Consequence	Responses
Pandemic	Low	Low to High	Work to the PowerNet Pandemic plan. Includes details such as working from home, only critical faults work and provide emergency kits for offices etc.
Car versus pole	Very Low	Low	Continue undergrounding in the City. Have resource to bypass 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. ie. tagging/graffiti would depend on the location and content. Any safety problems will be made safe as soon as they are discovered.

7.2.4 Corporate

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 consumers 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.

7.2.5 Projects

Major projects are evaluated by the UMS Optimisation Tool. Part of the analysis is a risk assessment of the project. An example from last year is shown below.



7.3 Contingency Plans

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

- PowerNet Business Continuity Plan
- PowerNet Pandemic Action Plan
- Network Operating Plans, details operational steps for major outages.

7.4 Insurance

EIL holds Public Liability insurance but no insurance on network assets.

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

8. Funding the business

Everything discussed in the Asset Management Plan so far has been (indirectly) about costs. This section discusses how EIL funds its business.

8.1 Business model

EIL's business model is based around the right-hand side of Figure 12.

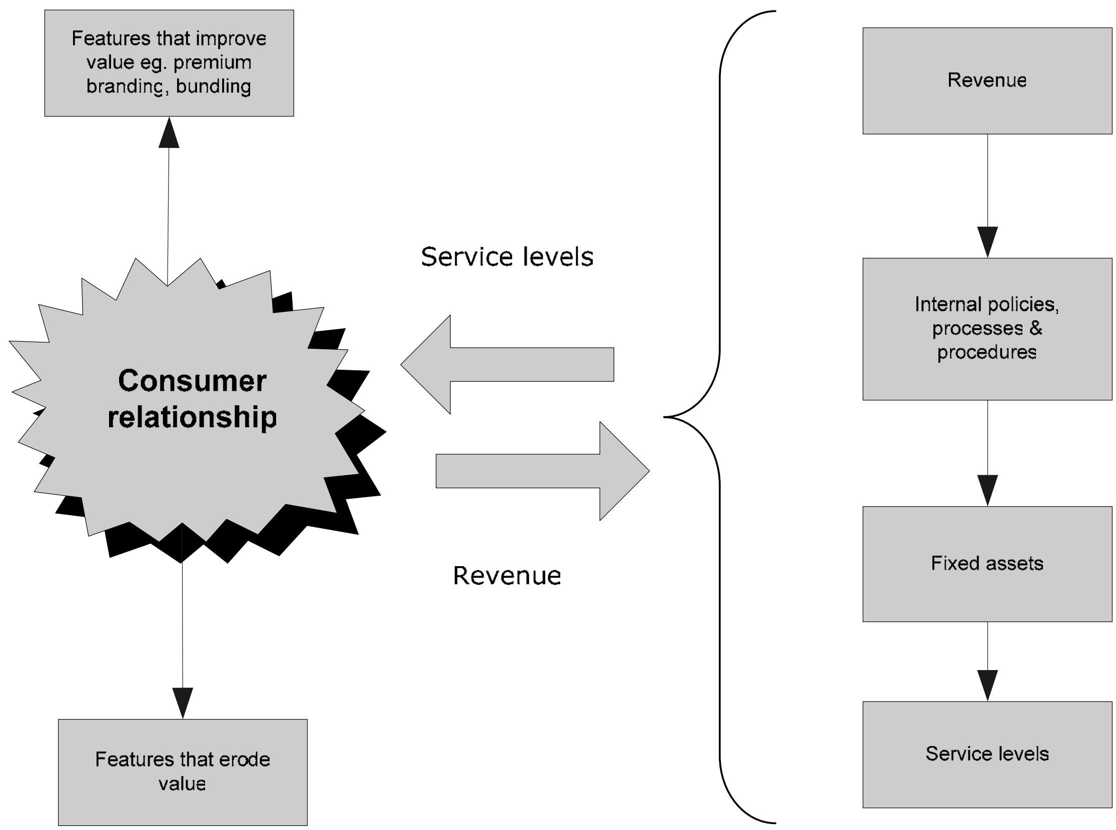


Figure 12 - Consume interface model

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

8.2 Revenue source

Revenue comes primarily from the retailers who pay EIL for conveying energy over the lines. A key feature of this relationship depicted on the left-hand side of Figure 12 is tariff regulation which essentially erodes EIL's ability to extract value from the consumer relationship.

8.3 Expenditure

Work is done to maintain the asset value of the network and to expand or upsize to meet consumer demands. The other area of major expenditure is the undergrounding programme.

8.4 Changes in the value of assets

Given the preferences expressed by the consumers for the following price-quality trade-offs:

- Pay about the same for about the same reliability. (18%)[13]
- Pay a bit more for a bit more reliability. (4% decrease, 41% increase)[13]

EIL's asset value should either remain about the same or be improved. However this presents EIL with the dilemma of responding to consumers' wishes for higher supply quality in the face of a "no material increase in charges requirement". Factors that will influence EIL's asset value are shown in Table 7.4(a) below:

Table 7.4(a) – Factors influencing asset value

Factors that increase asset value	Factors that decrease 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 the 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.

8.5 Depreciating the assets

As outlined in section 8.4 above, the accounting treatment of depreciation doesn't strictly model the decline in service potential of an asset - although 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.

[13] March 2006 Consumer Engagement Telephone Survey

9. Processes and systems

The core of EIL's asset management activities lies with the detailed processes and systems that reflect its thinking, manifest in its policies, strategies and processes and ultimately shapes the nature and configuration of the fixed assets. The hierarchy of data model shown in Figure 13 describes the typical sorts of information residing within the business (including in employees' heads).

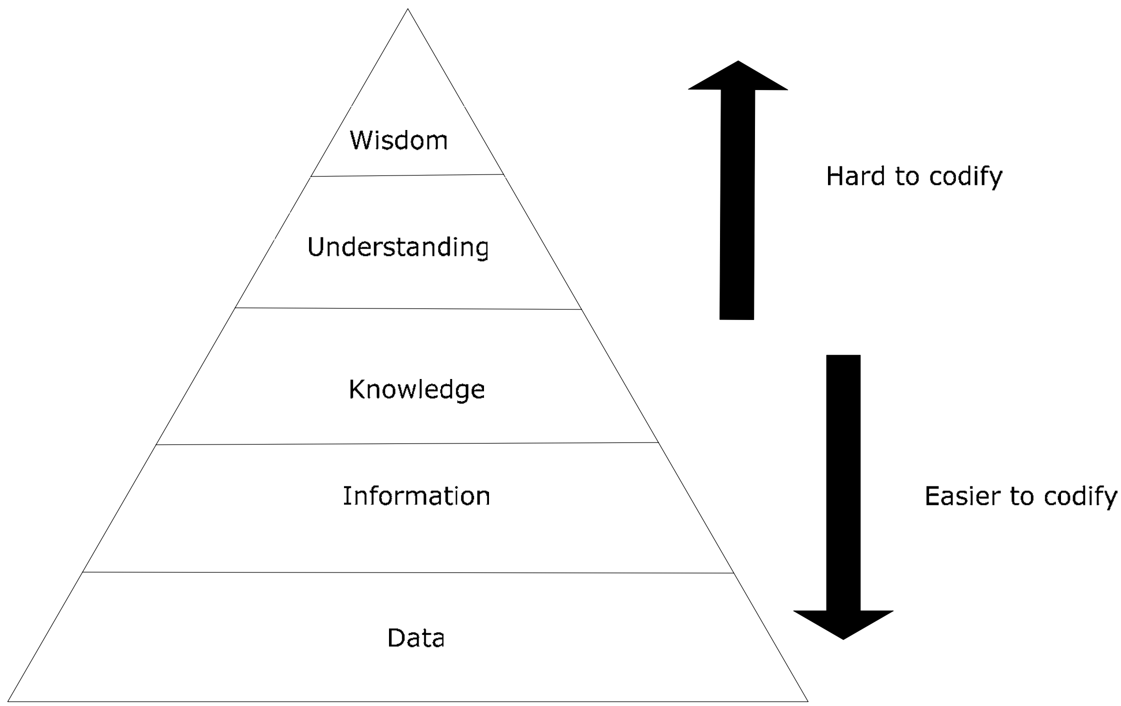


Figure 13 - Hierarchy of Data

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

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. As indicated in Figure 13 it is generally hard to codify these things, hence correct application is heavily dependent on skilled people.

9.1 Asset knowledge

EIL's asset data resides in three key locations:

- Asset description, location, age and condition information resides in the GIS.
- Asset description, location, age and condition information resides in the WASP.
- Asset operational data such as loadings, voltages, temperatures and switch positions reside in the SCADA.

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

9.2 Improving the quality of the data

The 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 a field manual of drawings and photo's to minimise subjectivity was developed.

Data for the WASP is collected by the Network Movement Notice that records every movement of serial numbered assets. Updating of data on assets that have not moved is planned to be undertaking by staff over the next summer holidays with assistance from students.

About 20% of the network (by length) each year is condition assessed to update asset condition data (noting that that asset condition is continually varying). Key process improvements will include more timely as-builts from contractors and use of hand-held data capture devices.

9.3 Use of the data

All data will be used for either making decisions within the 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 eg a decision to replace a zone substation transformer will be based on an aggregation of loading data.

9.4 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 14.

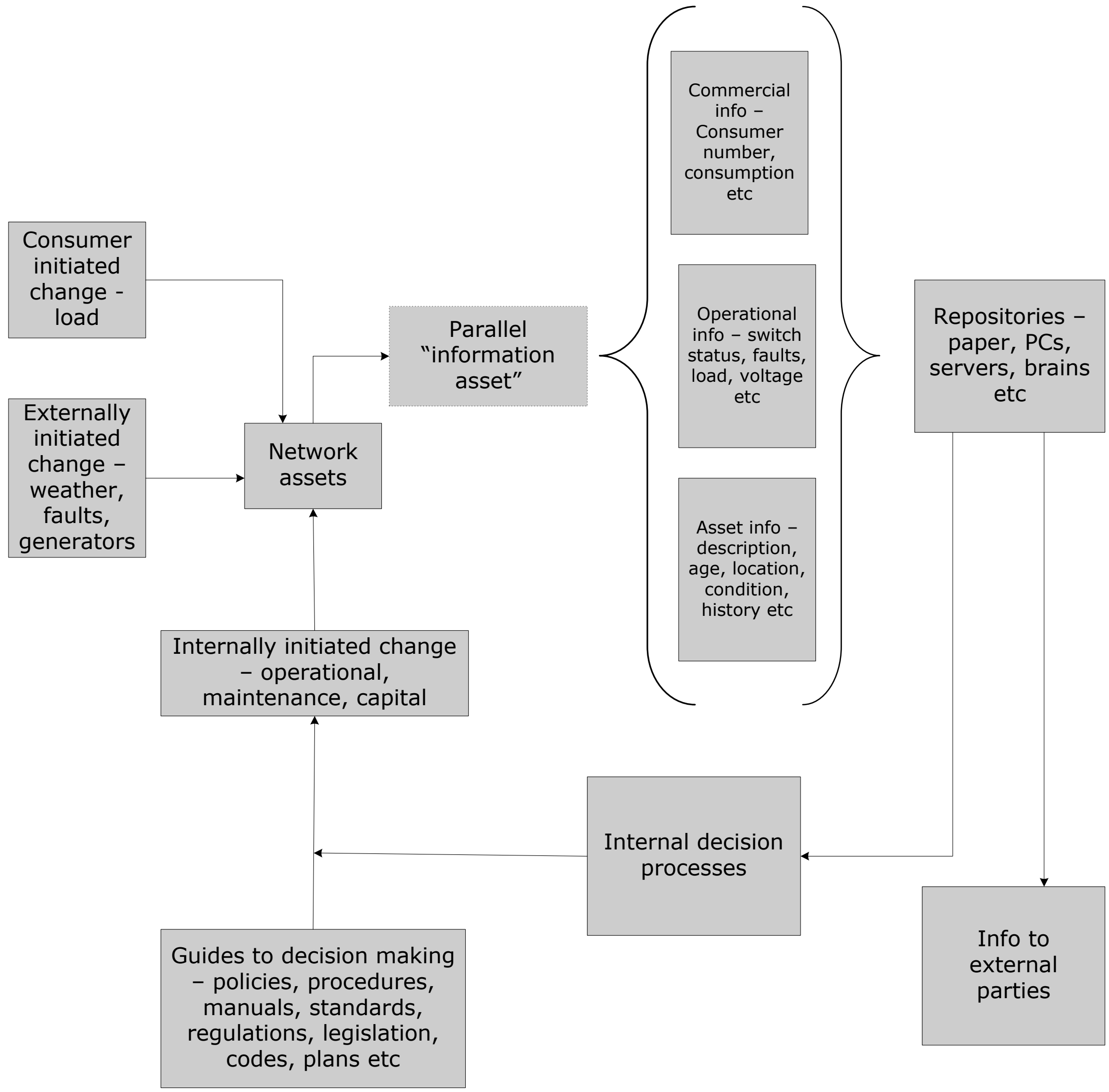


Figure 14 - Key information systems and processes

9.5 Key processes and systems

EIL's key processes and systems are based around the key lifecycle activities defined in Figure 9 and are described in the following sections:

9.5.1 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
Consumer Fault Calls/Retail Matters	PNM-87
Site Safety Management Audits	PNM-88
Meter/Ripple Receiver Control	PNM-121

9.5.2 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.

9.5.3 Renewal processes and systems

Network Development	PNM-113
Design and Development	PNM-114

9.5.4 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

9.5.5 Retirement processes and systems

Disconnected And/Or Discontinued Supplies	PNM-125

9.5.6 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
Consumer 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
Consumer Service Performance	PNM-119
Incoming and Outgoing Mail Correspondence	PNM-129

9.6 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 Asset Management Plans, together with data for on going day to day planning and control.

9.6.1 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.

9.6.2 WASP

WASP (Works, Assets, Scheduling, Purchasing) is a 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.

9.6.3 PNM-105 Maintenance Planning

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

Relevant inputs into the plan include:

- WASP Records
- Surveys (field, CDM)
- Analysis of faults database
- GIS database
- System network loading data
- Major consumers
- Growth (domestic, commercial, industrial) in geographic areas
- Legislation
- Cyclic maintenance on major plant items
- Current Asset Management Plan.

10. Performance and improvement

10.1 Outcomes against plans

PowerNet provides monthly Board Reports, which include a summary of all network operations for the directors. These reports review progress against the annual business plan both from a physical aspect and financially. In addition engineering staff attend weekly network performance meetings at which all incidents on the network are examined and action taken to prevent reoccurrences, mitigate the effects, or investigate further.

Outcome of last years annual business plan was 2.1% under the budgeted $2.1M for capital and 29.5% under the budgeted $1.5M for maintenance. The shortfall in the maintenance area was partly due to a new contractor winning the contract and the limited resources to undertake the work.

10.2 Performance against targets

10.2.1 Primary service levels

The charts below display the target versus actual reliability performance on the network. For the 2005/06 year the network has performed very well.

Unplanned (Type C)

	2005/06 AMP Target	Business Plan Target	12 Month Actual
SAIFI	0.931	0.96	0.53
SAIDI	28.93	31.50	19.18

Planned (Type B)

	2005/06 AMP Target	Business Plan Target	12 Month Actual
SAIFI	0.043	0.04	0.00
SAIDI	4.23	3.50	0.21

Total

	2005/06 AMP Target	Business Plan Target	12 Month Actual
SAIFI	0.973	1.00	0.54
SAIDI	33.16	31.00	19.39

10.2.2 Secondary service levels

Results for 2005/06 are shown in below, and show that only remedying justified voltage complaints exceeded the targets set.

Attribute	Measure	Target 05	Actual 06
Consumer Satisfaction: Trees	Written: Amount of information	None	4.6[14]
	Phone: Friendliness and courtesy	None	4.7[14]
	Phone: Time taken to answer call	None	4.6[14]
	Overall level of service	None	4.5[14]
	Contractor service	None	4.8[14]
Consumer Satisfaction: Connections	Written: Amount of information	None	3.9[14]
	Phone: Friendliness and courtesy	None	4.3[14]
	Phone: Time taken to answer call	None	4.3[14]
	Overall level of service	None	3.3[14]
	Contractor service	None	4.2[14]
Consumer Satisfaction: Faults Repair	Overall level of service	None	4.3[14]
	Phone: Friendliness and courtesy	None	4.3[14]
	Phone: Time taken to answer call	None	4.1[14]
	Contractor service	None	4.5[14]
	PowerNet Service	None	4.4[14]
Voltage Complaints	Number of consumers who have made voltage complaints	None	6
	Number of consumers who have justified voltage complaints regarding power quality	<15	2
	Average days to complete investigation	<20	19
	Period taken to remedy justified complaints	<56	106
Planned Outages	Provide sufficient information	None	#[15]
	Satisfaction regarding amount of notice	None	#[15]
	Acceptance of maximum of three planned outages per year	None	59%[15]
	Acceptance of planned outages lasing five hours on average	None	37%[15]

10.2.3 Other service levels

10.2.3.1 Efficiency

Measure	2005/06 Asset Management Plan Target	Actual	Comment
Load factor	None	55%	
Loss ratio	None	6.3%	Dependant on Retailer accruals
Capacity utilisation	None	40%	

[14] May 2006 PowerNet Phone Survey; Scale 1- 5 where 1 = Very Poor and 5 = Excellent, - = no responses from 200 interviewees, x% = percentage of respondents.

[15] March 2006 Consumer Engagement Telephone Survey; results are percentage of the 200 respondents. # means no outage recalled.

Efficiency on the network improved with losses reducing from 7.4% to 6.3% but utilisation declined by 2% to 40%. The cause of the decline in utilisation is due to the higher control of the network maximum demand, this was reduced by 2.75MVA.

10.2.3.2 Financial

Measure	2005/06 Asset Management Plan Target	Actual	Comment
Direct costs	None	$2,083.78	Cost per km of line
Indirect costs	None	$55.96	Cost per consumer

Change in Management allocation from PowerNet may impact on values in future years, with PowerNet's allocation audited by EIL's auditor.

10.3 Improvement areas

Growth of technical skill, resource and productivity in the contractors.

Reduce time taken to remedy voltage complaints.

Rationalise transformer capacities when new transformers are required or overloaded.

Minimise the maximum demand on the network using the load control system.

Continue to remove poles, so vehicles can not hit them and cause outages.

10.4 Improvement strategies

Create a long term relationship with contractors so they can build their resources and personnel.

Improve systems that can allow prompter actioning of network upsizing.

Continue to improve WASP data of transformers so that under-utilised units can be down-sized and used at a higher loaded site.

Continue to control the Invercargill GXP maximum demand to reduce Transpower charges for both networks.

Evaluate the cost and benefits of undergrounding industrial areas and the lines in Bluff.

A. PowerNet Consumer Engagement Survey

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?		

Interviewer: Indicate which sample you have been allocated	TPCL **1**	ONJV **3**	EIL **2**
	(Go to D1)	*(Go to D1)*	*(Go to Q1)*

D1: Do you live in a mainly rural or urban area?	Urban	**5**
	Rural	**6**

4

Question 1: PowerNet is proposing a maximum of three planned outages (interruptions to your power supply) per year in order to conduct maintenance or upgrade work on its network. Do you consider this number of planned outages to be reasonable?	Yes	**1**	*Go to Q2*
	No	**2**	*Go to Q1(a)*
	Don't know/unsure	**3**	*Go to Q2*

Question 1(a): What number of planned outages per year would you consider to be more reasonable?	

Question 2: PowerNet expects such planned outages will on average last around 5 hours each. Do you consider this amount of time to be reasonable?	Yes	**1**	*Go to Q3*
	No	**2**	*Go to Q2(a)*
	Don't know/unsure	**3**	*Go to Q3*

Question 2(a): What length of time would you consider to be more reasonable? *(Specify hours)*	

Question 3: Have you received advice of a planned electricity outage during the last 6 months?	Yes	**1**	*Go to Q3(a)*
	No	**2**	*Go to Q 4*
	Don't know/unsure	**3**	*Go to Q 4*

Question 3(a): Were you satisfied with the amount of information given to you about this planned outage?	Yes	**1**	*Go to Q3(b)*
	No	**2**	*Go to Q3(b)*
	Unable to recall	**3**	*Go to Q 3(b)*

Question 3(b): Do you feel that you were given enough notice of this planned outage?	Yes	**1**	*Go to Q 4*
	No	**2**	*Go to Q 3(c)*
	Don't know/unsure	**3**	*Go to Q 4*

Question 3(c): How much notice of planned outages would you prefer to be given? *(Specify days/weeks)*	

Question 4: Have you had an unexpected interruption to your power supply during the last 6 months?	Yes	**1**	*Go to Q 4(a)*
	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)*	

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)* ***Go to Q5(a)***	

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)*

Question 5(a): PowerNet is reviewing the level of service provided to its customers. Options include increasing or decreasing spending. What percentage change to the cost of your electricity bill do you consider would compensate for an….	…increase of one outage per year?	%
	Or how about a…	
	…decrease of one outage per year?	%

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 9*
	Unable to recall	**3**	*Go to Q 9*

Question 8: Were you satisfied that the system worked in getting you through to the right person?	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 9*
	No	**2**	*Go to Q 8(c)*
	Don't know/unsure	**3**	*Go to Q 9*

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 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(c)*
	Unable to recall	**3**	*Go to Q 9(c)*

Question 9(a): What did your enquiry relate to? *(Do not prompt)*	Voltage complaints	**1**
	Safety disconnections	**2**
	Other concerns	**3**

Question 9 (b): Were you satisfied with the performance of the PowerNet staff member(s) who handled your enquiry?	Yes	**1**	*Go to Q 9(c)*
	No	**2**	*Go to Q 9(c)*
	Don't know/unsure	**3**	*Go to Q 9(c)*

Question 9 (c): 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. Feeder demand projections

B.1. Doon Street

	Coincident Demand (MVA)	Max. Demand 2006 (MVA)	Proposed Annual MD Growth	Planned 5 yr MD	Notes
Doon CB3	0.00	0.00	0.00%	0.00	Spare (Ex-injection plant)
Doon CB4	0.68	4.72	0.25%	4.78	
Doon CB5	4.51	4.51	0.25%	4.57	
Doon CB6	3.44	5.21	0.25%	5.28	
Doon CB7	0.00	2.38	0.25%	2.41	
Doon CB8	3.17	3.76	0.25%	3.81	
Doon CB9	0.00	4.32	0.25%	4.37	
Doon CB10	2.91	3.19	0.25%	3.23	
Doon CB11	0.00	0.00	0.25%	0.00	
Doon CB12	1.37	4.83	0.25%	4.89	
Doon CB13	0.49	3.27	0.25%	3.31	
Doon CB14	4.01	4.31	0.25%	4.36	
Doon CB15	0.76	0.68	0.25%	0.69	
Doon CB16	0.00	0.00	0.00%	0.00	Spare (Ex-injection plant)
Subtotal	**21.34**	**41.18**		**41.70**	

B.2. Leven Street

	Coincident Demand (MVA)	Max. Demand 2006 (MVA)	Proposed Annual MD Growth	Planned 5 yr MD	Notes
Leven Street CB4	0.50	2.21	1.60%	2.39	
Leven Street CB5	0.00	0.00	0.00%	0.00	
Leven Street CB6	1.91	2.80	1.60%	3.03	
Leven Street CB7	0.51	2.14	1.60%	2.32	
Leven Street CB8	4.06	4.52	1.60%	4.89	
Leven Street CB9	1.12	1.99	1.60%	2.15	
Leven Street CB10	4.04	4.48	1.60%	4.85	
Leven Street CB11	1.86	2.65	1.60%	2.87	
Leven Street CB12	1.86	2.43	1.60%	2.63	
Leven Street CB13	3.72	4.36	1.60%	4.72	
Subtotal	**19.58**	**27.58**		**29.86**	

B.3. Racecourse Road

	Coincident Demand (MVA)	Max. Demand 2006 (MVA)	Proposed Annual MD Growth	Planned 5 yr MD	Notes
Racecourse Road CB 4	0.20	0.40	0.25%	0.41	
Racecourse Road CB 5	1.08	1.15	0.25%	1.16	
Racecourse Road CB 6	3.32	4.54	0.25%	4.60	
Racecourse Road CB 7	0.00	0.00	0.00%	0.00	Spare (Ex-injection plant)
Racecourse Road CB 8	2.02	2.80	0.25%	2.84	
Racecourse Road CB 9	2.93	3.05	0.25%	3.09	
Racecourse Road CB 10	0.77	3.57	0.25%	3.61	
Racecourse Road CB 11	0.00	0.00	0.25%	0.51	New load off CB12
Racecourse Road CB 12	2.15	2.40	0.25%	1.92	
Racecourse Road CB 13	0.00	0.00	0.00%	0.00	Surplus (Ex-injection plant)
Subtotal	**12.47**	**17.91**		**18.1**	

B.4. Southern

	Coincident Demand (MVA)	Max. Demand 2006 (MVA)	Proposed Annual MD Growth	Planned 5 yr MD	Notes
Southern CB6	2.50	3.14	0.25%	3.18	
Southern CB7	0.30	0.30	0.25%	0.30	
Southern CB8	4.16	4.15	0.25%	4.20	
Southern CB9	1.13	5.11	0.25%	5.17	
Southern CB10	3.71	5.59	0.25%	5.66	
Subtotal	**11.80**	**18.3**		**11.9**	

B.5. Bluff

	Coincident Demand (MVA)	Max. Demand 2006 (MVA)	Proposed Annual MD Growth	Planned 5 yr MD	Notes
Bluff CB3 (TPCL)	0.63	1.29	0.25%	1.31	
Bluff CB4	2.02	3.56	0.25%	3.60	
Bluff CB5	2.31	3.41	0.25%	3.45	
Subtotal	**4.96**	**8.3**		**5.0**	

Approval by Board of Directors

We, Philip James Mulvey and Ross Lindsay Smith, being Directors of Electricity Invercargill Limited certify that the Board has approved the disclosed Asset Management Plan for the years 2006 - 2016.

Philip James Mulvey

Ross Lindsay Smith

31 August 2006