



AusNet Gas Services Pty Ltd

Gas Access Arrangement Review 2018–2022

Appendix 2C: Gas Asset Management Strategy

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Asset Management Strategy: Gas Networks

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Gas Asset Management Strategy

EXECUTIVE SUMMARY

AusNet Services is an energy delivery service business that owns and operates Victoria's largest network of electricity and gas infrastructure that is committed to the safe, efficient, and reliable supply of energy.

AusNet Services' gas transmission and distribution business services approximately 665,000¹ customers across the west of Victoria, including the outer northern and north-west metropolitan area of Melbourne. The network consists of approximately 11,135km of mains operating at different pressures and pressure regulating facilities (e.g. City Gates, Field regulators, etc) spanning a geographically diverse region of approximately 60,000km.²

Demand on AusNet Services' gas network is forecast to remain reasonably stable over the next five years, with customer growth expected to compensate for lower consumption per capita. With strong population growth in Melbourne localities such as Hume, Melton and Wyndham and regional areas such as Bendigo, Ballarat and Geelong, overall customer growth is forecast to increase by an average of 2.1% to 2022.

The gas demand profile of the network is winter peaking, with a pronounced spike arising from the increased customer usage due to domestic heating.

The energy market is changing resulting in a decrease in demand per customer and an improvement in the relative competitiveness of electricity. These changes combined with a potential increase in gas retail price and a warmer climate are expected to further moderate gas consumption and could lead to a reduction in asset utilisation.

AusNet Services is one of three natural gas distribution business in Victoria; each considered a natural monopoly operating under a licence from the Department of Economic Development, Jobs, Transport and Resources (DEDJTR).² The Australian Energy Regulator (AER) is responsible for economic regulation of the network under the National Gas Law (NGL) and the National Gas Rules (NGR), with Energy Safe Victoria (ESV) responsible for the technical regulation, overseeing the safety of employees, contractors, consumers and the general public.

AusNet Services' corporate purpose is to:

Empower Communities and their Energy Future

This purpose, along with the **missionzero** initiative encompasses AusNet Services' underlying principles and its non-negotiable commitment to safety.

AusNet Services has established four (4) network objectives that govern how the gas network is operated and maintained. A suite of key performance indicators (KPI's) exist to track performance against these objectives:

- *Maintain network Safety in accordance with the Gas Safety Case;*
- *Maintain top quartile operating efficiency;*
- *Undertake prudent and sustainable network investment;*
- *Delivery of services valued by our customers.*

In aligning with these objectives, AusNet Services is committed to the provision of safe and reliable network services by investing in the upgrade and maintenance of the network. A total lifecycle approach is adopted, with AusNet Services' Asset Management System being accredited to the requirements of ISO 55001; the international standard for Asset

¹ Data as of July 2016.

² Formerly the Department of State Development, Business and Innovation (DSDBI).

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Management. Adoption of this standard enables AusNet Services to achieve its objectives through effective and efficient management of its assets.

The Gas AMS documents AusNet Services' holistic approach to the management of the network assets, and establishes the linkages with and between the underpinning detailed strategies, processes, and plans. This approach seeks to deliver optimal distribution network performance at efficient cost and by ensuring network objectives are considered at all times.

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Gas Asset Management Strategy

1 DOCUMENT OVERVIEW

1.1 PURPOSE

The Gas Asset Management Strategy (AMS) is central to AusNet Services' processes for the delivery of safe and reliable network services to customers in accordance with the Asset Management Policy (see Section 7.2).

This strategy has the following objectives:

- It outlines AusNet Services' overarching approach to the management of network assets;
- It defines the linkage between the Asset Management Strategy and the underpinning detailed asset specific management strategies, as well as the overarching Corporate Business Plan;
- It outlines the:
 - Demand for network services, in line with recent projections from CIE report;³
 - Current environmental and market conditions that gas is subject too;
 - The condition of network assets; and
 - Expected trends into the future.
- It articulates the key areas of focus in relation to asset management, key risks, key programs, and key cost and service standard outcomes.

The Gas Asset Management Strategy is written for both internal and external stakeholders.

It is AusNet Services' belief that the Gas Asset Management Strategy (and all the documents underpinning it) complies with all legal obligations imposed on AusNet Services for operation of its gas distribution and transmission assets, including but not limited to the National Gas Law (NGL), the National Gas Rules (NGR), the Gas Safety Act (1997), Gas Safety regulations (2008), the Victorian Gas Distribution System Code (GDSC) and relevant Australian Standards.

1.2 SCOPE

The Gas Asset Management Strategy (AMS) covers AusNet Services' natural gas distribution and transmission assets operating in the western region of metropolitan and rural Victoria, including all:

- Transmission pipelines, distribution mains and associated easements and access tracks;
- Regulators and regulating stations (including building and civil infrastructure), valves, heaters, filters, vents, syphons and auxiliary assets used in the operation of the distribution and transmission networks from the Victorian Transmission System (VTS) to end consumers;
- Corrosion protection, control, metering and communications equipment;
- Related functions and facilities such as spares, maintenance and test equipment; and
- Asset management processes and systems such as Supervisory Control and Data Acquisition (SCADA) and asset management information systems (including asset repositories).

³ CIE Report 2016.

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AMS 30-01 does not cover IT and its related infrastructure.

1.3 AMS STRUCTURE

The remainder of this document is structured as follows:

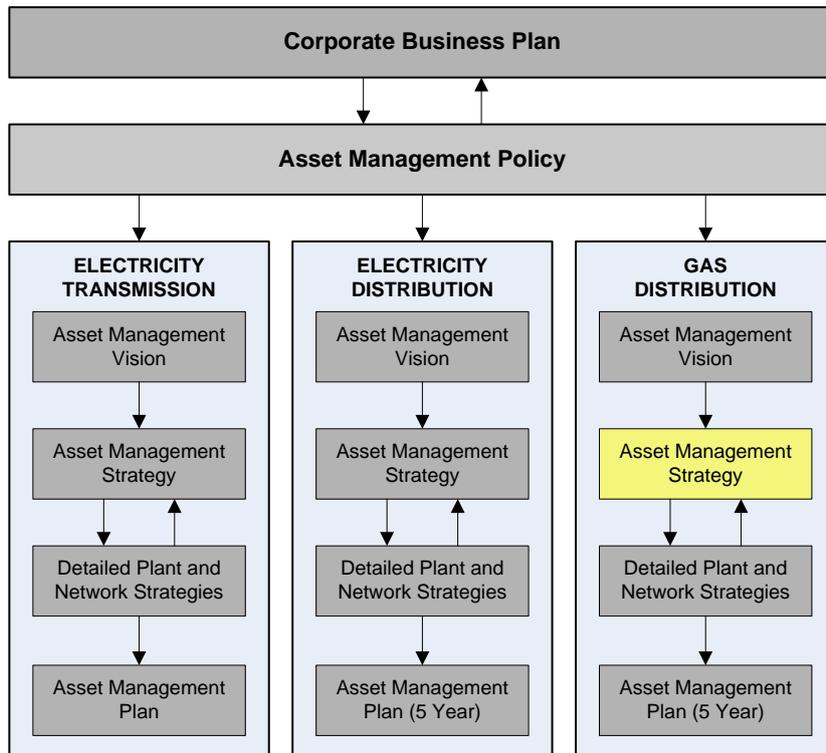
- **Overview** – Introduces and discusses AusNet Services and its strategic direction, current environmental conditions, and customer engagement.
- **Gas Network Overview** – Provides a network and industry overview, including stakeholder analysis.
- **Asset Management System** – Defines AusNet Services' asset management methodology and approach when managing the gas distribution network.
- **Asset Management Drivers** – Outlines the drivers influencing asset management decisions and network performance.
- **Network Objectives and Current Performance** – Summarises gas network objectives and historic performance against key metrics.
- **Process and System Strategies** – Overview of major 'system wide' strategies required to manage the distribution network as a whole.
- **Plant Strategies** – Overview of detailed plant specific asset management strategies including current and future capital and operational requirements.

1.4 RELATIONSHIP WITH OTHER MANAGEMENT DOCUMENTS

The Gas AMS is one of a number of asset management related documents developed and published by AusNet Services in relation to its gas distribution network. As indicated in Figure 1, the asset management strategy presents an all-encompassing strategy for the gas distribution network, with this overarching strategy being supported by numerous, more detailed, asset specific strategies.

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Figure 1: AMS Document Interdependencies



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2 THE EVOLVING ENERGY MARKET ENVIRONMENT

The role that traditional energy sources play in the global economy is evolving. Global population and economic growth continues to promote increased energy consumption, however energy efficiency improvements are slowing (and even reversing) this trend in some countries and sectors. This shift has been driven by improvements in the relative competitiveness of renewable and non-fossil fuel technologies such as grid-scale solar and wind. Complicated with an expected increase in retail price of gas, climate and energy concerns become more intertwined, allowing for changes in the market place.

Although Australia is in an advantageous position, with an abundance of traditional and renewable energy resources, AusNet Services is not exempt to the potentially adverse effects of a changing marketplace. Australia is moving towards a low carbon future by 2050 and it is unclear where gas is positioned within the energy mix. It is therefore important that the industry utilise these energy resources to develop new energy solutions and structure the energy system for the future.

2.1 DOMESTIC GAS CHALLENGES

The domestic gas market is facing a number of unique challenges that threaten the future of energy networks. In particular, market conditions are expected to deteriorate over the next regulatory period (2018-2022), ultimately driving down demand for gas. Some factors facilitating this change include:

- The decarbonisation of the Australian economy in the medium term, consistent with Government targets, imply that a shift from coal to renewables is required;
- Technology improvements and greater customer control in the electricity sector, along with increasing effectiveness and cost efficiency of electrical appliances (relative to gas appliances), threatens the competitiveness of gas;
- The new liquefied natural gas (LNG) export market in eastern Australia is pushing up retail prices for domestic gas as it is now exposed to world prices.⁴ This exposure to the global market may make gas less affordable in Australia;
- A range of influential key stakeholders are actively promoting the 'electrification' of homes, dissuading the installation of gas appliances; and
- Increased customer, political and regulatory concerns relating to the affordability of gas in the future.

It is forecasted that average consumption per residential customer is expected to decrease by 3% per annum in the 2018-2022 period.⁵ While fuel switching has not yet emerged as a material trend in Victoria, primarily due to the stronger growth of electricity prices relative to gas and the infrequency of a switching decision (i.e., new home construction or at the end of an appliance's life which is c. 12 years), expected increases in retail gas prices may act as a catalyst for fuel switching in the future, further decreasing demand and asset utilisation on the network. This will ultimately drive down the competitiveness of gas relative to electricity.

2.2 CUSTOMER ENGAGEMENT RESEARCH

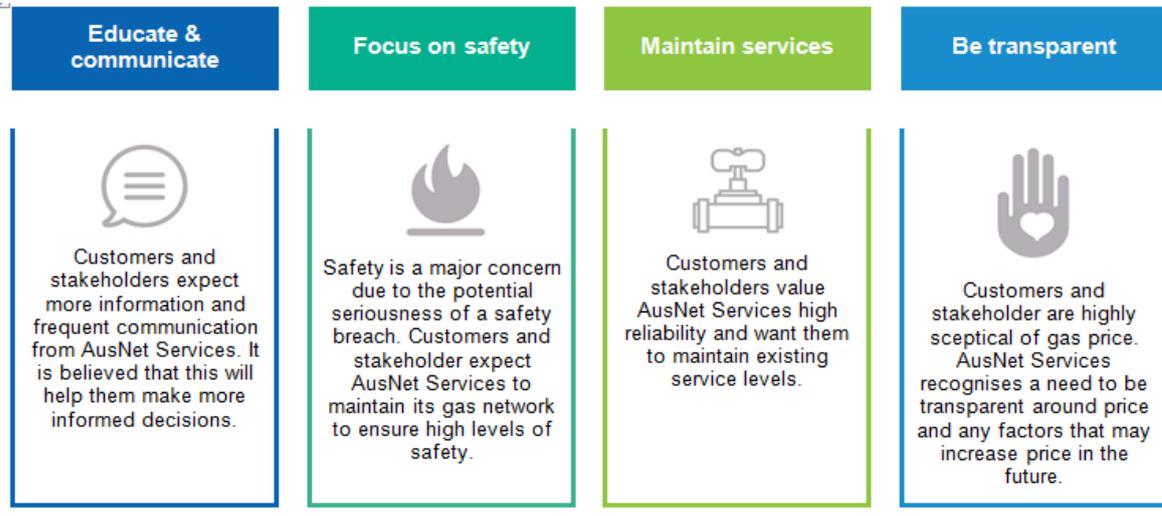
AusNet Services has undertaken a range of engagement activities aimed at understanding its customers' attitudes to network investment and trade-offs between reliability and safety outcomes and operating costs. 700 customers and stakeholders were engaged during the program across a range of customer categories and insights from their input are summarised below.

⁴ AEMO, *National Gas Forecasting Report*, March 2016.

⁵ CIE Report 2016.

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Figure 2: Customer and stakeholder engagement insights



The operation of the network in a safe manner was considered the top priority for customers. Customers were very supportive of investment that improved network and community safety. This support remained even when presented with the additional costs of certain programs.

Customers expressed a strong preference for current reliability levels. This satisfaction was shared across different customer and stakeholder groups.

Finally, there was general support for investment in innovation, particularly where it resulted in lower long term costs or higher community benefits such as improved safety or reliability.

This customer feedback has influenced asset strategy. At a high level, it has led to a series of coordinated decisions (for example, on the volume of low pressure and medium mains replacement) that stabilise price rises for AusNet Services’ customers while still delivering the improvements in community safety desired.

2.3 KEY CUSTOMER INSIGHTS

A range of customer insights that can be used to guide the future direction of our gas network were drawn from each of the studies. An overview of key findings is presented in Table 1.

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Table 1: Overview of key customer insights from Studies 1 – 4

Theme	Participant group	Key insights
Importance of safety	<ul style="list-style-type: none"> • Residential customers (study 1) • Small/Medium businesses (study 4) • Local councils (study 4) • Large Business (study 4) • Land developers (study 4) 	<ul style="list-style-type: none"> • Although safety-related incidents are not common, safety is a major concern due to the potential seriousness of the outcomes of a safety breach: explosion or death from inhalation. • Gas leaks are taken seriously and reported to their retailer or using the emergency number on the gas bill. • Given the serious nature of safety concerns, customers are not willing to trade a reduction in the cost of gas for compromised safety – safety is a non-negotiable. • For Business customers, safety is a high priority – both in their own business and across the gas network.
Valued attributes	<ul style="list-style-type: none"> • Residential customers (study 1) • Small/Medium businesses (study 4) • Local councils (study 4) • Large Business (study 4) • Land developers (study 4) 	<ul style="list-style-type: none"> • Gas is valued as an instantaneous energy source. This is particularly valued for heating during the winter months • It is typically viewed as a clean fuel. • The responsiveness of gas is a key benefit for heating and cooking. • If the supply was interrupted, customers would be most concerned about the loss of hot water. • Reliability of supply was noted by many of the small/medium business customers as a key valued attribute.
Affordability and price	<ul style="list-style-type: none"> • Residential customers (study 1) • Small/Medium businesses (study 4) • Local councils (study 4) • Large Business (study 4) • Land developers (study 4) • Insights validated by customer advocates (study 3) 	<ul style="list-style-type: none"> • The price of gas, while acknowledged to have increased over time, is generally regarded as reasonable among residential customers. • Gas is generally perceived to be cheaper than electricity. However, customers recognise that this may be because they tend use less gas relative to electricity. • The information provided on gas bills is sufficient to allow users to monitor usage over time. • Most customers use the comparative graphs provided on bills to make assessments of their usage behaviours. • For business customers, significant increases in the overall cost of gas in the past 5 years, and the corresponding impact on profit margins, are particularly salient. • Businesses are sceptical of the rate of return sought by distribution businesses as a part of their regulatory proposals. • Land developers’ perceptions of current contribution rates are variable.

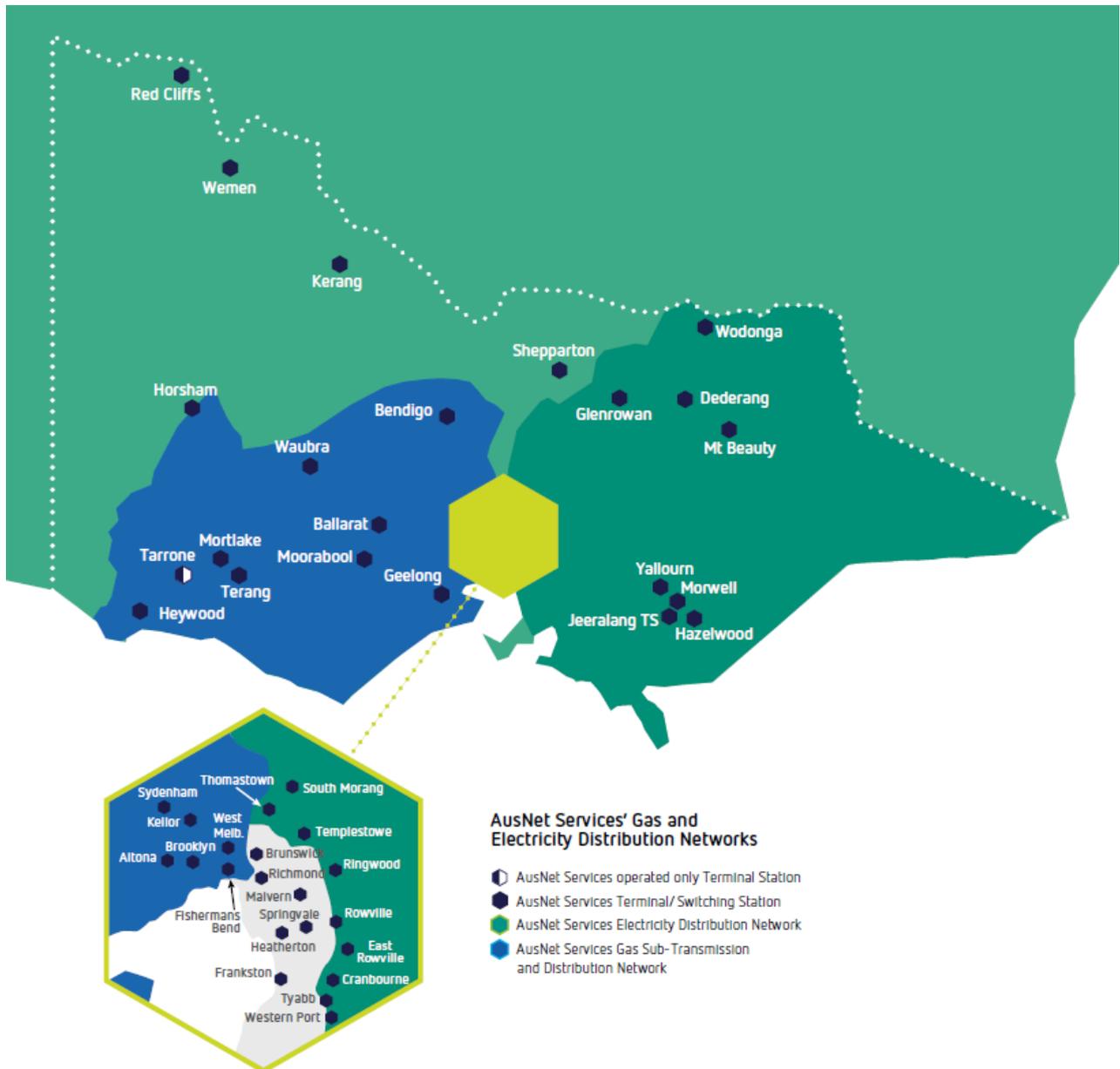
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<p>Future demand</p>	<ul style="list-style-type: none"> • Residential customers (study 1) • Small/Medium businesses (study 4) • Local councils (study 4) • Large Business (study 4) • Land developers (study 4) • Insights validated by customer advocates (study 3) 	<ul style="list-style-type: none"> • Gas is highly valued among customers and they are not actively seeking an alternative. • Most customers expect to be using gas in the future and to install gas appliances if building a new house. • Gas consumption is expected to gradually decrease as alternative energy sources become affordable. • While many business customers have plans to make process changes to become more energy efficient, projected increases in production are expected to offset reductions in consumption, resulting in a net increase in demand • Land developers believe that it will take time for buyers to realise the benefits of renewable energy sources, thus gas will remain a fuel of choice in the foreseeable future.
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3 AUSNET SERVICES OVERVIEW

Figure 3: AusNet Services Gas and Electricity Distribution Networks



AusNet Services is an energy delivery service business that owns and operates Victoria's largest network of electricity and gas infrastructure. We move energy from where it's made to where it's used in over one million Victorian homes and businesses.

We own and operate Victoria's **electricity transmission network**, responsible for transporting electricity from generation sources – via 49 terminal stations, 13,000 towers and 6,500 kilometres of high-voltage powerlines – into Victoria's five lower-voltage distribution networks.

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We also own and operate an **electricity distribution network** with more than 49,816 kilometres of powerlines and 380,000 powerpoles that feed lower-voltage electricity to 679,000 properties in Melbourne's north east and across all of eastern Victoria.

In addition, AusNet Services owns and operates a **gas distribution network** that supplies natural gas to more than 665,000 properties in western Victoria via 11,135 kilometres of underground pipelines.

AusNet Services also owns Select Solutions and Geomatic Technologies, two businesses that provide a range of services to the energy and other industries, including water, transportation, telecommunications, finance and property.

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4 AUSNET SERVICES PURPOSE STATEMENT

Our Renewed Purpose – ‘Empowering Communities and their Energy Future’

Our refreshed strategy starts with a refocused purpose. With input from employees, the Executive Leadership Team has developed a new purpose to position AusNet Services for today and tomorrow.

Our job is to move energy, our purpose tells people why. We believe our renewed purpose responds to the realities of our dynamic business environment and the increasingly active role all our communities play in the future of energy.

We want to empower our communities – our customers, local neighbourhoods, partners, regulators, governments, potential employees, to name a few – so we can achieve mutual benefits from our shared energy future.

4.1 FOCUS 2021 – OUR FIVE-YEAR PLAN

To achieve AusNet Services’ purpose, we will pursue a strategy that leverages our core capabilities in networks, assets, high value services, and innovation to build a portfolio of high performing and sustainable **regulated** and **commercial services** businesses. We are using the term commercial services to describe our business activity in non-regulated markets – this emphasises our growing customer and commercially focused mindset and culture.

Through our four strategic responses, we will **Lead** network transformation in our regulated business and deliver a step change in **Growing** our commercial services business. Across the whole portfolio we’ll **Drive** efficiency and effectiveness, and **Generate** trust and respect to build our reputation.



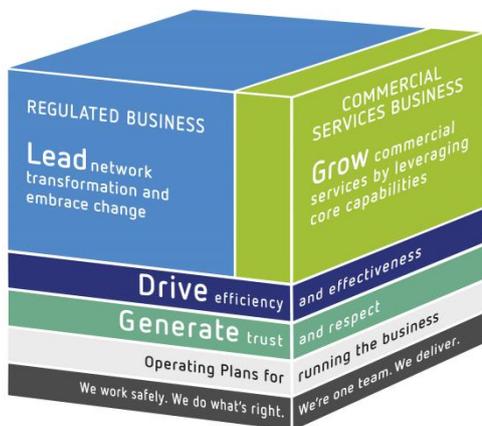
Underpinning the nine strategic initiatives under **Lead, Grow, Drive and Generate**, are our business-as-usual activities set out in our Operating Plans.

Implementation of the refreshed corporate strategy and the operating plans form the basis of the FY17-21 Business Plan, which will be implemented under the banner of Focus 2021.

The plan aims to make us a leading modern energy company with a diverse business portfolio:

- Operating all three core networks in the top quartile of efficiency benchmark; and
- Owning a substantial and sustainable commercial services business.

Figure 4: Corporate Strategy Alignment



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4.2 CORPORATE VALUES

A purpose, strategy, and aspiration, on their own, are not sufficient to define how the business will achieve company goals. We also need values to express what we stand for and guide the way we do things. AusNet Services has four company values:

Our **VALUES** are the foundation for how we achieve our objectives

We work safely

- > We never compromise on safety and we genuinely care for the wellbeing of people



We do what's right

- > We act with integrity in the best interests of our company, taking into account how our decisions affect the business and stakeholders
- > We recognise and celebrate successes, welcome straight-talk and constructive feedback, and learn from our mistakes
- > We have clear and consistently applied expectations of performance and behaviour across our business

We're one team

- > We work together as a united team with our partners and suppliers to achieve great results and build our company's reputation
- > People are the heart and soul of our business – we treat our People fairly, value their differences and support their development
- > We encourage knowledge sharing – we're open to good ideas and believe that these can come from anywhere in the business

We deliver

- > We are accountable to customers, communities, securityholders and each other, and we deliver on our promises
- > We are passionately invested in striving for excellence and high standards, and achieving great outcomes
- > We keep adapting through innovation, continuous improvement and change so as to secure our future success

4.3 NETWORK VISION STATEMENT

The Gas Network vision statement is:

“To provide our customers with valued services through the continued development and operation of a safe and sustainable gas network.”

The proposed vision statement has been formulated to include AusNet Services’ core focus on network safety, sustainability, and providing customers with services that they value.

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5 ALIGNMENT OF CORPORATE STRATEGY TO GAS NETWORK OBJECTIVES

AusNet Services' purpose statement is to "Empower communities and their energy future" places the customer (as individuals and communities) at the forefront as a business driver and acknowledges the critical relationship with their energy supply and usage, and is a key theme throughout the Corporate Business Strategy.

The figure below provides the linkage between AusNet Services corporate strategy, and the gas network vision consistent with providing valued customer service and sustainable network investment.

The gas network objectives, which stems network vision drives the development of the programs for each of the asset strategies.

Figure 5: Alignment of corporate, business and gas network objectives



The gas network objectives alignment with the business, regulators, and the delivery of plant strategies are detailed below:

1. Maintain network safety in accordance with the Gas Safety Case

Maintain the alignment to AusNet Services' commitment to 'Mission Zero'. The objective to maintain network safety is in recognition of AusNet Services' current safety performance and design of the gas network.

2. Maintain top quartile operating efficiency

Alignment to AusNet Services' Corporate Business Plan with the aspiration to operate "all three core networks in the top quartile of efficiency benchmarks".

3. Undertake prudent and sustainable network investment

Alignment to AusNet Services' obligation to undertake prudent and sustainable network investment, as defined in the National Gas Rules and Gas Distribution System Code.

4. Delivery of valued services to our customers

Establishes the need to better understand our customers (their needs and behaviours) and deliver the services they value.

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6 GAS NETWORK OVERVIEW

This section provides an overview of AusNet Services' gas distribution network including network and industry summaries, stakeholder expectations, and regulatory framework overview.

6.1 NETWORK SUMMARY

6.1.1 LOCALITY & GEOGRAPHY

AusNet Services owns an extensive natural gas transmission and distribution network throughout western metropolitan Melbourne and South-West and West regional Victoria. The network distributes natural gas from the declared gas transmission system to individual gas meters, which supply customers' appliances. In total, gas is delivered to approximately 665,000⁶ customers across a geographical diverse region spanning 60,000km.² The gas transmission and distribution network includes mains, mainline valves, pressure regulating facilities (including city gates, field and district regulators), service pipes, meters and ancillary equipment.

Figure 3 demonstrates the geographical footprint of the gas network that extends from the Hume Highway to the South Australian border, and North of Bendigo and Horsham. AusNet Services also owns an LPG vapour reticulation network at Mt Baw Baw.

6.1.2 NETWORK GROWTH

Demand on AusNet Services' gas network is forecast to remain reasonably stable over the next five years, with customer growth expected to compensate for lower consumption per capita. With strong population growth in Melbourne localities such as Hume, Melton and Wyndham and regional areas such as Bendigo, Ballarat and Geelong, overall customer growth is forecast to increase by an average of 2.0% to 2022. On the other hand, smaller housing, energy efficiency and the increasing competitiveness of electrical appliances is expected to reduce residential consumption per household by 1.7% per annum over the same period. The combination of customer growth and lower demand per customer is projected to result in Tariff V demand increasing by 0.6% in the next five years.

The gas demand profile of the network is winter peaking, with a pronounced spike arising from the increased customer usage due to domestic heating.

6.1.3 ASSET SUMMARY

The gas distribution network consists of 183km⁷ of licensed transmission pipelines operating at a minimum pressure of 1,050kPa to a maximum allowable operating pressure (MAOP) of 2,800kPa, as well as approximately 10,700km⁷ of distribution mains and services operating at high, medium and low pressures.

A small portion of the network operates at 'sub-transmission' pressure called HP2, with an operating pressure range of 515kPa to 1,050kPa.

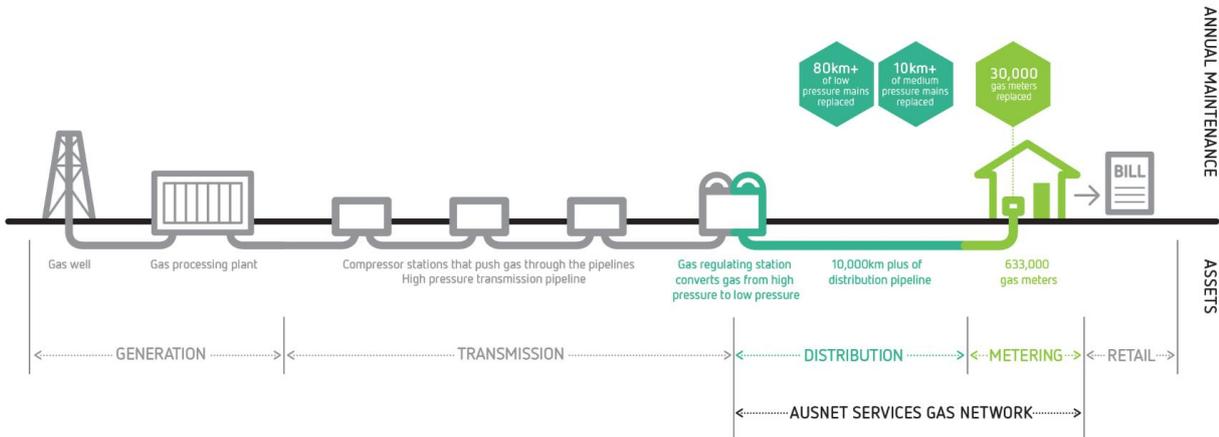
The majority of the distribution system operates at high pressure with a minimum allowable pressure of 140kPa to a maximum of 515kPa. Pressures are regulated through major facilities known as 'City Gates' which regulate supply from the VTS (owned and operated by APA Group in conjunction with the Australian Energy Market Operator – AEMO) to AusNet Services' distribution network.

⁶ As at July 2016.

⁷ As at June 2015.

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Figure 6: Process flow of gas distribution in Victoria



The network has been constructed over a period of more than 100 years and consequently consists of a variety of pipe materials. Cast iron and steel was predominantly used until the introduction of polyvinyl chloride (PVC) for low pressure like-for-like replacement and polyethylene for high pressure networks in the late 1970's. Today, PVC is no longer installed in the network leaving polyethylene as the dominant pipe material.

Table 2: Network Composition by Pipe Pressure and Material⁸

Material	Low Pressure	Medium Pressure	High1 Pressure	High2 Pressure	Transmission Pressure	Total
Cast Iron	254km	9km	-	-	-	263km
Polyethylene	17km	244km	7,121km	62km	-	7,446km
PVC	410km	-	-	-	-	410km
Uncoated Steel	43km	243km	-	-	-	286km
Coated Steel	22km	204km	2,259km	29km	185km	2,700km
Other	28km	-	-		-	28km
Total	776km	702km	9,381km	91km	183km	11,135km

⁸ As at June 2016.

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Table 3: Gas Distribution Network Asset Summary⁸

Asset	Number / Length	Mean Service Life (Average Years)	Expected Service Life
Transmission Pipelines	185km	42 years	80 years
Distribution Mains	10,951km	23.8 years	
– High Pressure 2 (HP2)	– 92km	– 30.3 years	60 years
– High Pressure (HP1)	– 9,381km	– 20 years	60 years
– Medium Pressure (MP)	– 702km	– 40.4 years	60 years
– Low Pressure (LP)	– 776km	– 43.8 years	60 years
Meter Types	655,602 units	9.94 years	-
– Domestic Meters	639,882 units	10.13 years	22 years
– Industrial & Commercial Meters	15,702 units	8.48 years	10-15 years
City Gates	38 units	30 years	50 (est.) years
Gas Pre Heaters	36 units	19 years	50 (est.) years
Field Regulators	106 units	31 years	50 (est.) years
District Regulators	73 units	26 years	50 (est.) years
SCADA (remote terminal units)	196 units	17.4 years	15 years
Cathodic Protection Units (CPU)	178 units		
Transmission	– 18 units	– Various	30 years
Distribution	– 160 units	– Various	30 years

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6.1.4 CHARACTERISTICS OF THE AUSNET SERVICES GAS NETWORK

There are a number of characteristics of AusNet Services' gas network which add complexity and cost to operating and maintaining the network:

- **Geography:** remoteness increases the need for remote control of core infrastructure and increases repair and inspection costs.
- **Weather:** a wide range of climatic conditions drives a need to increase current capacity margin. The rapid expansion / contraction of ground conditions caused by water saturation / drought increases the incidence of main failures, especially on the brittle cast iron network,
- **Ground Conditions:** existence of rock and clay-based soils increases pipe laying costs and frequency of failures due to ground movement.
- **Demographics:** urban growth corridors (areas) place increasing demand on the existing network.
- **Holiday Resorts:** seasonal demand and identification of faults results in additional costs to cater for uneven requirements on AusNet Services' resources.
- **Network Configuration:** much of the current growth is away from transmission pipelines, requiring large infrastructure development to meet reliability requirements.

6.1.5 STAKEHOLDER EXPECTATIONS

AusNet Services recently launched a customer and stakeholder engagement strategy for the gas network. The objective of this program was to deliver authentic, customer priority-driven engagement that will meet external stakeholder expectations, and inform the development of business plans.

This objective does not mean being 'customer compelled' in the development of current and future, but rather acknowledges that AusNet Services' approach to engagement will be driven by an understanding of the long term interests of consumers of natural gas. The advantage of this focus is that it serves a dual purpose of addressing the requirements for stakeholder engagement as part of the 2018-2022 GAAR, as well as longer term network planning for the gas network.

Given the level of maturity within AusNet Services and the industry in undertaking broader customer and stakeholder engagement to date, AusNet Services has adopted a realistic and pragmatic approach to customer and stakeholder engagement. A key benefit of this approach is that it is centred on devoting resources and effort to establishing a relationship with end-user customers and their advocates, and building internal capability through practical experience of customer consultation. The stakeholders for AusNet Services' energy networks are summarised in the table below.

Table 4: Stakeholder Expectation Summary

Stakeholders	Driver / Expectation
Connected Parties (energy consumers, electricity generators and gas producers, other network service providers)	<ul style="list-style-type: none"> - Responsive service - Efficient service costs - Network access - Capacity, reliability, quality, safety, environmental, compliance and security performance within Code or Agreement
Community	<ul style="list-style-type: none"> - Public safety - Environmental performance within Code
Employees and contractors	<ul style="list-style-type: none"> - Safe work place - Reward and recognition - Skill development

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Stakeholders	Driver / Expectation
Shareholders	<ul style="list-style-type: none"> – Return on investment – Growth in investment value – Commensurate opportunities, liabilities and risks
Energy Retailers	<ul style="list-style-type: none"> – Reliable information – Efficient service costs
Safety Regulator	<ul style="list-style-type: none"> – Compliance with Acts, Regulations & Codes – Improving safety performance – Transparent processes – Reliable information
Economic Regulator	<ul style="list-style-type: none"> – Compliance with Law, Rules & Codes – Efficient service costs – Transparent processes – Reliable Information
State and Federal Government	<ul style="list-style-type: none"> – Compliance with Acts and Regulation – Support economic development – Improving safety performance – Efficient service costs
Local Government and VicRoads	<ul style="list-style-type: none"> – Coordinated infrastructure development – Coordination of works – Public land reinstatement

Gas Asset Management Strategy

7 ASSET MANAGEMENT SYSTEM

This section provides an overview of AusNet Services' Asset Management System including its underlying methodology, context, process, objectives, decision making criteria, and certification.

Refer to AusNet Services' Asset Management System Overview (AMS 01-01) for additional details.

7.1 ASSET MANAGEMENT METHODOLOGY

AusNet Services is focused on delivering optimal distribution network performance at efficient costs. Except in the case where outputs are mandated, this requires an explicit cost benefit analysis to be undertaken in order to assess whether the overall economic value of capital expenditure is positive. In doing this, AusNet Services assesses the incremental costs of delivering an incremental change in network performance to customers, relative to the incremental benefits accruing to customers from the delivery of that enhanced network performance.

As per Section 79 (3) of the NGRs, in deciding whether the overall "economic value of capital expenditure is positive", consideration is to be given only to economic value directly accruing to the service provider, gas producers, users and end users". Consistent with this, AusNet Services, in assessing the incremental costs has regard to:

- Direct costs to AusNet Services; PLUS
- Allocation of AusNet Services' capitalised overheads; PLUS
- Imposed costs stemming from the program, which accrue to gas producers, users and end users.

The latter – incremental benefits – has regard to the full societal benefits, which includes:

- Direct benefits to AusNet Services' customers; PLUS
- Additional benefits stemming from the program, which accrue to gas producers, users and end users.

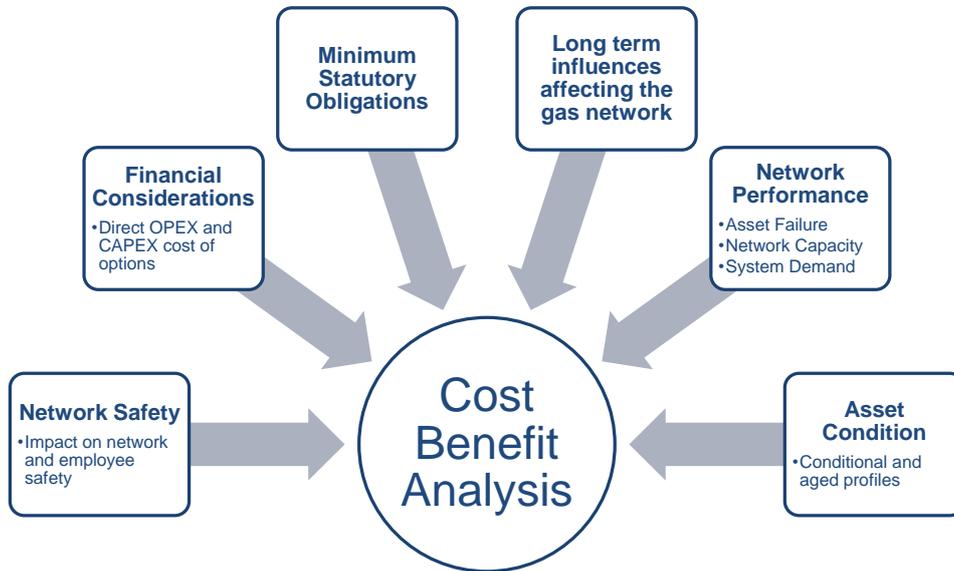
Where the delivery of certain outputs is a function of the external obligations placed upon the business (e.g. legislation stipulating network safety requirements), a different approach is undertaken. More specifically, AusNet Services adopts a cost effectiveness (least cost) analysis to ensure that the output is delivered at least cost.

The asset strategy therefore ensures that all decisions to augment, replace or maintain network assets are justified on economic grounds. The benefits are a function of the explicit customer value proposition, or proxy via the adoption of minimum performance standards which are stipulated in legislation or other statutory or regulatory instruments.

The various drivers that are brought to bear when undertaking AusNet Services' Cost Benefit Analysis are summarised in Figure 7.

Gas Asset Management Strategy

Figure 7: Cost Benefit Analysis Drivers



An assessment of the above drivers – both individually and collectively – are fundamental to the cost benefit analysis that underpins AusNet Services' approach to managing its gas distribution network.

7.2 ASSET MANAGEMENT POLICY

AusNet Services has formally endorsed an Asset Management Policy as illustrated in Figure 8. This Policy is consistent across all three energy networks and sets the foundation for all asset management decisions. It has communicated throughout the business and copies of this policy have been made available in each workplace.

Gas Asset Management Strategy

Figure 8: Asset Management Policy

Asset Management Policy



Provide our customers with superior network and energy solutions

This policy directs the content and implementation of asset management strategies, objectives and plans for AusNet Services' energy delivery networks. It guides employees, contractors, suppliers and delegates in each asset management decision.

Sound risk management and the continuous improvement practices of our integrated safety, health, environment, quality and asset management systems will manage the complete life cycle of network assets.

- > Hazards and risks to the safety of any person and their property will be minimised *"so far as is practicable"*.
- > *Provide consumers with information, tools and service options* to facilitate their energy choices.
- > *Effective consultation with stakeholders* to comprehend and integrate their requirements in asset management decisions.
- > The specification and application of assets will *comply with legislation, regulation, Australian Standards and industry codes*.
- > The *national energy laws, rules and their fundamental price, performance and security principles* will guide service development in the interests of customers.
- > *Innovation and technology will be embraced* to economically reduce service risks, increase service value and manage service performance commensurate with customer's emerging needs.
- > *Skilled people will be developed and deployed* to sustainably manage risks, increase the value of services and improve the range of services.
- > Energy network development will *balance the environmental, economic, and social needs of today without sacrificing the interests of future generations*.
- > Practices, systems and facilities will *continuously improve commensurate with certification to a recognised asset management standard*.



Nino Ficca
Managing Director
17 April 2013



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7.3 ASSET MANAGEMENT CONTEXT

The Asset Management Policy acknowledges the company's purpose and directs the content and implementation of asset management strategies, objectives, and plans for the energy delivery networks.

The Asset Management Policy recognises that the provision of a superior network requires the management of network assets over their lifecycle. This will be achieved by sound risk management and the continuous improvement practices of our integrated safety, health, environment, quality, and asset management systems.

7.4 ASSET MANAGEMENT OBJECTIVES

The Asset Management Policy summarises AusNet Services' fundamental asset management objectives. AusNet Services' asset management objectives have been developed to support the successful delivery of AusNet Services purpose. The asset management objectives for AusNet Services' energy networks are:⁹

- Deliver Relevant network services at prices that customers value;
- Reconcile network reliability with customers' preferences and regulatory incentives;
- Reduce bushfire ignition risk;
- Reduce network safety risks "as far as practicable";
- Use benchmarking to focus business improvement; and
- Efficiently manage asset risk and performance.

The below figure demonstrates the alignment and the connection of the overall asset management objectives which stem down to the gas network objectives.

⁹ 2016/17 to 2020/21 Asset Management Plan.

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Gas Network Objectives

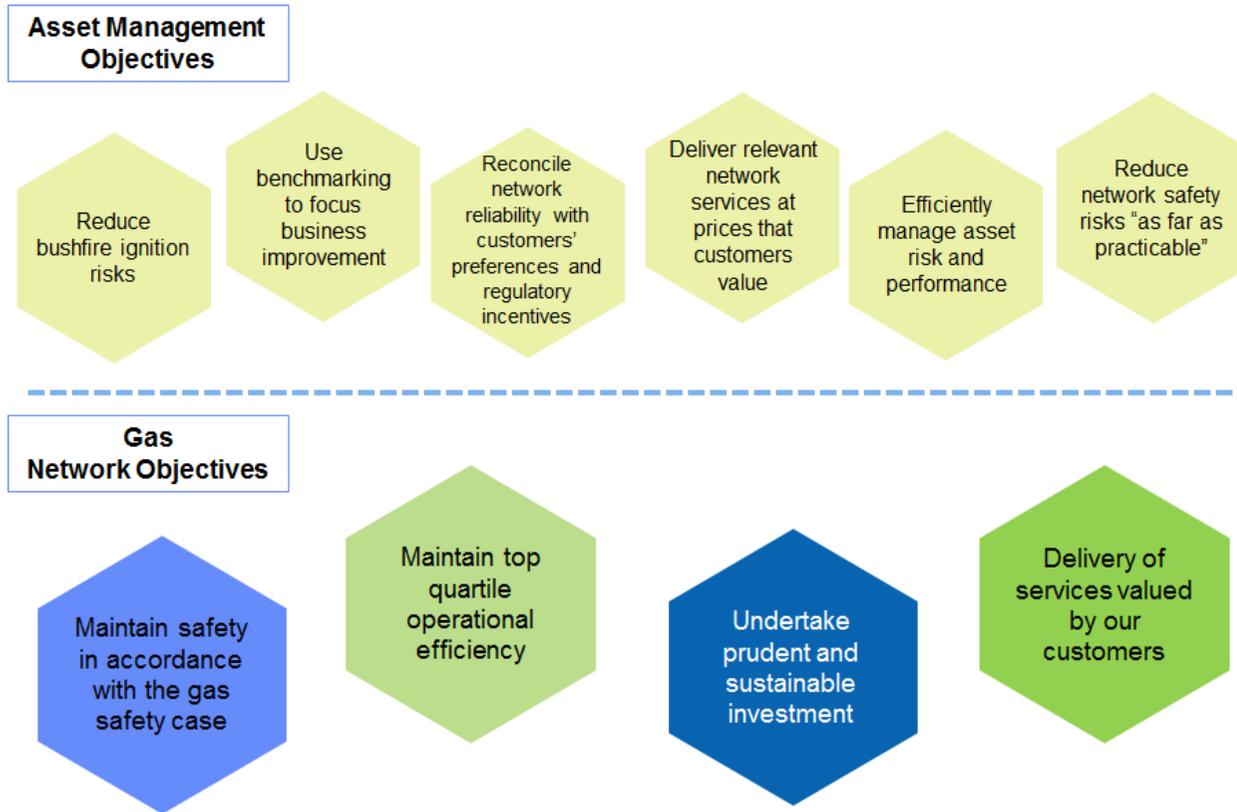


Figure 9: Alignment between business Asset Management Objectives and Gas Network objectives

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7.5 PLANNING TO ACHIEVE OBJECTIVES

AusNet Services' Asset Management System Overview (AMS 01-01) describes how AusNet Services' plans to achieve asset management objectives.

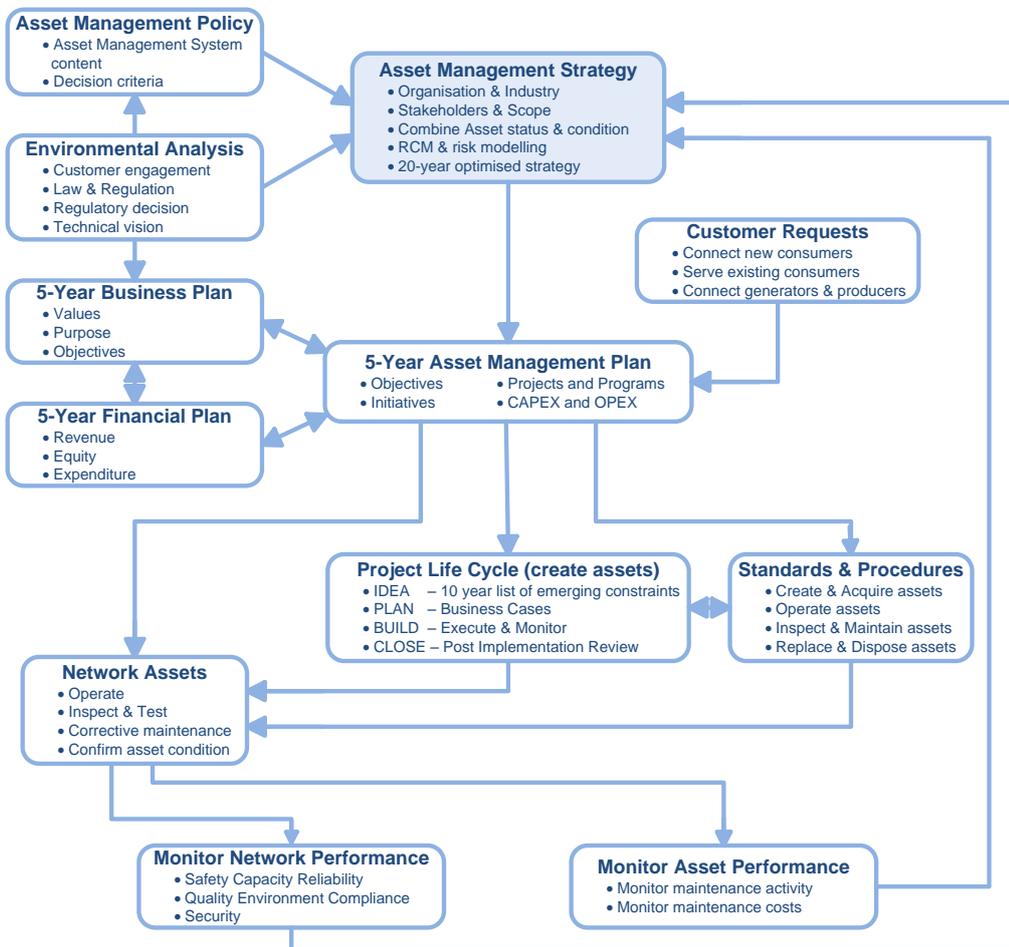
Refer to Section 10.3 – Asset Management System Overview (AMS 01-01).

7.6 ASSET MANAGEMENT PROCESS

AusNet Services' Asset Management System is describes in AMS 01-01. It includes an asset management process that is informed by corporate visions, business plans and an assessment of the external business environment. It is a critical guide for the development of longer-term asset management plans as well as more immediate work programs for enhanced performance and efficiency.

As illustrated in Figure 10, this AMS is a pivotal element of the asset management process.

Figure 10: Asset Management Process



7.7 ASSET MANAGEMENT SYSTEM CERTIFICATION

Refer to AMS 01-01 for accreditation to ISO 55001, the international standard for Asset Management.

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8 ASSET MANAGEMENT DRIVERS

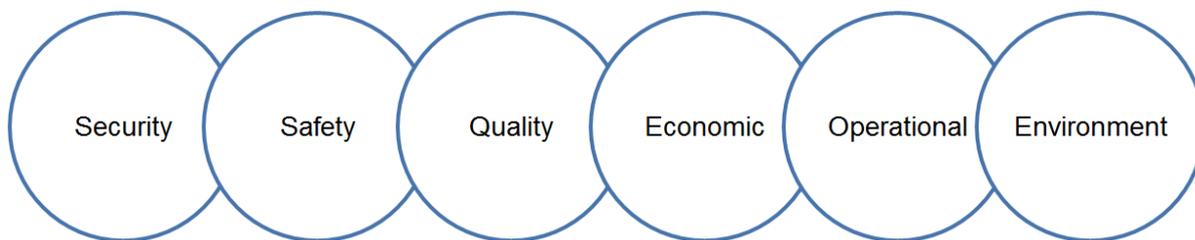
The objective of this section is to outline the major drivers influencing asset management decisions, including:

1. Legislative and regulatory obligations affecting the gas distribution network;
2. The lifecycle costs (CAPEX and OPEX) associated with different options for delivering outputs to consumers; and
3. Longer term issues influencing AusNet Services' gas distribution network.

8.1 LEGISLATIVE AND REGULATORY REQUIREMENTS

Legislative and regulatory requirements impact a number of areas of AusNet Services' gas distribution business. These are outlined in Figure 11 and discussed in the following sections.

Figure 11: Legislative and Legal Influences on AusNet Services' Gas Distribution Network



8.1.1 ASSET SECURITY

Legislation has been enacted to counteract the threat of terrorism or sabotage to critical infrastructure. Industry standards for security have also been established to reduce the risk of injury to the public, or asset damage caused by vandals, following unauthorized access to assets. These instruments reflect the increasing physical priority of security as a critical component of asset management.

8.1.2 SAFETY

Energy Safe Victoria (ESV) is an independent Victorian statutory authority responsible for the safety and technical regulation of electricity and gas networks (including pipelines) in Victoria. The *Energy Safety Victoria Act 2005* specifies the role and functions of the ESV. The responsibilities of ESV relevant to gas networks include:

- Safety of gas supply including transmission and distribution systems;
- Safety of gas installations in industrial, commercial and domestic premises;
- Safety of gas workers by the registration of contractors and the licensing of gas workers on the attainment of an appropriate level of gas safety competency;
- Safety of gas equipment by ensuring it meets minimum required gas safety standards before sale;
- The education of the community and the gas industry on the safe use of gas through a strong and focused awareness campaign;
- Issuing of guidelines for the preparation of gas safety cases and the compliance of gas companies with accepted safety cases;
- Assessing and auditing pipeline safety management plans and environmental plans to determine their adequacy and effectiveness;
- Investigation and analysis of incidents and accidents to identify trends and develop preventative measures; and
- Monitoring and enforcing compliance with the Act and the regulations including (but not limited to) the Gas Safety Act 1997 and the Gas Safety (Safety Case) Regulations 2008.

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Victorian safety legislation requires network businesses to lodge a Gas Safety Case (GSC) Management System, with ESV. Refer to Section 10.2 *Gas Safety Case* (pg. 43) of the AMS for further details.

8.1.3 QUALITY OF SUPPLY REQUIREMENTS

Quality of supply strategies in the AMS are focused on managing gas network pressures and the continuity of supply to AusNet Services' domestic and Industrial/Commercial customer base with reference to the GDSC, Version 11.

In the 2008-12 regulatory control period the AER introduced Guaranteed Service Levels (GSLs), recognising this as an area requiring additional focus. GSL's are unchanged for the 2013-17 regulatory period.

Broad planning and investment strategies, individual project economic evaluations, and network performance monitoring alike, must be cognisant of the quality of supply standards, including the *Gas Safety (Gas Quality) Regulations 2007* and Australian Standard No. 4564 *Specification for General Purpose Natural Gas*.

8.1.4 ECONOMIC

The AER has responsibility for the economic regulation of AusNet Services' network in accordance with the NGR and NGL. The AER's key gas related responsibilities include:

- Regulating the revenues of transmission and distribution network service providers;
- Monitoring the gas wholesale market;
- Monitoring compliance with the national gas law, national gas rules and national gas regulations;
- Investigating breaches or possible breaches of provisions of the national gas law, rules and regulations and initiate and conduct enforcement proceedings against relevant market participants;
- Establishing service standards for gas transmission and distribution network service providers; and
- Establishing ring-fencing guidelines for business operations with respect to regulated transmission and distribution services.

The economic regulation of the Gas Distribution industry is subject to a national regulatory framework. The framework is governed by the NGL, and contained in the NGR.

In relation to the former, the key sections are:

Section 23 of the National Gas Law outlines the National Gas Objective:

"The objective of this Law is to promote efficient investment in, and efficient operation and use of, natural gas services for the long term interests of consumers of natural gas with respect to price, quality, safety, reliability and security of supply of natural gas."

and...

The key rules underpinning the economic regulation of the Gas Distribution industry considered during development of this asset management strategy include:

Rule 79, which outlines the "New capital expenditure criteria", which in turn underpins the AER's assessment of AusNet Services' proposed capital expenditure requirements. Rule 79 states:

1. Conforming capital expenditure is capital expenditure that conforms with the following criteria:
 - (a) the capital expenditure must be such as would be incurred by a prudent service provider acting efficiently, in accordance with accepted good industry practice, to achieve the lowest sustainable cost of providing services;
 - (b) the capital expenditure must be justifiable on a ground stated in sub rule (2).
2. Capital expenditure is justifiable if:
 - the overall economic value of the expenditure is positive; or
 - the present value of the expected incremental revenue to be generated as a result of the expenditure exceeds the present value of the capital expenditure; or

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- the capital expenditure is necessary:
 - i. to maintain and improve the safety of services; or
 - ii. to maintain the integrity of services; or
 - iii. to comply with a regulatory obligation or requirement; or
 - iv. to maintain the service provider's capacity to meet levels of demand for services existing at the time the capital expenditure is incurred (as distinct from projected demand that is dependent on an expansion of pipeline capacity); or
 - the capital expenditure is an aggregate amount divisible into 2 parts, one referable to incremental services and the other referable to a purpose referred to in paragraph (c), and the former is justifiable under paragraph (b) and the latter under paragraph (c).
3. In deciding whether the overall economic value of capital expenditure is positive, consideration is to be given only to economic value directly accruing to the service provider, gas producers, users and end users.
 4. In determining the present value of expected incremental revenue:
 - (a) a tariff will be assumed for incremental services based on (or extrapolated from) prevailing reference tariffs or an estimate of the reference tariffs that would have been set for comparable services if those services had been reference services; and
 - (b) incremental revenue will be taken to be the gross revenue to be derived from the incremental services less incremental operating expenditure for the incremental services; and
 - (c) a discount rate is to be used equal to the rate of return implicit in the reference tariff.
 5. If capital expenditure made during an access arrangement period conforms, in part, with the criteria laid down in this rule, the capital expenditure is, to that extent, to be regarded as conforming capital expenditure.
 6. The AER's discretion under this rule is limited.

Rule 91, which outlines the “Criteria governing operating expenditure”, which in turn underpins the AER’s assessment of AusNet Services’ proposed operating expenditure requirements. Rule 91 states:

1. Operating expenditure must be such as would be incurred by a prudent service provider acting efficiently, in accordance with accepted good industry practice, to achieve the lowest sustainable cost of delivering pipeline services.
2. The AER's discretion under this rule is limited.

AusNet Services' asset management and operational policies are designed to comply with the NGL.

8.1.5 OPERATIONAL

Various Acts, Codes, Regulations, Guides, Standards and Agreements define the expected operating standards for the distribution system. As a minimum, the network must be designed and managed to meet the requirements set out in current versions of the:

- Access Arrangement (Sections A, B and C);
- Tariff Order;
- Distribution License;
- *Gas Industry Act, (2001)*;
- *Gas Safety Act, (1997)*;
- Gas Distribution System Code;
- *Victorian Occupational Health and Safety Act 2004*;
- *Pipeline Regulations 2007*; and

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- Appropriate Australian and International Standards.

The expected level of service is expressed in terms of various KPIs that are used to monitor the performance of individual asset items and the distribution system as a whole. Asset and performance data is submitted on a quarterly and annual basis to the AER and ESV as per *Information Specification – Performance Indicators Requirements for Reporting By Victorian Gas Distribution Companies; Essential Services Commission and Energy Safe Victoria – January 2009*. Refer to Section 1 of the AMS for recent gas network performance.

Further to the above, it is noted that planning for the VTS assets in Victoria is coordinated through three Gas Distributor companies and AEMO in its role as Victoria Transmission Network planner. Annually, each Gas Distributor provides new connection details and forecast load information to assist in the development of the Victorian Annual Planning Report (VAPR). This is published and is available on the AEMO website.¹⁰

8.1.6 ENVIRONMENT

The regulatory instruments (including the NGR and Distribution License) require AusNet Services to comply with all applicable regulatory obligations or requirements associated with the provision of network services. Environmental compliance, including the implementation of sustainable practices, is therefore a key objective for the Gas Asset Management Strategy.

In addition to the above, AusNet Services focuses on the protection of the immediate environment through its AS/NZS ISO 14001 certified Environmental Management System.¹¹ The environmental management system is the principle tool through which AusNet Services identifies environmental risks, develops and implements solutions and monitors success in controlling such risks.

As part of its environmental program, AusNet Services continues to mitigate risks associated with asbestos containing materials, oil contaminations, greenhouse gas emissions, and noise in order to address community and customer expectations.

National Greenhouse and Energy Reporting which was established by the National Greenhouse and Energy Reporting Act 2007, is completed on an annual basis. This includes company information of greenhouse gas emissions, energy production, energy consumption and other information required. AusNet Services maintains the emissions below industry benchmark.

8.2 ASSET LIFECYCLE

AusNet Services adopts the lifecycle approach to the management of its assets. This means the different phases of an assets lifecycle are considered when determining the optimal cost-benefit solutions to network issues, as shown in

¹⁰ www.aemo.com.au

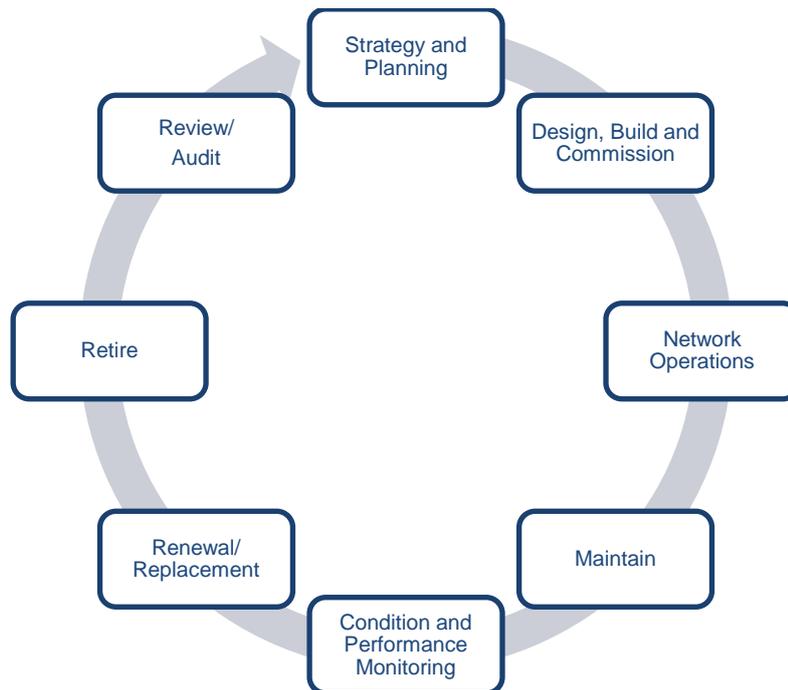
¹¹ EMS 10-01 Environmental Manual, AusNet Services.

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Figure 12.

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Figure 12: Asset Lifecycle



8.2.1 STRATEGY & PLANNING

AusNet Services has both short-term and long-term strategies that align with AusNet Services' corporate objectives. Strategies cover the operation and maintenance of existing assets, as well as network expansion, both organically and through new reticulation of regional towns.

8.2.2 DESIGN, BUILD AND COMMISSION

The network design function is divided into three major categories:

- **Network / System Design** – incorporates the high-level, strategic design of the network. It takes into consideration elements such as future load growth, asset capacity, major customer developments and overall network performance; including reliability and security.
- **Complex designs** – incorporates the design of complex facilities, such as field regulator stations and city gates. It typically involves site-specific designs with references to Australian and international standards, as well as focusing on the design considerations and risk assessments associated with the asset concerned.
- **Standard Designs** – involves the application of standard network designs, documented design standards, procedures and principles to a range of less complex assets. Such design works typically incorporate mains replacement and reticulation extensions and are undertaken on an as-need basis (i.e. for specific projects). The designs are carried out in accordance with design standards, procedures and principles developed and specified by AusNet Services.

Construction activities are divided into two following categories:

- **General Construction** – involve the application of AusNet Services' standards, documented procedures, AusNet Services' or industry-accepted equipment and materials for the construction of an asset to a standard design. Such works typically include mains and services reticulation work and are generally undertaken by a contractor on behalf of AusNet Services.
- **Complex Construction** – encompass installations of a unique nature and incorporate non-standard items of plant and/or equipment. Such installations typically include city gates, field regulators and transmission pipelines. Construction of such installations typically incorporates a range of different activities such as civil works, structural works, construction and commissioning, etc.

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In addition to AusNet Services' standard procedures and specification, specific procedures are developed (if required) in compliance with industry standards for commissioning of assets constructed under this category. Support from external experts is sought if not available internally.

8.2.3 NETWORK OPERATIONS

Day-to-day management of the network is necessary to monitor and control network pressures to ensure reliability of supply, safety, and other operating requirements are maintained. Operations also include responding to faults and emergencies.

8.2.4 MAINTAIN

AusNet Services categorises its maintenance into the following:

- **Unplanned Maintenance** – Work carried out in response to reported problems or defects (e.g. pipe failure causing leakage, mechanical failure), with the aim being to provide speedy, appropriate and effective response to unforeseen equipment or system breakdown; minimising interruption, inconvenience and risk to the customer.
- **Condition Maintenance** – Work carried out to a predetermined frequency (e.g. inspection of cathodic protection systems, leakage surveys). The aim is to ensure that plant and equipment operate reliably and economically as the first part of a preventive maintenance program.
- **Scheduled Maintenance** – Work carried out to a predetermined schedule (e.g. regulator overhaul for City Gates, Field and District Regulators, lubrication of valves, etc.). The aim of this maintenance is to perform routine major maintenance at preselected intervals to maximise equipment life and minimise the possibility of interruption of supply to the customer, whilst maintaining costs at an optimum level in accordance with best practice.

More specific details on asset maintenance can be obtained from the AusNet Services' Gas Maintenance Plan (AMP 30-02).

8.2.5 CONDITION & PERFORMANCE MONITORING

The expected level of service is expressed in terms of various KPIs that are used to monitor the performance of the individual asset items and the distribution system as a whole.

AusNet Services is benchmarked against the other distribution businesses by the AER in its Gas Industry Comparative Performance Report.

Further details on AusNet Services' current performance are contained within Section **Error! Reference source not found. Error! Reference source not found.** of the AMS.

8.2.6 RENEWAL/REPLACEMENT

Asset renewals are undertaken to restore, rehabilitate, replace or renew an existing asset to its original or improved capacity. Factors driving these activities are:

- the safety of the entire network;
- reliability of supply;
- compliance with performance requirements; and
- efficiently manage maintenance costs.

The main activities in this area are the pipe mains renewal and meter replacement programs.

8.2.7 RETIRE

This encompasses retiring or de-commissioning of faulty, old or redundant assets. Strategic planning, Risk Assessment and Network Modelling determines and prioritises the assets to be decommissioned from the network.

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De-commissioning of faulty or old assets helps in eliminating or reducing the risks associated with the outgoing asset and increases network safety. Retirement of fault prone assets also increases network performance and prevents inefficient increases in maintenance costs.

Disposal and/or decommissioning may occur for the following reasons:

- obsolescence;
- failure to meet regulatory requirements;
- repairs exceed replacement costs; and/or
- policy changes.

8.2.8 REVIEW / AUDIT

AusNet Services' facilities are subject to regular reviews and audits to verify compliance with specified technical, operational and safety standards and legislative requirements. Reviews and audits are undertaken in accordance with specified procedures to ensure the requisite compliance is achieved in all aspects of the design, construction, installation, operation and maintenance of the network.

Audit plans are developed annually in accordance with AusNet Services' Technical Compliance Audit Strategy (QMS 21-11).

8.3 LONG TERM INFLUENCES AFFECTING THE GAS DISTRIBUTION BUSINESS

8.3.1 NETWORK GROWTH

The reliability of the network can be at risk due to complex operating procedures that raise and lower network pressure to re-distribute peak loadings. AusNet Services continues to invest in core infrastructure to meet the growing demand for natural gas within these and other small areas of development within the state. Notwithstanding ongoing investment in network augmentation, AusNet Services has managed to maintain high levels of network utilisation, which demonstrates efficient spend of capital, while managing the risk to security of supply during times of peak demand (i.e. one-in-two winters peak).

There are a number of risks arising from high utilisation:

- Accelerated deterioration of gas assets, specifically pressure regulating assets, caused by elevated operating;
- The need to establish sophisticated, case specific, contingency plans to minimise customer load-at-risk;
- A heightened reliance on frequent and sophisticated condition monitoring and maintenance to ensure loading conditions are not impacting design parameters or causing rapid deterioration of the plant;
- Reduced flexibility to access equipment for maintenance or repair;
- Compromised network reliability performance and subsequent GSL payment penalties; and
- Increased operating and capital cost associated with reduced flexibility to access network assets for maintenance; and the requirement for increased strategic spares, particularly high cost items such as regulators, to mitigate the risks of network failure.

8.4 ADVANCES IN TECHNOLOGY

The changing market conditions on the gas network including decrease in demand per customer and penetration rates, coupled with technology improvements and greater customer control in the electricity sector, threatens the competitiveness of gas; in order to develop and remain a relevant energy network future efforts in new technologies and systems need to be developed.

The current focus on energy efficiencies and climate change policy are fuelling advances in new gas fired generation (at a macro and micro level), gas fired air conditioning and more efficient co-generation and tri-generation solutions at both the domestic and industrial commercial level. At a domestic level gas micro-

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generators are being developed in Europe, North America and Asia to assist balancing residential electricity demand. At the industrial and commercial level cogeneration units (cogen) and regeneration units can supply electricity, heating and cooling to aquatic centres, clubs, hospitals to name a few.

As the energy market transitions to clean energy future, there is a place for gas during the transitional period where emission can be reduced by the use of gas fired power generation stations rather than coal. Gas appliances can also help to reduce emissions with highly efficient appliances. There is also the opportunity for renewable gas (Biogas), to enter the market. Biogas is created from biomass which can be captured and utilised as an energy source. The introduction of Biogas has been incorporated into Sydney's Decentralised Energy Master Plan (2012-2030).¹²

At the primary asset level new technology often brings with it significant improvements in functionality and reduced maintenance costs, however asset management strategies must also consider the implications for older equipment that may become unsupported and hence obsolete before the end of their intended service lives.

The benefits of advances in technology in primary asset classes include:

- Increasing reliability through the use of fewer components and improved materials;
- Increasing availability of integrated condition monitoring equipment;
- Reducing need for intrusive maintenance; and
- Aggregation of previously discrete primary assets.

The dominant trend in secondary systems is toward the application of digital technology devices and systems with in-built intelligence and integrated functionality. These digital technology platforms add value by:

- Increasing functionality, reliability and availability through the use of microprocessors, solid-state devices, digital technology and optic fibre-based communication systems;
- Lowering per function costs whilst increasing performance capability;
- Embedding intelligent diagnostic software that optimises operation and improves asset management;
- Rationalising equipment via functional integration and multiple signal processing capability; and
- Providing remote management facilities for network elements based on real-time data communications.

8.4.1 TECHNOLOGY ADVANCEMENT STRATEGIES

The following long-term maintenance strategies are adopted for technology advancement activities on AusNet Services' gas distribution networks.

- Investigate new appliances and material types available to the gas market, ensure they provide benefit to the gas network before implementation;
- Drone Inspection of critical pipelines across network;
- Water extraction and Pipe inspection;
- Portable Gas Storage units, to be utilised on high demand days;
- Trial digital metering to understand the benefits of new meters, and implications of a move towards digital metering.
- Hydrogen network assessment

¹² Energy Networks Australia, Australia's Bright Gas Future (2015).

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9 KEY PERFORMANCE INDICATORS OF THE GAS NETWORK

AusNet Services' Gas Distribution Network is highly reliable; however these high reliability levels can only be sustained currently and into the future with continual maintenance and investment in the replacement, augmentation, and optimisation of distribution assets.

The following key performance indicators (KPI's) represent AusNet Services' expectations of future service levels. These measurements are subject to significant variability determined by many uncontrollable factors including, but not limited to, the following:

- **Environment** – rapid changes in the environment can cause ground movement, leading to cracks in mains; these cracks can be the cause of gas leakage. In terms of the low pressure distribution system, water entry into the network can then occur through these cracks, and this is often the cause of outages.
- **Weather** – in particular, higher rainfall levels have a marked impact on outages caused by more water entering the distribution system (predominantly limited to the low pressure network).
- **Third Party Damage** – many outages are caused by a third party digging into gas mains. AusNet Services seeks to minimise these types of outages through the *Dial Before You Dig* program, and the continuation of onsite asset location provings.
- **High Activity** – restoration of supply times can also be affected by the number of outages experienced at any time, a large number of outages at any one time will lead to longer response times.

AusNet Services' activities are designed to maintain or improve the KPI's in the following sections, however due to the above reasons and as evident from historical performance, some degree of variability around targeted KPIs is to be expected.

The following sections display relevant KPIs to each gas network objective.

1. To maintain network safety in accordance with the Gas Safety Case

- a) Continuation of Mains Replacement Program (Primary)
- b) Mains Leakage rate by pressure tier (Secondary)
- c) Network Leaks – 12 Month Rolling Average (Primary)
- d) Third Party Damages on Mains and Services (Secondary)
- e) Recordable Injury Frequency Rate (Secondary)

2. To maintain operating efficiency performance in the top quartile

- a) Total Factor Productivity (Monitor)
- b) Totex per customer (Monitor)

3. To undertake prudent and sustainable network investment

- a) Capital performance (Monitor)
- b) Unaccounted for gas (Monitor)

4. To deliver valued services to our customers

- a) Unplanned Supply Average Interruption Duration Index (USAIDI) (Primary)
- b) Emergency Response Times (Primary)
- c) Asset Cost per customer (Monitor)
- d) Number of customer complaints (Secondary)

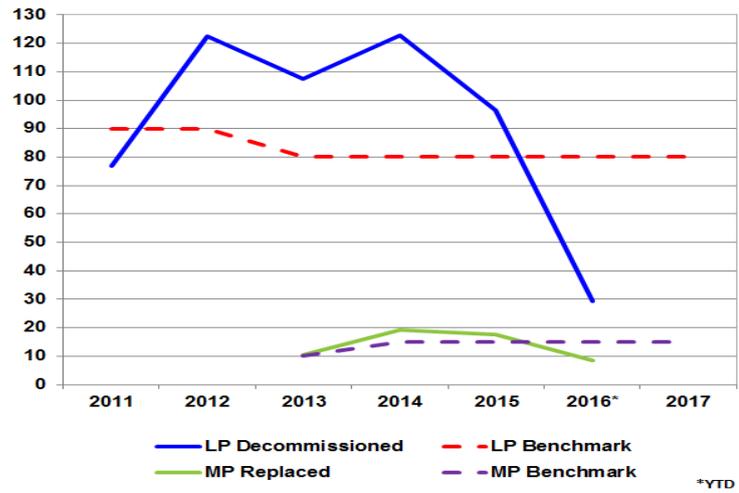
The following network targets align with the gas network objectives. The targets will be reviewed on an annual basis to ensure they are the most meaningful indicator of performance.

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Objective 1: Maintain network safety in accordance with the Gas Safety Case

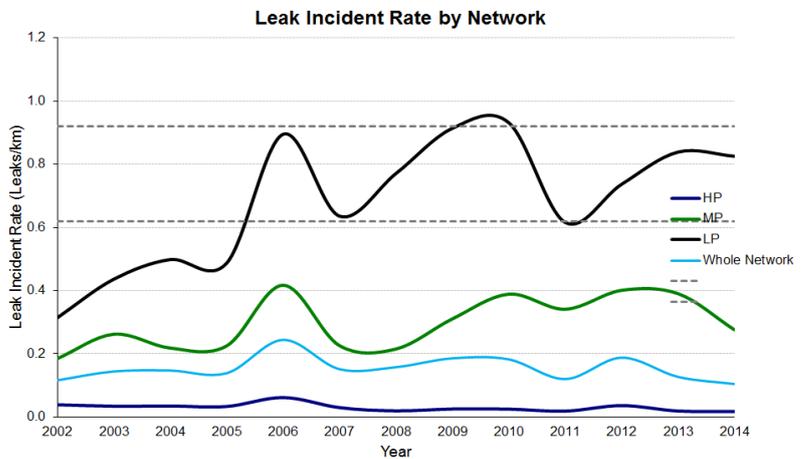
1(a) Proactive replacement of deteriorated mains including low and medium pressure mains replacement (primary)

- Reduce total leaks on network.
- Targets based on internal benchmarks
- 80km LP Replacement
- 15km MP Replacement



1(b) Mains Leakage rate by pressure tier (Secondary)

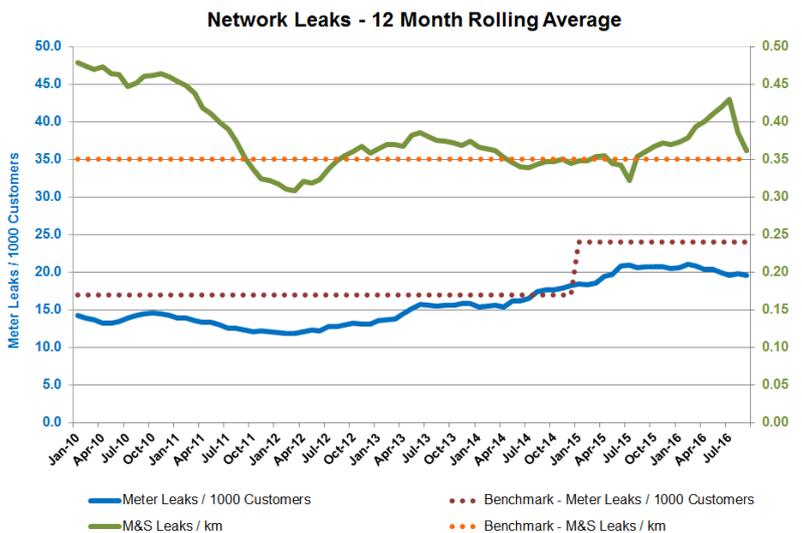
- Benchmark is represented as a band of the highest and lowest leakage rate since 2010. Measures performance of replacement program at each of the network pressures
- Target leakage rates within the identified bands (0.92 and 0.62 Leaks/km)



1(c) Network Leaks-12 Month Rolling Average (Primary)

Target is to minimise leaks on the network, as an indicator of health and safety. Each leak has to potential to cause harm to both property and person.

- Mains and Service leak trend is determined by current 3-year average leak incident rate.
- **Mains and Services leakage rate maintained at 0.35 Leaks/km**
- Meter Leak trend: Determined based on 2016 targets. Program is reviewed with recent failures in regulators.
- **Meter Leak target to be maintained at ≤ 24 Leaks per 1,000 customers.**



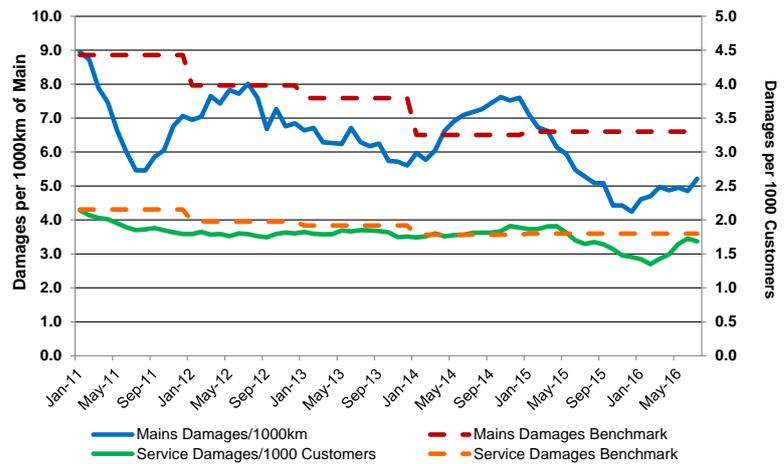
Gas Asset Management Strategy

1(d) Rate of third party damages on mains per 1000km, and services per 1000 connections (Secondary)

- Internal benchmarks are set to maintain current performance

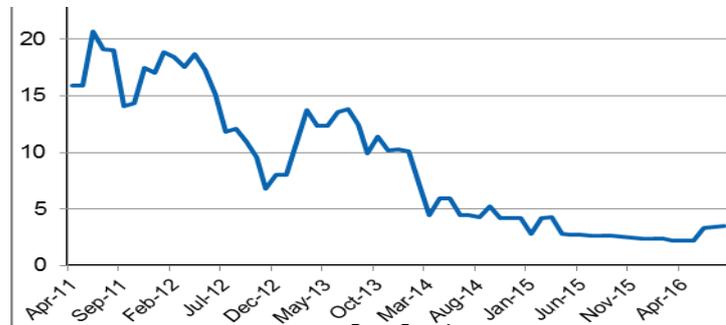
Target: Mains Damages per 1,000 km target ≤ 6.6

Target: Service Damages per 1,000 customer connections ≤ 1.8



1(e) Recordable Injury Frequency Rate (Secondary)

- Monitor trend in gas RIFR

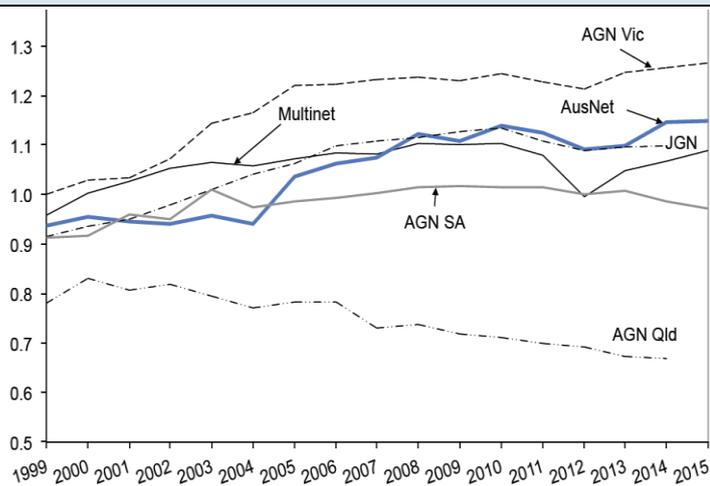


Objective 2: To maintain operating efficiency performance in the top quartile

2(a) Total Factor Productivity (Monitor)

Measure of efficiency of inputs (mains length, services, meters and other capital) to business outputs including customer numbers and system throughput.

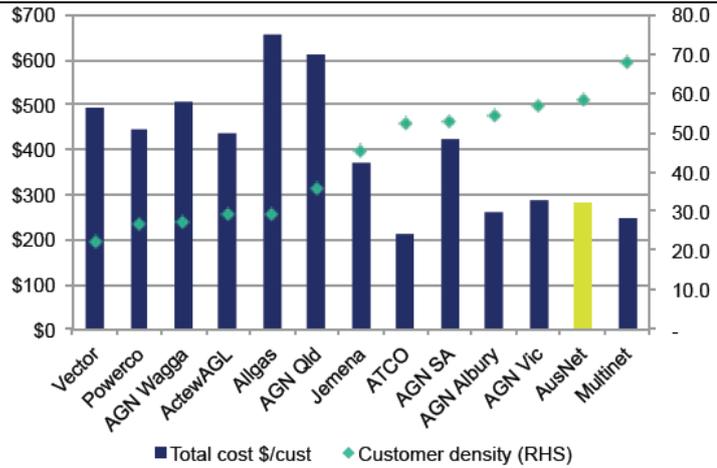
- Target: Maintain current top quartile operating efficiency



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2(b) Totex per customer (2009-2013) (Monitor)

- Maintain operating and capital cost relative to customer density
- Target: Maintain low Totex cost per customer



Objective 3: Undertake prudent and sustainable network investment

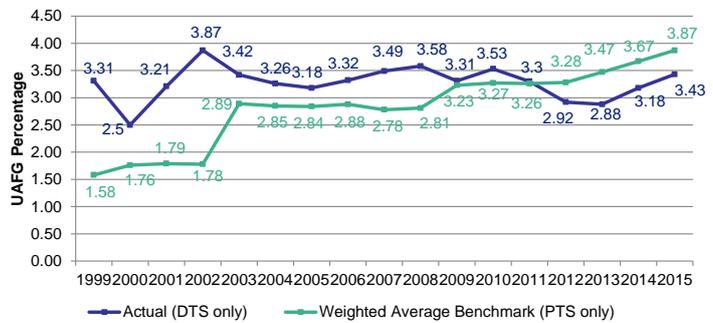
3(a) Capital performance (Monitor)

- Maintain cost to connect customers to network
- Maintain current replacement programs in line with customer numbers

Criteria	Unit rate	Target unit rate (2018-2022)
Gas Customer Connections capex	\$2,280 per connection	<\$2400 per connection
Gas Replacement Capex	\$57 per customer	>\$50 and <\$70 per customer

3(b) Unaccounted for Gas (UAfG) (Monitor)

- Regulatory benchmarks are established by the regulator for each regulatory period. AusNet Services has outperformed benchmarks in the last four years.
- Maintain current rate of performance



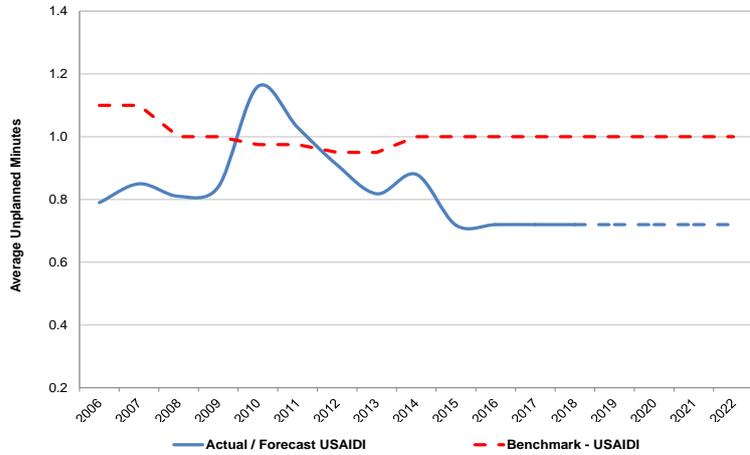
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Objective 4: To deliver valued services to our customers

4(a) Unplanned Supply Average Interruption Duration Index (USAIDI) (Primary)

USAIDI represents the average outage duration for each customer. The gas network is inherently reliable and with this measure primarily influenced by rainfall.

- AusNet Services' customers experience on average a 0.81 minute outage p.a. (2016)
- Internal benchmark is to be maintained at 1 min outage p.a.



4(b) Emergency Response Times (Primary)

Emergency response times are a core reactive safety indicator. Benchmark is set by Energy Safe Victoria (ESV).

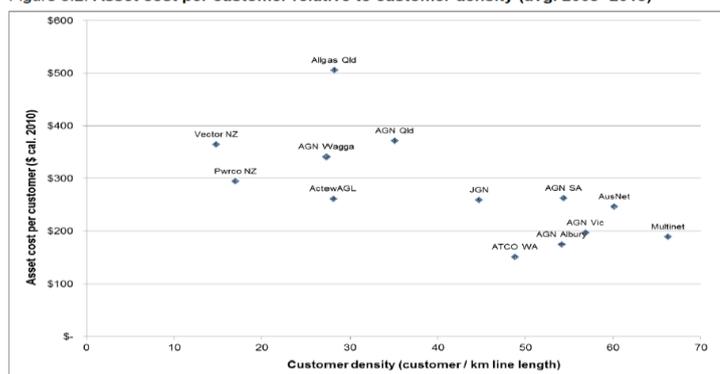
- They are a measure of the percentage of 'Class A' emergencies responded to within 60 minutes
- Tracked on a monthly basis
- Target: Maintain current performance in line with meeting regulatory benchmark

Priority A Response	Benchmark ¹	2010	2011	2012	2013	2014	2015
Metro Business Hours	95%	98%	99%	99%	97%	98%	99%
Metro After Hours	90%	98%	98%	99%	97%	98%	99%
Non Metro All Hours	90%	97%	98%	99%	96%	97%	99%

4(c) Asset Cost per customer (Monitor)

- Benchmark is to maintain low cost per customer

Figure 3.2: Asset cost per customer relative to customer density (avg. 2009–2013)



Source: Economic Insights gas utility database. Asset cost is defined as real revenue minus real opex.

4(d) Number of customer complaints (Secondary)

- AusNet Services expects continuous decrease of customer complaints.

AusNet Services will track its customer service via customer complaints and customer effort (how difficult/easy it was for the customer to obtain a resolution). AusNet Services has had a recent decrease in complaints, after concerted efforts to reduce customer dissatisfaction regarding reinstatement after mains renewals.

Gas Asset Management Strategy

10 PROCESS AND SYSTEM STRATEGIES

The objective of this section is to provide an overview of the major processes and system strategies required to manage AusNet Services' gas distribution network for the achievement of network objectives.

10.1 RISK MANAGEMENT APPROACH

AusNet Services operates a corporate Risk Management Framework¹³ that utilises the principles of Australian Standard AS/NZ 4360:2004 and AS/NZ ISO 31000 *Risk management – Principles and Guidelines, 2009* to assess a range of business risks under the following categories:

- Financial;
- Regulatory;
- Safety;
- Environmental; and
- Corporate Image.

By adopting common metrics across the broad range of business risks and investment portfolios, AusNet Services can more effectively manage business risk and optimize network outcomes and objectives.

AusNet Services' Risk Management Policy and Framework (RM 001-2006) sets out the overarching philosophy, principles, requirements and responsibilities for a sound approach of risk oversight, management and ongoing internal control assurance required within AusNet Services. The Framework addresses the following:

- Governance and responsibilities;
- Risk management principles and methodology;
- How AusNet Services assesses and manages risk; and
- How AusNet Services monitors and reports on risk.

10.1.1 RISK RANKINGS FOR EACH ELEMENT OF THE GAS DISTRIBUTION BUSINESS

As part of AusNet Services' Gas Safety Case, a Formal Safety Assessment (FSA) has been carried out consistent with the Gas Safety Act 1997 and the Gas Safety (Safety Case) Regulations 2008 in order to assess risks associated with AusNet Services' gas distribution network, as defined within the Facilities Description and Safety Management System Overview (GSC 10-01) which forms part of the Safety Case documentation.

Refer to AusNet Services' Safety Case and FSA for a complete list of identified risks.

Within the gas distribution network, all identified risks are contained within acceptable limits. However, action plans to further mitigate the greater risks are in place or planned over the next 5 years. An example being the risk associated with leakage from cast iron and unprotected steel mains, which have driven the need for annual mains renewal programs on AusNet Services' low and medium pressure networks.

10.2 GAS SAFETY CASE

Safety Legislation requires gas network businesses to lodge a Gas Safety Case (GSC) Management System with ESV. AusNet Services' GSC for the forthcoming regulatory period was accepted by the ESV for approval in May 2010. The revised GSC was submitted in 2015, and is currently being reviewed by the ESV.

¹³ RM 001-2006 Risk Management Framework, 2007, AusNet Services.

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The Gas Safety Case provides a road map to the systems AusNet Services has in place to manage the safe operation of the natural gas transmission, distribution and LPG networks. The document:

1. Describes the AusNet Services gas network;
2. Identifies the hazards and risks faced by the network; and
3. Describes the Safety Management System in place to ensure identified risks are managed to a level that is As Low As Reasonably Practicable (ALARP).

The GSC meets the requirements of the Gas Safety Act 1997, Version No. 34, effective from 13 December 2009.

The AMS has been prepared with regard to the latest GSC requirements, and is intended to facilitate AusNet Services' compliance with those requirements.

10.3 ENVIRONMENTAL MANAGEMENT

AusNet Services is committed to responsible environmental and resource management through its ISO 14001 accredited Environmental Management System (EMS).

10.3.1 GREENHOUSE EMISSIONS

AusNet Services directly and indirectly emits greenhouse gases in its day-to-day activities. These emissions – principally methane and carbon dioxide – are associated with losses incurred in the transport of gas through our network, primarily as a result of leaking pipes.

AusNet Services has a number of action plans in place to reduce the level of greenhouse gas emissions. These include:

- Gas main replacement;
- Network augmentation programs;
- Electronic pressure control on major regulating stations; and
- NGRS reporting.

10.3.2 PIPELINES AND THE ENVIRONMENT/CULTURAL HERITAGE

Before the construction and commissioning of pipelines, AusNet Services conducts a range of environmental studies along the pipeline route and adjacent areas to:

- Establish characteristics, values and level of significance of the area;
- Identify key environmental issues and potential impacts on the area; and
- Devise methods and management practices to mitigate potential impacts on the area.

10.3.3 ASBESTOS

The *Occupational Health and Safety (Asbestos) Regulations* (2003) requires strict work methods for removal of asbestos from the workplace as well as stringent requirements when working with asbestos-containing materials. Environmental Protection Authority (EPA) guidelines detail transport and disposal requirements.

Asbestos has been identified at a number of the former TLPG (Tempered Liquid Petroleum Gas) and coal gas production sites. The asbestos is found in some wall and roof cladding. The material is deemed safe and has been labelled and recorded in the AusNet Services asbestos register. The demolition and land remediation will encompass the safe removal of the asbestos.

10.3.4 LAND CONTAMINATION

Eight former gas works sites in western Victoria, from which only three remain, have been identified as having contaminated soil, arising from historical production of town gas from black coal prior to AusNet Services' purchase of the business.

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An environmental management plan was put in place in 2001 to monitor site conditions and manage the risks posed by each site. The status of each site is summarised in the table below.

Table 5: Status of decontamination work at former gas works sites

Site	Status
Colac, Horsham, Castlemaine ¹⁴	Sold – Site no longer owned by AusNet Services
Stawell	EPA inspection / signoff completed. Awaiting sale.
Ararat	Remediation and clean-up work completed, waiting on EPA inspection / signoff
Portland, Warrnambool, Hamilton	Awaiting remediation

10.4 CONDITION MONITORING

10.4.1 OVERVIEW

AusNet Services manages the condition of its assets through:

- Real-time data acquisition and recording (via SCADA);
- Leakage surveys, leak reports, and UAfG monitoring;
- Asset inspection programs and corrosion surveys; and
- Gas quality monitoring, including management of oil-in-gas issues.

These various condition-monitoring activities are outlined below.

10.4.2 REAL-TIME DATA ACQUISITION AND RECORDING (SCADA)

AusNet Services uses a Supervisory Control and Data Acquisition (SCADA) system to monitor and control assets across the network from the transmission system to the network fringe. The SCADA system provides data on the real-time performance of the assets, and data for long-term evaluation of gas demand and network performance to identify potential system deficiencies.

Section 11.7 SCADA (pg. 78) of the AMS provides an overview of AusNet Services' Gas SCADA network, including the capital plans to extend network coverage to provide complete real-time visibility of networks.

10.4.3 LEAKAGE SURVEYS

AusNet Services has a risk based leakage survey methodology that focuses leakage survey efforts to the areas of highest risk. Currently, all mains in locations of high risk are surveyed on an annual basis. Transmission pipelines, internal services and high-risk special crossing (e.g. railway line crossing) are also surveyed on an annual basis. Cast iron mains are subject to spot surveys when monthly leakage rates within a postcode exceed pre-determined levels. The Technical Standard TS-5201 Leakage Survey outlines AusNet Services' leakage survey methodology.

All leaks are assessed by field crews (Class 1 or Class 2) and if deemed hazardous are repaired before the next leakage survey cycle. Class 2 leaks on mains identified within a proposed (i.e. to be completed in the coming 18 months) mains replacement program are periodically monitored to ensure the leak does not deteriorate outside of acceptable limits.

All public reported leaks are considered Class 1 and are immediately attended to.

¹⁴ Binding contract of sale entered into by AusNet Services and developer with specific details of settlement times to be determined.

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10.4.4 PUBLICLY REPORTED LEAKS

Publicly reported leaks are captured through the AusNet Services' emergency response system (i.e. PowerOn). A response team is sent out to assess the leak and leak information is then entered into the SAP system in a similar manner to survey results. This means that important leaks are addressed immediately and also factored into AusNet Services' pipe replacement and future leakage survey programs.

10.4.5 UNACCOUNTED FOR GAS (UAFG)

UAFG is the difference between the amount of gas injected into the Distribution System and the amount of gas withdrawn by Consumers. The level of UAFG is influenced by, amongst other things, meter inaccuracies and theft.

Refer to Section 10.13 *Unaccounted for Gas* of the AMS for further details on AusNet Services' UAFG Strategy.

10.4.6 REGULATOR INSPECTIONS

AusNet Services has a number of different regulators for city gates, field, district and residential purposes. These are inspected regularly, and inspection information collected in SAP (see Table 6) for a description of the SAP system). This data is analysed to identify any adverse performance trends to inform decisions about models purchased and maintenance/replacement programs. Pressure records from regulators with chart recorders (showing the inlet and outlet pressures of the unit) are also collated weekly.

Refer to Sections 11.2 *Regulating Facilities – Network* and 11.3 *Regulating Facilities – Consumer* of the AMS for further information on AusNet Services' management of regulating facilities.

10.4.7 SURGE PROTECTION/CORROSION SURVEYS

Electrical surge protection is placed on steel pipes to minimise the risk of electrical discharge through the steel pipe system. All surge protection devices are inspected annually and specialised devices have additional testing every five years.

Surveys are performed on protected steel pipes to assess corrosion protection levels every:

- Six months for high-risk areas (e.g. transmission pipe and stray current zones); and
- Twelve months for low risk areas.

The surveys measure the performance of the corrosion protection unit by checking the voltage resistance of the pipe through a test point, which are situated approximately every kilometre along the pipe route. This information is collected by the corrosion investigator and used to develop a corrosion protection upgrade program targeting the worst affected areas first.

Refer to Section 11.6 *Corrosion Protection* (pg. 76) of the AMS for further information on AusNet Services' corrosion protection strategy.

10.4.8 GAS QUALITY MONITORING

AusNet Services' gas quality monitoring is primarily concerned with odorant checks to ensure enough odorant is present to allow leaks to be detected by the public. However, some areas of the network have suffered from oil contamination originating from upstream plant passing into the system. This oil contaminates downstream assets including field/district regulators, commercial regulator/meter assemblies, gas/burner control trains, and safety equipment on Type B appliances (where excessive oil can cause 'flame-outs'). Some major customers are affected, particularly high use Tariff D consumers at end points of the network in Ballarat and Geelong.

A Liquids in Gas Strategy (30-2507-19) has been developed to:

- Address specific safety issues identified pertaining to oil contamination;
- Monitor the causes of gas contamination to identify safety issues and areas for improvement;
- Obtain more accurate information from parties suspected of causing the contamination as to the amount of oil currently in the system and how much is continuing to be released into the system; and

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- Maintain consumer and other stakeholder confidence in the integrity of the gas distribution system, including provision of technical expertise to major customers with identified problems.

The long-term strategy for liquids in gas includes the following:

- Chemical analysis of oil found in the distribution system to identify source, and mapping of networks to identify known problem areas;
- Installation of Coalescers to affected major consumers and city gates; drainage of oil from siphon points (including affected meter regulator sets) and recording the volumes of oil drained;
- Liaising with APA GasNet regarding pigging schedules, and undertaking combined risk assessment and contingency planning before pigging is undertaken;
- Conducting regular, detailed briefing sessions with major consumers and retailers; and
- Develop gas flow velocity profiles of the network, and continuing research into oil flow characteristics and suitability of various entrapment methods and devices.

The incidence of oil in gas in the networks has significantly reduced in recent years, due to improved manufacturing at the injection points, and improved operations on the transmission network.

10.5 OPERATIONS MANAGEMENT

The operation of the overall system and of individual assets is a key part of asset management to ensure that system performance targets are achieved, the integrity of the assets is not compromised, and safety and environmental requirements are met.

AusNet Services determines its operational requirements by reference to industry best practice, and by introducing incremental refinements to established programs as a result of accumulated knowledge of the asset base.

An overriding principle is to ensure that operational staff have access to systems that can provide them with relevant information in a format that assists them to make timely and accurate decisions.

The following strategies will provide improved operation of the network:

- Implement key SCADA system improvements including:
 - Continue to develop enhanced pressure management systems to better protect and respond to energy and network demands; and
 - Implement Distribution Management systems that provide real time monitoring, management and optimisation tools such that network components can be more effectively monitored for failure and better predictive actions;
- Maintain and enhance plant operating thresholds and schedules to assist network controllers;
- Outage management system to be integrated with asset management systems and Geographical Information Systems (GIS);
- Field mobility for data collection and validation;
- Continue to optimise the timing of the planned outages of assets using the maintenance management and network management systems;
- Further development of 'SMART network and metering' techniques;
- Continue to enhance and develop the direct contacting of customers during network pressure issues;
- Regular review of all current operational procedures to ensure they remain relevant with the introduction of new technologies; and
- Continue to enhance and ensure that the backup Control Room (i.e. the Customer & Energy Operations Team) and back up Data Management Centre are regularly tested.

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10.6 CONTINGENCY PLANNING

AusNet Services has developed a Gas System Contingency Plan (AMS 30-05) to support the recovery from incidents adversely affecting the performance of AusNet Services' gas system. Such incidents may result from plant failure, natural events or deliberate actions by individuals or groups.

Effects from isolated intentional attacks on physical facilities are only marginally different from those of natural events. This analogy applies to the nature of the damage inflicted and to the ability to begin repair operations.

As each emergency may be different in size, duration, and impact, the systems contingency plan provides an initial response, and is aimed at bringing the emergency under control by:

- Managing the immediate cause of the emergency;
- Identifying the parts of the system affected by the emergency; and
- Identifying and allocating appropriate resources to ensure the continued operation of the system assets.

10.7 SKILLS AND HUMAN RESOURCES MANAGEMENT

Maintaining adequate numbers of skilled employees in the future is an important aspect of maintaining the knowledge that underpins AusNet Services' asset management activities.

To maintain the availability of relevant skills for business operations, a steady effort of recruitment and training is required. The development and maintenance of gas-related competencies by both staff and contractors is strategically important to mitigate risks and ensure the continuing safety and integrity of the gas distribution network. To achieve this, AusNet Services actively facilitates the training and subsequent compliance auditing of relevant competencies across the industry's workforce. This activity also ensures compliance with AusNet Services' obligations as set out in the Gas Safety Case.

A broad set of national gas industry competencies have been established. These are set out in the 'Gas Industry Training Package – Competency Standards Index' (also referenced in the Victorian Natural Gas Construction and Maintenance Competency Guidelines).

AusNet Services has a close relationship with E-Oz Energy Skills Australia and is a financial member and active contributor to the national gas industry training regime.

AusNet Services utilises these nationally recognised competences and requires its contractors to do likewise, also to comply with company-specific requirements when working on AusNet Services assets. Staff and contractors are trained by a registered training organisation in these competencies. Personal Development Plans (which reference these competences where relevant) are formulated for each AusNet Services' employee on an annual basis, and are reviewed and updated every six months.

10.8 CUSTOMERS

The Gas Distribution System Code specifies the minimum standards for connection and disconnection of customers to AusNet Services' distribution network. In summary, AusNet Services must, upon request and within specified time periods, connect a customer to the distribution network if it complies with regulatory requirements and on fair and reasonable terms. In essence, standard residential connections with existing infrastructure passing the property are connected without charge (from AusNet Services) to the customer. Connections that are not as straight forward are assessed utilising a 'Customer Contribution Model' to calculate a connection charge based on the cost of augmentation relative to expected future revenues to AusNet Services.

Capital Expenditure (CAPEX) Prioritisation

AusNet Services operates an overall capital governance process designed to ensure the objectives of customers, regulators, owners, and other stakeholders are met as efficiently as possible.

Selection of capital projects and programs into the company wide portfolio of projects is the prime responsibility of the respective business portfolio. The selection is aided by the prioritisation methodology and process, which is managed by EPMO.

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The prioritisation model has been designed to capture, per project, the answers to a set of criteria which are consistent across the network. The capture of these responses is incorporated in SAP – Portfolio Performance Management.

For each portfolio, the outcome of running the model is to provide a list of projects which are ranked in order of priority based on the scores of each project in that portfolio. These lists can be produced as required to support business planning and price reviews. The list produced from the model will form the basis of discussion by relevant stakeholders to ensure that an agreed prioritisation list of projects is balanced and meets business objectives efficiently.

The selection criteria are as follows:

- Stage 1 (criteria 1 and 2) is a gate which considers the level of discretion and the level of commitment. Projects which have already commenced or are mandatory to commence due to their nature (e.g. safety, regulatory obligations etc.) are given the highest possible ranking, at this point, and
- Stage 2 (criteria 3-7) contain five criteria which are used subsequent to stage 1's prioritisation to further rank projects with consideration of Strategic Alignment, Technical Assessment, Certainty of Benefit Realisation, Risk Reduction and Financial Return.

This capital governance process ensures that the overall level of capital is adequate to achieve an appropriate set of outcomes for customers and other stakeholders, and that CAPEX is explicitly managed in the most efficient manner.

NETWORK MAINTENANCE

GENERAL OVERVIEW

Routine maintenance is the regular day-to-day operations necessary to keep assets operating safely and reliably. AusNet Services categorises maintenance work in five areas:

- **Scheduled Maintenance:** preventative maintenance work carried out to a predetermined schedule (e.g. regular overhaul of city gates, field regulators and district regulators, lubrication of valves).
- **Condition Monitoring Maintenance:** work carried out at a predetermined frequency (e.g. inspection of cathodic protection systems, leakage surveys, checking access to valves).
- **Unplanned Maintenance:** work carried out in response to reported problems or defects (e.g. pipe failure causing leakage, mechanical failure).
- **Site Management:** maintaining the site in a clean, functional, safe and visually acceptable condition.
- **Damages:** repairs to assets (i.e. services and mains) damaged by third parties.

Most plant is checked at fixed time intervals. For example operational checks are conducted biannually on all city gates and field regulators, and annually on district regulators and line valve installations on transmission pipelines. AMP 30-02 Gas Maintenance Plan details the unplanned, condition monitoring and scheduled maintenance activities for each asset class, referencing the particular AusNet Services' Technical Standard or Field Procedure to which the work is to be performed.

HISTORICAL PERFORMANCE

Over the 2002-2012 period, Reliability Centred Maintenance (RCM) analysis was applied to a number of the maintenance applications with the biggest impacts made in changes on maintenance frequencies. These were applied on regulator station maintenance (i.e. City Gates, Field Regulators, and Industrial and Commercial installations), leakage survey methods, leak repair criteria and potential surveying of CP protected steel distribution pipelines.

Mains and services leak repairs amount to approximately 30% of total maintenance expenditure. Older cast iron and bare steel pipes in the inner suburban low-pressure areas generate the majority of the leaks and subsequent expenditure. These pipes are the primary contributors to water ingress and gas supply problems that occur on the network.

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Small domestic regulators passing up to 10 m³/hr, have no preventative maintenance and are replaced on failure. Approximately 6,000 or less than 1% of small regulators fail each year.

AusNet Services uses a number of strategies (post-commissioning) to reduce the occurrence of damage to assets including:

- Daily patrol of transmission pipelines;
- No Go Zone;
- 'Dial Before You Dig';
- 'Hot spot' patrolling;
- Work Permit system;
- Use of inspectors when working within 3 metres of transmission pipelines;
- Marker-posts;
- Installation of tracer wire, marker tape and protective slabbing; and
- Easement landowner visits.

METHODOLOGY USED TO DEVELOP MAINTENANCE PROGRAMS

AusNet Services determines its maintenance activities by reference to industry best practice, and by introducing incremental refinements to established programs as a result of accumulated knowledge of the asset base. From time to time these schedules are revised to cater for external changes (e.g. new legislation) or reviewed from a zero-base (e.g. application of Reliability Centered Maintenance to maintenance schedules).

Maintenance programs are established to minimise the total lifecycle cost of the asset, taking into account the risk and consequence of failure.

MAINTENANCE FORECAST

Reactive maintenance activity is forecast to reduce in the next 10 years on a per connection basis due to the targeted capital investment planned for the network, particularly the mains replacement program. This investment will result in a reduced number of leaks that AusNet Services must action, and reducing the number of activities associated with visits to regulators. This however will not reduce overall maintenance due to growth on the network.

As the network grows, so does the number of assets needing maintenance and repair from third party damages. Based on planned renewal rates, AusNet Services' Low Pressure network will be removed by 2025, which is also the expected turning point where network expansion maintenance will exceed the reduction in maintenance improvement programs. However, this increase is offset by the average cost of maintenance per customer, which is expected to decline as the network expands through contiguous growth.

MAINTENANCE STRATEGIES

The following long-term maintenance strategies are adopted for maintenance activities on AusNet Services' gas distribution networks.

- Continue to apply and further refine risk-based and RCM approach to maintenance;
- Add minor assets (services, meters and regulators) to the Asset Management Systems and instigate RCM analysis to optimise CAPEX and OPEX;
- Further ease the possibility of asset damage by:
 - Education sessions to construction industry associations;
 - Information brochures to councils;
 - Promoting *Dial Before You Dig* via plant and equipment hire companies;
 - Media advertisements.

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CONTRACTOR MANAGEMENT

OPERATIONS & MAINTENANCE CONTRACT

In April 2013, AusNet Services' operations, maintenance and minor capital contract was outsourced under a 5 year (5 years + 1 year extension for five years if targets are met) contractual arrangement. The structure of the agreement aims to better align contractor incentives to continually improve network and operational performance. The revised contract underwent a competitive tender process with the contract awarded to Downer as the best compliant and commercial offering.

The agreement is a unit rate contract where the contractor is paid monthly for units completed. These units include such activities as searching for escapes (subsequent to a public report of smell of gas), conducting leakage survey, repairing mains and other standard maintenance activities. Within this contract AusNet Services' primary service provider also provides the majority of customer connections works, these are standard connections in terms of laying mains and services. For larger developments the connection work is generally referred to the capital works tender panel.

Ongoing contract performance is monitored and controlled via KPIs, which are regularly reviewed to ensure the contractors' performance continues to be consistent with AusNet Services' businesses objectives.

10.8.1 MAJOR CAPITAL WORKS

Major capital works projects typically have a value of over \$100,000 and are awarded to successful applicants pursuant to the Installation Service Provider (ISP) or capital works agreement. The ISP Panel consists of 5 panel members appointed for a 5 year period (3 + 1 + 1) ending on 31st March 2017. Panel members have been selected based on an assessment process where their safety, competitiveness, quality, delivery record and financial viability are assessed, and their performance against these variables determine whether their term on the panel is extended.

Individual projects are periodically released to the panel members, who are invited to bid competitively. Following an appraisal and approval process, the works are awarded to the successful panel member. Projects are typically negotiated to be delivered within a set timeframe and are subject to fixed price agreements to transfer price risk to the service provider. AusNet Services' internal resources focus on the core functions of project planning, overall project delivery and contract management.

AusNet Services' contracting approach benefits AusNet Services and our customers by:

- appropriately balancing the use of internal and external resources;
- utilising market expertise and intellectual property;
- securing lower prices by requiring panel members to compete for work;
- obtaining economies of scale by ensuring that panel members expect to deliver appropriate volumes of work; and
- Ensuring high quality and timely project delivery through effective monitoring of performance.

10.9 INFRASTRUCTURE SECURITY

Commonwealth and State governments have imposed legal responsibilities on both the owners and operators of critical gas infrastructure and to take all necessary preventative security measures to ensure continuity of supply.

The five main security threats to the gas distribution network are:

- **Safety** – of untrained persons in the vicinity of energy-containing equipment;
- **Malicious** – motivated by revenge, fame, association or challenge;
- **Criminal** – profit driven; includes theft, fraud, sabotage or extortion;

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- **Terrorism** – threat or use of force to influence government or public through fear or intimidation,¹⁵ and
- **Accidents or natural disasters** – that breach secure perimeters and/or cause security protections to fail.

The Infrastructure Security Risk Assessment Tool (ISRAT) is used to assess physical security risks and control measures in AusNet Services' installations. The Infrastructure Security Strategy is informed by more than 50 individual assessments, of major sites, and 20 generic assessments for the multiplicity of less significant installations. These assessments are enhanced by a representative sample of physical inspections by qualified and competent Security Risk Management practitioners that validate the ISRAT findings.

AusNet Services' physical security control measures are founded on the following principles:

- Consistent risk identification and quantification;
- Defence in depth – increasing the number and sophistication of control measures commensurate with the degree of intrusion risk;
- Deterrence – measures including signage, lighting, site attendance, law enforcement awareness training (leading to patrol attendance) and more to deflect would-be intruders towards other targets;
- Delay – measures including locks, fences, barbed wire and lighting to increase the time and effort required to successfully intrude;
- Response – Mobile Patrol and Security guarding measures to promptly and appropriately deal with intruders and associated consequences; and
- Contingency planning – measures to promptly recover service and minimise societal impact.

AusNet Services' Infrastructure Security Policy (AMS 20-14) covers all high risk installations across AusNet Services' three energy networks, inclusive of City Gate regulating facilities.

SPIRACS (AusNet Services' Integrated Response and Contingency System) contains detailed instructions to inform and instruct a person tasked with managing security at any impacted sites to do so competently and comprehensively.

AusNet Services' Corporate Security Policy details an organisation-wide approach to security preparedness and, amongst other things, provides a detailed framework for the application and administration of access control protocols dictating staff access to sites.

10.10 ASSET MANAGEMENT DATA & INFORMATION SYSTEMS

AusNet Services manages asset-related data in a series of specialist systems.

The table below provides a summary of such systems. Each system is operated by internal specialists and supported by internal software owners or expert contractors. Daily system backups to a remote site provide disaster recovery capability. All systems can be operated remotely.

¹⁵ A 'terrorist act' is an act or threat intended to advance a political, ideological or religious cause by coercing or intimidating an Australian or foreign government or the public; causing serious harm to people or property, creating a serious risk of health and safety to the public, disrupting trade, critical infrastructure or electronic systems - *Criminal Code Act 1995* [Commonwealth].

Gas Asset Management Strategy

Table 6: AusNet Services' Gas Business Systems

System	Function
AREVA	Monitoring and Remote operation of gas facilities
Spatial Data Management Gas	SDMG is AusNet Services' vehicle for accessing and maintaining network system connectivity, and spatial asset location data. SDMG operates on the GE GIS application.
AutoCAD	Drawing application used for storing detailed information on assets.
SAP	Asset maintenance management system. All network assets (except meters) are registered in Q4, together with their operations, inspection, and maintenance records. Q4 produces programmed maintenance work instructions, based on age or condition, with scheduled due dates.
SAP	Project initiator, generates project number and expenditure authority documentation.
GRR	Gas Regulatory Reporting, automated KPI reporting.
Hansen Hub	Customer data management system used to track and record meter information.
Objective	Drawing viewing software.
SAP	Financial management system.
SAP	Project tracking database (Scoping, Business Case, Approval, Delivery and In Service data and key dates).
PI	Transmission and distribution information repository for SCADA history.
PowerOn	Connection point management system used to manage and store supply fault information and outage management.
PowerOn Web	Connection point management system used to manage all service order work and to log fault calls.
SAP	Enterprise-wide software system which incorporates AusNet Services' key business functions encompassing Finance, Assets, Human Resources, Service Delivery, etc.
SCADA Web	Real Time SCADA desktop monitoring.
Stoner/SynerGEE	Network planning model used for design of network capacity.

Gas Asset Management Strategy

10.11 DATA MANAGEMENT

AusNet Services has recognised the need to “transform” to become a more customer focused and process driven organisation. With the implementation of SAP into the business there is opportunity to:

- Enhanced understanding of asset management capability;
- Refinement and streamlining of processes and systems;
- Improve operational efficiency and effectiveness of the business;
- Transform AusNet Services’ cost base to a more competitive and sustainable level; and
- Improve customer experience in dealing with all aspects of the AusNet Services’ business portfolio;

10.12 NETWORK CAPACITY

AusNet Services has an obligation to various regulatory authorities to use all reasonable endeavours to maintain sufficient distribution system pressures consistent with the Gas Safety Case (this being compliant with the Gas Safety Act and Gas Safety Regulations) and the Gas Distribution System Code.

AusNet Services’ annual augmentation program, which includes network reinforcements resulting from expectations of both customer numbers and throughput, is required to create new assets, or upgrade the capacity or functionality of existing assets to achieve appropriate outcomes for customers and other stakeholders.

Network augmentation includes:

- Installation of new supply and reticulation mains;
- Upgrade of existing regulating and metering facilities, including auxiliary equipment;
- Installation of new regulating and metering facilities, including auxiliary equipment; and
- Installation of future supply mains as an enabler for network growth.

The Gas Network Capacity Strategy (AMS 30-17) outlines the augmentation required on AusNet Services’ distribution and transmission assets required to meet its regulatory obligations.

10.12.1 DRIVERS UNDERPINNING NETWORK AUGMENTATION

Demand on AusNet Services’ gas network is forecast to remain reasonably stable over the next five years, with customer growth expected to compensate for lower consumption per capita. With strong population growth in Melbourne localities such as Hume, Melton and Wyndham and regional areas such as Bendigo, Ballarat and Geelong, overall customer growth is forecast to increase by an average of 2.1% to 2022. On the other hand, smaller housing, energy efficiency and the increasing competitiveness of electrical appliances is expected to reduce residential consumption per household by 1.7% per annum over the same period. The combination of customer growth and lower demand per customer is projected to result in Tariff V demand increasing by 0.6% in the next five years.

10.12.2 HISTORICAL NETWORK PERFORMANCE

Overall asset utilisation is moderating due to an overall decrease in demand across the network. Demand forecasts are expected to increase by 2% in the next five years. Growth corridors are subject to high demand due to high volume of connections; areas including the surf coast have suffered poor supply. Works are in place to ensure that demand is met in the growth areas of concern.

10.12.3 METHODOLOGY USED TO IDENTIFY NETWORK REINFORCEMENT

AusNet Services’ distribution networks are continually expanding due to residential growth, and commercial and industrial development. To manage this, continued planning and management is undertaken with the aid of computer-calibrated models that predict the operation of the networks in the field. Models are based on 1-in-2 winters peak day (also known as a 14.60 Effective Degree Day). This standard is based on the system coincident peak day with a 50% probability of exceeding this value in any given year.

Gas Asset Management Strategy

Modelling of forecast gas consumption often indicates the need for future augmentation to the networks to ensure the security of supply and maintenance of fringe pressures in accordance with the Gas Safety Case and the Gas Distribution System Code. AusNet Services' Network Planning group identifies necessary augmentation by simulating forecast growth and demand, which in turn determines the appropriate timing of individual projects.

A major input to augmentation planning is the winter testing program – i.e. a detailed pressure monitoring program conducted at selected locations across the network during peak load conditions. Winter testing data is analysed and used to ensure the accuracy of network models, as well as to identify required reinforcements to ensure that network fringe pressures remain above required minimum levels – even in peak load conditions

Network models are validated on a periodic basis or as required (i.e. following a major augmentation project on a network). Document AMS 30-14 Gas Network Planning – Winter Testing defines the criteria for prioritising and selecting networks for winter testing.

Table 7: Minimum Network Pressure – Gas Distribution System Code

Network Pressure	Minimum Obligated Pressure
High Pressure	140kPa
Medium Pressure	15kPa
Low Pressure	1.4kPa

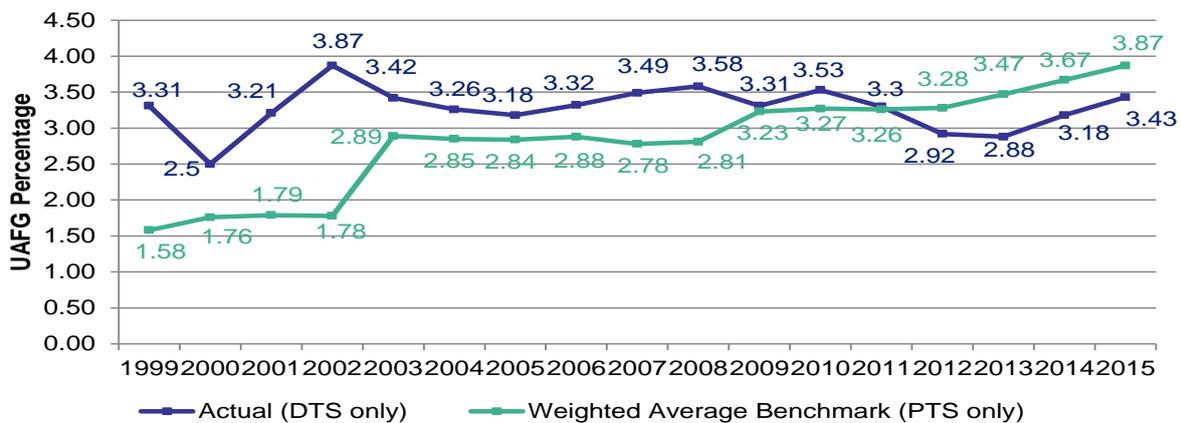
Source: Gas Distribution System Code, Version 11, Schedule 1, Part A

10.13 UNACCOUNTED FOR GAS

Unaccounted for Gas (UAfG) refers to the difference between the measured quantity of gas entering the gas distribution system and the amount of gas used by consumers. UAfG can arise because of leakage from the system, metering errors, theft, inaccuracy in the conversion from quantity of gas measured to energy (reflecting discrepancies in temperature, pressure, heating value, altitude or the gas compressibility factor), and a number of other minor causes.

AusNet Services' Gas Distribution Network is subject to a UAfG incentive mechanism set by the ESC. The benchmark data can be found in Schedule 1 Part C of the GDSC (Version 11). In 2012, AusNet Services obtained a favourable UAfG result (for the first time in over a decade), with the actual UAfG being less than the benchmark; shown in Figure 13.

Figure 13: Unaccounted for Gas – 2006-2015



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Retailers pay the difference of the metered consumption and the UAfG benchmark. As a result the Distributor carries the risk of meeting the UAfG Benchmark. If the benchmark is exceeded (i.e. unaccounted for gas is more than allowed), AusNet Services pays retailers for the excess volume of gas at prevailing market rates. The opposite occurs if UAfG is below benchmarks.

In 2011 AusNet Services commissioned an independent consultant to conduct an in-depth analysis to gain a better understanding of the drivers of UAfG to enable a focused effort to out-perform the benchmark.

A key finding is that:

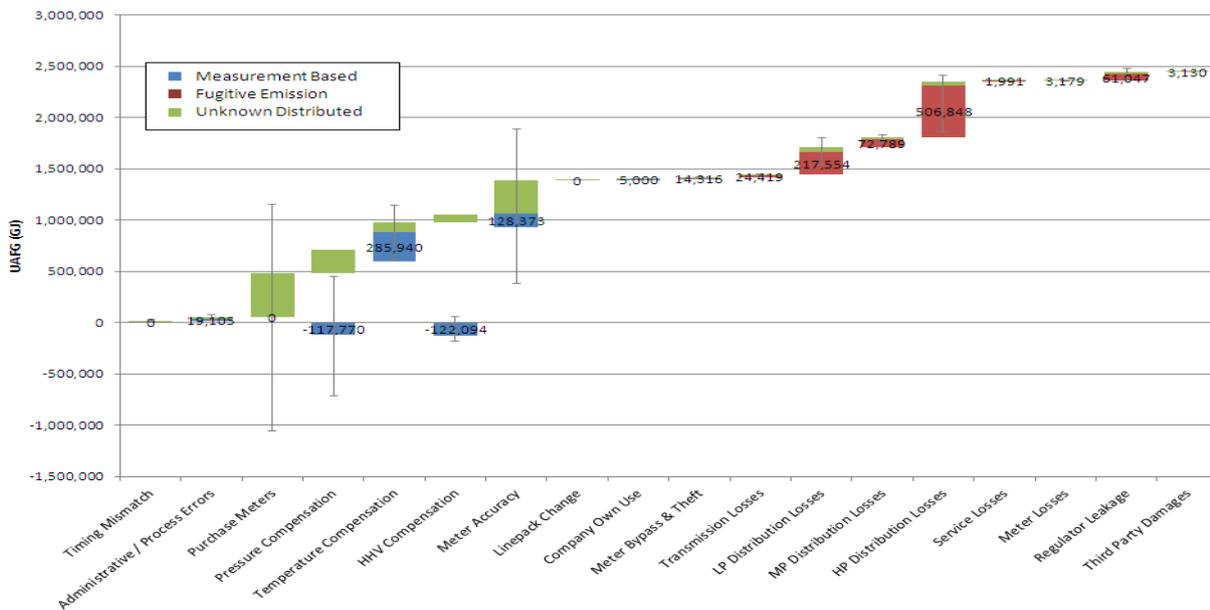
“The estimation of UAfG to each category results in 54% of actual UAfG not attributed to any category. This emphasizes the uncertainty associated with UAfG.”

Noting that fugitive emissions are often incorrectly referred to as UAfG (as UAfG also includes measurement based errors) the report grouped the components into two sub categories:

1. Measurement Based UAfG; and
2. Fugitive Emissions.

Each component was then assessed for its expected UAfG contribution together with the uncertainty limits stemming from the assumptions used in each calculation. Each component of UAfG, together with its uncertainty (represented by error bars) is shown in Figure 14.

Figure 14: UAfG Components and Uncertainty¹⁶



Moving forward AusNet Services plans to focus on the following components.

- **Purchase Custody Transfer Meters (CTMs)**

Uncertainty of CTMs ranges from 1.5% to 3% of throughput. Small errors on large throughput can have a large impact on UAfG. For example a systemic 1.5% error in CTM readings would contribute to 45% of UAfG.

- **Large Tariff D Customer Uncertainty**

As with CTM accuracy, uncertainty in large Tariff D customers’ consumption can have a large effect on total UAfG.

- **Temperature Compensation**

¹⁶ Asset Integrity Australasia P/L UAfG Phase B Report – Review of AusNet Services’ Strategy and Data Requirements for Desktop UAfG Review.

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Temperature assumption for basic meter customers introduces an error that is estimated to increase UAfG and is more pronounced for customers on HP networks. The addition of customers to HP networks is increasing UAfG slowly on an annual basis.

- **Classification of Class A Meters**

Movement of customers between the classifications can have a significant impact on UAfG both positive and negative to AusNet Services. As such greater clarification of the definition of Class A is required in order to establish rules for initial classification and any subsequent classification movement due to changes in consumption.

AusNet Services' strategy for maintaining UAfG is contained within the document AMS 30-22 – Unaccounted for Gas.

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11 PLANT STRATEGIES

The objective of this section is to provide an overview of AusNet Services' detailed plant strategies, with reference to future capital and operational requirements. Highlighted within each strategy will be:

- Asset/plant overview;
- Historical and current performance;
- Capital requirements;
- Operational requirements; and
- Plant specific strategies.

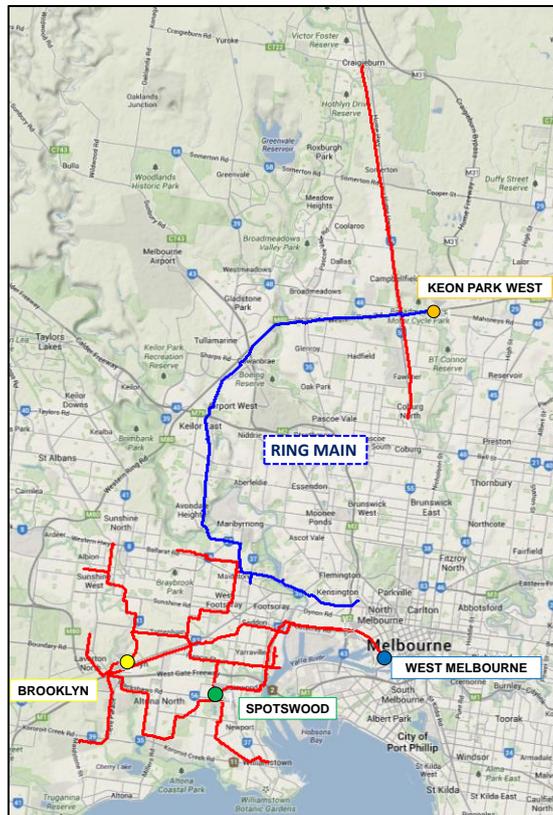
11.1 TRANSMISSION PIPELINES

11.1.1 ASSET OVERVIEW

AusNet Services currently has 20 individually licenced transmission pipelines totalling 185km, operating at pressures up to 2,800kPa and ranging in diameters from 150mm to 500mm. Transmission pipelines operate at high pressure to efficiently convey large amounts of energy over large distances. Permits to operate licensed pipelines are issued by the Department of Economic Development, Jobs, Transport and Resources (DEDJTR),¹⁷ with written consent from the Minister of Energy required for their operation. The individual licences contain details of pipe location and route, length, size, maximum allowable operating pressure and material specification.

AusNet Services also has 12 City Gate Sites licenced by DEDJTR.

Figure 15: AusNet Services' Metropolitan Gas Transmission Network



¹⁷ Formerly the Department of State Development, Business and Innovation (DSDBI).

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In 2007, the DEDJTR altered the licensing regulations such that if a new installation is approved by the ESV, then a licence is not needed. As such, neither Plumpton nor Wyndham Vale City Gates (AusNet Services' newest City Gates) are licenced. Instead, these sites have gas easements placed upon them.

Transmission pipelines are designed and constructed to Australian Standard (AS) 2885.1 using high-grade steel and maintained and operated to the latest version of AS 2885.3 (2008). Corrosion protection and pipeline patrols are examples of proactive measures used to maintain the integrity of the transmission network.

The average age of AusNet Services' pipelines is 35 to 40 years, with the latest pipeline constructed in 1991 (Portland City Gate to Portland Smelter). The conservative engineering life of transmission pipelines is 80 years.

Further details on AusNet Services' Transmission network can be found in the Transmission Pipelines Plant Strategy (AMS 30-50).

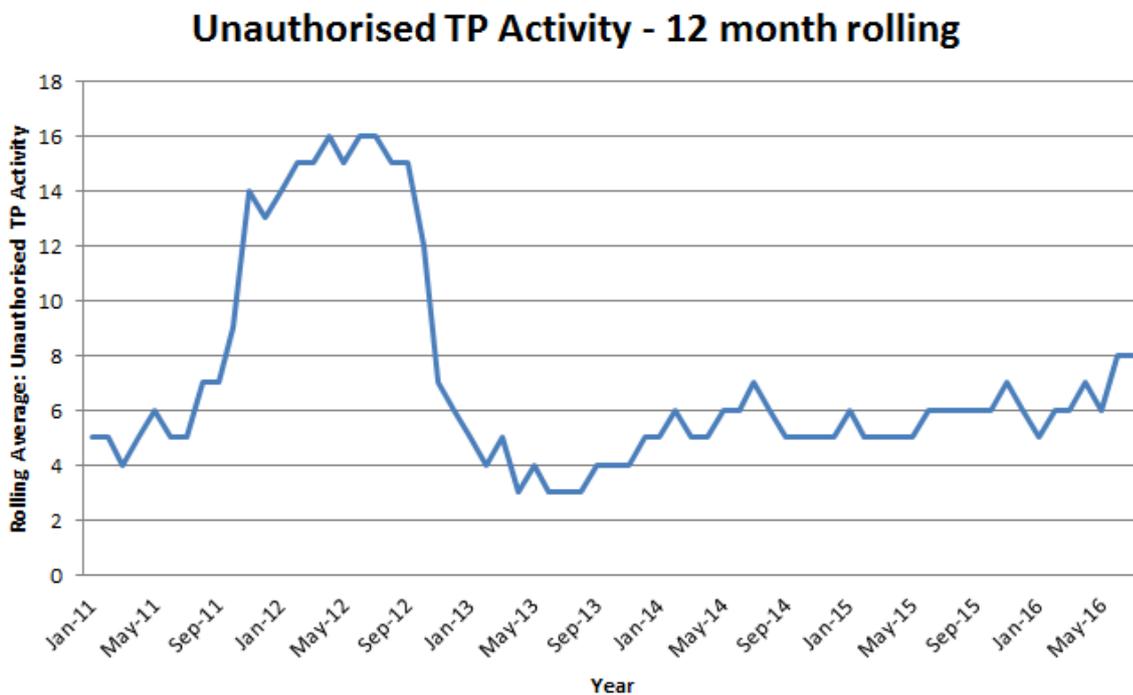
11.1.2 CURRENT PERFORMANCE

The transmission system is in good condition due to original construction techniques and controls, and the ongoing maintenance management, particularly the cathodic protection program.

Network analysis indicates that the existing transmission system remains adequate (in terms of capacity), based on current load forecasts with sufficient supply from the VTS, which is operated by AEMO.

Figure 16 demonstrates the 12 month rolling average of unauthorised TP activity. An incident may result in physical contact with a transmission pipeline or loss of supply. All near misses are reported to the ESV as they occur.

Figure 16: Unauthorised Transmission Pipeline Activity



11.1.3 CAPITAL REQUIREMENTS

The management of AusNet Services' existing transmission network is considered operationally intensive when compared to ongoing capital requirements.

Increased pipeline integrity, which leads to increased public safety and security of supply, are the primary drivers for proposed capital works in the short to medium term. The requirement for new pipelines or major

Gas Asset Management Strategy

alterations of existing pipelines is predominately customer driven and not discussed within this section. Refer to Section 10.12 *Network Capacity*, for further details on pipeline alterations driven from capacity constraints.

Capital programs to 2022 are detailed within Gas Transmission Pipeline Strategy (AMS 30-50).

11.1.4 OPERATIONAL REQUIREMENTS

Public safety and regulatory (license) compliance are the dominant drivers underpinning maintenance activities on licensed pipelines. Maintenance includes pipeline patrol, third party work inspections, leakage survey, corrosion (cathodic) protection, minor coating repairs, fault repairs, maintenance of pipeline markers and easements, pipeline integrity inspections and line valve/branch valve maintenance.

AusNet Services has developed and maintains a Transmission Pipeline Integrity Management Plan (AMP 30-03) which covers each of AusNet Services' licensed pipelines. A qualitative pipeline risk assessment has been used for the purposes of prioritising pipelines based on risk rankings.

Each pipeline is reviewed every 5 years and assessed in terms of:

- Historical data (coating defects, pigging data, damage data, repair data);
- Asset data (MAOP, wall thickness, design factors, %SMYS, operating pressure);
- Assessment data (Hot spots, over-pressure protection review, MAOP review); and
- Environmental Line List.

Utilising a risk based approach; strategies for further maintenance and/or inspections may be recommended following the assessment of individual pipelines.

Inspection strategies may include:

- Increase coating defect survey intervals;
- Intelligently pig the pipeline;
- Non-invasive pipe inspection tools (eg, Dig ups, No Pig Tool); and
- Increase leakage survey frequency.

Proposed Operating Strategies may include:

- Pressure downgrading of pipeline;
- Review of current protection measures; and
- Introduction of automated control of line valves for instant pipeline isolation.

11.1.5 PLANT SPECIFIC STRATEGIES

The following plant specific strategies are employed for the management of transmission pipelines. Refer to *Transmission Pipelines Strategy* (AMS 30-50) and *Transmission Pipeline Integrity Management Plan* (AMP 30-03) for further details.

- Ongoing revision of maintenance practices (e.g. pipeline patrol). Implement changes based on "risk" rather than historical practices.
- Remediation works identified in the environmental line list
- Continuation of hot spot surveying, identifying and recording areas of high risk. Increase frequency of integrity dig-ups confirming the integrity of protective coatings.
- Investigate and implement improved methods of demonstrating pipeline integrity.
- Continue management of cathodic protection systems with the aim of maintaining levels of protection above 98%.
- Relocate below ground, for the purposes of safety and security of supply, identified sections of above ground transmission pipelines.

Gas Asset Management Strategy

11.2 REGULATING FACILITIES – NETWORK

11.2.1 ASSET OVERVIEW

11.2.1.1. PRESSURE REGULATORS

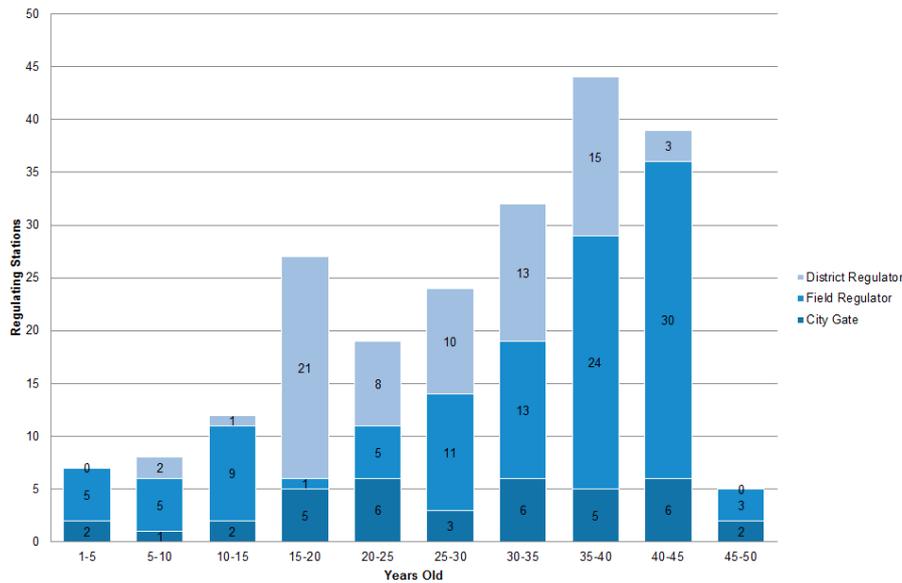
A pressure regulator is a valve that automatically opens or closes to match the flow of gas through the regulator to the demand for gas placed on the downstream network. The regulator does this by maintaining a predetermined set pressure downstream of the regulator. Pressure regulators are used throughout the network to maintain safe and useable pressures within its networks.

There are three (3) broad classifications of network pressure regulating stations:

- **City Gates** that regulate gas into AusNet Services' high-pressure and transmission pressure networks from Victoria's VTS.
- **Field Regulators** that feed gas into AusNet Services' high-pressure and medium-pressure distribution networks. The facility is either supplied by AusNet Services' transmission or high-pressure distribution network.
- **District Regulators** that control the pressure levels in the low-pressure reticulation system by the reduction of either high or medium pressure to low-pressure.

Each facility may include a host of auxiliary equipment namely valves, filters, SCADA, civil assets and cathodic protection. A city gate also includes highly accurate metering assets known as CTMs, which are owned and maintained by the VTS operator.

Figure 17: Age Profile Regulator Stations¹⁸



11.2.1.2. HEATERS

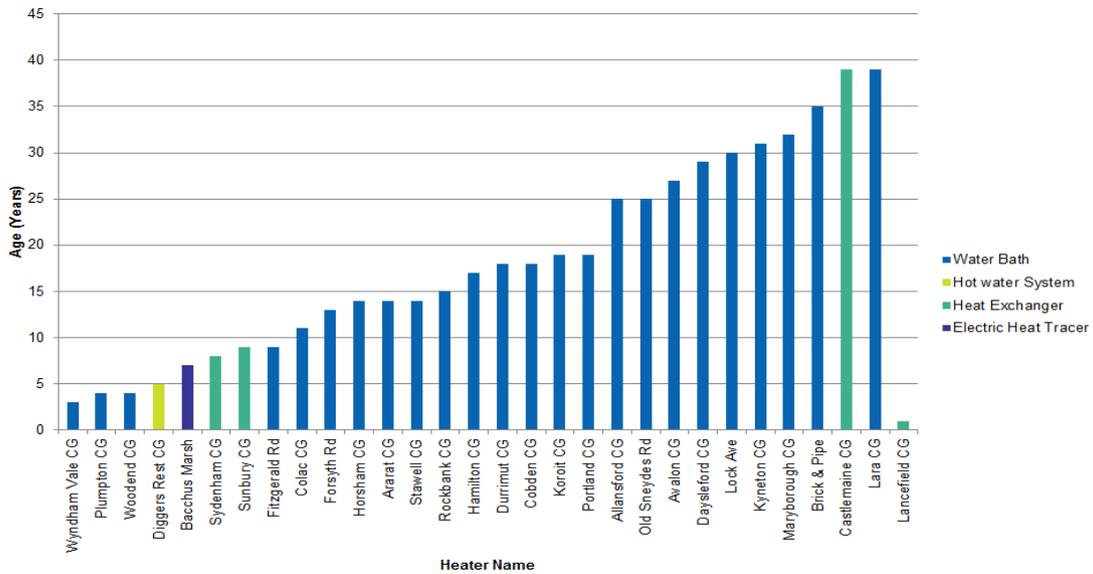
Gas pre-heat is required at City Gates or Field Regulators where the pressure drop across the facility causes a significant drop in gas temperature resulting in icing of pipework. The phenomenon is known as the Joules-Thompson effect which equates to approximately a 5.6°C temperature drop per 1,000kPa decrease in pressure. Icing of pipe work causes reliability and control problems with regulators and an inability to operate site valves. AusNet Services currently operates 36¹⁹ gas pre heaters at various city gate sites.

¹⁸ As of June 2016.

¹⁹ As of June 2016.

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Figure 18: Age Profile of Network Heaters (as at June 2016)



11.2.1.3. LIQUID CONTAMINATION (COALESCERS)

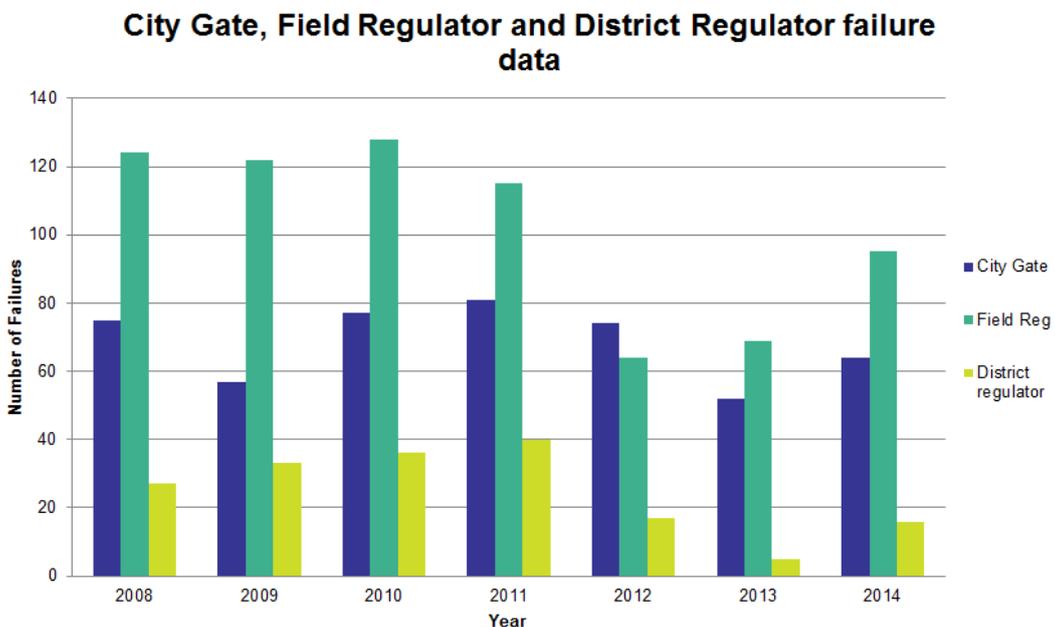
To prevent liquids entering AusNet Services' networks a number of Coalescer filters have been installed at City Gates and consumer connection points. Additionally, two portable skid-mounted Coalescers have been built and are available for rapid installation within the network when signs of liquid contamination arise. Portable Coalescers have also been used to protect AusNet Services' assets during pigging operations conducted by the VTS operator.

11.2.2 CURRENT PERFORMANCE

11.2.2.1. PRESSURE REGULATORS

The reliability of AusNet Services' regulating stations is critical to system integrity and continuity of supply. The reliability of each site type, since 2008 is summarised below:

Figure 19: City Gate, Field Regulator and District Regulator failure date



Gas Asset Management Strategy

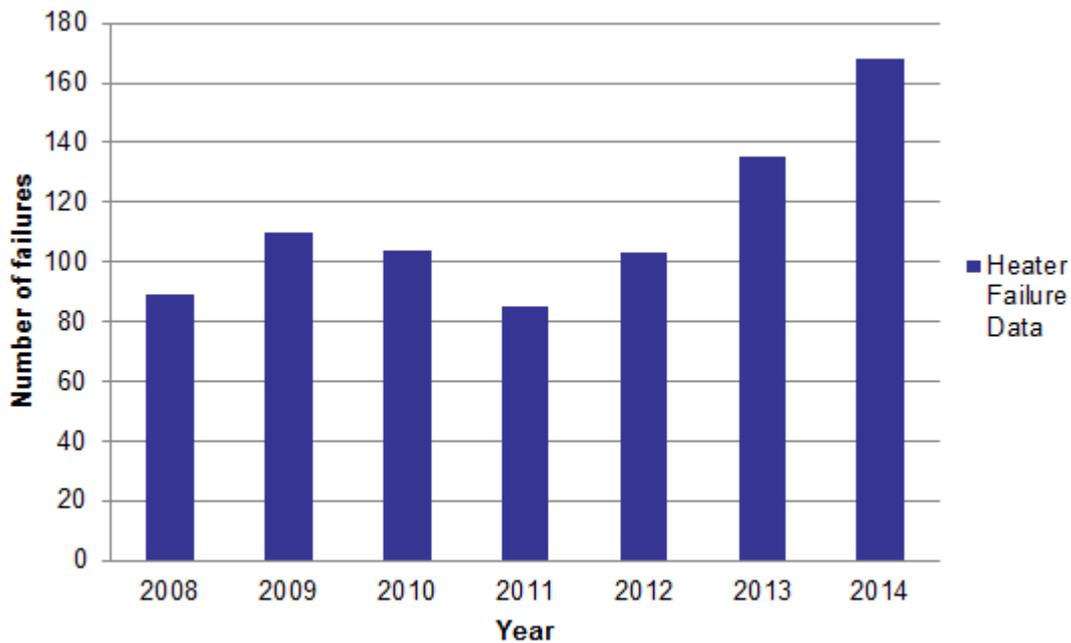
- **City Gates:** There are currently 38 city gate sites on the network. There is a decrease in city gate failure due to the benefits of replacement of Welker Jet and Grove regulator sites.
- **Field Regulators:** AusNet Services has 106²⁰ field regulator sites. Failure rates of these regulators have remained stable.
- **District Regulators:** AusNet Services currently has 92²⁰ district regulators. District regulators are removed from the network as part of the mains replacement program and failure rates have remained relatively stable.

Due to high levels of redundancy within pressure regulator station design, (with three levels of protection on City Gates / Field Regulators and two levels on District regulators) no gas outages have been associated with the above failures.

11.2.2.2. HEATERS

Failure rates on heater sites have increased. The majority of the increase in failures is due to pilot lights going out, resulting in the heater system failing.

Figure 20: Heater Failure Data



11.2.3 CAPITAL REQUIREMENTS

Capital programs identified from maintenance or operational deficiencies are detailed within AusNet Services' Regulating Facilities – Network Strategy (AMS 30-51). Capital requirements (upgrade or replacement) due to capacity constraints are captured within AusNet Services' Network Capacity Strategy (AMS 30-17).

The following principles/strategies are followed during the definition of the capital program for network regulating facilities.

- **Asset Replacement:** Proactive replacement of aged and/or obsolete regulators operating at high, medium and low pressures where parts are no longer manufactured by the Original Equipment Manufacturer (OEM).

²⁰ As of June 2016.

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- **New Facilities:** Installation of new heaters to major regulating stations to improve downstream asset integrity.
- **Asset Safety:** Programs to increase public and/or employee safety. Examples include the installation of water bath heater platforms to reduce OH&S risks onsite and a program to relocate regulating stations to underground due to urban growth encroachment.
- **Asset Security:** Upgrade of security fencing at high risk sites to prevent unauthorised access.

11.2.4 OPERATIONAL REQUIREMENTS

Operational requirements and maintenance frequencies for network regulators are contained within AusNet Services' Asset Maintenance Plan (AMP 30-02), and summarised below.

11.2.4.1. PRESSURE REGULATORS

City Gates have full refurbishment schedules that vary from 'breakdown only' for low risk stations to 10 years for low risk stations, 6 years for medium risk stations and 3 years for high risk stations.

Detailed analysis of historical fault data via RCM modelling, on the various types of city gate configurations and components as well as the impact of failure on the network has determined the best fit maintenance regime.

Field and District regulators are stripped and rebuilt every 6 or 10 years depending on whether they are deemed high or low risk. Operational checks are conducted at least every six to 12 months.

City gates, Field and District regulators have a useful life of 60 years with this type of major maintenance.

11.2.4.2. HEATERS & COALESCERS

Water bath heater maintenance and Coalescer maintenance is performed at the same time as the City Gate regulator maintenance as they are part of the same City Gate station facility.

Heater coil inspections/refurbishments are carried out every 8 years or as identified during full maintenance.

Filtering elements within Coalescers are replaced during the scheduled full maintenance of the regulating facility it operates.

Refer to Regulating Facilities – Network Strategy (AMS 30-51) for additional details on current and future maintenance programs.

11.2.5 PLANT SPECIFIC STRATEGIES

The following plant specific strategies are employed for the management of AusNet Services' network regulating assets. Refer to AusNet Services' Regulating Facilities – Network Strategy (AMS 30-51) for further details.

- Replace aged and/or obsolete regulators where parts are no longer manufactured by original equipment manufacturer (OEM) providers.
- Installation of heaters at City Gates to mitigate freezing of regulating facilities and downstream assets.
- Asset Safety & Security investment to mitigate and reduce hazards.
- Continual optimisation of maintenance frequencies (based on RCM principles) to improve or maintain network safety and reliability.
- Introduction of new network technology to automate network pressure control.
- Improved asset selection that minimises total lifecycle costs.

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11.3 REGULATING FACILITIES – CONSUMER

11.3.1 ASSET OVERVIEW

As with network regulators, each supply point (i.e. connection) from the distribution network contains a regulator that matches the flow of gas through the regulator to the demand for gas by the consumer. In total AusNet Services has approximately 660,000 connection points²¹ to the distribution network, each with a dedicated regulating facility.

Regulators are sized based on expected consumer demand which can range from 6m³/hr for domestic loads to in excess of 2,500m³/hr for large industrial and commercial customers, for which a purpose-designed regulator unit is installed. Regulator assemblies exist in a variety of designs (e.g. single run or dual run) and enclosures (e.g. black boxes, metering room, etc) which are dependent on the consumers demand profile and underlying site conditions.

The standard metering pressure for domestic customer is 1.1kPa (for low pressure networks) or 2.75kPa (for medium and high pressure networks). Industrial & Commercial consumers can have metering pressures up to 100kPa subject to AusNet Services approval.

Accompanying the pressure regulator, each supply point also contains a gas meter used to measure the volume of gas flowing to the consumer.

Refer to Section 11.5 of the AMS for AusNet Services' management of metering assets.

11.3.2 CURRENT PERFORMANCE

AusNet Services' asset management database does not record the location and detail of domestic regulators commissioned within the network, therefore, the age profile of domestic regulators can be estimated but is essentially unknown.

A rising trend of leaks on meters has heavily influenced the network leakage rate which attributes 75% of those leaks as occurring at the meter. At the end of 2015, the rate of meter leaks stood at >20 leaks / 1,000 customer connections, translating to an overall fault rate of 1.9% for existing meter installations.

The increase in recorded meter leaks correlates with the increasing failure rates of domestic regulators. The trend seen Figure 18 in could therefore be attributed to the rise in domestic regulator leaks. Under the current practice of reactive replacement of domestic regulators (i.e. upon failure), the field fault rate of domestic regulators could double by 2025.²²

Internal analysis²³ suggests that 91% of 'meter leaks' occur on a component of the regulator unit, and in 60% of those cases the regulator had to be replaced.²⁴ The recommended strategy is to introduce a proactive replacement methodology to be delivered in conjunction with the Meter Replacement Program, to decrease consumer regulator leakage rates across the network.

²¹ Data as of 30th June 2016.

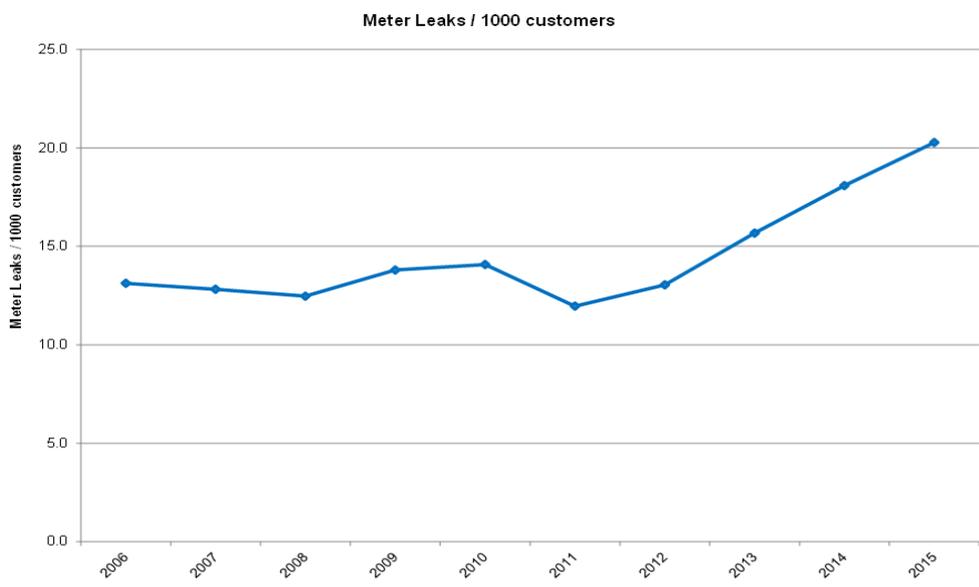
²² NCS Meter Leaks Report 2015.

²³ NSC Meter Leaks Report 2015.

²⁴ The remaining 40% of regulator leakage cases were due to a leaking joint.

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Figure 18– Domestic Meter Leaks / 1000 customers.



11.3.3 CAPITAL REQUIREMENTS

Capital requirements for consumer regulators are identified proactively during maintenance activities and reactively if a regulator was to fail. Security of supply, public safety, spare part availability, and financial efficiencies are all drivers for capital works on consumer regulators.

An overview of capital programs delivered for consumer regulators is provided. Refer to AusNet Services' Regulating Facilities – Consumer Strategy (AMS 30-53) for further details.

- **Replacement of Obsolete Industrial & Commercial Regulators:** Active replacement of industrial and commercial regulators that have become obsolete with spares no longer manufactured by the OEM providers. Proactive replacement promotes network integrity and security of supply.
- **Miscellaneous Works:** Capital expenditure is regularly incurred on minor ad hoc work at industrial and commercial sites. This work is required due to a combination of OH&S, risk mitigation, regulatory compliance, asset integrity, and/or operational requirements.
- **Proactive Replacement of residential regulators:** This program is designed to curb the trend of increasing “meter” leaks (which is inclusive of domestic regulator leaks), since the majority of these recorded leaks were found to occur on the regulator.

11.3.4 OPERATIONAL REQUIREMENTS

Domestic regulators are *'run to fail'* with no scheduled maintenance conducted. When failure does occur, it is replaced with a new regulator of similar capacity. Domestic regulators are not refurbished as it is not financially viable to do so.

Industrial and Commercial installation with outlet pressures $\geq 4\text{kPa}$ are classified as system operations units and undergo 6 or 12 monthly operational checks. In addition, the same regulating installations are periodically refurbished (soft rubber components are replaced) as part of the preventative maintenance regime. The interval between refurbishment, 6 years or 10 years, is based upon the RCM principles and the criticality of the regulating station.

11.3.5 PLANT SPECIFIC STRATEGIES

The following plant specific strategies are employed for the management of AusNet Services' consumer regulator assets. Refer to Regulator Facilities – Consumer Strategy (AMS 30-53) for further details.

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- Improve the safety, security and accessibility of legacy installations.
- Replace obsolete regulating assets on commercial and industrial stations (before in-service failure) where the consequence of failure is significant.
- Improved asset selection that minimises total lifecycle costs.
- Implement IT system to record the location and asset details of domestic regulators.

11.4 DISTRIBUTION MAINS & SERVICES

11.4.1 ASSET OVERVIEW

The gas mains distribution network is comprised of approximately 10,951 kilometres²⁵ (km) of mains that operates up to 1,050kPa maximum operating pressure. The distribution system transports gas from the transmission network (>1,050 kPa) via three main pressure tiers to consumer service lines. The pressure tiers are referred to as low, medium, and high with a fourth minority pressure tier known as 'High Pressure 2'. This pressure tier accounts for less than 1% of the total distribution network. In relation to material types, four dominant material types exist (cast iron, poly vinyl chloride, polyethylene and steel).

Table 8: Length of mains by pressure classification²⁵

Pressure Tier ²⁶	Operating Pressure (kPa)	Length (km)	% Allocation
Low (LP)	Up to 3 kPa	776	7%
Medium (MP)	15 kPa – 140kPa	702	7%
High (HP1)	140 kPa – 515 kPa	9381	86%
High (HP2)	515 kPa – 1050 kPa	92	<1%
Total		10,951	100%

²⁵ As at July 2016.

²⁶ AusNet Services' Technical Standard TS-7600.

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Gas services operate at pressures up to 515kPa. They are predominantly constructed from polyethylene with a small percentage constructed in steel, aged wrought iron and poly vinyl chloride (PVC).

The age profile of AusNet Services’ distribution mains are displayed in the chart below. The age profile of the network ranges to 116 years with an average network age of 23.6 years.²⁷ The breakdown of network average age is detailed below:

Figure 22: Whole Network Age Profile

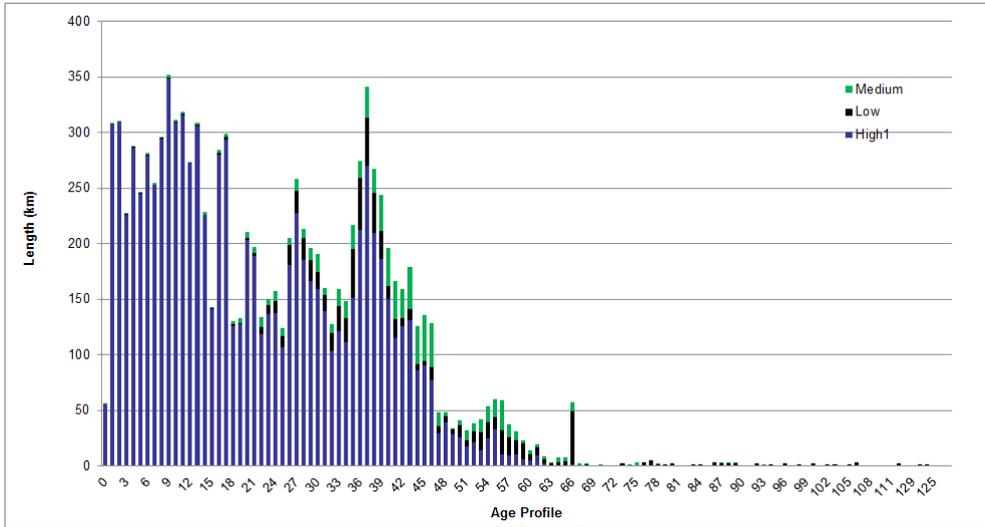


Table 9: Pipe Material Summary

Material Type	Network
Cast Iron	264km
Polyethylene	7,446km
Uncoated Steel	287km
Protected Steel	2,515km
PVC	410km

Source: Refer to Section 4.3of the AMS for network composition by pipe pressure & material.

11.4.2 CURRENT PERFORMANCE

Figure (Mains) and Figure 4 (Services) show the leakage rate (leaks per km of mains) for mains and services over the 12 years (to 2014) by network pressure classification.

²⁷ Average age is calculated with 2016 as the base year.

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Figure 23: Mains leakage rate of whole network by pressure classification

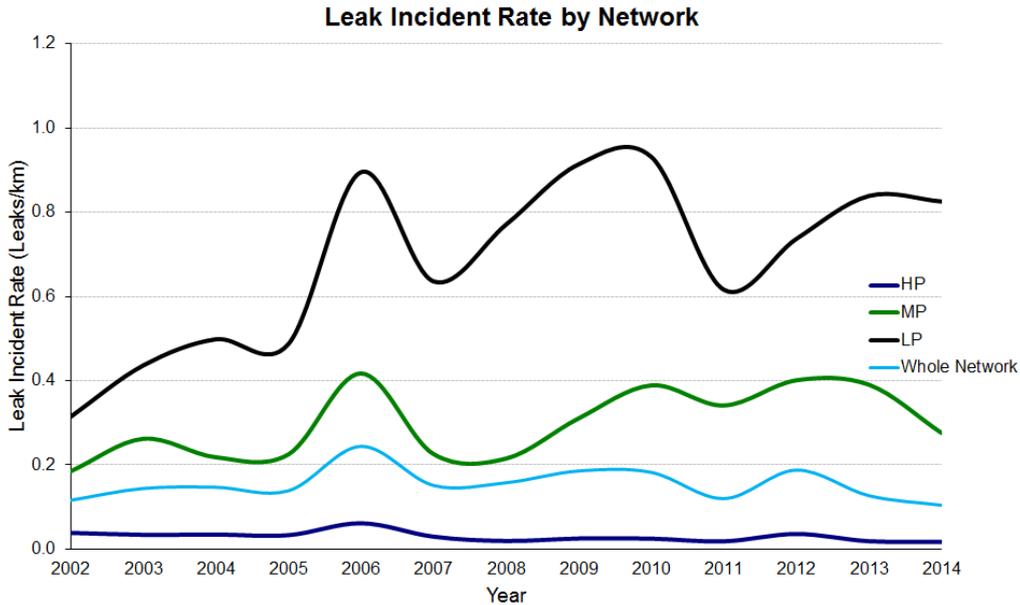
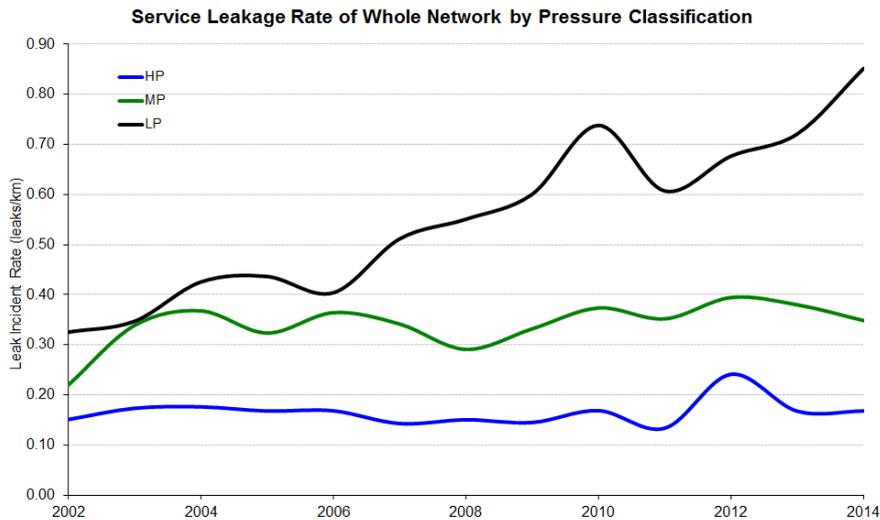


Figure 24: Service leakage rate of whole network by pressure classification



Periodic review is completed of failure data to monitor the relative performance of material types and pressure tiers. Cast iron mains contribute the most in terms of volume and leakage rates within the network. As cast iron is predominantly found within the low pressure system, the low pressure network contributes to the majority of network failures.

Refer to AusNet Services' Mains and Service Strategy (AMS 30-52) for detailed breakdowns of asset performance by material type and pressure tiers.

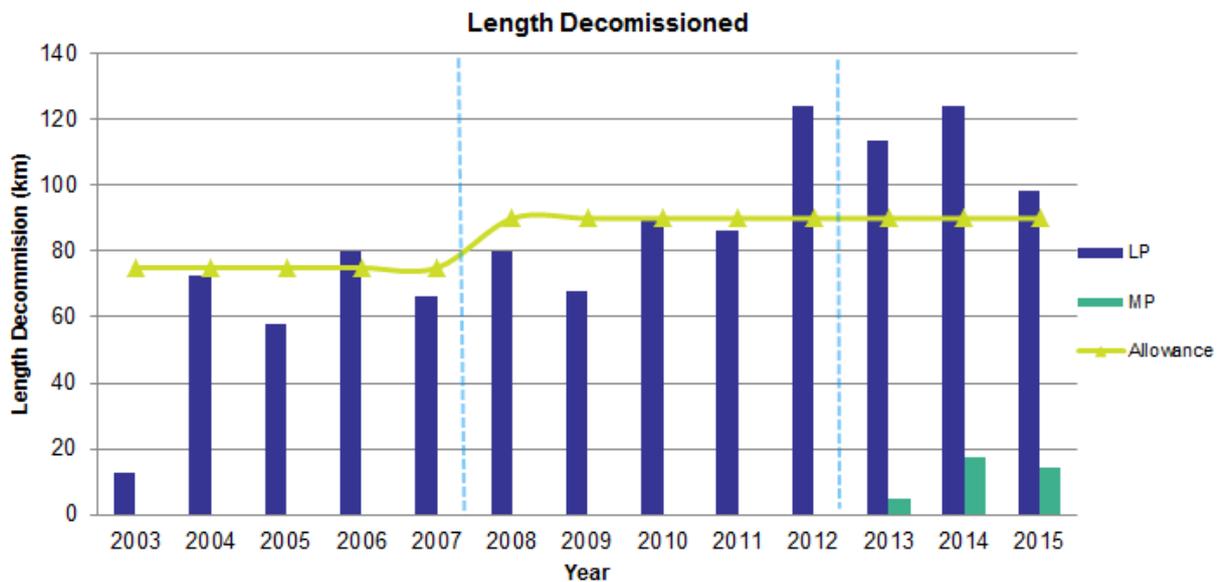
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11.4.3 CAPITAL REQUIREMENTS

11.4.3.1. MAINS REPLACEMENT

The mains replacement program involves replacement of aged and leaking LP mains with polyethylene main. Since the introduction of the program in 2003, AusNet Services has demonstrated its commitment to completing the program by 2025 with the abandonment of over 1,100km of low pressure to date. In the current regulatory period, leakage rates were expected to increase due to the rate deterioration. However with a targeted and increased rate of replacement, leakage incident rates have been maintained on the network in line with meeting the network objective of maintaining network safety.

Figure 25: Length of mains decommissioned



The focus of current replacement program is to target heavily deteriorated low pressure cast iron mains; as inferred by a high incidence of leaks and replace with high pressure polyethylene mains. The responsible replacement of aging mains, on a safety risk prioritisation basis, is a key mitigation control set out in the Gas Safety Case.

In summary the mains replacement program has the following drivers:

- maintains network risk;
- Improved system capacity and reliability;
- Continued compliance with regulatory benchmarks, the GSC and GDSC;
- Reduction in carbon emissions and environmental impact;
- Long-term reduction in network maintenance; and
- Move towards a uniform high pressure gas network.

The rationale for undertaking the low pressure replacement program is based on a risk assessment of the network by material type. This risk assessment also applies to medium pressure mains, which demonstrates that certain material types within that asset group also represent a significant safety risk. AusNet Services' analysis indicates that although the risk of a medium pressure asset failure occurring is low; the associated consequence (in any populated area) could be significant.

The analysis in the table below shows the relative risk associated with different main material types at different pressures. Failure modelling indicates that replacing the Low Pressure network and additionally targeting some Medium Pressure mains of specific material types will maintain safety and reliability by reducing incidence of leaks and, resultantly, outages.

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Table 10: Risk Weighting Results (as at Dec 2014)

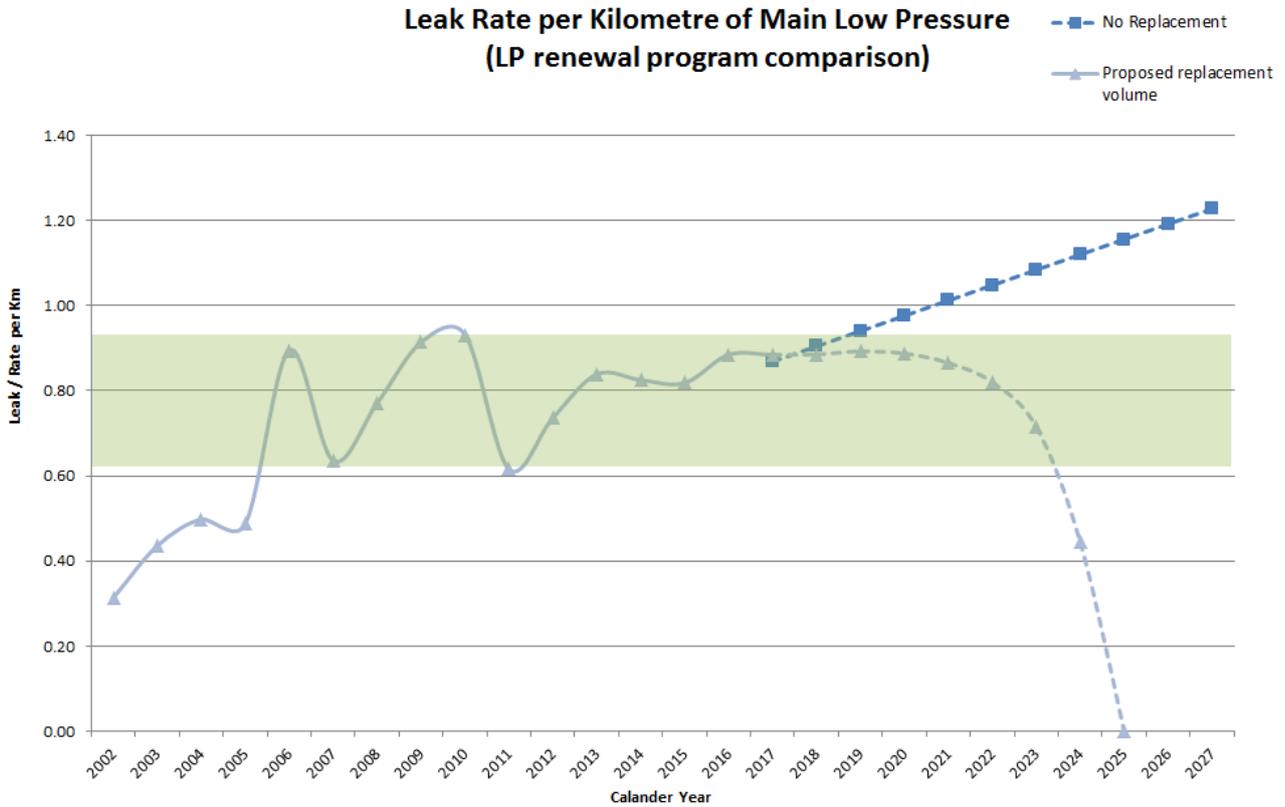
Pressure Tier	Material	Length (km)	Ave Annual LIR (leaks / km)	Gas Flow Ratio	Risk Weighting
High Pressure	Steel Protected	2289	0.02	11.95	0.24
	PE	7055	0.02	11.95	0.24
Medium Pressure	Steel Protected	305	0.09	4.01	0.36
	Steel Unprotected	147	0.76	4.01	3.05
	PE	204	0.05	4.01	0.20
	Class 250 PE (P4)	39	0.95	4.01	3.81
Low Pressure	Steel Unprotected	70	0.46	1.00	0.46
	Cast Iron	266	1.07	1.00	1.07
	PVC	420	0.14	1.00	0.14
	PE	18	0.07	1.00	0.07

A program to replace deteriorated medium pressure mains will replace (highest failure risk) and the worst performing CL250 PE and unprotected steel mains for the network. The medium pressure program commenced in calendar year 2013 and achieved a reduce leak incidence per km profile of the medium pressure network. With the highest risk mains replaced on the MP network (cast iron) by the end of 2017, the program is forecast to be reduced to 11km per annum from an average of 15km.

The gradual replacement of the entire low pressure network is required to maintain a stable leakage rate. Plans are established to continue to replace 80-90km of main per annum in line with the historical average. If left unchecked, the expected deterioration of the remaining cast iron and unprotected steel mains on the low pressure network is forecast to lead to rapid increases in leak incidences as demonstrated in the figure below. The replacement rate of 80-90km per annum provides a sustainable approach to managing the risk profile of the low pressure network, as demonstrated in Mains and Services Strategy (AMS 30-52). AusNet Services plans to continue the low pressure mains replacement program until all low pressure assets are replaced, this is targeted to occur during, or around, 2025.

Gas Asset Management Strategy

Figure 26: Leak incidence per km of low pressure mains



11.4.3.2. MINOR MAINS REPLACEMENT

Small sections of mains length identified by maintenance that is beyond repair and require urgent/emergency replacement are capitalised. It is expected that current failure rates will continue for minor mains replacement program.

11.4.3.3. SERVICE REPLACEMENT

Any services identified by maintenance that fail a pressure test and/or are beyond repair, are replaced under a reactive mechanism and capitalised. It is expected that current failure rates will continue for minor mains replacement program.

11.4.4 OPERATIONAL REQUIREMENTS

Both proactive and reactive maintenance is conducted on AusNet Services' distribution mains and services to ensure their ongoing integrity, as well as to minimise public risk and lifecycle costs.

Proactive maintenance includes leakage survey program which employs a risk based survey methodology by targeting areas of highest risk. Cathodic protection techniques are also applied to steel mains to extend their useful life by limiting the incidence of corrosion.

The predominant form of reactive maintenance is the repair of both mains and service leaks identified through public reports and leakage survey activities.

11.4.5 PLANT SPECIFIC STRATEGIES

The following plant specific strategies are employed for the management of AusNet Services' distribution mains and services. Refer to Mains and Services Strategy (AMS 30-52) for further details.

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- Continuation of the current low pressure mains renewal methodology. Renewal of the low pressure network to high pressure is expected by 2025.
- medium pressure mains replacement to address concerns with unprotected steel and first generation polyethylene mains (CL250).
- Ongoing review of leakage management policies to find the correct balance between reactive and proactive maintenance activities.
- Improve asset data quality on mains and services, with particular attention on leak data, pipe characteristics and risk profiles, which are key inputs to AusNet Services' mains renewal and leakage management programs.

11.5 METER MANAGEMENT

11.5.1 OVERVIEW

Gas meters are used to measure the volumetric flow rate of gas passing through the device. The volume of energy that passes through the meter is dependent on both gas pressure and temperature at the time of measurement.

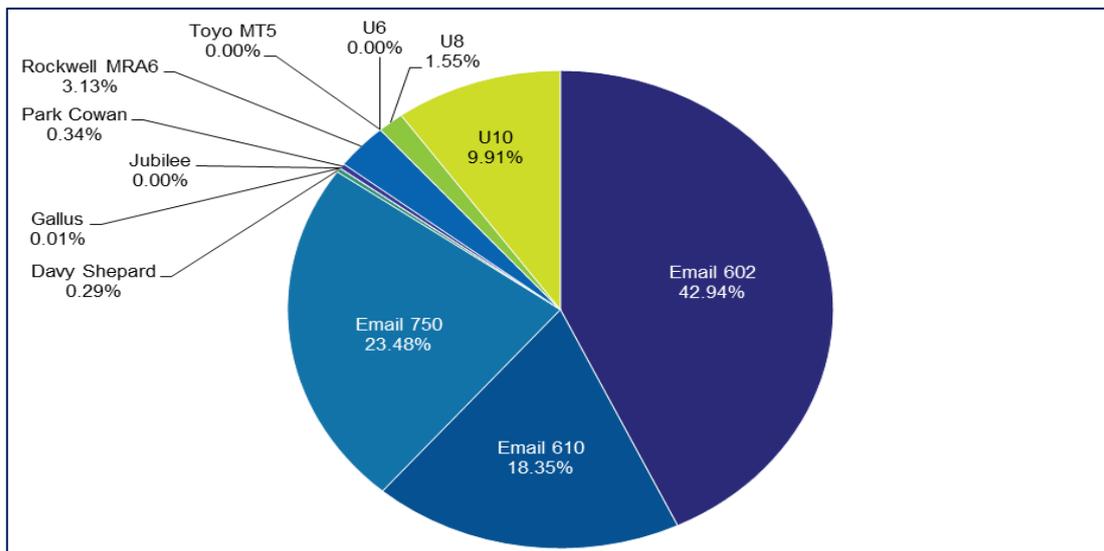
AusNet Services is required by the Gas Distribution System Code to provide an appropriate metering installation at each supply point (i.e. connection) off the distribution network. AusNet Services is required to periodically maintain these installations, replace meters when their field life has expired, and provide periodic metering information to retailers for billing purposes.

Overall AusNet Services has a fleet of 655,602²⁸ meters installed of which 639,882 are classed as residential type meters and 15,720 are Industrial and Commercial (I&C) meters.²⁹

11.5.1.1. RESIDENTIAL METERS

Residential meters are small capacity meters (<10m³/hr) typically found at the front of domestic properties. All of AusNet Services' domestic meters are diaphragm type gas meters.

Figure 27: Domestic Meter Types (as at June 2016)



²⁸ As of June 2016.

²⁹ Industrial & Commercial Meter Types are those with a capacity of >10m³/hr.

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11.5.1.2. INDUSTRIAL AND COMMERCIAL METERS

Industrial and commercial sites are high users of gas, usually greater than 25m³/hr. A combination of three (3) higher flow meter types; rotary, diaphragm or turbine gas meters is commonly used at I&C installations.

Table 11: Breakdown of Industrial & Commercial meter types (as at June 2015)

Meter Type	Maximum Flow rate	Number of Meters
Diaphragm	500 m ³ /hr	15,205
Rotary	1,500 m ³ /hr	364
Turbine	9,000 m ³ /hr	151

11.5.2 CURRENT PERFORMANCE

The recent performance of AusNet Services' metering fleet (i.e. faults) and the results of key works programs are summarised in the table below.

Historically, meter failure rates have averaged 0.36%³⁰ of the meter population each year with most failures occurring from third-party damage. Annual time expired replacement programs consistently achieve replacement rates of >95% per program.

Table 12: Historical performance of Domestic and I&C meter types

Installation Type	CY11	CY12	CY13	CY14	CY15	Average
Domestic Meter Failures	1,761	2,044	2,049	1,970	2,988	2,162
- % Population	0.31%	0.35%	0.35%	0.32%	0.47%	0.36%
I&C Failures	191	239	193	82	109	163
- % Population	1.20%	1.48%	1.20%	0.54%	0.70%	1.02%
Total Meter Failures	1,952	2,283	2,242	2,052	3,097	2,325
- % Population	0.33%	0.38%	0.33%	0.33%	0.48%	0.38%

From recent analysis we can make the following statements on the performance of domestic and I&C meter types:

- In CY15 faults accounted for about 0.5% of meter population;
- Of the meters tested each year for Field Life Extension over the last 5 year period , approx. 52,000 failed, (8% of total domestic meters);
- On average, 98% of the Domestic Time Expired program has been completed each year – the 2% become “No Access” Meters.

11.5.3 CAPITAL REQUIREMENTS

A range of annual meter testing and replacement programs is completed to ensure ongoing compliance with the Gas Distribution System Code, Version 11. An overview of each program is provided. Refer to the Meter Management Strategy (AMS 30-54) for further details.

³⁰ Failure statistics only include meters that have failed during operation.

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- **In-service compliance testing program:** Annual in-service compliance testing is completed on small capacity (<25m³/hr) diaphragm meter families nearing the end of their in-service compliance periods. Testing follows the requirements of AS/NZS 4944:2006 (*Gas Meters – In-service Compliance Testing*) where meters are tested through either the 'variables' or 'attributes' sampling methods. Outcomes of compliance testing lead to a field-life extension (5, 3, or 1 year) or the meter family being removed from the field.

The in-service compliance testing program does not extend to I&C meters which are automatically removed from the field at the end of their in-service compliance periods.

- **Time expired meter replacement program:** Meters at the end of their in-service compliance periods (i.e. useful life) are removed from the field and have been replaced with new or refurbished assets of similar capacity.

The domestic replacement program includes meters that are at the end of their in-service compliance periods, meters outstanding from previous replacement programs, and meter families that are prematurely retired to avoid extreme volatility in replacement program sizes. Typically, AusNet Services aims to remove 25,000 to 35,000 meters per annum within the domestic meter replacement program.

The cost of refurbished meters has recently increased and an assessment of whole life meter costs was undertaken. This assessment identified that refurbishment of domestic meters provides no economic advantage over the installation of new meters so refurbished meters will no longer be included in the meter replacement program.

The I&C meter replacement program includes meters at the end of their in-service compliance periods and those outstanding from previous programs. AusNet Services typically replaces 300 to 600 I&C meters per annum.

- **Non-compliant meter:** Dedicated programs are established to target and replace meters that remain in the field beyond their in-service compliance periods. An inability to gain access to the meter during the time expired replacement program (due to locked gates, guard dogs, refused entry, etc.) is the primary reason for non-compliant meters within AusNet Services' network. In total, non-compliant meters equate to approximately 0.10% of all commissioned meters.
- **Meter Faults:** AusNet Services reactively replaces meters that fail within operation. Typically, AusNet Services replaces approximately 2,000 to 2,500 meters annually, equating to approximately 0.38% of the metering fleet.

Meter replacement and sampling volumes for the aforementioned programs, to 2022, are defined within AusNet Services' *Meter Management Strategy* (AMS 30-54).

11.5.4 OPERATIONAL REQUIREMENTS

I&C regulator units, in which the meter forms a vital component, are maintained on either a 6-monthly or annual basis. Maintenance of the physical meter is limited with the exception of rotary meters which require oiling of componentry.

Domestic meters are not periodically maintained outside the in-service compliance-testing program.

11.5.5 PLANT SPECIFIC STRATEGIES

The following plant specific strategies are employed for the management of AusNet Services' Metering assets. Refer to the Gas Meter Management Strategy (AMS 30-54) for further details

- Continuation of in-service compliance testing programs to ensure meter lifecycle costs are minimised.
- Extend in-service compliance testing to other meter families that meet program criteria (i.e. diaphragm > 10m³/hr).
- Maximise the replacement of meters rather than refurbishment, consistent with recent price increase for refurbished meters, and poor performance on compliance testing.

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- Implement a 'smoothing' strategy to replace an average of 25,000 to 35,000 meters per year to prevent extreme volatility within replacement programs, which inflates per unit replacement costs.
- Embrace any digital meter developments.

11.6 CORROSION PROTECTION

11.6.1 ASSET OVERVIEW³¹

AusNet Services utilises Cathodic Protection, and associated systems to actively defend against corrosion of its buried steel assets within its gas transmission and distribution networks.

The gas transmission and distribution system features 183 active cathodic protection units of various current outputs that protect 2,683km of steel pipeline and mains from corrosion. All 183 km of AusNet Services' transmission network is fully cathodically protected. The steel mains of the distribution systems are also largely shielded; however, 398 km of isolated steel main is dispersed within the distribution network that cannot be effectively protected due to electrical isolation. Protection is also aided by approximately 851 magnesium sacrificial anode bed sites which provide low levels of cathodic protection current. Earthing and stray current drainage sites, which remove unwanted electrical interferences, are also integral to the cathodic protection system operations.

A necessary adjunct to the cathodic protection systems are the numerous electrical isolation and surge protection devices used throughout the network. These assets provide electrical isolation of the steel assets to allow for targeted cathodic protection. The systems also aid in providing protection for field personnel from electrical surges.

11.6.2 CURRENT PERFORMANCE

The cathodic protection system is monitored via direct measurements of electrical potential (cathodic protection level). This is performed through test points directly wired to the steel assets throughout the network. AusNet Services aims to achieve the following percentages of its protected assets within the optimal range of cathodic protection (-850mV to -1100mV):

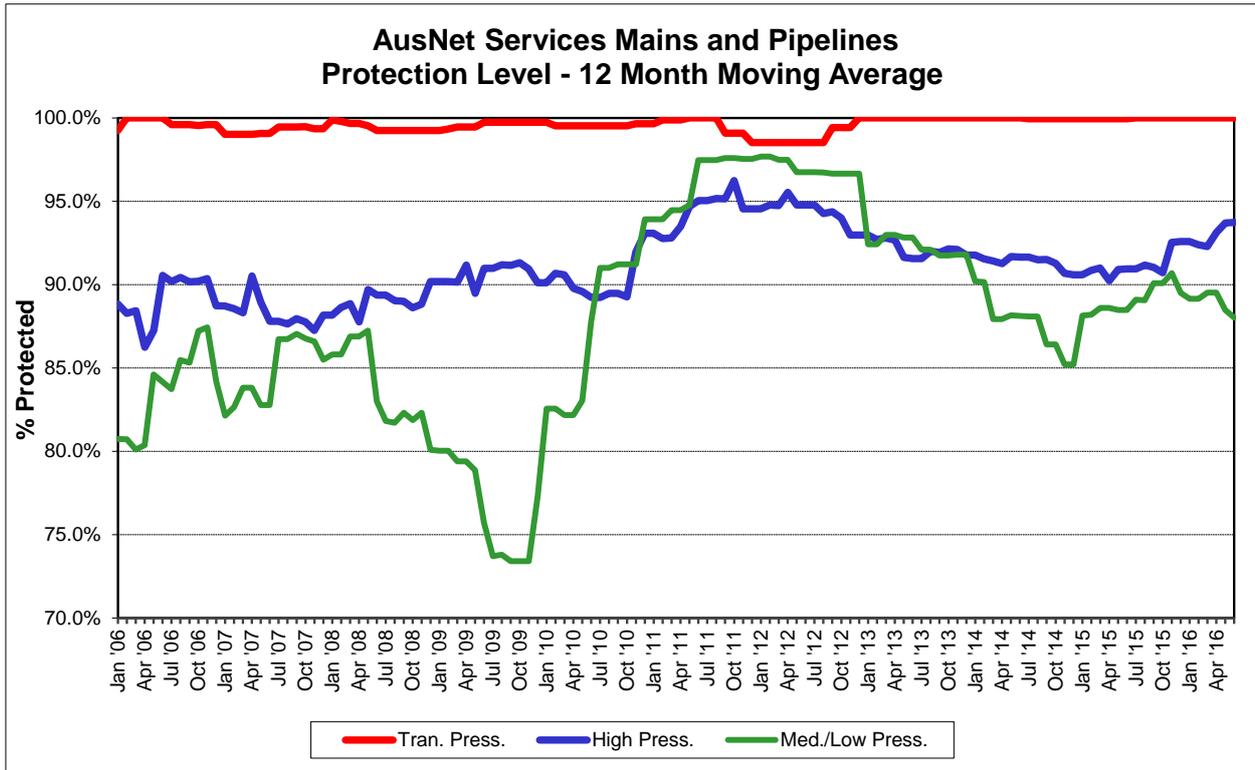
Table 13: Target Cathodic Protection Levels

Pressure	Target Protection Level
Licensed Pipelines (TP)	98%
High Pressure Networks	90%
Medium Pressure Networks	85%
Low Pressure Networks	80%

³¹ As at January 2014.

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Figure 28: Historical Cathodic Protection Performance (May 2015)



Through AusNet Services’ capital investments in cathodic protection, these levels have steadily increased, as evidenced in the figure above. The drop in cathodic protection of the medium pressure network over the 2008/2009 period is attributed to drier ground conditions over this time, which inhibits cathodic protection currents.

11.6.3 CAPITAL REQUIREMENTS

Cathodic protection capital requirements are primarily driven by the potential survey program used to monitor network performance. If the protection level for a specific area is found to be below the desired level, and operation of the local cathodic protection unit is confirmed, then rectification work will result.

Cathodic protection systems have a variable useful life that is dependent on factors such as the environment in which they are located, the condition of the main they are shielding, and other environmental factors. As such, the existing systems require routine capital investment to ensure their correct function.

Capital programs to 2022 are detailed within AusNet Services’ Cathodic Protection Strategy (AMS 30-56) and follow the following principles:

- **Corrosion Protection:** The corrosion protection work program includes the installation of additional corrosion protections units (CPUs), upgrading of existing systems, installation of sacrificial anodes and replacing those that have been depleted. This program ensures cathodic protection levels are maintained in accordance with AusNet Services' Gas Safety Case, reducing corrosion rates and hence the safety risk of corrosion induced leakage.
- **Surge Protection:** The surge protection programs consist of installing surge protection to the AusNet Services' below ground installations. This work mitigates the chances of electrical surges and hence the dangers of electrocution, equipment damage and ignition of fugitive emissions that are associated with them.

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11.6.4 OPERATIONAL REQUIREMENTS

Operational requirements for the cathodic protection system are aimed at maintaining the systems to ensure current levels of performance and coverage are maintained. This involves 6-monthly potential level surveys of both the transmission and distribution systems, coating defect surveys of transmission pipelines, coiling (interference) testing and stray current electrolysis testing conducted by the Victorian Electrolysis Committee (VEC). These works also allow capital works to be effectively targeted at areas requiring improved cathodic protection levels.

11.6.5 PLANT SPECIFIC STRATEGIES

The following plant specific strategies are employed for the management of AusNet Services' Corrosion Protection assets. Refer to AusNet Services' Gas Corrosion Protection Strategy (AMS 30-56) for further details.

- Medium and Low pressure networks will progressively be upgraded to High Pressure with subsequent corrosion protection becoming redundant.
- Corrosion Protection Units for the Transmission Pipelines to be fully owned and operated by AusNet Services by 2017, eliminating the current 'shared sites' arrangement
- All City Gates and Field Regulating units to be appropriately protected from spark or surge currents in accordance with CPS 2308 (*Protection from Electrical Surges and Induced Voltages*).
- Introduction of SCADA technology to monitor and control Cathodic Protection systems.

11.7 SCADA SYSTEM

11.7.1 ASSET OVERVIEW

AusNet Services uses a Supervisory Control and Data Acquisition (SCADA) system to monitor and control assets across the network from the transmission system to the network fringe. The SCADA system provides data on the real-time performance of the assets, and data for long-term evaluation of gas demand and network performance to identify potential system deficiencies.

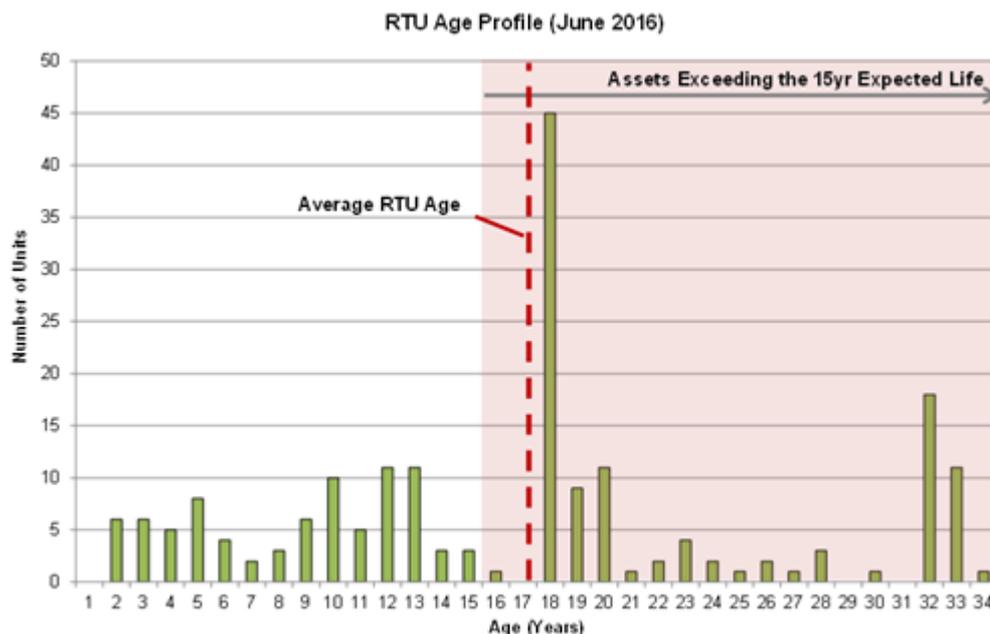
The SCADA system is made up of Remote Telemetry Units (RTUs), a radio and telephone communications system, and a host computer system supporting the Customer Energy Operations Team (CEOT), which operates 24 hours a day, 365 days a year. Three classes of site are covered by the SCADA system:

- **Controlled regulator sites** where the SCADA system maintains a set fringe pressure by altering gas outlet pressures, either automatically or via remote manual control from the control room.
- **Monitored regulator sites** where outlet pressures are adjusted by field personnel and SCADA is used to alert the control room operators if pre-determined pressure alarm limits are breached.
- **Fringe sites** where SCADA is used to monitor the pressure at the lowest-pressure extremity of the system, allowing control room operators to react to pre-determined alarm limits.

Alarm limits and conditions have been set on the SCADA system which, when triggered, indicate abnormal conditions within the network. The limits, conditions, and required responses are reviewed annually following each winter peak.

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Figure 29: Age Profile of AusNet Services' RTUs (June 2016)



11.7.2 CURRENT PERFORMANCE

Currently, almost 50% of all high-pressure networks are operating under automatic control, with the remaining networks being monitored installations. There are also 12 low-pressure systems operating under solenoid control to vary the outlet pressure of district regulators via pre-determined time settings. This dynamic control of pressure is used to minimize leaks and unaccounted for gas (UAfG).

11.7.3 CAPITAL REQUIREMENTS

The Gas SCADA System Strategy (AMS 30-57) provides details on plans to expand the current SCADA coverage and implement further controlled installations to ensure and maintain levels of service as the network grows. Asset replacements are also planned when existing equipment reliability or capability is presenting significant risks. The SCADA system has an effective life driven by factors such as functionality, environment, technological obsolescence and the initial quality of the hardware.

The overall key drivers of SCADA capital program include network growth, improved consistency in network operation and fringe pressures, reduction in identified network risks, regulatory compliance and improved operating costs through greater automation.

The SCADA capital program falls within the following categories. Refer to the Gas SCADA System Strategy (AMS 30-57) for further details.

- End of Life Replacement – replacement of obsolete equipment with current technology.
- Common Earthing Installation – all identified city gate site to have common earthing installed.
- Slam Shut Indicator Installation – installation of slam shut indicators on B leg of identified sites.
- Cabinet Circuit Breaker Installation – installation of cabinet circuit breakers on identified RTU cabinets.
- Fringe RTU installation / relocation: As the size and flow characteristics of networks change, the fringe points of existing networks also change. Existing fringe points need to be relocated to more accurately control and monitor the network.
- Innovation: implement remote pressure loggers in order to obtain greater data accuracy on network performance for input to network modelling.

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11.7.4 OPERATIONAL REQUIREMENTS

An in-house team of qualified technicians maintain AusNet Services' SCADA network. Operational activities include:

- Periodic operational checks and full maintenance of core and auxiliary equipment;
- Breakdown maintenance as required; and
- Data collection activities.

AusNet Services' Gas Maintenance Plan (AMP 30-02) provides details of required maintenance frequencies for SCADA assets.

11.7.5 PLANT SPECIFIC STRATEGIES

The following plant specific strategies are employed for the management of AusNet Services' SCADA assets. Refer to the SCADA Strategy (AMS 30-57) for further details.

- Fringe point control to be implemented on selected high and medium pressure networks.
- Ongoing replacement of defective or obsolete equipment to ensure network integrity.
- Installation of equipment in order to increase safety of site including common earthing installations, Slam Shut Indicators and cabinet circuit breakers.
- Installation of pressure transmitters at critical customer sites.
- Increased network innovation including the implementation of new series remote pressure loggers.
- Review of communications technologies for integration with AusNet Services' "3 networks" SCADA strategy.

11.8 EXPOSED PIPEWORK

11.8.1 ASSET OVERVIEW

Exposed pipes consist of gas mains infrastructure located above-ground due to the requirement for the gas main to cross or straddle a natural or manmade obstacle. Typically, exposed pipes occur on roads, rivers, creeks and drainage crossings, as well as in some instances due to historical maintenance activity or previously removed above ground assets i.e. meter or regulators.

In total, AusNet Services has 70 sites classified as exposed pipework.

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Table table below provides a summary of exposed pipes within AusNet Services' network. Please note that most of the 70 identified locations feature multiple descriptors.

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Table 14: Asset Summary – Exposed Pipework³²

Description	TP	HP2	HP	MP	LP	Total
Pipe attached to side of bridge	-	1	14	2	2	19
Pipe suspended under structure	2	1	31	3	4	41
Pipe over railway	-	-	2	2	1	5
Pipe over channel	3	1	48	3	6	61
Pipe under walkway / roadway	2	1	31	3	4	41
Encased pipe / conduit	-	-	17	-	2	19
Pipe not exposed, but subject to erosion	1	-	1	-	-	2

11.8.2 CURRENT PERFORMANCE

Of the 70 exposed pipework installations, the vast majority were installed in the 1970's and 1980's, with a dramatic decline in their use post-1990 due to policy and technology developments. No new exposed pipework has been installed in the AusNet Services' network since 1997; instead, it has actively been removed. Eight sites have been decommissioned since 2006.

Periodic inspections of this asset class began in 2006 with 15 of the inspected sites initially 'failing' one or more of the inspection criteria (coating, pipework / corrosion, transition zone, supports and insulating pad conditions) and requiring priority repair works. Subsequent inspections have resulted in two repairs (2008 and 2011) of exposed assets.

11.8.3 CAPITAL REQUIREMENTS

As exposed pipework represents an increased risk both in terms of safety and security of supply, it remains AusNet Services' preference that above ground pipework be isolated and removed if alternatives are available, or decommissioning becomes possible. As such the future capital requirements of AusNet Services' above ground pipework assets are aimed at their removal from the system.

The basis of this approach is computer modelling of the individual networks featuring exposed pipework to determine if they can be isolated and removed without a detrimental impact on the natural gas supply to the area. This modelling may also indicate that removal is possible provided additional reinforcement mains are installed at an alternate location.

11.8.4 OPERATIONAL REQUIREMENTS

Inspection frequencies of exposed pipework is determined based on a risk based methodology. Inspections have been conducted to evaluate asset condition based on seven critical parameters;

- Coating;
- Crevice Corrosion;
- Mechanical Damage;
- Pitting and General Corrosion;
- Transition Zone;
- Insulating Pads; and
- Supports.

³² As at February 2013.

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Outcomes of asset assessments – where parameters are rated Fail, Borderline or Satisfactory – lead to the allocation of priorities; which in turn sets timeframes for future inspection or remediation. Sites that obtain a 'fail' score for any parameter must result in remediation works.

Further, exposed transmission pipelines and HP2 sites are inspected on an annual basis regardless of inspection outcomes due to asset criticality and public risk.

11.8.5 PLANT SPECIFIC STRATEGIES

The following plant specific strategies are employed for the management of AusNet Services' exposed pipework assets. Refer to AusNet Services' Exposed Pipework Strategy (AMS 30-55) for further details.

- Where possible, it is AusNet Services' preference that above ground pipework be isolated and removed if alternatives are available, or decommissioning becomes possible.
- Installation of exposed pipework as a last resort, following a risk assessment.
- Periodic inspections of all known exposed pipe assets through the application of AMS 30-19 Exposed Pipe Inspection Strategy.

11.9 LPG RETICULATION

11.9.1 ASSET OVERVIEW

AusNet Services owns and operates a liquefied petroleum gas (LPG) vapour reticulation network at Mt. Baw Baw alpine village from a single LPG source. The network is known as an island network, and is not subject to AusNet Services' Access Arrangement.

The network supplies reticulated gas to the village's commercial and club premises, and 2 gas-fired generators operated by AusNet Services (Electricity), which supply electricity to the mountain village. The network was commissioned in May 1998.

In total, the network comprises of 1,700m of polyethylene mains operated at 140kPa, supplying 33 metered customers.

11.9.2 CURRENT PERFORMANCE

The design of the distribution network provides for an approximate 20-year forecast of gas demand for the village, including the generator station. At present it is functioning at 50% of available capacity (Total capacity = 750m³/hr).

No new applications for gas have been received for the Mt Baw Baw network in last 5 years.

11.9.3 CAPITAL REQUIREMENTS

Due to the physical size and unutilised capacity within the network, capital requirements to 2020 are limited.

In 2013, all meters at Mt Baw Baw were replaced as part of the time-expired meter replacement program. This was combined with the upgrade of consumer regulators as a precaution due to tampering of the over pressure shut off (OPSO) device.

Refer to AusNet Services' Mt. Baw Baw LPG Reticulation Network Strategy (AMS 30-58) for further details.

11.9.4 OPERATIONAL REQUIREMENTS

Maintenance is conducted annually on all LPG assets at Mt. Baw Baw including:

- Leakage survey of the total mains, service and meter/regulator system; performed by walking the entire reticulation system, including regulator/ meter installations and generator room, with a specialised highly sensitive gas detector,
- Operational check of the gas reticulation system isolation valve.
- Gas samples from the two odorant test points are also taken and tested, ensuring they are within required levels.

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Elgas Ltd is the owner of the LPG tank supplying the reticulation network. They are responsible for the control, maintenance, safety and security of the LPG storage vessel, its associated pressure regulators, vaporizer unit and pipework to the boundary of the security compound.

Energy Safe Victoria conducts an annual audit of the facility usually coinciding with programmed maintenance.

Refer to AusNet Services' Mt. Baw Baw LPG Reticulation Network Strategy (AMS 30-58) for additional details on operating and maintenance programs.

11.9.5 PLANT SPECIFIC STRATEGIES

The following plant specific strategies are employed for the management of AusNet Services' alpine LPG reticulation assets at Mr Baw Baw.

Refer to AusNet Services' LPG Reticulation Strategy (AMS 30-58) for further details.

- Increased signage requirements to increase public awareness and safety.
- Installation of meters at currently unmetered sites and the Elgas vaporizer to enable accurate measurement of Unaccounted for Gas (UfG) and subsequent carbon emissions.

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12 GLOSSARY

ACCC	Australian Competition and Consumer Commission
AEMO	Australian Energy Market Operator
AER	Australian Energy Regulator
AMS	Asset Management Strategy
CEOT	Customer and Energy Operations Team
CNG	Compressed Natural Gas
CP	Cathodic Protection
CTM	Custody Transfer Meter
DB	Distribution Business
DEDJTR	Department of Economic Development, Jobs, Transport and Resources
DTS	Declared Transmission System
EMS	Environmental Management System
EPA	Environmental Protection Agency
ESC	Essential Services Committee
ESV	Energy Safe Victoria
FSA	Formal Safety Assessment
GDSC	Gas Distribution System Code
GIS	Graphical Information System
GSC	Gas Safety Case
KPI	Key Performance Indicator
LNG	Liquefied Natural Gas
MAOP	Maximum Allowable Operating Pressure
NECF	National Energy Customer Framework
NGL	National Gas Law
NGR	National Gas Rules
OEM	Original Equipment Manufacturer
One-in-two	An effective degree day of 14.60 with a 50% chance of exceeding this value in any given year
OPSO	Over-Pressure Shut Off
Q4	Asset management Database
RCM	Reliability Centred Maintenance
SCADA	Supervisory Control and Data Acquisition
STEM	Strengthen, Transform, Extend and Modernise
Tariff D	The peak gas demand charge assessed for industrial and commercial customers
Tariff V	The tariff charged by volume for domestic customers
TLPG	Tempered Liquid Petroleum Gas

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TP	Transmission Pipeline
UAfG	Un-Accounted for Gas
UCAIDI	Unplanned Customers Average Interruption Duration Index
USAIDI	Unplanned Supply Average Interruption Duration Index
USAIFI	Unplanned Supply Average Interruption Frequency Index
VAPR	Victorian Annual Planning Report
VTS	Victorian Transmission System
VEC	Victorian Electrolysis Committee
SAP	Enterprise-wide software system.