Jemena Gas Networks (NSW) Ltd

2020-25 Access Arrangement Proposal

Attachment 5.1

Capital expenditure

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Abbreviations

AA	Access Arrangement
AER	Australian Energy Regulator
ALARP	As Low As Reasonably Practicable
CABS	Customer and Billings System
Capex	Capital Expenditure
DBYD	Dial Before You Dig
ELMS	Emergency Load Management System
GIS	Geographic Information System
HSE	Health and Safety Executive's
I&C	Industrial and Commercial
km	Kilometre
MDLs	Meter Data Loggers
NBN	National Broadband Network
NGO	National Gas Objective
NGR	National Gas Rules
RF	Radio Frequency
RIN	Regulatory Information Notice
STTM	Short Term Trading Market
TRS	Trunk Regulating Station
UAG	Unaccounted for Gas

Overview

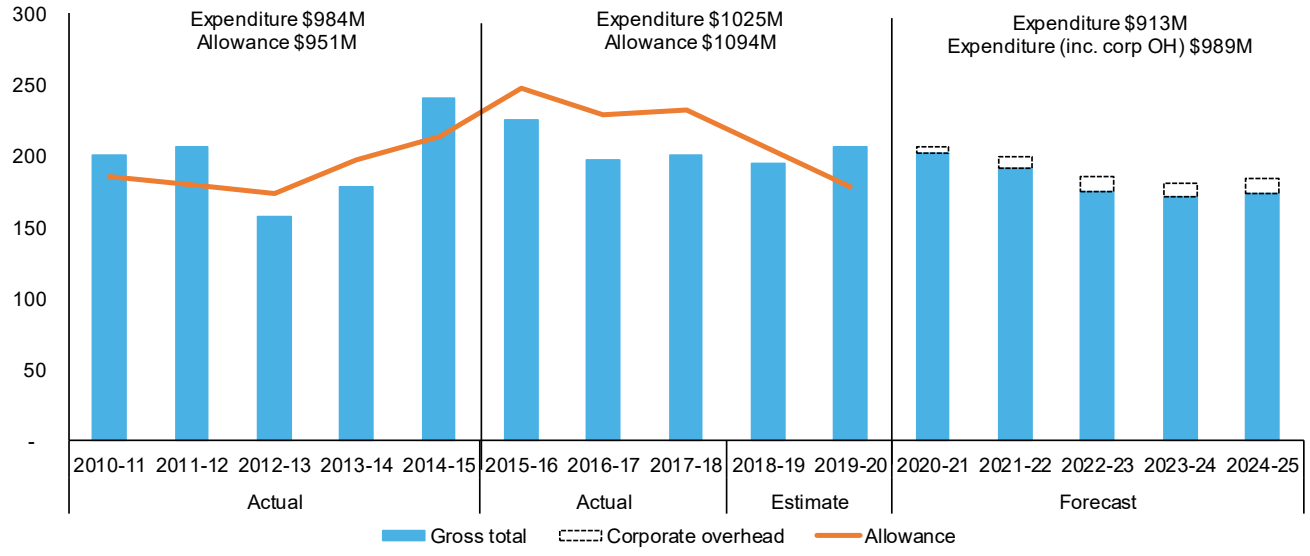
Our capital expenditure (**capex**) program is focussed on delivering outcomes for our customers. We invest to remove unacceptable safety risks, maintain our current standard of service and lower bills (by connecting new customers).

Over the 2020-25 period we propose to continue to invest in:

- **Connections** – Allowing us to spread out our largely fixed costs across more customers and improve affordability, which customers told us was their first priority.[1] The 130,000 new customers we will connect will result in about $300M in bill reductions ($200 per customer) over the period to 2050.
- **Meter replacement** – Replacing defective and inaccurate meters so that our customers' bills reflect their usage, and avoid estimated bills which customers told us are frustrating.[2]
- **Facilities and pipes** – Ensuring we can continue to safely operate our ageing high pressure facilities and pipelines in line with customer expectations: that we do not compromise on safety.[3]
- **Information technology (IT)** – Maintaining the IT systems that enable our business operations. These systems allow us to remotely operate the network to keep it safe, minimise billing errors and quickly identify where it is safe and unsafe for third parties to dig.
- **Augmentation** – Strengthening our network to ensure that we can continue to connect new customers and reduce safety risks borne by our customers and the public. We received customers endorsement on our strategies to building two new secondary mains to reduce risks from the Sydney Primary Main.
- **Mains replacement** – Replacing 146km of deteriorating mains to improve the safety, efficiency, capacity and reliability of our network. Customers endorsed our plan to take a risk based approach to replacing these mains.
- **Other** – Investing in our properties, fleet and equipment to ensure that we can continue to safely operate our network.

In the 2020-25 period we are forecasting to spend less than both the Australian Energy Regulator's (**AER**'s) allowance and our actual spend in the 2015-20 period.

Figure OV–1: Our capex over time ($2020, Millions, including overheads)



1 Straighttalk 2018, *Jemena customer engagement report*, p.11 (included in Attachment 2.2)

2 Straighttalk 2017, *Customer engagement report,* p.15 (included in Attachment 2.2)

3 Straighttalk 2018, *Jemena customer engagement report*, p.24 (included in Attachment 2.2)

Table OV–1: Capex over the 2020-25 period ($2020, Millions including overheads)

	2020-21	2021-22	2022-23	2023-24	2024-25
Connections	93.0	84.7	84.5	85.7	89.2
Meter replacement	21.1	22.6	26.5	30.0	32.5
Facilities and pipes	29.1	23.5	7.9	7.7	13.5
IT	16.3	22.8	27.0	19.9	21.3
Augmentation	19.1	22.1	14.8	12.0	0.7
Mains replacement	13.6	6.8	7.6	10.8	11.7
Other[4]	9.8	8.4	6.8	4.8	5.0
Gross total	202.1	190.9	175.0	170.9	173.9
Contributions	5.1	2.0	2.0	2.1	2.1
Net total	**197.0**	**188.9**	**173.0**	**168.9**	**171.8**

How customers guided the development of our capex forecast

Section 1 of this document outlines how we pushed out the customer engagement frontier to involve customers in the development of our capex forecast and how we have considered the views provided by customer advocacy groups.

In additional to getting a high-level view on what customers value, we sought detailed direction from our customers on how to respond to the uncertainty our gas network faces. Over a series of three days, with five separate groups of customers across NSW, we outlined the uncertainty facing the gas network, and presented different views on what may occur. We then discussed with customers investment options and the potential implications of each choice. With this information at hand customers were able to provide us with guidance based on their values and preferences.

We used the direction provided by customers, and most importantly their reasoning, to develop our Draft 2020 Plan.[5] We subsequently checked with customers whether we heard them correctly and had made the right decisions. Customers endorsed the three specific programs we engaged them on.

Our investment performance

Section 2 highlights our track record of efficient and prudent investment, our industry leading asset management system and how we continually adapt our investment plans.

Our evolving investment program

Section 3 provides a category by category view of how our investments create customer value and in turn are justified in accordance with the National Gas Rules (**NGR**). We outline the material changes that have occurred over the 2015-20 period and how this has informed the development of our 2020 Plan.

At a high level our performance over the 2015-20 can be summed up as connecting more customers (resulting in lower bills) and reprioritising our program to reduce capex elsewhere (resulting in lower bills).

We were able to do this by focussing our investments on responding to the surge of new connections, driven by Sydney's housing boom and our market positioning. To provide a sense of scale, in 2017-18 we connected almost

4 Other includes property, fleet and SCADA (the system which controls our network).

5 In January 2019 we published a draft of our 2020 Plan for consultation. We did this to ensure that the decisions we make about our services, costs and prices accurately reflect our customers' priorities and long-term interests.

as many dwellings as all gas distribution businesses in the UK[6] – who collectively have a customer base of about 27 million.

Additional connections is fantastic news for our existing (and new) customers as they allow us to spread our largely fixed costs across more customers and lower customer bills. They are, in part, what has allowed us to propose the price reductions included in our 2020 Plan.

To ensure that we make these connections and lower bills, we reprioritised our capex program, by taking advantage of changing circumstances and new information to find cost savings elsewhere.

Our best practice management systems and processes—we are the first utility in Australia to be jointly certified to ISO 55001 (asset management) and ISO 27001 (information security management) standards—helped us constrain our costs and offset the increase in connections capex. These cost savings have translated into a lower asset base (relative to what we had forecast in our 2015 Plan), which have also contributed to the price reductions included in our 2020 Plan.

These changes reflect that our plans are dynamic. Rather than 'set and forget' we continually review and adapt our program. Over the 2015-20 period we were able to identify and take advantage of a number of opportunities to deliver greater customer value – at a lower cost than allowed by the AER.

Our 2020 Plan is built on the cost savings we have achieved over the 2015-20 period— which has enabled us to forecast an overall reduction in capex from the 2015-20 period.

We have also been extremely conscious of the future uncertainty we face and have engaged customers to help identify which investment options best achieve the National Gas Objective (**NGO**).[7] Our 2020 Plan only includes investments which generate enough customer benefits by 2050 to exceed the costs.

Compliance with the NGR

Section 4 summarises the compliance of our capex with rule 79 requirements. Further detail on the justification of our capex forecasts is set out in RIN Document Index[8] as well as in project specific documentation.

Further information

This document supplements Chapter 5 of our 2020 Plan. It serves as a bridge between the summary provided in Chapter 5 and the detailed technical material provided in project and program specific materials.

As set out in Table OV–1-2 and Table OV–1-3 further information is available in attachments to our Access Arrangement (**AA**) Proposal together with our response to the AER's Regulatory Information Notice (**RIN**). A more detailed mapping of our documentation is provided in our Document Index.[9]

Table OV–1-2: List of capex attachments in our 2020 AA Proposal

Attachment	Name	Author
5.1	Capital expenditure	JGN
5.2	Capital expenditure forecast model	JGN
5.3	Network Asset Management Plan	JGN
5.4	Information Technology Plan	JGN
5.5	BIS Oxford Economics Input cost escalation	BIS Oxford Economics

6 In 2017-18 UK's gas distribution businesses collectively connected 61,238 customers. See Ofgem 2019, *RIIO GD1 Annual Report 2017-18 Supplementary data file*. In 2017-18 we connected 58,958 dwellings in 2017-18.

7 Clause 23 of the National Gas Law.

8 RIN Attachment 16 - JGN - Document Index - 20190630 - Public.pdf

9 RIN Attachment 16 - JGN - Document Index - 20190630 - Public.pdf

Table OV–1-3: List of capex supporting information attached to our RIN response

Category	Documentation
Overarching documents	• Asset Class Strategies (for Facilities, Pipelines, Networks, Measurement, Fleet, Property and SCADA) • Connections and metering forecast methodology • Jemena Infrastructure Cost Estimation Methodology • IT capex forecast and governance guide • IT capex forecast model • Delivery plan • Minor capital budgeting and project approval
Connections	• Connections capex forecast model • NPV model of our 2020-25 connection program
Meter replacement	• Meter replacement capex forecast model • Meter replacement volume model • 4 Options analysis's[10] • 10 Opportunity Briefs[11] and Project mandates[12]
Facilities and pipes	• 11 Options analysis with supporting NPV models • 9 Opportunity Briefs and Project mandates • GPA Engineering risk reports
IT	• 20 Investment briefs • ERP corporate white paper
Augmentation	• Capacity augmentation development plan with supporting NPV models
Mains replacement	• 6 Options analysis's with supporting NPV models • 6 Opportunity Briefs and Project mandates
Other	• Fleet model • Property justification paper • 5 Opportunity Briefs and Project mandates • 1 Investment brief

All capex in this document is presented on a direct costs $2020 basis unless otherwise stated to ensure all capex is shown on a like-for-like basis.

10 These documents analyse the credible options to identify the preferred solution and have been provided for projects with forecast costs above $2 million or for groups of similar projects which total more than $2 million.

11 These documents are pre-project development documents detailing the problem and credible solution options and have been provided for projects scheduled beyond 2021 or which are forecast to cost less than $2 million.

12 This document is a pre-project development document for projects which have progressed from the Opportunity Brief stage. This document has been produced our Front End Engineering Design team and has been produced for documents scheduled during 2021 and which are forecast to less than $2 million.

1. How customers guided the development of our capex forecast

We sought customers' views to inform the development of our capex program. We also sought and considered the feedback provided by consumer advocacy groups.

Customers' views were most valuable where several investment options meet the requirements of the NGR. To identify the option that best achieves the NGO we must balance and trade-off each component of the objective. Our customers, informed of the trade-offs and consequences of different options, are best placed to tell us which option best meets their needs and values.

We asked our customers, after providing sufficient context over several sessions, to provide guidance on how we should invest given the uncertain future facing the gas network.[13] We asked our customers whether we should shorten the time horizon used when developing our capex program and *why* they came to their position.

Although customers were concerned about affordability they told us to invest for the long term, even though this option costs more in the short term. They told us that they preferred we build more capacity now—recognising that this capacity might not be used if the gas network declines—to reduce the risk that we have to undertake rework in the future. Customers also told us to be bold and invest with confidence.

We used this feedback to inform the development of our Draft 2020 Plan. We listened to customers' rationale and sought to balance their concerns about affordability with the circumstances of each investment. Overall we ended up adopting a range of options from investing for the medium term to the long term, depending on the specific circumstances of each project.

After the publication of our Draft 2020 Plan, we tested our plans with customers to ensure we heard and acted on their feedback correctly. A majority of customers endorsed the decisions we made. Where customers disagreed it was generally because they thought we should be investing *more* rather than less.

Consumer advocate feedback was more wide-ranging, touching on a large number of matters related to our capex plans. This valuable advice was also considered in the development of our proposal.

1.1 Medium or long term investment horizon?

In Chapter 3 of our 2020 Plan and Attachment 7.11 we discuss the growing uncertainty around the future of our gas network. In the past, there was never any doubt that our network would continue to grow and be used. Now, although large numbers of customers are connecting, growth in peak usage is slowing, average consumption is falling, and the NSW Government has introduced a net-zero carbon policy which could see utilisation of the gas network reduce or cease altogether.

In preparing our Draft 2020 Plan we considered responding to this uncertainty by either:

- **Investing for the long-term – with a horizon of beyond 2050,** assuming current levels of growth and use of the network will continue, with no impact from government policies to reduce carbon emissions. This option will deliver the lowest cost solutions to customers if growth continues. However, if the growth reduces there is a risk we build infrastructure that isn't required.
- **Invest for the medium-term – with a horizon of 2050,** assuming that future levels of growth and usage reduce. Under this option we account for the risk of reduced growth and usage by avoiding building infrastructure that might not be required. If customers transition away from gas this would be the right thing to do. But if current levels of growth and utilisation continue we will have to undertake additional upgrades later at higher overall costs.

Our investment program is focussed on customers. We invest when customer benefits exceed the costs of the investment – consistent with the NGO and requirements of the NGR. The only difference between investing for

[13] See Chapter 3 of our 2020 Plan for more information.

the long and medium term is the investment horizon: whether we include customer benefits realised after 2050 in deciding whether or not to invest.

In considering what investment approach to take, we have not considered *when* customers pay for the investments made. Given the uncertainty around our gas network, there is a risk that customers in the near term receive most of the benefits while customers beyond 2050 pay most of the costs. We are seeking to mitigate this by aligning when customers pay for and receive the benefits of each investment (see attachment 7.10).

However, at this stage the uncertainty does not impact all categories. This is true whenever customer benefits provided over the 25 years to 2050 exceed the investment costs. This means at this stage the following categories are unaffected:

- **Connections** – Which will deliver $300M of bill reductions by 2050—even after taking into account of the additional investment required.
- **Metering** – We need to replace inaccurate and defective meters to continue to provide accurate billing (and minimise customer frustration), a crucial part of the service we provide.
- **Facilities and pipes** – Investments required to keep our ageing network safe. Without these investments we would not be able to continue to safely operate our network up to 2050.
- **IT, fleet and property** – To continue operating our network we need to replace poor condition vehicles and end of life IT systems. These investments don't affect our service beyond 2050, as we do not expect the IT systems and vehicles purchased in 2025 to still be in operation 25 years later.

The differences lies in those investments which have the potential to be used and provide customer benefits over a longer period of time. Specifically:

- **Augmentation** – In planning our deep[14] infrastructure—the mains that transport gas to local streets—do we build infrastructure to provide enough capacity up to 2050 or do we provide capacity for the longer term (i.e beyond 2050)?
- **Mains replacement** – While we will continue to replace our ageing deteriorating mains to reduce leaks—thereby lowering safety risks, preventing costs from increasing and improving network capacity and reliability—should we go further and replace additional deteriorating mains to reduce costs over the longer term and prepare the network for hydrogen or some other low-carbon alternative?

Neither option impacts safety or reliability but there are different bill impacts—depending on whether the gas network is thriving or declining in 2050 and whether we invest for the long term or medium term.

- **If gas network usage declines** network bills will *increase* regardless of our investment approach, as there will be less customers to spread our largely fixed costs across in the future.

  In this scenario investing for the medium term would be the best approach. It results in smaller bill increases as we avoid building infrastructure that isn't required. The medium term approach saves customers about $12 per year over the next 40 years, relative to the long term approach.

- **If usage of the gas networks thrives** network bills will *fall* as we divide our largely fixed costs across less customers, regardless of our investment approach.

  In this scenario the longer term approach is best. Taking a medium term approach would result in lower bills initially but we will have to go back and install additional infrastructure (as we did not install enough capacity) at a higher cost. We estimate that the long term approach would save customers an average of $2 per year over 40 years.

Overall customers told us that they were comfortable paying for new investments earlier as this could be easily reverted in the future with no negative repercussions. This is done by reducing asset lives and shortening the

[14] By deep we mean the higher capacity mains and facilities which form the backbone of our network.

period over which customers pay for the investment. However, customers were much more uncomfortable with the prospect of having to go back and invest more in the future to make up for less investment today. Customers told us that they value the future implications of today's decisions. Implicitly, customers recognise that changing asset lives is something that could be revisited as the future becomes clearer without impacting service quality or reliability while changing investment strategies does not.

1.2 Guidance from our customers

In developing our Draft 2020 Plan we sought direction from our customers. Most customers (72%) preferred a long term approach. Customers told us:

- To limit how much rework we do in the future – to reduce additional traffic disruption and repairs to local (non-gas) infrastructure.
- Rework is wasteful and that we should install the right amount of infrastructure in the first place.
- Excess capacity is not as wasteful as it could be used by future generations.
- Be bold and invest with confidence.

We took this direction and balanced it against other feedback we received, including that affordability is customers first priority and that we should maintain current levels of reliability and safety. We then applied this feedback to two areas of our capex program:

- Augmentation – how much capacity do we install when building the deep infrastructure required to connect new customers?
- Mains replacement – should we accelerate our mains replacement program to realise the benefits of newer mains earlier and prepare for hydrogen or some other low-carbon alternative?

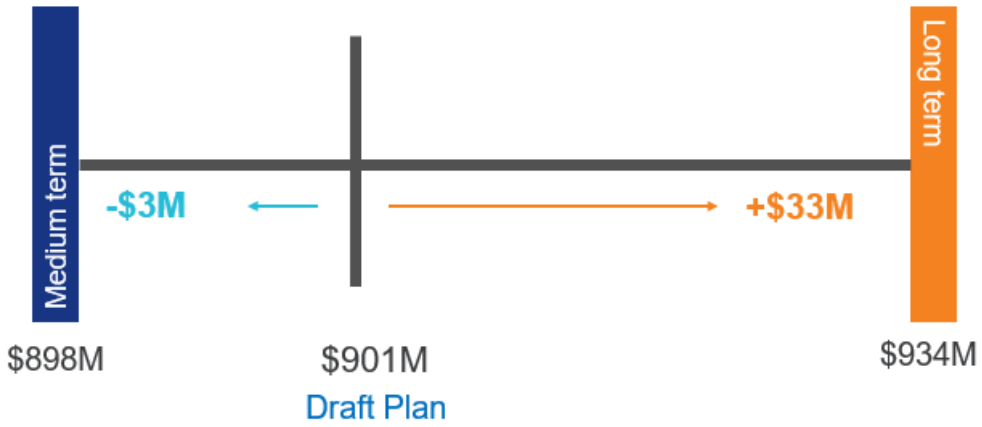
Although not directly related to the medium versus long term investment question, we also sought customer views on whether we should prioritise short term affordability or reducing costs overall. To do this we asked customers for their preference on two potential options to continue to supply gas in Sydney's north.

Following the publication of our Draft 2020 Plan we held a fourth customer forum. Our goal was to check whether we heard their feedback correctly and seek views on our Draft 2020 Plan. The following sections outline customer feedback from our fourth forum, which we held in March 2019.

1.2.1 Augmentation

Our Draft 2020 Plan opted for a mixed approach for augmentation: a combination of long and medium term solutions across different areas of our network. Figure 1-1 (which we presented at our fourth customer forum) shows how adopting either a medium or long term approach for augmentation would have changed our Draft 2020 Plan capex forecast.

Figure 1-1 Draft 2020 Plan combination approach for augmentation



We chose a long term approach when the likelihood of further development in the future is high (such as when there are future plans for development nearby) and when the costs of providing additional capacity now is relatively low.

We chose a medium term approach where we do not expect significantly higher costs in the future or where the chance of additional development is low.

This can be seen in our plans to bring gas to the Aerotropolis – the centre of Sydney's Western Parkland city which is expected to grow by 464,000 people and 180,000 dwellings by 2036. Bringing gas to the Aerotropolis requires three separate mains. These mains could either be installed with a diameter of 200mm (medium term capacity) or 250mm (long term capacity).

For the two mains which supply the central areas of the Aerotropolis, we are proposing to install larger diameter pipes as these areas are highly likely to require additional capacity in the future. Installing additional capacity to these areas later would cost significantly more than laying larger diameter pipes upfront— about $10M later rather than an additional $2.5M now.

We adopted a different approach for the third main, to the Sydney Science Park. Based on the development plans we have seen, it is unlikely that additional capacity will be required in the future. As a result, we propose to save on costs now by only building a medium term solution.

Outside of the Aerotropolis we went with a medium term approach, as we thought it would be unlikely that any of the areas we evaluated would require capacity above what the medium term option provides.

We took this approach based on feedback from customers. It balances customers concerns about affordability and their desire for a long term approach. It also limits current period investment while lowering the risk of higher costs and greater levels of traffic disruption and restoration from future rework. However, this approach is more cautious than bold.

At our fourth customer forum we worked through the Aerotropolis example. We showed the cost differences between medium and long term options and the associated risks. This includes installing capacity that is potentially not used, or alternatively, incurring higher costs in future if we rework is required to install additional capacity.

We asked our customers to vote on whether we should stick with our Draft 2020 Plan approach or change. Just over half of our customers at the forum (53%) voted for sticking with the combination approach included in the Draft 2020 Plan. Our customers told us: [15]

[15] Attachment 2.2 - JGN's customer engagement, RPS, pp. 22-23

> *It seems the reasons behind why we voted long term have been listened to, but the decision not. An approach that covers both options in parts seems to be the best solution.*
>
> *I think that the scale of the Aerotropolis means that it should logically be planned for the long term, but that just as Jemena has planned, it makes sense for the Science Park [to] less likely expand as dramatically, meaning that a medium-term plan for that area is more than reasonable.*

Of the remaining customers, 34% voted for the long term approach. Customers reported that:[16]

> *We agreed to plan for the long term, and this is not shown in your plan.*
>
> *With Sydney's growth, I would have thought you would look at the long term. Bold, confident, show consumers you are here for a long term, not short term.*
>
> *Part of projects aligns with forums, but not all. Forums except Bathurst said, "Think big." I would plan for larger demand in all three areas because I have seen incredible growth in the Western Sydney area, and the increased cost will pay off if hydrogen is successful (and I think it has to be successful).*

The remaining customers (13%) said we should adopt a medium term approach. Customers raised several concerns including whether developers or governments should instead fund the works and whether regional customers will benefit from the investment.

Customers are correct that under the current regulatory arrangements most of the augmentation costs will be funded from all customers (regional and metropolitan) with limited contributions from developers or governments.[17] But this does not mean bills will be higher. The additional cost is more than offset by the bill reductions which flow from connecting new customers (who will share in the largely fixed costs of our network across more customers).

Our entire augmentation program will lead to bill *decreases* of about $35M by 2050 – or about $20 per customer.[18] We are confident that this investment will help achieve our customers priority to improve the affordability of gas while providing new customers access to gas, a service our current customers have told us they value.

Consistent with the direction provided by the majority of our customers, we are proposing to maintain our mixed approach for augmentation.

1.2.2 Mains replacement

Our Draft 2020 Plan adopted a medium-term approach for mains replacement.

We decided not to adopt a long-term approach, which would require accelerating our program to remove all cast iron mains. This option would cost more initially but would allow us to begin realising the benefits of newer mains sooner and help prepare the network for a possible hydrogen future, should this be a viable alternative to natural gas.

Figure 1-2 (which we presented at our fourth customer forum) shows how adopting a long term approach for mains replacement would have increased our Draft 2020 Plan capex forecast.

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16 Ibid, p.22

17 Consistent with the requirements of the NGR, we charge contributions where the cost of connecting a new customer exceeds the expected revenue. This ensures that existing customers will not be worse off. We also work with Governments as much as possible to ensure we find the lowest cost solution.

18 Our augmentation program will $35M in benefits (revenue – expenditure), see JGN-2-3.15-2-Capacity Augmentation Development Plan-NPV Model (1) -50 years-20190630-public. We calculate the benefit per customer by dividing the benefits ($35M) by the number of customers forecast to be connected in 2025 (1.5M).

Figure 1-2 Draft 2020 Plan approach for mains replacement

Unlike with augmentation, it is the medium term approach that leads to a smaller amount of traffic disruption and restoration works, at least in the short term. The only difference between approaches is *when* we replace each area of mains. If the network continues to grow we will replace areas of deteriorating mains later. There is limited risk of rework, additional tariff management or restoration works.

While customers told us to invest for the long term, the medium term option for mains replacement was more consistent with the reasoning provided. The medium term option has the lowest initial cost and requires the smallest amount of disruption (as we schedule to replace the lowest risk mains to be replaced later). This option delivers on affordability, but is more cautious than bold.

At our fourth customer forum, we asked our customers whether the mains replacement program should stay as is or whether we should accelerate it. 91% of customers voted for us to stay with the current timing. They said:[19]

> *We haven't been asked before about the mains, but I'm happy with how Jemena is managing things.*
>
> *Today we have talked about the mains, and I'm happy with how Jemena manages the Mains Replacement Program.*
>
> *Even spread of replacement which keeps the cost control is the best way to go; keep replacement limited to needed basis.*

As customers endorsed our Draft 2020 Plan approach we have continued to adopt a medium term approach.

1.2.3 Sydney Primary Main Integrity Management (Lane Cove to Willoughby)

Despite not being a trade-off related to the future uncertainty of the gas network, we asked our customers about our plans to construct two new mains to supply Sydney's northern beaches.

We need to take steps to reduce the risks of continuing to operate the Lane Cove to Willoughby section of the Sydney Primary Main, one of the oldest parts of our network.[20] We have two credible options:[21]

1. Build two new secondary mains to strengthen supply in Sydney's north allowing us to reduce risks to an acceptable level by lowering the pressure of the Lane Cove to Willoughby section of the Sydney Primary Main. This would cost $27.8M.

[19] Ibid, p.24

[20] Further details on our steps to reduce mitigate the rising risks of continuing to operate the Sydney Primary Main are set out in section 3.4.4.

[21] The numbers presented here are consistent with the 2020 Plan. However, 2020 Plan numbers are presented with overheads while numbers in this document are not.

Reconfigure the Lane Cove to Willoughby section of the Sydney Primary main so that we can inspect it with an intelligent pig. We would still need to build the two additional secondary mains to address capacity issues in the 2030s. As a result this option would cost $19.3M now and an additional $24.5M later providing a total cost of $43.8M.

Our preferred solution is to build the northern secondary mains earlier (option 1). This will allow us to lower the pressure of the last leg of the Sydney Primary Main. Operating the main at secondary pressure reduces the consequences of a gas escape (and in turn the risks to the public) removing the need to pig the main.

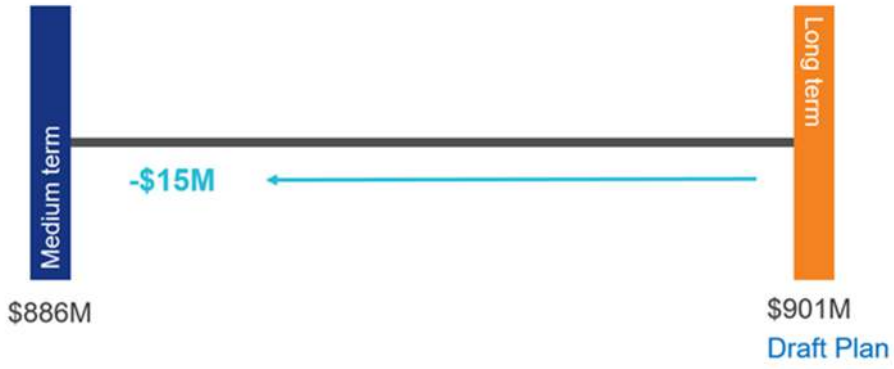
Building the northern secondary mains now has a lower long-term cost, and results in a substantially safer network—mainly by reducing the consequence of a third party hit in a densely populated area—but has a higher capital cost in the short term.

Our preferred option would cost $27.8M (with $24.5M in 2020-25) rather than a total of $43.8M (with $15.7M in 2020-25).

We asked our customers whether we should prioritise short term affordability or lowest overall costs.[22]

Figure 1-3 (which we presented at our fourth customer forum) shows that adopting option 2 would reduce our the capex forecast set out in our Draft 2020 Plan *for the 2020-25 period.*

Figure 1-3 Draft 2020 Plan approach for Sydney Primary Main integrity project



80% of customers voted to prioritise reducing overall costs instead of short term affordability. Customers told us:[23]

As far as this example goes, it makes much more sense to do it once and do it properly.

The short term extra spend is worked around by the fact that so much money will be saved in the long term.

Lower overall cost option—right decision.

Feel Jemena is best placed to make this decision. I feel like you are making the right choices for the situations relating to different projects.

Given the customer support for this project, our 2020 Plan includes the costs of installing two new secondary mains to supply northern Sydney's rather than upgrading the last leg of the Sydney Primary Main. Doing so will allow us to de-rate the last leg of the Sydney Primary Main from Lane Cove to Willoughby and in turn reduce the risk to the public.

22 We did not discuss the risk benefits from lowering the pressure of the primary man.

23 Ibid, p.24

1.3 Guidance from consumer groups

We received two submissions on our Draft 2020 Plan. One from PIAC and the other from ECA (who also attached a report from its consultant, TRAC partners).

1.3.1 Medium and long term investment approaches

The ECA supported the adoption of a medium term approach to all investment, rather than the mix of medium and long term investment that we are proposing. The ECA considered that:[24]

> *It appears to us that, in circumstances where there may exist uncertainty about the long-term usage of the network, adopting a medium-term approach to these investments could be a better "no regrets" solution than spending more on the particular investments. This is because:*
>
> *• if growth continues, while additional expenditure will need to be incurred in the future, it will only result in a negligible increase on average charges over time.*
>
> *• However, if the network is in decline in the future, the increase in charges that may arise at that point in time will be significantly less than had a long-term approach to investment been adopted (because of the higher asset base value).*
>
> *• If growth continues, there will be additional inconveniences to consumers – such as traffic congestion caused by the need to undertake dig-ups to lay additional pipework. However, this can be managed.*

We recognise the merits of adopting a purely medium term approach—especially if the risks to the gas network are realised and the network declines. However, we have decided to maintain the approach set out in our Draft 2020 Plan as it is consistent with the feedback we received from our customers.

As a general principle, where customers have voted in support of a proposal, we have incorporated it into our 2020 Plan. We recognise that in some instances this has meant that our proposal is at odds with feedback from views from other stakeholders. However, consistent with our engagement objectives (discussed in Chapter 2 of our 2020 Plan), we have sought to ensure that customers' views shape our regulatory proposal. We also believe that the NGO will be achieved to the greatest degree when our customers' views are reflected within our proposal.

1.3.2 Cost recovery mechanisms for large infrastructure projects

Similar to customers, the ECA questioned the current cost-recovery mechanisms for large infrastructure projects of national and state significance. Noting that customers of gas (who also use electricity) will fund both new electricity and gas infrastructure for the Aerotropolis.

It's important to keep in mind that while our customers will be funding most of our augmentation projects, they will not pay more. Bills will not increase. The costs of the investment will be offset by the bill reducing effects of spreading our largely fixed costs across more customers.

The only decision we can make is to either invest or not, as Government policy and regulatory settings are beyond our control. As these investments will deliver customer benefits (via bill reductions) we have included them in our 2020 Plan.

1.3.3 How to fund large projects

The ECA suggested that we think harder on how projects are funded and cited the example of Endeavour Energy's approach to connecting the Aerotropolis. Endeavour Energy initially forecast to spend $61.2M.[25] It later revised

[24] ECA 2019, Submission Jemena Gas Networks Draft 2020 Plan, p.14

[25] Endeavour Energy 2019, *2019-24 Capital Expenditure Plan, Western Sydney Aerotropolis,* p.18

the proposal to spend $68.3M, but in two parts $39.3M now and $29.0M in later periods.[26] Endeavour Energy said it considers this option to be efficient as it provides the flexibility to respond as capacity constraints as they arise in future periods.

While we don't know the details of Endeavour Energy's plans, at a high-level the central trade-off is similar to the ones we explored with customers. The Endeavour Energy choice could be seen as a choice between a medium or long term approach. Alternatively, the Endeavour Energy choice could also be characterised as a trade-off between prioritising short-term affordability or reducing overall costs.

Either way, the direction provided by our customers is to invest for the long term and to focus on reducing overall costs rather than short term affordability. This means that adopting an Endeavour Energy style solution, based on feedback from our customers, would not best achieve the NGO in our circumstances.

1.3.4 Other issues raised

ECA and PIAC raised a variety of other issues that relate to capital expenditure. These are discussed in Table 1-1 below.

Table 1-1: Submissions on our capex plans and how we are responding

Author	Feedback	How we are responding
ECA	We would like JGN to outline in more detail the following information (and we would expect the AER to require such detail): JGN's risk management framework to determine priorities for capital expenditure initiatives. In particular, to ensure that all regulatory obligations are being met, but also to ensure that saving expenditure in one period on preventative maintenance does not lead to greater expenditure being incurred in subsequent periods on reactive maintenance. Having this further explanation provided will also give us greater comfort with the prudency and efficiency of the capital expenditure forecast for 2020-25. The reasons for the significant variances in these expenditure line items.[27]	Section 3 provides a detailed summary of our capex program including our 2015-20 capex performance and the efficiencies we have achieved flow through to our 2020-25 forecast. Further detail on our risk management framework is also provided in our Network Asset Management Plan.[28]
ECA	..indicate how JGN will pursue productivity improvements in its capital expenditure program.[29]	We have integrated productivity in several ways. First, we have flowed through all the efficiencies savings we have achieved in the 2015-20 period into the 2020-25 forecast. Second, we have included future productivity savings such as from the removal of our hot water metering product. Third, in preparing a lean capex forecast we bear a higher risk of spending additional capex with a reduced prospect of finding offsetting cost savings. For instance we may need to move forward mains replacement projects in certain locations if leak tests reveal worse than expected main deterioration.

[26] Ibid, p.18

[27] ECA 2019, Submission Jemena Gas Networks Draft 2020 Plan, p.14

[28] Attachment 5.3 of our AA proposal.

[29] Ibid, p.14

ECA	Connections capital expenditure – while we support the principle of the cost of connections being included in the asset base (on the understanding that it would lead to an overall reduction in the network charges for each customer), it would appear that JGN does not compare favourably with industry peers. We would like further clarification on the prudency and efficiency of the forecast connection capital expenditure given that it represents 45% of the total forecast capex being proposed during the 2020-25 period. [30]	We agree that connection capex should be included in the asset base, due to the immense customer value it delivers to existing and future customers. Our connection costs compare favourably to other businesses, once different market segmentation and operating contexts are taken into account. We provide further details on our connections forecasting approach in our connections and metering forecasting methodology document.[31]
ECA	We would also like JGN to outline the extent to which the replacement capex it proposes to incur will align with the AER's industry practice application note for asset replacement planning. [32]	Our capex forecast was developed through our ISO 55001 certified asset management system – we are the first Australian utility to be jointly certified to ISO 55001 (asset management) and ISO 27001 (information security management) standards. Our forecast was not developed with a focus on the AER's guideline as it was developed for electricity businesses and was only published in January 2019 (although several of our senior engineers attended the February 2019 workshop). As the AER considers that its guideline accords with international standards (such as ISO 55001) there should be a high degree of alignment.
ECA	We would like to get further clarity that the medium term approach to certain capex items will have no adverse impact on future customers than compared to a long term approach to investment.[33]	There is a trade-off between medium and long term approaches. As outlined in section 1.1 above, the medium term option is the higher cost option if the network continues to thrive.
ECA	Proposed approach to mains replacement capex – staggered investment to replacement mains only where the costs and risks from continuing to use the pipe clearly exceed the replacement costs – appears to be in the long term consumer interests[34]	As 91% of customers considered we should adopt a medium term approach for mains replacement, we agree.
PIAC	..PIAC contends that significant investment in new gas pipelines to connect households to the gas system is likely to be inherently inefficient and, arguably, not in consumers' long-term interests.[35]	Putting aside that we are required to make these connections (to comply with Rule 119 of the NGR), these connections deliver significant customer value to existing and future customers. Our augmentation program will provide customers with about $35M in customer benefits, in the form of lower bills, by 2050. While our connections program will deliver benefits in the order of $300M over the same period. It will also provide new customers with access to gas, an energy source our customers have told us they value and want us to continue to provide.

30 Ibid, p.11

31 JGN-2-3.15-2-Connection and metering forecasting methodology-20190630-public

32 Ibid, p.13

33 ECA 2019, Submission Jemena Gas Networks Draft 2020 Plan: Attachment A – TRAC Partners analysis, p.6

34 Ibid, p.15

35 PIAC 2019, Submission to Jemena Gas Networks' Draft 2020 Plan, p.3

PIAC	In general, PIAC considers that risk should be allocated so that those exposed to risks have the ability and incentive to manage them. This is particularly important in the regulated network segments of the energy supply chain. Under the current regulatory frameworks, any network investment costs have been borne by consumers – i.e. socialised – through a regulated fee, regardless of actual asset utilisation or benefits accrued. PIAC does not consider this to be an appropriate allocation of risk. Instead, risk should be shared between consumers and businesses based on an assessment of which party has the ability and incentive to manage it. To address this, we support incentivising pipeline service providers to use the speculative capital expenditure account with appropriate return on the risk associated with that expenditure. However, we remain concerned about the operation of this mechanism. PIAC is particularly concerned about this risk as it relates to distribution networks' supply of residential consumers. For example, when a distribution pipeline service provider builds a network to supply a residential development, they may wish to invest in extra capacity to ensure they can serve future gas demand in that area. Given the changing economics of residential gas demand, this investment would be inherently speculative. [36]	While all customers pay the costs of our augmentation and connections program they also receive the benefits (which exceed the costs). The speculative capex account is for capex that does not currently (but might in the future) meet the requirements of the NGR. Our proposed augmentation and connection expenditure is in customers interest and meets the rule requirements now – for further details see section 3.6.

[36] PIAC 2019, Submission to Jemena Gas Networks' Draft 2020 Plan, p.4

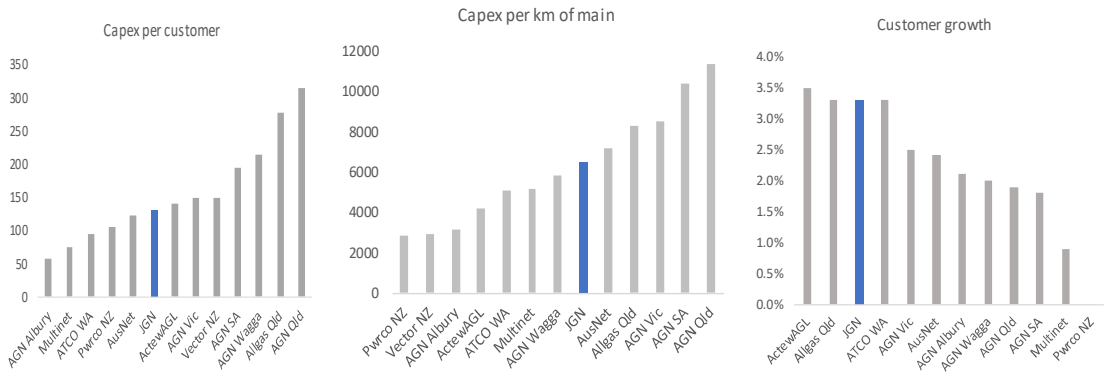
2. Our investment performance

We have a track record of efficient and prudent investment.

Given our history of private ownership and natural gas being a fuel of choice, we have always been driven to maintain gas' competitive value proposition. As a result, we have always strived to constrain our levels of investment (and consequent price impacts), without compromising safety, reliability or impeding access to our network.

Our success flows through to high-level benchmarks, as shown in Figure 2-1, which show our competitive performance against other Australian and New Zealand gas networks.

Figure 2-1 How our customer growth and capex compares to other Australian networks ($2010)



Source: JGN, based on Economic Insights data (Attachment 6.4). Charts rely on the longest time horizon presented: capex is average over the last five years; customer growth is since 1999 (or earliest available)

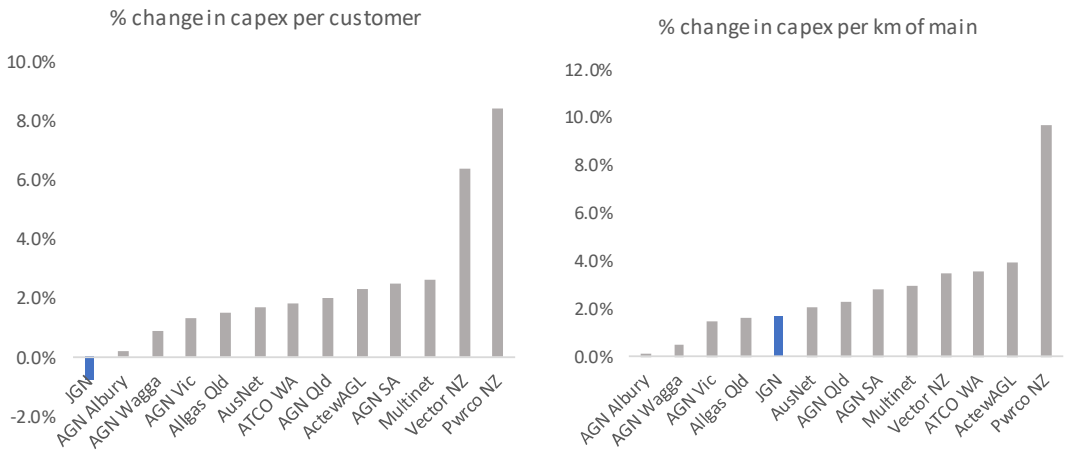
Our investment performance has been delivered in an environment of mounting cost pressures, including:

- Connecting record numbers of new customers – our network is one of the fastest growing in Australia.
- Managing a network that spans a large geographic area, including Sydney, regional towns such as Dubbo and Griffith along with major regional centres such as Newcastle and Wollongong.
- Relatively low customer density, increasing the amount of infrastructure we require to serve each customer.
- The additional infrastructure and costs required to safely deliver gas through dense built up areas, such as Sydney's CBD.
- Keeping our network safe despite high levels of construction across NSW. About 45%-50% of all Australian cranes are currently operating in our network area.[37]
- Managing a variety of design standards and construction methods, as our network was formed from several distinct networks.

Despite these factors, and growing investment requirements all are networks are facing to manage ageing assets, we have been able to constrain our capex. This can be seen in the benchmarks in Figure 2-2, which compare investment growth on a per customer and per kilometre (**km**) of main basis.

37 Rider Levett Bucknall 2019, *RLB Crane index Q1 - 2019*, p.2

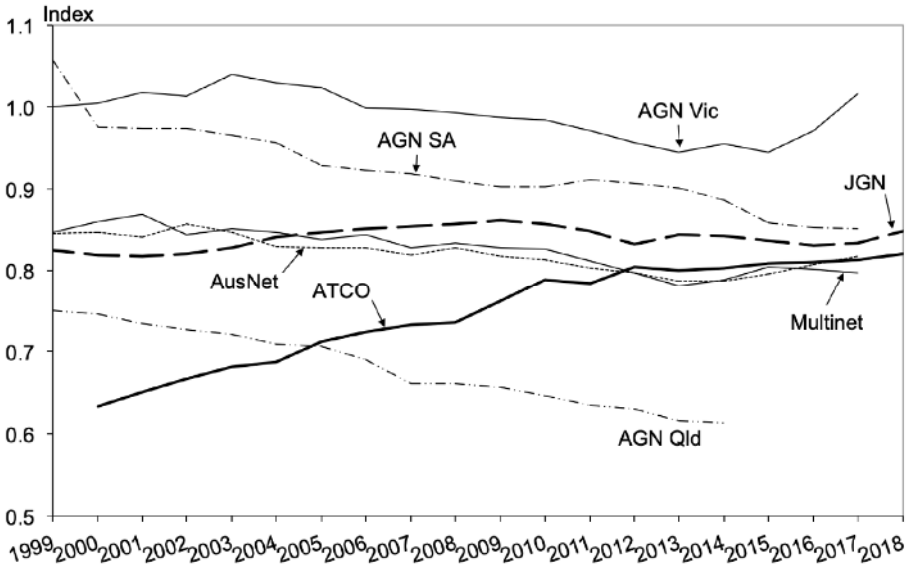
Figure 2-2 How our capex growth compares to other Australian networks ($2010)



Source: JGN, based on Economic Insights data (Attachment 6.4). Charts rely on the longest time horizon presented: since 1999 (or earliest available).

Our efforts can also be seen in productivity metrics. Economic Insights has found that we have the second highest capital productivity of all Australian gas businesses measured in 2018, see Figure 2-3.

Figure 2-3 Economic Insight's calculation of capex productivity using a multilateral capital partial factor productivity Index[38]



While we have delivered efficiently in the past we have applied our best practice management systems and processes to produce our forecast. We are the first utility in Australia to be jointly certified to ISO 55001 (asset management) and ISO 27001 (information security management) standards.

These high level benchmarks, measures of productivity and certification to worlds best practice asset management standards means customers and the AER can also be confident that our capex also conforms to Rule 79(1)(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..*

[38] Attachment 6.4: Economic Insights 2019, *Relative Efficiency and Forecast Productivity Growth of Jemena Gas Networks (NSW)*, p.63

3. Our evolving investment program

We continually seek to reduce the cost of delivering what customers value by taking advantage of the opportunities presented and mitigating the risks that arise.

2015-20 period

Over the 2015-20 period our investments have focussed on responding to the surge of new connections, driven by Sydney's housing boom and our market positioning. We ramped up our connections capex so that it accounts for 57% of our whole program.

To provide a sense of scale, in 2017-18 we connected almost as many dwellings as all gas distribution businesses in the UK[39] – who collectively have a customer base of about 27 million. These additional connections required us to invest $144.5M (43%) more than our allowance, as shown in Table 3-1. Moreover, we made these connections at a lower average cost than in the previous 2010-15 period.

Additional connections is fantastic news for our existing (and new) customers as they allow us to spread our largely fixed costs across more customers and lower customer bills. They are, in part, what has allowed us to propose the price reductions included in our 2020 Plan.

To ensure that we could take advantage of this opportunity to lower bills, we needed to reprioritise our capex program. To do this we took advantage of changing circumstances and new information to find cost savings elsewhere.

Our efforts to offset the increase in connections capex and reprioritise our investments can be seen in Table 3-1 where we lowered costs in almost all other expenditure categories. This is great news for our customers as these cost reductions have led to a lower asset base (relative to what was forecast at the beginning at start of the 2015-20 period) and, as with our connections investments, have contributed to the price reductions in our 2020 Plan.

Table 3-1: Capex ($2020, Millions, excluding overheads)[40]

	2015-20		2020-25
	Allowance	Actuals/estimate	Forecast
Connections	336.4	480.9	387.5
Meter replacement	165.3	85.1	118.0
Facilities and pipes	107.1	63.8	72.2
IT	147.6	119.5	107.2
Augmentation	94.2	40.0	60.8
Mains replacement	64.5	27.3	44.8
Other	44.4	45.5	34.3
Gross total	**959.4**	**862.1**	**824.8**
Contribution	22.4	14.7	13.4
Net total	**937.0**	**847.4**	**811.4**

At a high level our performance over the 2015-20 can be summed up as connecting more customers (resulting in lower bills) and reprioritising our program to reduce capex elsewhere (resulting in lower bills).

[39] In 2017-18 UK's gas distribution businesses collectively connected 61,238 customers. See Ofgem 2019, *RIIO GD1 Annual Report 2017-18 Supplementary data file*. In 2017-18 we connected 58,958 dwellings in 2017-18.

[40] We have not included overheads in this attachment to make it easier to compare costs over time. Totals differ (but are consistent with) the numbers presented in Chapter 5 of our 2020 Plan. We also include capex by asset class in Attachment 7.2 and Attachment 7.3.

At an aggregate level we are forecasting to spend 6% less than the allowance set by the AER over the 2015-20 AA period. This is consistent with recent divergences in Australia which have ranged from overspends of 9.9% (for Multinet gas[41]) to underspends of 13.2% (for AGN's South Australian network[42]). Similarly, UK gas distribution businesses as a whole are forecasting an average underspend of 11.4% against their current total expenditure allowances set by Ofgem, Great Britain's energy regulator.[43]

Our 2020 Plan

In preparing our 2020 Plan we have been extremely conscious of the future uncertainty we face and have engaged customers to help identify which investment options best achieve the NGO. Our 2020 Plan only includes investments which generate enough customer benefits by 2050 to exceed the costs.

Despite our future focus, we have taken into account what we have learned and achieved over the 2015-20 period. To ensure these efficiencies flow through to our forecast, where possible, we have adopted revealed cost approaches. We have prepared a lean capex forecast for the 2020-25 period, below what we expect to spend over the 2015-20 period.

We will continue to connect customers over the 2020-25 period, although at a reduced rate due to the expected slowdown in the housing market, unlocking $300M in bill reductions over the period to 2050.

In many cases our work to reduce costs over the 2015-20 period has also resulted in a lower 2020-25 forecast. However, this is not always the case. We are proposing to invest more in:

- Our metering program, as we have only been able to lower costs in the 2015-20 period by shifting the replacement of meters to the 2020-25 period (based on meter performance). Wear on these old meters means they will need to be replaced to ensure our customers' bills remain accurate.
- Our facilities and pipes as well as augmenting categories to keep our ageing infrastructure safe. The biggest project is reconfiguring of the Sydney Primary Main to reduce the risks to the public and customers from a potentially catastrophic loss of containment. Our proposal is the lowest cost option to reduce the risks borne by customers to as low as reasonably practicable (**ALARP**).
- Mains replacement primarily to replace mains in the Newcastle area to halt increasing repair and lost gas costs increasing safety and ensuring reliable gas supply to customers.

In the following sections we provide a category-by-category overview of each component of our capex program. For each category we identify how we managed to constrain our costs and maximise customer value. We then summarise the key elements of our 2020 Plan and how the forecast builds on our performance over the 2015-20 period.

3.1 Changes since our Draft 2020 Plan

Since the publication of our Draft 2020 Plan we have continued to review and improve our forecast for the 2020-25 period. At an aggregate level our 2020 Plan is consistent with our Draft 2020 Plan, however there has been movement in some categories of capex.

Table 3-2 shows that the most material change is an increase to our forecast connections costs where we have refined our models and updated for new information. We also updated our connections capex forecast to reflect the audited financial data reported in our response to the AER's RIN (the Draft 2020 Plan was based on draft data).

41 AER 2017, *Draft decision – Multinet Gas access arrangement 2018-22, Attachment 6 – Capital expenditure,* p.6-9

42 AER 2015, *Draft decision: Australian Gas Networks Access Arrangement 2016-21, Attachment 6 – Capital expenditure,* p.6-10

43 Ofgem 2019, *RIIO-GD1 Annual Report 2017-18,* p.2

Offsetting this increase is a reduction in our augmentation and mains replacement programs, resulting in a lower forecast than included in our Draft 2020 Plan. This is a combination of identifying lower cost solutions and, based on updated network information, deferring projects into subsequent regulatory periods.

Other categories have changed slightly as we received final cost estimates for the forecast projects/programs.

Table 3-2: Comparison of between our Draft 2020 Plan and 2020 Plan ($2020, Millions, excluding overheads)

	Draft 2020 Plan	2020 Plan	Difference
Connections	365.3	387.5	22.2
Meter replacement	116.8	118.0	1.2
Facilities and pipes	73.5	72.2	-1.3
IT	103.3	107.2	3.9
Augmentation	78.7	60.8	-17.9
Mains replacement	54.3	44.8	-9.5
Others	29.3	34.3	5.0
Total (gross)	**821.1**	**824.8**	**3.7**

3.2 Connections

Our connection program makes up the largest part of our capital program.[44] It includes new mains along streets, services to homes and businesses, and meters to measure how much gas is used.

Our connections program benefits customers in two ways:

1. **Lowers bills.** A larger number of customers means we can spread our largely fixed costs over more customers. Our investment in connections will lower bills by about $300M – $200 per customer – over the 2020-2050 period.
2. **Ensuring equal and fair access to the benefits of gas.** Our connections program ensures that people living in new homes can enjoy the benefits of gas. Our customers told us they enjoy the kind of instantaneous heat gas provides (for space heating and cooking) and value the security and reliability from having both an electricity and gas connection.

Over the last few years, new dwelling construction has been tracking at about double of 2010 levels. This has led to sustained demand for gas connections. In particular, we have seen a sharp rise in high-rise dwelling construction over the last few years. This has led to an increase in connections expenditure as shown in Figure 3–1.

Figure 3–1 also shows that our average connection costs have fallen. This is partly due to relatively less expensive high-rise connections now make up a larger proportion of connections. But it is also due to our out-sourcing strategy which has enabled us to efficiently increase the resources required to respond to the increase in demand for connections while keeping costs constrained.

The exception is existing homes where we have seen reductions in the number of connections and increases in the cost to connect. Connecting existing homes is more expensive. They occur in more established areas which require more traffic management and higher restoration costs to restore footpaths. Both of these costs have increased in recent years due to more onerous traffic management requirements and higher charges from local

[44] Connections capex is justified under Rule 79(2)(a), 79(2)(b) and 79(2)(c)(iv). We ensure that the expected revenue from each connection is higher than the cost (otherwise we charge a contribution) satisfying Rule 79(2)(b). In turn this means that Rule 79(2)(a) is also satisfied, for two reasons. First, the economic value to existing users is positive as if the revenue exceeds the cost then it results in bill reductions. Second, the economic value to new users must be positive as it can be assumed that by applying for a connection they value the connection above the future charges (which must be higher than the cost to connect). Lastly, we are required to connect customers in line with our obligations set out in Part 12A of the NGR.

councils. Connecting existing homes also costs more as we tend to do less at a time. We may only connect a single household in a street while with new homes we lay the mains and services for whole streets at once.

As shown in Table 3-3, our costs and the AER's allowance diverged in the 2015-20 period. This was partly due to the unprecedented building boom in Sydney and the higher demand for connections than originally forecast. The difference is also due to unit rates in the AER's allowance (which we accepted) being set below our costs.

Given the large consumer benefits our connection program delivers, we reallocated capex from other programs to ensure we had sufficient funding and resourcing in place to connect these new customers. We cannot defer connecting a customer. Delays risk potential customers deciding to use other fuels (such as electricity) in place of gas – resulting in a missed opportunities to reduce bills for our existing customers.

For the 2020-25 period, we have applied the principles from the AER's preferred connection cost forecasting methodology. Our forecast is based on revealed average costs.[45] This approach smooths out year-to-year movements and ensures that our forecast includes the efficiency savings we have achieved. We adjust our historical connection costs to reflect the latest movements in supplier prices.

Our forecast also includes savings from our volume boundary strategy for new high-rise buildings.[46] The introduction of our boundary metering product in 2015 and the removal of hot water metering for new high-rise buildings from 1 July 2020 has resulted in a forecast cost reduction of $56M over the 2020-25 period. This comprises a $26M saving due to the introduction of our boundary metering solution and a further $30M due to the removal our of hot water metering product for new high-rise buildings.

Figure 3–1: Annual connections capex and average connection costs per new dwelling ($2020, excluding overheads)

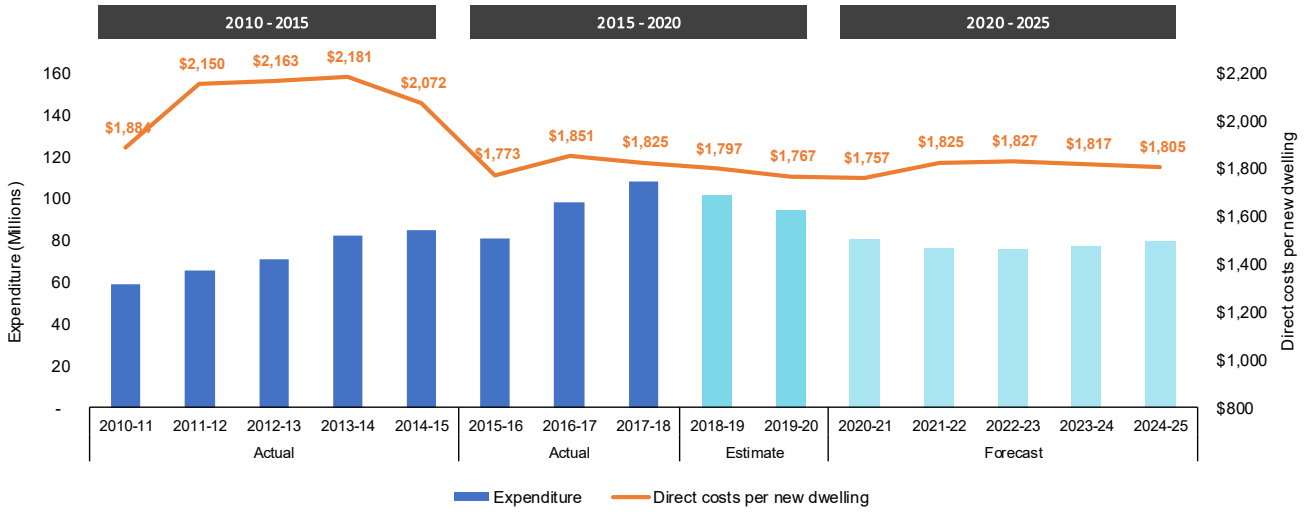


Table 3-3: Connections capex ($2020, Millions, excluding overheads)

	2015-20		2020-25
	Allowance	Actuals/estimate	Forecast
Connections capex (gross)	336.4	480.9	387.5
Contributions[47]	20.3	9.4	10.4
Connections capex (net)	**316.2**	**471.6**	**377.1**

45 Further explanation of our connections capex method is provided in our connections and metering forecasting methodology. See: RIN supporting document JGN-2-3.15-3--Connection and metering forecasting-methodology-20190630-public

46 For more information on our volume boundary strategy for new high-rise buildings, see Chapter 4 of our 2020 Plan, and Attachment 4.1.

47 Our capital contributions forecast is based on the last 3 years of actuals. We add in larger contributions separately, based on the projects in our capex forecast that we expect to attract contributions.

3.3 Meter replacement

An essential part of the service we provide is metering each customers gas consumption.[48] This information is used to accurately charge customers for their usage of our network and for the cost of gas (purchased and shipped by retailers).

Our metering program aims to maintain the performance of our fleet of gas meters to ensure we:

- Replace meters prior to failure to avoid estimated bills and customer frustration.
- Meet our obligations to provide at least two actual meter reads every 12 months.[49]
- Accurately bill customers to ensure network and gas usage charges are fair. Estimated reads may result in some customers paying for others usage.

Over the 2015-20 period we have been able to constrain our meter replacement spend by:

- Taking advantage of better than expected asset performance to defer replacement of residential gas meters ($9.6M) and hot water meters ($27.3M). These savings were enabled by our proactive monitoring of asset performance and meter testing program.
- Prolonging the life of our MDLs, technology originally developed for JGN 20 years ago ($22.3M).
- Improving our operational performance. We have achieved efficiencies in our meter replacement programs ($9.7M), defective industrial and commercial (**I&C**) meter costs ($0.9M) and meter testing costs ($8.2M).
- Identifying synergies with future projects that allow us to deliver the same outcome at a lower cost , such as our postponement of our Trunk Regulating Station (**TRS**) meters to coincide with our ongoing facilities compliance program (saving $1.8M).

Our 2020-25 forecast builds on these efficiencies. Our forecasting approach[50] (wherever possible, uses revealed historical costs. For example:

- We used actual average unit rates to forecast volume driven work (planned replacements) and apply this unit rate to the volume forecast (based on asset age profiles and performance).
- Where the costs of a replacement program were steady – such as for the defective meter replacement program – we used an average of annual program costs.

Where the above approaches are not possible, we used bottom up builds, using our Project Estimation Methodology, to estimate costs. These cost estimates also take into account the cost savings we have achieved over the 2015-20 period.

Metering costs cannot be avoided – only deferred. Although we have been able to avoid replacing a large number of residential gas and hot water meters over the 2015-20 period (lowering bills for customers) these meters still need to be replaced. Consequently, as shown in Table 3-4, our meter replacement costs will step up in the 2020-25 period.

[48] Meter replacement capex is justified under Rules 79(2)(c)(i)-(iii). It is required to maintain the safety and integrity of services as well as to comply with our jurisdictional obligations.

[49] Retail Market Procedures (NSW and ACT), clause 3.6.6(a)

[50] See RIN supporting document JGN-2-3.15-3--Connection and metering forecasting-methodology-20190630-public

Table 3-4: Meter replacement capex ($2020, Millions, excluding overheads)

	2015-20		2020-25
	Allowance	Actuals/estimate	Forecast
Residential gas meters	44.5	36.2	55.9
Residential hot water meters	45.7	17.6	22.9
Meter data loggers	26.6	5.4	6.9
I&C meters	33.8	21.8	28.8
Metreteks	3.0	2.9	1.7
Testing	9.2	1.0	1.6
Other	2.6	0.2	0.1
Total	**165.3**	**85.1**	**118.0**

3.3.1 Residential gas meters

Residential gas meter replacements make up almost half of our meter replacement costs. Inside each of these meters are diaphragms which inflate and deflate as gas passes through. These diaphragms are connected to levers which power an internal odometer-like device to record consumption.

Overtime these internal components wear, leading to measurement inaccuracy. We regularly test our gas meters to ensure they continue to provide accurate readings and replace those that are found to be inaccurate. We also replace gas meters when they are found to be defective. This is typically identified by our IT systems when no consumption is recorded between consecutive reads.

Table 3-5 sets out the programs and the associated capex for each of our residential gas meter programs.

Table 3-5: Residential gas meter capex ($2020, Millions, excluding overheads)

	2015-20		2020-25
	Allowance	Actuals/estimate	Forecast
Planned	31.6	22.0	41.0
Statistical	0.7	1.1	1.3
Defective gas meters	4.9	4.5	4.5
Defective regulators	7.2	8.7	9.1
Total	**44.5**	**36.2**	**55.9**

Planned replacement

Over the 2015-20 period we have seen remarkable performance of our residential gas meters. For the 2015-20 period we assumed that meters would need to be replaced at 20 years of age – beyond their design life of 15 years. Through our statistical sampling program, we have been able to further extend the life of several families of meters to 25 years. This five year life extension postpones the replacement of meters from the 2015-20 period to the 2020-25 period shifting capex from 2015-20 to 2020-25, as seen in Table 3-5. This deferral has allowed us to reduce our asset base and lower prices. While overall our meters performed well, not all meters passed their 20 year tests. Those that didn't were replaced.

Our 2020 Plan takes into account the improved performance of our gas meters and now, in the absence of statistical testing results, assumes our meters will be replaced at 25 years (up from 20 years in the 2015 Plan). Over the 2020-25 period we are forecasting to replace the meters deferred from the 2015-20 period as well as an additional meters which will reach 25 years of age in the 2020-25 period.

Statistical testing

Extending the life of our meter families, increases the number of meter families we need to continue to test, increasing statistical sampling costs in both the 2015-20 and 2020-25 periods.

Defective replacement

Over the 2015-20 period, our defective replacement costs have been close to our forecast. While in the longer term we expect these costs to rise (as our meter fleet ages) in the shorter term the replacement numbers are relatively steady.

The forecast costs included in our 2020 Plan are consistent with the historical average, as we base our forecast on the most recent four years of costs.[51]

Regulator replacement

Accompanying each residential gas meter is a regulator to lower the gas pressure. At this stage, we don't run a planned replacement program as the failure rates are relatively steady. As with our gas meters, defective gas regulator costs are similar to the allowance and the forecast for the 2020-25 period.

3.3.2 Residential hot water meters

We currently offer a residential hot water metering product for high-rise buildings. This product has been adopted by some high-rise buildings with centralised hot water systems. We measure how much hot water is used by each individual dwelling. This information is used to bill each dwelling for the gas used by the centralised hot water system.

Hot water meters are generally installed together with accompanying Meter Data Loggers (**MDLs**) which record consumption for each dwelling at a central point. This allows us to reduce costs as we don't need to visit each individual dwelling in a building to read each meter. Instead the MDL sends consumption information back to us electronically.

Hot water meters communicate with the MDL by sending pulses to indicate how much hot water is consumed. The drawback with this approach is that it requires each hot water meter to be powered. Most of our existing hot water meters are powered by a battery. While it is possible to replace the batteries it is more cost efficient to replace the whole meter.

Table 3-6 summarises our hot water meter programs including associated capex.

Table 3-6: Hot water meter capex ($2020, Millions, excluding overheads)

	2015-20		2020-25
	Allowance	Actuals/estimate	Forecast
Planned	35.6	8.3	12.0
Defective	10.1	9.3	10.9
Total	**45.7**	**17.6**	**22.9**

Planned replacement

In 2011 we identified an above average failure rate for a particular model [redacted] of hot water meters. These failures were causing billing issues and customer frustration. If we cannot bill customers for their usage other customers could be paying higher charges.[52] Following the identified product failure, we increased the scope of

[51] For further details see: RIN supporting document JGN-2-3.15-3--Connection and metering forecasting-methodology-20190630-public

[52] As the hot water meters are used to allocate gas consumption without accurate reads we cannot allocate gas usage in line with actual consumption. This means each customer may be paying more or less than what they actually consumed.

the planned replacement program by including an additional accelerated replacement program for the [redacted] that were likely to prematurely fail.

In July 2015 we selected [redacted] to supply hot water meters [redacted] for both our replacement and defective programs based on their previous meter performance. [redacted]
We therefore had to pause our aged meter replacement program so that we could continue to use our stock of [redacted] meters for our defective replacement program.

In parallel to the selection of [redacted] meters, we were conducting ongoing negotiations with [redacted]
Before we rolled out these meters we undertook assurance testing and allowed time for [redacted] to ramp up production.

While these negotiations occurred, we found the [redacted] failure rates returned back to normal levels. We concluded that the bulk of the meters that would fail had already failed. We cancelled our accelerated replacement program to constrain our investment, lowering our asset base and in turn prices for customers.

However, a backlog of meter replacements in the 'replacement program' exists due to the inability to use the [redacted] meters and the time taken for the [redacted] meter to be available.

Over the 2020-25 period we intend to work through the backlog of about 25,000 meters over 8 years as well as the meters due for replacement.

Defective replacement

As with our residential gas meters our defective hot water meter forecast is based on an average of our recent annual defective replacement costs.

3.3.3 Meter data loggers

As mentioned above, MDLs record consumption from each meter in a high-rise building then communicate usage back to a central server. The capex for each MDL program is shown in Table 3-7.

Table 3-7: Meter data logger (MDL) capex ($2020, Millions, excluding overheads)

	2015-20		2020-25
	Allowance	Actuals/estimate	Forecast
Planned	24.1	1.9	2.9
NBN rollout	0.9	1.4	0.4
Wireless RF	-	1.1	2.3
Defective	1.6	1.0	1.3
Total	**26.6**	**5.4**	**6.9**

Planned and NBN rollout

Our MDL system was originally developed for us in 1997. In preparing our 2015 Plan we were concerned about future support from the sole MDL supplier, possible obsolescence of the technology as well as the impacts of the rollout of the National Broadband Network (**NBN**). We expected to replace all existing MDLs with a newer technology over the 2015-20 period.

Over the 2015-20 period we identified that we could prolong the life of the existing systems by only replacing a single component to reduce costs. This allowed us to upgrade the systems to communicate over 3G/4G rather than rely on obsolete copper wire.

This solution does not address the ongoing supplier risks. Our approach is to continue to bear this risk for as long as possible to contain costs. However, replacement of these systems will likely be required towards the end of the 2020-25 period or the subsequent 2025-30 period. Our 2020 Plan does not include any costs for this program.

Wireless RF

Our 2020 Plan includes a program to improve meter reading in apartment buildings that are not fitted with an MDL. These legacy sites required a meter reader to visit each individual dwelling. Gaining access to these sites is difficult and often leads to no meter read.

Our solution is to install radio frequency (**RF**) technology to allow us to read these meters without entering each dwelling. This solution allows us to read meters faster and ensure that we can provide customers with frequent meter reads.

Defective

Our 2020 Plan forecast defective replacement costs based on an average of recent years annual program costs.

3.3.4 Industrial and commercial meters

We have a variety of gas meters for our I&C customers who use larger volumes of gas. Each customer is supplied with a meter that is appropriately sized for how much gas they use.

We categorise our meters into three groups based on their internal mechanism: diaphragm, turbine and rotary/ultrasonic. The spend for each of our I&C metering programs is listed in Table 3-8.

Table 3-8: Industrial and commercial meter capex ($2020, Millions, excluding overheads)

	2015-20		2020-25
	Allowance	Actuals/estimate	Forecast
Planned - diaphragm	11.1	7.0	9.7
Planned - rotary	5.3	3.0	4.6
Planned - turbine	3.9	0.6	0.8
Statistical sampling	0.7	1.0	3.1
Defective	2.9	2.0	2.0
Meter capacity upgrades	8.5	7.7	7.4
Meter kit change out	1.3	0.6	1.2
Total	**33.8**	**21.8**	**28.8**

Planned diaphragm

I&C diaphragm meters function in the same way as residential gas meters. We test these meters, using statistical sampling, to determine if we can extend their life. As these meters age, test results received have allowed us to extend their life from 20 to 25 years. As with residential gas meters, this has resulted in a deferral of capex from the 2015-20 to 2020-25 period and increased statistical sampling costs.

Planned rotary and turbine

Our rotary and turbine meters are used for connections which have higher capacity requirements. Rotary meters are for connections than cannot be metered with a diaphragm meter. Turbine meters are used by our largest demand market customers. We replace our rotary and turbine meters at 10 and 5 year intervals respectively. Meter failure and inaccuracy has significant consequences due to the large volumes of gas measured.

We typically replace rotary and turbine meters with refurbished meters and avoid purchasing new meters. Each time we take a meter out of service we then refurbish it ready for the next customer.

Over the 2015-20 period we have been able to reduce our refurbishment costs. The efficiencies flow through to the 2020-25 forecast.

Defective

We have also been able to reduce our defective meter replacement costs. This was primarily driven by identifying a new solution to fixing a common issue with turbine and large diaphragm meters. Rather than removing the meter for repair we worked with the manufacturer to develop alternative approach allowing us to repair the meter on site. Our new approach allows us to improve customer outcomes by repairing the meter faster and lowering overall repair costs.

Our 2020 Plan takes into account the efficiency savings we achieved over the 2015-20 period.

Meter kit change out

Our meter capacity upgrade program captures the cost of installing larger meters when a customer's capacity requirements increase. These costs have not materially diverged from the allowance. Our forecast is in line with 2015-20 actuals.

Our meter kit changeout program reviews the meters we have in service to ensure that our larger meters are safe, compliant and continue to meet customer needs. In addition to making sure customers have an appropriately sized meter it also allows us to downgrade meters and reduce our planned defective replacement programs. We were able to achieve savings over the 2015-20 period by taking advantage of improved performance with certain families of meters to reduce our review frequency.

3.3.5 Metreteks

Metreteks are communication devices enabling us to remotely read consumption for our larger customers. As with our MDLs, Metreteks were built to communicate via a dial-up modem through copper telephone lines. Metretek capex is outlined in Table 3-9.

Table 3-9: Metretek capex ($2020, Millions, excluding overheads)

	2015-20		2020-25
	Allowance	Actuals/estimate	Forecast
Planned	1.6	0.1	-
Defective	1.4	0.9	1.0
NBN rollout	-	1.8	0.7
Total	**3.0**	**2.9**	**1.7**

We have a planned replacement program primarily to ensure ongoing capability with the roll out of the NBN and subsequent retirement of the old copper telephone lines. Working with our suppliers, we identified a more efficient solution to ensuring these devices continue to communicate with us. This was to upgrade each unit with Honeywell CNI-2s which include a data logger, serial data communication product and 3G/4G transceiver on a single integrated circuit board – rather than replace the whole system.

The CNI-2 has higher power requirements than earlier generations of Metreteks. This requires us to also install a solar power unit where a 240V power source is not available. These costs will continue as the NBN continues to be rolled out.

3.3.6 Testing

In addition to the statistical sampling programs for our residential and I&C diaphragm meters, we run three additional testing programs: field failure, warranty and assurance testing. The costs for each of these programs is provided in Table 3-10.

Table 3-10: Testing capex ($2020, Millions, excluding overheads)

	2015-20		2020-25
	Allowance	Actuals/estimate	Forecast
Field failure	5.1	0.3	0.3
Warranty testing	2.9	-	0.8
Quality assurance	1.2	0.7	0.5
Total	**9.2**	**1.0**	**1.6**

Field failure

Our field failure testing program tests and analyses failed meters. We use this information to better understand the factors influencing our metering performance and to select the right meters for our network conditions. We also use this information to support negotiations with metering suppliers.

We insourced our field failure testing functions as part of our changes to our meter delivery model. This has allowed us to achieve cost savings in this period, which have flowed through to the 2020-25 forecast.

Warranty testing

Our 2015 Plan included a program to undertake warranty testing. This involved sampling meters to confirm that they are functioning correctly before the warranty period expires.

We have been able to reduce our warranty testing costs by adopting a risk based approach, informed by desktop reviews as well as our asset performance and integrity review process. We now only warranty test meter models where we have seen higher failure rates of similar meter models.

Our 2020 Plan includes the cost of undertaking warranty test for three new models of meters, where we do not have historical performance data on these meters consistent with Australian standards.

Quality assurance

Lastly, our quality assurance testing program focusses on testing new meter models that have never been deployed throughout JGN. We test these meters at our meter testing centre before we deploy a batch on our network. Our costs were marginally lower than the allowance as we deployed fewer new meter models than expected. This cost saving has also flowed through to the 2020-25 forecast.

3.3.7 Other metering costs

From time to time we incur costs that don't form part of the main programs discussed above. The forecast spend in our 2020 Plan is consistent with our actual spend over the 2015-20 period, as shown in Table 3-11.

Table 3-11: Other metering capex ($2020, Millions, excluding overheads)

	2015-20		2020-25
	Allowance	Actuals/estimate	Forecast
Planned - Flow Computers, Gas Chromatographs, Dew Point Analysers	0.5	-	-

	2015-20		2020-25
	Allowance	Actuals/estimate	Forecast
Planned - Gas Chromatographs	0.2	-	-
Planned - TRS gas meters	1.8	0.0	-
Planned - Dew Point Analysers	0.0	-	0.1
JGN Sulphur Analyser	-	0.1	-
Installation of I&C Regulator Test Facility	-	0.1	-
Total	**2.6**	**0.2**	**0.1**

Our 2015 Plan included costs to upgrade gas quality measurement equipment which provides essential information for billing purposes. We have been able to extend the life of our flow computers and gas chromatographs as manufacturers are continuing to provide ongoing support for the models we use.

We deferred the planned replacement of Trunk Regulating Station (**TRS**) meters as we found that these meters could be more efficiently replaced as part of our facilities risk based safety upgrade program. We have also been able to contain these costs by cycling through the emergency spares rather than purchasing new meters.

Lastly, we incurred costs in installing an I&C regulator testing facility. We use this facility to better understand the performance of our I&C regulators – as part of our change in approach to insource certain metering functions.

3.4 Facilities and pipes

Our facilities and pipes category covers capex related to our high pressure pipelines and facilities.[53] Our spend is primarily focussed on maintaining the safety of these ageing assets.

Over the course of the 2015-20 period, we were able to take advantage of changes to the external environment and the latest information on the condition of our assets to reduce expenditure without increasing safety or reliability risks to customers.

However, to continue to operate our ageing facilities and pipelines we need to continue to invest. Over the 2020-25 period we will:

1. Reduce the risks to the public and customers from a loss of containment event of the Sydney Primary Main, which would have catastrophic consequences. We will do this by reconfiguring the pipeline to be inspected by an intelligent pig – which will provide a complete picture of any corrosion or mechanical damage (allowing us to pin point the location and make the required repairs).
2. Reduce the risks to the public and our employees by completing our program of risk based safety upgrades to the electrical and instrumentation components of our facilities.
3. Reduce the risks to the public and customers from our shallow secondary mains in densely populated areas. We will do this by either lowering the depth of our mains or installing additional protective barriers to reduce the risk that a third party contractor hits our mains which, could lead to a gas explosion and result in loss of life and property.

A comparison of spend across the 2015-20 2020-25 is set out in Table 3-12.

[53] Our facilities and pipes capex is primarily justified by Rule 79(2)(i)&(ii) as these investments are required to maintain the safety and integrity of our services. We also invest for capacity reasons. When this occurs this capex is justified under Rules 79(2)iv) (to maintain capacity to meet levels of demand for services existing at the time the capex is incurred) or 79(2)(b) (present value of incremental revenue exceeds the present value of the capex) depending on whether it is required to supply load from existing or new customers.

Table 3-12: Facilities and pipes replacement capex ($2020, Millions, excluding overheads)

	2015-20		2020-25
	Allowance	Actuals/estimate	Forecast
Facilities country upgrade	14.2	0.0	-
Facility safety upgrades	28.0	20.4	17.5
Facility capacity upgrades	2.7	9.1	0.5
Sydney Primary Main risk reduction	14.2	10.5	28.2
Pigging, validation & integrity digs	26.7	11.7	-(1)
Shallow secondary mains	-	1.2	16.1
Secondary district regulator replacement	12.5	5.1	3.0
Other minor works	8.8	5.9	6.6
Total	**107.1**	**63.8**	**72.2**

(1) Pigging costs are allocated to opex for the 2020-25 period (further details are provided in Attachment 6.1). For comparison purposes we are forecasting to spend $7.5M on pigging, validation and integrity digs.

3.4.1 Facilities country upgrade

Our 2015 Plan included $14.2M in capex to upgrade our country facilities to support the planned pressure upgrade of the Moomba to Sydney transmission pipeline (owned and operated by APA) which transports gas to our regional networks.

This change would have required us to upgrade seven of our country facilities. However, the pressure upgrade has not occurred so we cancelled these projects. We have not included any similar projects in our 2020 Plan.

3.4.2 Facility safety upgrades

We invest in our facilities to ensure that they continue to operate safely as they age and deteriorate. The cost of these programs is presented in Table 3-13.

Table 3-13: Facility safety upgrade capex ($2020, Millions, excluding overheads)

	2015-20		2020-25
	Allowance	Actuals/estimate	Forecast
Facility safety upgrades	**28.0**	**20.4**	**17.5**

Our 2015 Plan included several projects to address risks around our facilities including:

- Degraded electrical and instrumentation components, including earthing systems which pose an electrocution risk for our staff (and don't meet electrical safety standards).
- Pits – we had identified that the structural integrity of our pits was compromised. This presented a safety risk to our employees who enter these confined spaces to access valves and instrumentation.
- Pipework in pits – degraded coatings are leading to corrosion of the pipework and valves in pits which, if not addressed, can lead to a loss of gas containment.
- Automatic line break valves – these safety valves automatically isolate the primary main in the event of a loss of containment. While we had already addressed issues (such as obsolete control panels) we had planned to undertake further work to also refurbish the rotary vanes given their condition.

We reprioritised our facilities investment to ensure we targeted the highest risks first and to free up resourcing and funding to address the surge in new connections. Changes in our program included:

1. An additional project to address security threats (additional security cameras, fences etc) costing an additional $2M.
2. Delayed commencement of our program to address electrical and instrumentation issues at our facilities ($3M) as well as to address safety risks from the valves and pits at several of our Primary Regulation Stations. We put in place temporary mitigation measures to manage these risks.
3. Postponed $4M of works on automatic line break valves (which we periodically test to ensure functionality) pending a holistic review, given they are now no longer supported by the manufacturer. This will be undertaken over the 2020-25 period. No capex has been included for this.

For 2020-25 period, we are not forecasting any new programs. We have only included costs to complete our program of works.

3.4.3 Facilities capacity upgrades

From time to time we need to upgrade the capacity of our facilities to ensure we can continue to supply growing loads. The costs of these projects is shown in Table 3-14.

Table 3-14: Facility capacity upgrade capex ($2020, Millions, excluding overheads)

	2015-20		2020-25
	Allowance	Actuals/estimate	Forecast
Facility capacity upgrades	**2.7**	**9.1**	**0.5**

We spent more than our allowance in the current period due to our decision to defer upgrades to our Campbelltown and Eastern Creek TRSs from the earlier 2010-15 period to the 2015-20 period to allow a cheaper solution to be implemented.

In both cases our original solutions required hot tapping – where we connect two high pressure pipelines while they continue to supply gas. We later identified an alternative solution which could avoid these hot taps and lower costs. The identification of this solution and updated design resulted in a short delay.

There are no facility capacity upgrades in our 2020 Plan.

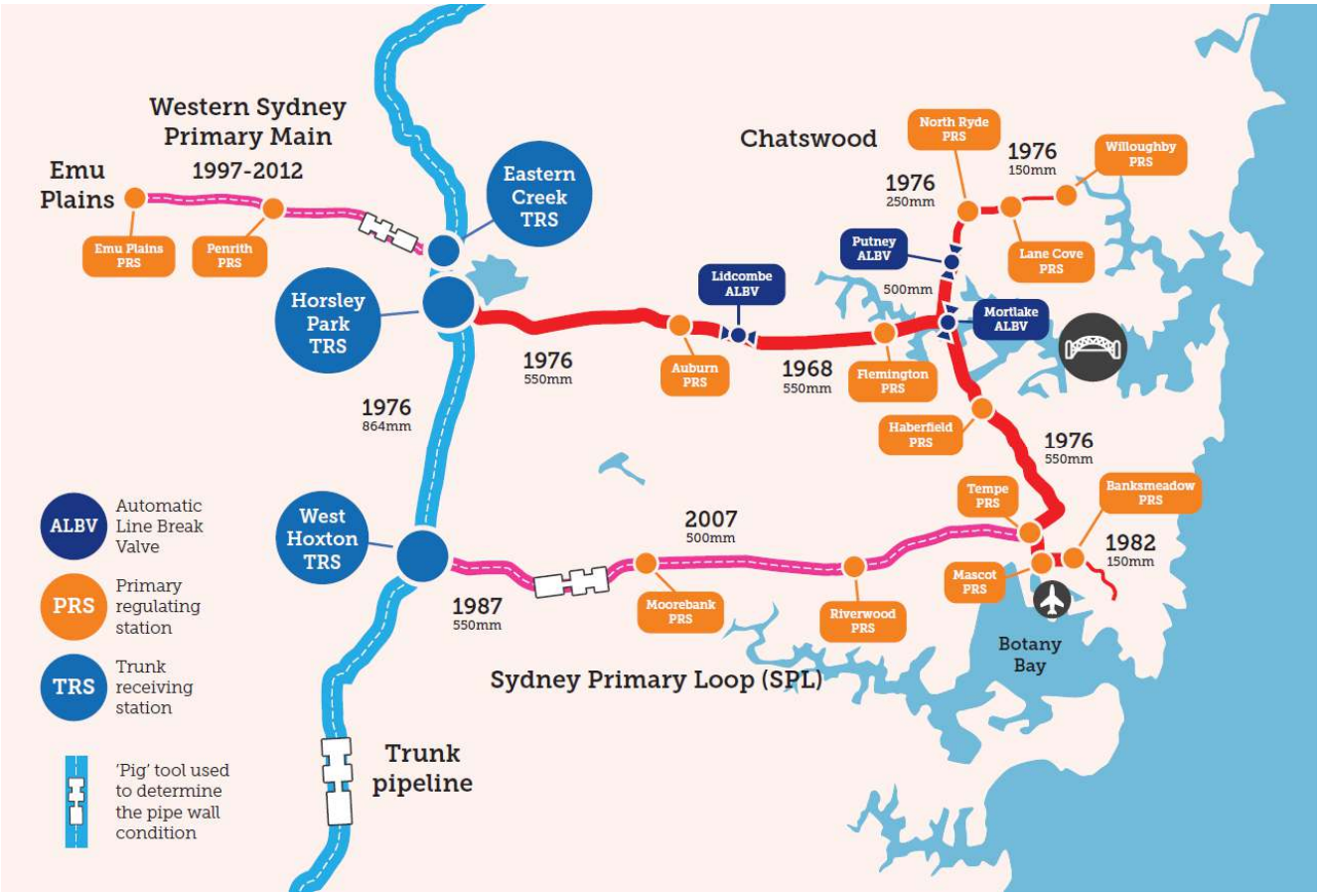
3.4.4 Sydney Primary Main risk mitigation projects

The Sydney Primary Main is the central artery of the gas network in Sydney. As the pipe is underground, it is difficult to directly inspect for damage or corrosion that could lead to a gas leak. A gas leak from the Sydney Primary Main poses a significant safety risk due to the high pressure of gas within. If a gas leak ignited it would have catastrophic consequences.

All modern pipelines are regularly inspected through the use of an intelligent pipeline inspection tool commonly referred to as a pig, which inspects the thickness of the pipe wall from the inside. Pigging a pipeline is the most efficient and effective way to identify defects which could have arisen since the main was first laid, either due to corrosion or damage from an unreported third party hit. It provides a complete picture of the thickness of the pipeline wall without interrupting supply to customers, allowing us to identify and correct material defects and halt corrosion.

Figure 3-2 shows the backbone of our Sydney network, including the Sydney Primary Main (red) as well as the Sydney Primary Loop and Western Sydney Primary Main[54] (both pink). The Sydney Primary Main is made up of several sections built at different times with different specifications by different organisations.

Figure 3-2 Our Primary and Trunk mains in Sydney



We regularly inspect all of our newer pipelines. However, the Sydney Primary Main, was built before pigging was industry standard. To date we have monitored the condition of the pipeline by conducting integrity digs - where we dig up high-risk sections of the main to conduct a spot check.

The cost of keeping the Sydney Primary Main safe is set out in Table 3-15.

Table 3-15: Sydney Primary Main risk reduction capex ($2020, Millions, excluding overheads)

	2015-20		2020-25
	Allowance	Actuals/estimate	Forecast
Sydney Primary Main risk reduction	**14.2**	**10.5**	**28.5**

2015-20 period

Over the 2015-20 period we began to reconfigure the Sydney Primary Main to allow it to be inspected with an intelligent pig.[55] We planned on modifying the pipeline in certain locations (widening bends) to ensure the pig can travel through without getting stuck. We also needed to install pig launchers and catchers to insert and remove the pig from the pipeline.

54 The Western Sydney Primary Main is made up of the Penrith Primary Main and another section from Penrith to Emu Plains.

55 We have recently completed the reconfiguration and will soon inspect the pipeline with a pig.

We started with the Horsley Park to Lidcombe section of the Sydney Primary Main, as it is the longest section, has a large diameter and was expected to be relatively easy to reconfigure. We planned to continue monitoring the condition of the remaining sections by undertaking integrity digs.

In completing these works we were able to realise cost savings in two ways.

Firstly, we did not have to purchase land to secure a site for the pig catcher, saving customers $1.2M. Our 2015 Plan assumed that we would need to purchase land to ensure other parties could not build nearby. If another party secured the land this would have required us to relocate the pig-catcher (incurring significant additional costs) or worse, it would have prevented us from undertaking pig runs altogether. However, this land purchase was avoided as the local Council offered us an easement at no cost.

Secondly, detailed investigation found that widening the bends was not required and the pipeline did not need to be modified, reducing the costs of upgrading the main. This finding also means that it is likely that we won't need to modify similar bends in the remainder of the Sydney Primary Main,[56] reducing the cost of reconfiguring the similar Lidcombe to Mortlake section.[57]

While altering the Horsley Park to Lidcombe section cost less than expected, we found that the cost of undertaking integrity digs for the remaining sections was increasing. This was due to the rising traffic management requirements and restoration works in Sydney.

Given the rising cost of integrity digs and the decreasing costs of altering the Sydney Primary Main we changed our strategy to reconfigure the remainder of the Sydney Primary Main to allow it to be pigged. As the remainder of the pipeline will be pigged we reduced the number of integrity digs over the 2015-20 period.

Our 2020 Plan

Our 2020 Plan mostly reflects our revised strategy to pig the remainder of the Sydney Primary Main.

We will reconfigure most of the remaining sections of the Sydney Primary Main to enable us to use pigging technology to inspect the mains. Not only will this option improve the safety of our network it will also end up costing less as it will allow us to reduce the number of integrity digs we undertake overtime.

We intend to take a different approach to the last leg of the Sydney Primary Main, from Lane Cove to Willoughby. This section is different as it is one of the oldest sections, is in the worst condition and has the smallest diameter (which means it will need the most works to reconfigure). The main also traverses through densely populated areas with high levels of pedestrian activity (day and night) and construction works.

Our preferred alternative is to de-rate the pressure in the last leg, but this requires two additional secondary mains in northern Sydney. These mains will allow us to operate the Lane Cove to Willoughby section of the Sydney Primary Main at secondary pressure lowering the risk to the public by an order of magnitude.[58] This approach removes the need to pig the main saving on the costs of reconfiguration.

As outlined in section 1.2.3, we asked our customers about what investment option we should adopt. We asked customers whether we prioritise short term affordability or lowest overall costs. Customers told us to prioritise lowest overall costs – which is consistent with our preferred solution.

Our solution of installing additional mains is not only the lowest cost option, it also results in a substantially safer network and alleviates a future capacity constraint.

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56 We expect that the smaller diameter sections of the Sydney Primary Main will need to be modified as it is less likely that the bends in these sections are sufficiently wide.

57 Our cost estimate for this work does not include modifications for bends similar to the kind of bends in the Horsley Park to Lidcombe section.

58 This option is consistent with Principle 6 of the AER's Industry Practice Note on asset replacement planning.

Unfortunately, we cannot apply this approach for the all sections of the Sydney Primary Main, as the level of network reinforcement would be substantially higher than the costs of reconfiguring the existing mains to enable pigging.

As the solution for the Lane Cove to Willoughby section requires the network to be strengthened we have included the costs of these additional mains in our augmentation category, see section 3.6.

Although these investments can be justified on reducing costs alone, we have also sought advice from risk experts GPA Engineering[59] to assess whether our preferred options will mitigate the risk and if the investments required for those options are proportionate to the risk. If the costs are proportionate, then we are required to invest to ensure the risks from our network are ALARP as required under Australian Standards (AS2885.6).

GPA Engineering did this by semi-quantifying difference in risk based on the effectiveness of each option. This was then used in calculating a 'maximum justified spend' based on the UK's Health and Safety Executive's (**HSE**) Cost Benefit Analysis checklist. GPA Engineering recognise there is a large degree of uncertainty in attempting to numerically calculate the consequences and in turn costs of a distribution network incident. The maximum justified spend figures only provide an order of magnitude indication on whether the proposed spend is proportionate to the risk as a means to demonstrate ALARP. GPA Engineering found that our proposed investments are proportionate to the risks.

3.4.5 Pigging, validation and integrity dig costs

To ensure safety to the public we regularly inspect our high pressure mains to monitor corrosion and check for third party damage. We do this in three ways:

1. Pigging – where we send a device through the pipe to inspect the thickness of the pipeline wall.
2. Validation digs – where a pig identifies a defect we inspect the pipeline by digging and physically inspecting the pipeline.
3. Integrity digs – where we can't pig a pipeline we conduct spot checks in high-rise areas of the pipeline. The location is identified through assessment of corrosion data and other inspection data.

The costs of these programs is provided in Table 3-16.

Table 3-16: Sydney Primary Main risk reduction capex ($2020, Millions, excluding overheads)

	2015-20		2020-25
	Allowance	Actuals/estimate	Forecast
Pigging, validation & integrity digs	**26.7**	**11.7**	**-(1)**

(1) Pigging costs are allocated to opex for the 2020-25 period (further details are provided in Attachment 6.1). For comparison purposes we are forecasting to spend $7.5M on pigging, validation and integrity digs.

Over the 2015-20 period, we have been able to reduce our pigging costs [redacted]

We also cancelled some validation digs as we had good correlation between previous pig runs and the most current pigging run results – something we could not forecast at the time of the access arrangement.

Our 2015 Plan included a large integrity dig program for the Sydney Primary Main as it is not currently piggable. However, as we explain in section 3.4.4 we have changed our approach and intend to reconfigure most of the Sydney Primary Main to allow it to be pigged. This allowed us to cancel the integrity dig program for the Sydney Primary Main.

59 RIN supporting document GPA-2-315-1-Risk Cost Reports-Pipelines-20190625-public and

The lower pigging costs per run have been incorporated into our forecast. However, we intend to undertake more pigging runs in the next period, mainly due to the reconfiguration of the Sydney Primary Main to enable it to be pigged. As outlined in Attachment 6.1 our 2020 Plan includes these costs in our opex (not capex) forecast.

3.4.6 Shallow secondary mains

In 2018 a third party rock breaker punctured a secondary gas main in Sydney's CBD, causing a large gas escape. The incident led to the closure of one of Sydney's CBD railway stations and the evacuation of several commercial premises due to the high safety risks of being in close proximity to a leaking high pressure gas main.

Following this incident, we reviewed the safety risks from our shallow secondary mains in high density community use areas. We found that the controls that reduce the risk were not as effective as we had thought, leading to a change in our risk assessment.[60]

Our 2020 Plan includes a project to identify locations of shallow mains in high density community use areas and lower the risk of another third party hit, by either relaying the mains at a lower depth or installing a physical barrier to protect the main. These additional controls will lower the risk to the public to ALARP. Our proposed spend is proportionate to the risk, as shown by comparing the cost of the project against the maximum justifiable spend calculated by our external risk consultants GPA engineering.[61] The cost of this project is presented in Table 3-17.

Table 3-17: Shallow secondary mains capex ($2020, Millions, excluding overheads)

	2015-20		2020-25
	Allowance	Actuals/estimate	Forecast
Shallow secondary mains	**-**	**1.2**	**16.1**

3.4.7 Secondary district regulator replacement program

In order to supply gas to our customers at a useable pressure, we use district regulator sets to lower the pressure from secondary pressure (1050kPa) to medium and low pressures. The costs of this program is shown in Table 3-18.

Table 3-18: Secondary district regulator replacement capex ($2020, Millions, excluding overheads)

	2015-20		2020-25
	Allowance	Actuals/estimate	Forecast
Secondary district regulator replacement	**12.5**	**5.1**	**3.0**

In developing our 2015 Plan, we relied on visual reports from our gas service technicians which indicated that our fleet of district regulator sets were deteriorating. In 2010, we started a program to replace the affected regulators sets to ensure we could maintain a safe and reliable supply of gas.

Before replacing the regulator sets, we undertook a series of more detailed internal inspections and tests to prioritise the order or replacement of the fleet. When undertaking the detailed inspection we found that despite the poor surface condition, a portion of the fleet was still technically sound and could continue to be safely operated. Our validation of the regulators allowed us to reduce the size of our replacement program over the current period.

We are not proposing to any specific regulator set replacement program for the 2020-25 period.

60 RIN supporting document GPA-2-315-1-Risk Cost Reports-Pipelines-20190625-public

61 RIN supporting document GPA-2-315-2-Risk Cost Reports-Shallow Secondary Mains-20190625-public

3.4.8 Other minor works

The remainder of our facilities and pipes expenditure is incurred on a variety of minor works. For instance, where natural erosion removes the covering earth above a pipeline leading to an exposed main. Most of these works are recurrent and are forecast based on historical spend.

Table 3-19: Other minor works capex ($2020, Millions, excluding overheads)

	2015-20		2020-25
	Allowance	Actuals/estimate	Forecast
Other minor works	**8.8**	**5.9**	**6.6**

The main differences between our allowance and actual spend over the 2015-20 period is driven by two projects, as shown by Table 3-19.

The first was our program to replace our boundary regulators. These devices lower the pressure of gas before it is supplied to high-density areas such as shopping centres. We delayed the start of this program to ensure we could respond to the surge of new connections. This program will continue into the 2020-25 period.

We also found cost savings in our replacement of some of our cathodic protection equipment ($2.1M). These devices monitor and control stray currents on steel mains and pipelines and help us ensure that our cathodic protection (which protects against pipeline corrosion) is effective.

Over the 2015-20 period, we upgraded our telemetry to remotely monitor our cathodic protection systems. This system allows us to identify and repair a failed unit in a matter of days reducing the consequence of a failed device. In turn we increased our tolerance for a data logger failure and cancelled our proactive replacement program. This upgrade to our telemetry also meant we could reduce the need to physically visit each cathodic protection site on a monthly basis.

Our 2020 Plan does not include a program to proactively replace cathodic protection equipment.

3.5 Information technology

IT underpins the delivery of safe, reliable and cost-effective gas services to customers.[62] IT provides the essential platform which support almost all of our operations. For example, our systems correct billing errors before they reach the customer and help us to quickly respond to network incidents allowing us to keep the supply of gas safe and reliable.

Over the last several years we have overhauled our legacy technology systems. We focussed our investments on maintaining our current level of service by reducing risks and preventing cost increases from running ageing and often unsupported systems. A significant component has been our transition from the 25 year old, internally built GASS+ system to a modern enterprise wide information management system which supports our billing, works management, corporate processes and reporting functions.

Over the 2015-20 period we delivered almost all of the outcomes we planned (e.g. new GIS and field mobility solutions) and some additional programs – but at a lower cost. These cost savings have flowed through into our 2020-25 forecast.

Our 2020 Plan is focussed on maintaining the foundational platforms we have put in place over the 2015-20 period. As a result, our recurrent spend will return to the steady state as we begin to refresh the systems deployed over the 2015-20 period, see Table 3-21. Recurrent spend over the 2015-20 period was naturally depressed due to the overhaul of our legacy IT systems as we didn't refresh systems we were replacing.

[62] IT capex can be justified under in many ways. Generally our IT capex is justified under Rule 79(2)(c)(i) as it is required to maintain the integrity of services. Our compliance IT capex tends to be justified under Rule 79(2)(c)(iii) to comply with a regulatory obligation of requirement. In many cases our IT solutions are the lowest cost solutions and accordingly are also justified under Rule 79(2)(a) as the overall economic value to network users is positive.

We are also forecasting to spend $7.6M on improving the customer experience, in line with rising expectations around digital interactions. This investment will streamline customer interactions and provide customers with better information, for instance on the progress of their connection request.

Our 2020 Plan does not include any projects primarily justified on the basis of a cost benefit analysis. However, we have included an additional category of expenditure in Table 3-20 for completeness.[63] We also recognise that our investments are likely to unlock operating efficiencies over time. To ensure our customers realise this benefit, we have included a productivity growth component in our opex forecast to reflect the efficiency savings we hope to achieve.

Below we have split our IT capex forecast in two ways: by category and by recurrent/non-recurrent.

Table 3-20: Information technology capex ($2020, Millions, excluding overheads)

	2015-20		2020-25
	Allowance	Actuals/estimate	Forecast
Maintain	131.6	119.1	101.4
Cost benefit	0.0	0.0	0.0
Compliance	11.4	0.1	0.0
Customer	4.6	0.3	5.8
Total	**147.6**	**119.5**	**107.2**

Table 3-21: Recurrent and Non-recurrent Information technology capex ($2020, Millions, excluding overheads)

	2015-20		2020-25
	Allowance	Actuals/estimate	Forecast
Recurrent	91.7	59.3	79.5
Non-recurrent	55.9	60.1	27.7
Total	**147.6**	**119.5**	**107.2**

3.5.1 Maintain service

The majority of our IT investments are required to maintain the service we provide to customers. Over the 2015-20 period we were able to constrain our level of IT investment and spend less than our allowance.

Our 2020 Plan is much lower than our actual 2015-20 spend, see Table 3-22. Our forecast includes the cost savings we have achieved to date and takes into account that we only need to refresh, rather than overhaul our existing systems.

Table 3-22: IT maintain service capex ($2020, Millions, excluding overheads)

	2015-20		2020-25
	Allowance	Actuals/estimate	Forecast
Asset Management & Geospatial systems	15.2	13.6	8.8
Corporate systems/SAP Enterprise Resource Planning	63.5	61.6	29.6
Customer experience[64]	0.0	0.5	1.7

[63] We apply a consistent approach to IT across JGN and Jemena Electricity Networks. While many projects will serve both networks all costs presented in this document represent only the costs allocated to JGN, consistent with our Cost Allocation Method.

[64] This category covers the costs of maintaining our existing customer IT systems. Expenditure for new projects to delivery additional customer value are captured in the 'customer' value driver category, see Table 3-24.

	2015-20		2020-25
	Allowance	Actuals/estimate	Forecast
Cyber-security	2.2	5.1	10.3
Enabling platforms & networking	27.1	14.7	21.3
End user services & support	9.5	7.6	11.7
Metering	10.5	4.0	16.4
Real time systems/SCADA	3.7	12.0	1.6
Total	**131.6**	**119.1**	**101.4**

Asset management & Geospatial systems

Over the 2015-20 period we deployed a new Geographic Information System (**GIS**) (and surrounding systems) as planned. As we now have GIS in place, our 2020 Plan is forecasting a reduction in spend as we will focus on enhancing the capability and undertaking lifecycle upgrades of the current system.

Corporate systems / SAP Enterprise Resource Planning

We completed the major overhaul and replacement of our legacy systems over the 2015-20 period. As part of the project we also addressed a range of other requirements (gas business to business (**B2B**) harmonisation, introduction of the National Energy Customer Framework) as well as the changes required to roll-out our mobilisation solution to field technicians.

Our 2020 Plan is much less than our 2015-20 spend as we intend to refresh our current systems rather than replace the systems with alternative platform.

Cyber-security

In response to the increasing cyber security threats we face, we have strengthened our defences and improved our ability to quickly respond. This has required an investment above what was included in our allowance ($2.7M).

Our 2020 Plan continues this increased level of investment to ensure that we have the capability to continue to protect our systems and customers' data from these rapidly evolving cyber-attacks.

Enabling platforms & networking

Enabling platforms and networks covers the costs of our IT infrastructure. This category accounts for the largest cost savings we have been able to achieve over the 2015-20 period ($14.1M).

The cost savings we have been able to achieve have been primarily driven by our strategy to replace several bespoke gas distribution systems with a common consolidated platform and taking advantage of new technologies to run several servers "virtually" on larger shared servers. This has allowed us to replace specialised hardware and technologies with cheaper off the shelf products. Running fewer larger servers (rather than many smaller ones) and also allows us to take achieve greater economies of scale to reduce our infrastructure costs.

While these cost savings have flowed through into our forecast for the 2020-25 period, we have forecast an increased infrastructure requirement in our 2020 Plan.

While we have been able to constrain our spending to date, our systems are reaching capacity. The load on our infrastructure is increasing for two main reasons. We are expanding the capability of our existing systems. We have also increased the size of our infrastructure in the 2015-20 period for the introduction of our new SCADA system (discussed below). While the initial cost of the additional servers was captured in the SCADA cost category the refresh of the underpinning platform (due in the 2020-25 period) falls in this category.

End user services & support

End user services and support covers the user devices such as computers, mobile phones and tablets for our corporate and field staff.

We have also been able to find cost savings in our delivery of this cost category by including the required server changes as part of our corporate system upgrade costs. We have also been able to extend the life of our corporate users' devices.

Our 2020 Plan includes a slight uptick in this category to account for an increasing number of field devices. There is also a natural increase due to the age profile of the devices in use.

Metering

Our metering category covers our metering and billing systems. This expenditure ranges from our metering data collection systems, including support for the hand held devices used by our meter readers, through to the integration tools which we used to build the interfaces that take this data through the billing processes and deliver it to the market.

Over the 2015-20 period we postponed a number of investments for our MV-RS system (which collects data from our meter readers and plans their route) as well as the applications which support our Metretek (commercial sites) and MDL (meter-data logger) metering solutions. These meter data collection systems are discussed further in section 3.3.

We deferred these investments to wait for other changes to our corporate systems and to allow time for the market for these products to evolve. We anticipated that alternative solutions which would allow a greater level of rationalisation would come to market and allow us to replace these ageing systems.

Unfortunately, new products, which would allow greater integration with our corporate systems, have not yet been sufficiently developed by external software vendors. Furthermore, we do not consider that there were any alternative options available (such as developing an in-house product) that would have resulted in a more efficient outcome for customers than deferring our originally intended investments until a suitable product was available externally. The current systems we have in place are unlikely to be able to continue to efficiently enable the provision of services through to the end of the next regulatory period without work to stabilise them. Given the importance of customer metering data and our billing processes, our 2020 Plan includes the minimum investments required to refresh our current systems and ensure continued support.

We are also forecasting expenditure to provide the back office support for our RF meter reading solution discussed in section 3.3.3 and also permit more innovate solutions to the no-access problem, such as customer self-reads, that can provide alternative avenues for meter data to feed in to the billing process.

Real time systems / SCADA

Over the 2015-20 period, although not included in our allowance, we made a major investment in SCADA[65] - the system which allow us to remotely monitor and control our network. We made more comprehensive upgrades to replace the underpinning SCADA platform. We made this change to improve our real-time monitoring of the network as well as the reporting and handling of outages, ultimately enhancing the safety of our network.

Due to the upgrades we have already made, our 2020 Plan does not include any significant investments in SCADA over the 2020-25 period.

3.5.2 Compliance

Our 2015 Plan included a project to make the changes required to comply with the market changes arising from the harmonisation of the gas B2B procedures. The costs of this project is presented in Table 3-23.

[65] Consistent with the AER's preference we have split our SCADA costs into two components. The systems which sit behind our network firewall are included in IT where as our field telemetry sits in other.

We managed to implement these changes more efficiently by undertaking the work as part of our broader IT system transformation away from the GASS+ system. The costs for this are included in our corporate systems line of our maintain service sub-category.

For the 2020-25 period we will replace our platform which underpins our Customer and Billings System (**CABS**), Emergency Load Management System (**ELMS**) and provides data required for the Short Term Trading Market (**STTM**) to continue to operate (this is a jurisdictional requirement).

We are rewriting these critical systems as the entire code base is bespoke and the developers are no longer available to work on the system posing an unacceptable risk of failure and a complete inability to modify the system to respond to market changes. If it failed it would adversely impact the quality and timeliness of data inputs to the STTM resulting in financial impacts to market participants and a breach of JGN's obligations to the market.

Table 3-23: IT compliance capex ($2020, Millions, excluding overheads)

	2015-20		2020-25
	Allowance	Actuals/estimate	Forecast
Compliance	**11.4**	**0.1**	**0.0**

3.5.3 Customer

Although we had forecast to improve customer interactions over the 2015-20 period, we later decided to defer these programs to wait for the implementation and stabilisation of underpinning systems (such as our GIS). Customers would not have been able to realised the full value of these upgrades with these underpinning systems.

As our GIS has been now been successfully deployed, our 2020 Plan includes investments to improve how we interact with customers.

We plan on deploying a new customer interaction system which will allow customers to communicate with us, when they want, using channels that suit their preference. It will also be able to pull information directly from our other systems allowing us to provide customers with almost instant responses to their requests. For instance, we will be able to instantly provide detailed information from our GIS in response to a customers' Dial Before You Dig (**DBYD**) request or automatically inform customers whether they can access gas without a contribution (e.g. if they are already on a line of main).

Similar to other systems used by large organisations, such as Australia Post, we will be able to automatically provide customers with status updates and tracking whenever they request we provide a service (for instance a new connection).

In addition to keeping up with evolving customer expectations, by making the connections process seamless we will also make it easier for customer to connect to gas and in turn allow us to further lower bills for our existing customers.

Our IT customer capex is presented in Table 3-24.

Table 3-24: IT customer capex ($2020, Millions, excluding overheads)

	2015-20		2020-25
	Allowance	Actuals/estimate	Forecast
Customer	**4.6**	**0.3**	**5.8**

3.6 Augmentation

Our augmentation program covers capex for installing new gas pipes and regulators. We augment our network for several reasons including:

1. To cater for higher levels of demand when peak demand grows.[66]
2. Enable new customers to connect to our network.[67]
3. Improve the integrity of our network or reduce the risks borne by our customers, employees and the general public.[68]

Our augmentation is 'lumpy' as it is not routine in nature. The drivers for this expenditure vary over time.

In preparing our 2015 Plan, we forecast capex to allow us to meet rising peak demand. This required a number of capacity driven projects across our network and the construction of a primary main in Sydney's north to ensure long term supply. Peak demand growth has since slowed and we responded to these changes.

We went beyond simply deferring projects to adapting our investment approach. Slower peak growth and our investment in better monitoring systems has allowed us to increase the investment thresholds and apply a more just-in-time approach to upgrading the capacity of our network. Our achievements in managing network capacity at lower cost have flowed through into a reduced capex forecast for the 2020-25 period.

The second part of augmentation investments is the strengthening of our network to connect new customers. We continually monitor market activity, adopt a flexible and proactive approach and work with stakeholders to reduce costs.

Our connection driven augmentation forecast for the 2020-25 period is based on the latest government and developer plans. We have only included projects that will provide revenue in excess of these costs, to ensure that each project provides customer benefits via lower bills. As the number of new estates over the 2020-25 period are similar to the number connected over the 2015-20 period so too are our actual and forecast costs.

Lastly, as outlined in section 3.4.4, we are planning on laying two new secondary mains to reduce the safety risks related to the last section of the Sydney Primary Main (from Lane Cove to Willoughby).

Table 3-25: Augmentation capex ($2020, Millions, excluding overheads)

	2015-20		2020-25
	Allowance	Actuals/estimate	Forecast
Addressing peak demand growth	28.1	7.2	2.9
Connections driven	40.2	32.0	33.3
Northern primary main	22.2	0.5	-
Sydney Primary Main Integrity Management (Lane Cove to Willoughby)	-	0.0	24.5
Total	**94.2**	**40.0**	**60.8**

As seen in Table 3-25, our augmentation investments driven by new connections and increasing peak demand included in our 2020 Plan are consistent with our actual spend over the 2015-20 period. The increase in overall augmentation expenditure is driven by the project to reduce safety risks from continuing to operate the last leg of

66 Justified under Rule 79(2)(iv) to maintain capacity to meet levels of demand for services existing at the time capex is incurred.

67 Justified under Rule 79(2)(b) as the present value of the expected incremental revenue to be generated as a result of the expenditure exceeds the present value of the capex. NPV models are attached which demonstrate this for all augmentation projects in our 2020 Plan.

68 Justified under Rule 79(2)(c)(i) or 79(c)(ii) to maintain the safety and integrity of services.

the Sydney Primary Main at primary pressure. Relative to alternative options this project has the lowest costs, provides the greatest safety benefits and removes a future capacity constraint.

3.6.1 Addressing peak demand growth

Historically we have observed and planned for growth in peak gas demand. Peak growth was seen in established areas largely due to customers upgrading their appliances, for instance due to rollout of instantaneous hot water systems. These appliances increase peak consumption by using large quantities of gas over short periods of time at peak hours of the day.

Peak gas use lowers the pressure within the network and can lead to poor or no supply outcomes. To ensure a reliable supply we monitor the pressures in key areas of our network.

The cost of addressing peak demand growth is shown in Table 3-26.

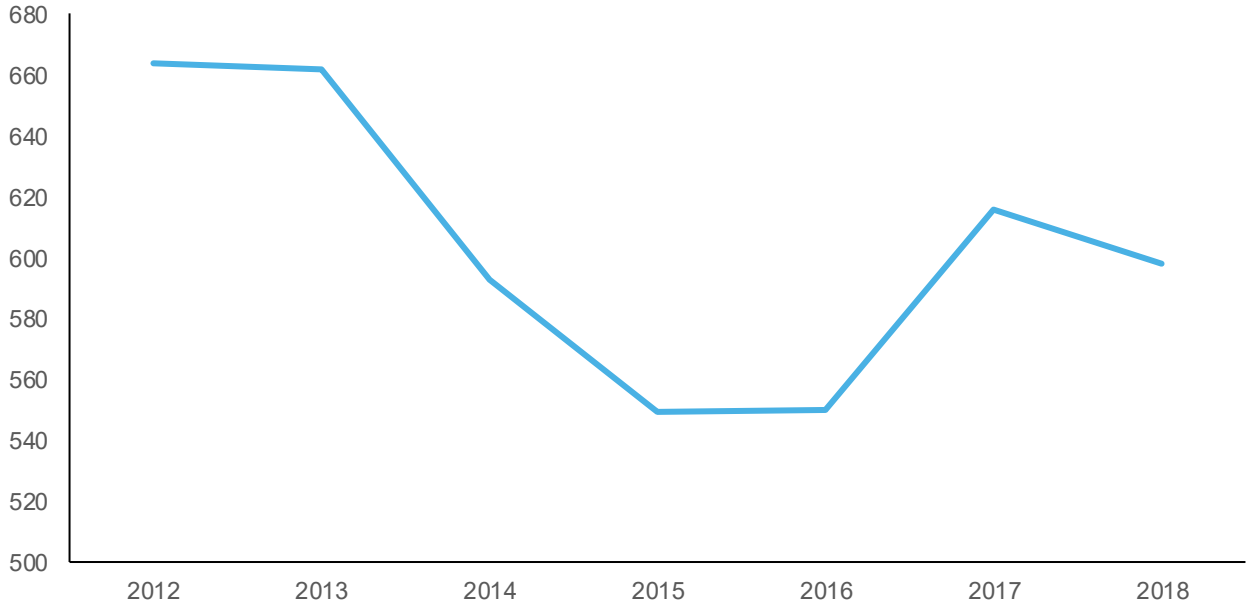
Table 3-26: Addressing peak demand growth capex ($2020, Millions, excluding overheads)

	2015-20		2020-25
	Allowance	Actuals/estimate	Forecast
Addressing peak demand growth	**28.1**	**7.2**	**2.9**

Over the 2015-20 period we saw a slowing in peak demand growth due to the saturation of instantaneous hot water systems and a shift to reverse cycle heating. This can be seen in the pressure levels in our secondary network in Narrabeen, shown in Figure 3-3.

In Narrabeen pressures in the secondary network steadily fell from 2012 to 2015. If these pressures had continued to drop our customers would have experienced poor or no supply outcomes. However, since 2015 we have seen network pressures in this area stabilise reducing the need for network reinforcement.

Figure 3-3 Narrabeen secondary network pressures (kPa, calendar years[69])



69 Calendar years are used to avoid splitting winter into two separate regulatory years.

To reduce costs for customers we went further than deferring capacity projects based on slower peak load growth. We used these changing circumstances to review our investment approach. We identified that it was not only possible to defer these projects but to also increase the threshold for investing and increasing network capacity.

Previously, at the medium pressure level (210kPa) we installed additional capacity whenever network pressures fell below 70kPa.[70] With slower peak demand growth we are able to continue monitoring our network and only install capacity when pressures drop below 40kPa.[71] To facilitate this we upgraded our network monitoring systems from ~60 mechanical gauges to ~300 newer electronic gauges which allowed us to monitor more locations with greater data granularity.

We are confident this change in approach will not result in supply issues as slower peak growth provides us more time to monitor network performance and respond by installing additional capacity. Further, a smaller number of capacity projects reduces the risk that we cannot mobilise at short notice to install additional capacity, due to resourcing or delivery issues.

Our adaption to the latest patterns of customer usage is what has allowed us to significantly reduce our augmentation capex over the 2015-20 period. This change has flowed through to our 2020-25 forecast as we have applied our higher investment threshold and lowered our forecast of peak demand growth in existing areas.

If peak demand growth picks up or if we need to revert to installing additional capacity at 70kPa (based on increased reports of poor supply) we will need to invest more than we forecast.

3.6.2 Northern primary main

Our 2015 Plan included a project to provide long term supply to Sydney's northern region over the next 20-30 years. This cost of this project is shown in Table 3-27.

Table 3-27: Northern primary main capex ($2020, Millions, excluding overheads)

	2015-20		2020-25
	Allowance	Actuals/estimate	Forecast
Northern primary main	**22.2**	**0.5**	**-**

The primary goal was to enhance the overall capacity and security of supply in the northern region of our network. The project also enabled us to downgrade the Lane Cove to Willoughby section of the Sydney Primary Main to reduce the safety risks due to corrosion or a third party hit.

The project was forecast to cost $95M with $22M to be incurred over the 2015-20 period. The project was made up of four parts:

1. Engineering assessment and feasibility study ($0.5M).
2. Purchase land for the site of a new PRS in Pymble and lay 3.7km of 350mm steel in North Ryde at primary standard ($23M).
3. Lay 6.5km of 250mm steel in Frenches Forest ($16.3M).
4. Purchase land required for the installation of pig launcher facilities ($0.1M).

While undertaking the engineering assessment and feasibility study our capacity monitoring identified that peak load consumption was not growing as fast as expected. Our latest assessments have found that our network has

[70] We also need to consider the interactions between each layer of our network. For instance, lower pressures on our secondary network may cause capacity constraints at the medium pressure level.

[71] This is only possible on a case by case basis depending the location of our larger customers. Lowering pressures below this threshold leads to customer complaints about poor supply.

sufficient capacity up to 2031. The reduction in peak demand allowed us to revisit our strategy for supplying gas to the northern region.

While the capacity concerns have fallen away, we still need to manage the integrity of the Lane Cove to Willoughby section of the Sydney Primary Main. As discussed in section 3.4.4, our solution is to instead lay two new secondary mains to strengthen our network and de-rate this section of the Sydney Primary Main. This customer endorsed solution (see section 1.2.3) is the lowest overall cost and safest option whilst still allowing us to connect new customers in the Northern Beaches beyond 2031.

3.6.3 Connections driven augmentation

Our connections program is driven by new estates and high-rise developments, predominately along transport corridors. To support these connections we sometimes need to strengthen our existing network. This generally involves installing new feeder mains and regulators.

Table 3-28: Connections driven augmentation capex ($2020, Millions, excluding overheads)

	2015-20		2020-25
	Allowance	Actuals/estimate	Forecast
Projects we did forecast	40.2	12.1	1.3
Projects we didn't forecast	-	19.9	9.1
Forecast for the 2020-25 period	-	-	23.0
Total	**40.2**	**32.0**	**33.3**

Our 2015 Plan forecast a series of augmentation projects based on the best information available on the likely location and numbers of new connections over the 2015-20 period. We rely on plans provided by the governments and developers.

Investment decisions are regularly re-assessed to take into account changing market forces and the impact of large transport projects, such as Sydney's new metro system. These changes often affect the timing of each development and which parts of each area develop first. In turn this changes the best solution to deliver gas to each area. It also means that some projects did not go ahead while others we did not forecast did. This leads to changes to our capex as shown in Table 3-28.

We continually monitor market forces and trends, including industry or developer initiatives, new market entrants and other infrastructure developments. Each of these constantly changing factors influences when, where and what type of new dwellings are constructed across our network.

Our constant monitoring provides us with an understanding of what will be required, and, more importantly when. This in turn allows us to work with all stakeholders to find efficiencies and reduce costs. In some cases this means expediting projects to fall in line with timing of new infrastructure projects such as new roads or bridges while for others it means adopting a just in time approach.

We also ensure that we only build infrastructure which delivers net customer benefits by checking that the incremental revenue is higher than the expected capex. Where this is not the case we ask for a contribution towards the connection cost.

Our forecast is again based on current plans provided by developers and dwelling forecasts prepared by the Department of Planning and the Environment. We have taken into account the existing infrastructure in place and checked to ensure each development provides incremental revenue in excess of the costs. This has allowed us to reduce our forecast from $70M down to $32M.

While connections over the 2020-25 period are expected to be lower than the 2015-20 period, the reduction is largely due to a reduction in the number of high-rise buildings. The expected number of new estate connections is expected to reduce by a much smaller amount. As a result we are forecasting a similar level of connection driven augmentation capex for the 2020-25 period.

As discussed in section 1.2.1 in building new capacity we could either build capacity for the long term (beyond 2050) or the medium term (up to 2050). Given the uncertainty our gas network faces we engaged our customers to identify which option will best achieve the NGO.

Based on customers feedback we adopted a mixed approach. Where the costs for future rework to boost capacity is high and there is a prospect of future development we adopted a long term approach. Where the cost or rework are lower and the prospects of increasing capacity requirements are low we adopted a medium term approach.

For our 2020 Plan this means we adopted a long term approach for two mains we will lay to supply the Western Sydney Aerotropolis. For the last area of the Aerotropolis and all other areas we are adopting a medium term approach.

We checked with customers on whether we heard them correctly and chose the right option. Most customers endorsed our mixed approach. Most customers who did not agree with our approach preferred that we invest more and adopt a long term approach.

3.7 Mains replacement

Our mains replacement program manages our old and deteriorating pipes to ensure the safety,[72] reliability[73] and affordability of our network.[74] Often each project has several drivers.[75] Our mains replacement capex is shown in Table 3-29.

We do this by constantly monitoring, assessing and looking at new information (through new technologies and data) to ensure we efficiently operate our network. This was the case for both a Penrith Primary Main project and our deteriorated mains replacement program where cost efficiencies were achieved.

The Penrith Primary Main project was to address the safety risks of operating a high pressure pipeline. New gas demand data indicated that we no longer had to operate the pipeline at trunk pressure and instead could reduce the pressure of the pipe to address the risks. The pressure reduction resulted in a significant cost saving.

We were also able to constraint our mains replacement costs. This was achieved by finding cost savings and adapting to new information which allowed us to defer two mains replacement projects.

Although our 2020 Plan assumes that we will replace fewer sections of our network, we are completing more works overall due to the large Newcastle area replacement program of 136km, with 104km being replaced in the 2020-25 period.

Table 3-29: Mains replacement capex ($2020, Millions, excluding overheads)

	2015-20		2020-25
	Allowance	Actuals/estimate	Forecast
Penrith Primary Main	14.9	0.0	-
Rehabilitation	44.0	18.7	38.2
Other	5.6	8.6	6.6
Total	**64.5**	**27.3**	**44.8**

72 Justified under Rules 79(2)(i)-79(2)(iii) to maintain the safety and integrity of our network and comply with our regulatory obligations.

73 Justified under Rule 79(2)(c)(ii) to maintain the integrity of the network. If the project strengthens the network to provide additional capacity for existing or new customers then it is also justified under either Rule 79(2)(c)(iv) (to maintain our capacity to meet levels of demand for services existing at the time the capex is incurred) or Rule 79(2)(b) (present value of the expected incremental revenue to be generated as a result of the expenditure exceeds the present value of the capex). This includes areas of our network where we will be increasing the pressure from 2kPa to 210 kPa to allow customers to use devices such as instantaneous hot water systems.

74 Justified under Rule 79(2)(a) where the project delivers cost savings (generally by halting increases in repair and lost gas costs) that exceed the costs of investment. We present NPV models of each project in our 2020 Plan identifying the expected cost savings.

75 Often our mains replacement programs are justified by the combination of several drivers. For example, a project may cost slightly more than the cost savings it is expected to deliver (generally by halting opex increases) but the value of the additional reliability or capacity benefits mean the project as a whole is justified.

3.7.1 Penrith Primary Main

The Penrith primary main was designed and built in stages to trunk standards to provide long-term supply to Western Sydney and the Blue Mountains. Consistent with the standards of the time, we placed protective barriers above the main to minimise the risk of an excavator hit.

Since it was built, new 'trenchless' technology has become prevalent. This technology allows third parties to easily and quickly install infrastructure by drilling under roads and towards our mains that often laid parallel roadways.

This change significantly increases the likelihood and safety consequences of a rupture. To address the risk to the public we planned to replace a section of the main with a thicker pipe over the 2015-20 period.

Updated gas demand forecasts in the region indicated that a pipeline operating at trunk pressure would not be needed until 2056. This enabled us to de-rate the pipeline from a trunk to a primary main and significantly lower the pressure, allowing us to reduce the safety risk and defer expenditure.

We are not forecasting any similar works relative to the Penrith Primary Main in our 2020 Plan.

3.7.2 Rehabilitation

We replace our deteriorating gas mains to:

1. Reduce safety risks to the public (from leaks), and our employees/contractors that work on the mains.
2. Avoid cost increases from rising repair costs.
3. Improve supply reliability.
4. Improve the capacity of the network.

Our network predominately consists of modern material such as nylon and polyethylene due to upgrades undertaken in the 1990's. Not all mains were replaced. In a number of locations we instead kept the pressure low delaying the need to replace these mains.

We have adopted a risk based approach to managing deteriorating mains – which customers endorsed (see section 1.2.2). In each network section we balance the cost against the customer benefits. We prioritise and rank which areas we replace and when. We believe this approach is consistent with our customers' preferences for us to focus on affordability without compromising safety.

We continually adopt our plans based on new information we receive. New information and improving our performance by finding efficiencies have allowed us to either defer or reduce the costs of our investments.

These efficiencies have flowed through into our forecast. Our 2020 Plan includes four projects to replace mains relative to five areas this period. One of the planned projects (Newcastle) requires replacing 104 km of mains over the 2020-25 period resulting in an overall increase in our level of investment, as shown in Table 3-30.

Table 3-30: Mains rehabilitation capex ($2020, Millions, excluding overheads)

	2015-20		2020-25
	Allowance	Actuals/estimate	Forecast
Projects completed	22.7	13.8	-
Deferred	15.9	0.0	0.3
Forecast	4.0	4.9	37.4
Minor works	1.3	0.0	0.4
Total	**44.0**	**18.7**	**38.2**

Projects completed

Over the 2015-20 period we completed and achieved efficiencies in the delivery of several of our mains replacement projects: Mt Druitt, Kensington, Bidwill and Maitland.

The largest savings were made with Mt Druitt, where we replaced 18km of large diameter (200mm and 150mm) medium pressure steel mains. Unlike most of our mains replacement projects, we had not recently replaced similar medium pressure mains. This made it difficult as we did not have recent costs on which to base our forecast.

We have experience in replacing all of the mains to be replaced over the 2020-25 period and this recent cost information has been used in preparing our 2020-25 cost forecasts.

We generally replace mains by inserting new mains in the existing pipes, although this is not always possible. Sometimes we need to lay new mains to ensure that we can maintain the capacity of the network. We typically do this by digging a new trench, laying the new main and restoring the established area.

In Mt Druitt we were able to use directional drilling technology due to the lower customer density, and in turn smaller number of service connections that needed to be made. As a result we were able to avoid costly restoration activities and reduce the impact to customers and the public. Customers told us they preferred we avoid digging up local streets and reduced the impact of construction on their local communities.

Our 2020 Plan takes into the account efficiencies that directional drilling can provide in forecasting the cost of our Kurri Kurri project, which also has low customer density.

Deferred projects

Over the 2010-15 period we deferred mains replacement programs in Goulburn, Wollongong as well as the Bankstown / Chullora / Greenacre area. However, we also brought forward the Matraville mains replacement project.

In Goulburn we had planned to continue the mains replacement program that commenced in the earlier 2010-15 period. We replaced the mains with the highest safety risks first: areas with shallow mains in denser commercial areas. Before proceeding with the last stages we undertook a leakage test of the last sectors and found that these areas were in better condition than expected. Accordingly, have deferred these works beyond the 2020-25 period.

For Wollongong, we planned to replace mains to increase the capacity of the network so we could supply nearby residential and commercial developments. This project followed on from earlier mains replacement works undertaken in the 2010-15 period. However, the planned developments did not occur and a subsequent leak test found that the condition of the remaining mains was better than expected. Based on this new information we were able to defer the replacement of the last sections until the 2025-30 period.

Forecast projects

Over the 2020-25 period we expect to complete mains replacement projects in Kurri Kurri, Mittagong and Matraville. We will also commence mains replacement projects in Newcastle.

We had planned to replace the mains in Kurri Kurri in the 2015-20 period. In our preparations we found exposed mains, creek crossings above mines subsidence areas and coal tar inside pipework (from when the mains supplied towns gas). As a result, before we could begin the mains replacement project we needed to first address these issues. As these preparatory works have been completed, we have forecast to undertake the mains replacement works across the 2015-20 and 2020-25 periods.

For Mittagong we will start works this period to replace the current cast iron and steel network operating at medium pressure. The main reason for rehabilitating this area is to improve the safety due to a high number of gas leaks and difficulty in isolating gas supply on cast iron and steel mains during emergency situations.

Our largest project is Newcastle where we are replacing a total of 136km of cast iron and steel mains. Due to the size and scale of the project, we are completing the project over five years with 104km this period. This project will halt increasing repair and lost gas costs increasing safety and ensuring reliable gas supply to customers.

While we have deferred some projects we have also brought forward our Matraville mains replacement program. One of our commitments to customers for this period is to ensure the same level of service for customers. Matraville (once Maitland is completed) will be the last network operating at 2kPa and rehabilitating the mains in this area will enable customers to install modern appliances such as instantaneous hot water systems.

Our forecast also includes costs to commence detailed planning in 2025 for mains replacement programs we expect to undertake in the 2025-30 period (such as Haberfield / Strathfield / Campsie and Bankstown / Chullora / Greenacre areas).

Other projects

In additional to the larger projects described above we will also:

- Deliver ad-hoc projects such as replacing a degraded secondary main on Lees Bridge. This project was moved to the 2015-20 period (from the prior 2010-15 period) to coordinate with government authorities.
- Undertake minor capital works on mains and services which pose an unacceptable safety and reliability risk. These are ad-hoc replacements that are identified from field investigations of high leakage areas or customer complaints. These projects are vital in ensuring we offer the expected service to customers and the public.

Our 2020 Plan includes minor capital works and ad-hoc projects based on the historical average.

3.8 Other

Our other category of capex covers the remaining, generally smaller, parts of our investment program. It includes the investments in property, fleet and mobile plant and equipment required to keep our network operating. It also includes the cost we are required to incur to relocate our assets (where we do not own the land our assets reside on) as well as our SCADA system (which enables us to remotely monitor and control our network).[76]

Over the 2015-20 period capex was higher than expected, as the forecast costs from our property relocation project was based on preliminary estimates and some spend was deferred from 2015 into the 2015-20 period. This was partially offset by our strategy to smooth the peakiness of our vehicle replacement program.

For the 2020-25 period we are forecasting costs below both our actuals/estimates and the allowance for the 2015-20 period as set out in Table 3-31.

Table 3-31: Other capex ($2020, Millions, excluding overheads)

	2015-20		2020-25
	Allowance	Actuals/estimate	Forecast
Property	6.1	21.9	6.9
Vehicles	18.3	10.2	18.6
Relocations	2.8	4.5	3.7
Telemetry	10.5	2.4	2.2
Mobile plant and equipment	4.5	3.2	2.9
Mines subsidence	2.0	3.2	-
Total	**44.4**	**45.5**	**34.3**

[76] These items are justified under Rule 79(2)(c)(i) as this capex is required to maintain the integrity of services and/or to comply with a regulatory obligation or requirement Rule 79(2)(c)(iii). In many cases our solutions represent are the lowest cost solutions and accordingly are also justified under Rule 79(2)(a) as the overall economic value to network users is positive.

3.8.1 Property

Our property spend captures the costs of purchasing and fitting out our office and depot locations. Due to terminating leases, we consolidated our NSW office functions into a single leased property, purchased a site and built a new depot, and relocated our Melbourne head office.

Our forecast was developed by an external consultants based on preliminary design concepts – we indicated at the time that these costs would change as we went to market for the fit-out. Our actual costs differed in two ways. First a greater proportion of the costs were incurred in the 2015-20 period (rather than 2015)[77] and second market costs were higher than our forecast.

Our property spend for the 2020-25 period is focussed on maintaining the condition of our existing property portfolio. We also intend to relocate our existing offices in Bathurst, as our current offices do not have sufficient space to safely accommodate the required trailers, vehicles and plant required to efficiently serve the central west region of NSW.

3.8.2 Vehicles

To ensure we can deliver our investments and respond to network incidents we continually invest in our fleet of vehicles.

We replace our vehicles based on their individual performance and condition. For our light commercial and passenger vehicles this is generally at the 150,000km mark (about 6 years old). We apply a higher kilometre threshold (relative to smaller urban networks) as we have taken into account our specific circumstances, such as the large geographic area we cover.

Over the 2015-20 period we identified that a number of light commercial vehicles were due for replacement in a single year. Replacing a large number of vehicles increased our exposure to specific model risks (where a specific model/year of a vehicle may be affected by a similar defect) and potential price/deliverability risks, in particular in relation to the specialised fit outs of our vehicles

As a result, we have applied a light commercial vehicle replacement cap to smooth out the peak in replacement numbers, which ultimately results in the replacement of some light commercial vehicles being deferred. We expect to see an increased level of maintenance costs (opex) as a result of these deferrals but believe that these are offset by the benefits of procuring a more steady number of vehicles (diversifying away the model risk and reducing potential deliverability/pricing risks).

While this strategy does not change the overall cost of our replacement program, it does result in an underspend for the 2015-20 period, as we have deferred the replacement of some vehicles to the 2020-25 period.

3.8.3 Relocations

From time to time, government authorities or private landowners require us to move its gas mains or facilities to enable the authority to perform works such as road re-alignment or widening, or to make way for activities that the property owner has planned. Where arrangements with the relevant authority or landowner do not provide us with a right guaranteeing the location of its assets, we are bound to relocate them as required by the authority or landowner at its own expense. In cases where we do have rights it will recover the cost of relocation from the authority or landowner.

We are forecasting 2020-25 costs consistent with 2015-20 actuals.

3.8.4 Telemetry

Telemetry represents the part of our SCADA investments which sit outside our network firewall (these costs fall in our IT cost category).

[77] This will be adjusted as part of our asset base roll forward.

Our costs in the 2015-20 period were lower than expected due to the roll-out of our new SCADA system (most of which were captured in our IT costs).

Our 2020 Plan includes a slight decrease in spend, due to our recent upgrades being made over the 2015-20 period.

3.8.5 Mobile plant and equipment

Mobile plant and equipment capex covers a range of minor equipment and tools necessary to operate the gas network, such as tools, gas masks, gas detectors, bench grinders, heavy duty battery drills, road drillers, wet and dry vacuums, safety equipment, purge burners, temperature probes and Drager gauges.

Our 2020-25 forecast is consistent with our current period actual spend.

3.8.6 Mines subsidence

Portions of our high pressure (trunk) system traverse zones where subsurface coal mining occurs. Coal mining results in movement or subsidence of the ground as coal is removed. This has the effect of displacing the pipe at these locations, subjecting it to stress that may jeopardise the integrity of the pipe. To maintain the integrity of services, JGN manages and mitigates these effects on the pipeline. JGN must also monitor the pipeline's condition where subsidence is anticipated.

We have completed this program and no further capex is required at this time.

3.9 Speculative capex

We are investigating the transformative technologies available through hydrogen with the 'Western Sydney Green Gas Trial' ('**Green Gas Trial**') project. The project will split water to produce hydrogen and inject it into our network to replace UAG.

The Green Gas Trial project provides an opportunity to support hydrogen and promote the energy markets' drive towards decarbonisation via storage service provisioning, distribution and export of clean and renewable energy (i.e. hydrogen). Unlike projects that focus on reliability and safety outcomes, the Green Gas Trial project is about trialling changes to how the network is used.

Although JGN does not have any hydrogen producing facilities currently, we have undertaken research and development to support managing the network. Other gas networks in Australia and abroad are exploring hydrogen as a potential alternative energy source to natural gas that is predominately methane based. We consider the exploration of how existing gas networks can integrate hydrogen into their systems is now consistent with a prudent service provider acting efficiently, in accordance with accepted good industry practice. This is evidenced by similar trials/pilots being delivered by our peer networks Australian Gas Industry Group, ATCO Gas and Evoenergy.

If successful, we expect the overall economic value of the expenditure to be positive because the key benefits from the project include:

- Resolving technical and regulatory barriers to enable hydrogen produced from renewable energy to be injected into the gas distribution network.
- Using hydrogen to replenish a portion of network UAG.
- Reduced carbon emissions by displacing natural gas from domestic gas use – consistent with the NSW Government's net-zero carbon target.
- Improved long term sustainability and growth of the gas network by supporting renewable gas injection as the energy market continues to decarbonise.

Although JGN has not included the project capex in its conforming capex forecast for 2020-25, JGN does propose including that expenditure (net of ARENA funding) in a speculative capex account – as allowed for in Rule 84 of the NGR. We intend to apply, if the project is successful, to include the capex in our Regulated Asset Base (**RAB**).

If successful, then the project expenditure would comply with the new capex criteria in NGR because:

1. It is prudent for service providers like JGN to undertake research and development projects like the Green Gas Trial to explore alternative and more cost-effective ways to cover UAG obligations and to find new ways of using its assets to future-proof the network, and as it is now stated COAG policy to allow up to 10% hydrogen in domestic gas networks (rule 79(1)(a))

2. The project has been developed in accordance with good industry practice and by starting with a trial – rather than large scale production – is seeking to minimise initial costs (rule 79(1)(a)).

3. The project will have proven that hydrogen is a viable alternative to natural gas and the facility can deliver it in a cost-effective way – meaning that JGN and its customers can benefit from lower UAG costs, lower carbon emissions (and costs), and proven alternative uses for the network (rule 79(2)(a))

4. The hydrogen can be used to meet JGN's regulatory obligation to offset UAG from its network (rule 79(2)(c)(iii)).

If the capex is eventually included in JGN's RAB, then any revenue from alternative uses generated by facility would be removed from the allowed revenue allocated to the reference service so that customers benefit from the project's success.

4. Rule 79 compliance

For capex to be included in the capital base it must conform with the three criteria outlined in Rule 79 of the NGR.

Efficient

The first criteria is that the expenditure must be efficient, or specifically what *"...would be incurred by a prudent service provider efficiently in accordance with accepted good industry practice, to achieve the lowest sustainable cost of providing services.."*.

We have a long history of efficient delivery. Our strong performance has led to:

- An enviable track record of relatively low expenditure while connecting record numbers of new customers and keeping our ageing network safe (outlined in section 2).
- Being one of the first businesses in Australia to achieve ISO 55001 Asset Management certification demonstrating that our processes and systems are robust and consistent with industry best practice and in turn support the efficient delivery of our investment program.
- Ensuring that the network continues to perform to our customers' expectations around safety and reliability. This is evidenced by our consistently strong performance in responding to emergency incidents and comparable reliability performance across Australian gas businesses.

Our focus on cost and delivering in line with accepted good industry practice is weaved throughout our proposal. For instance, our forecast costs are generally based on our past costs to ensure that the historical cost savings we have achieved flow through to our forecast.

Justified

The second criteria outlines what the capex must achieve for it to be justified. All of our capex programs achieve one (or sometimes several) outcomes specified by Rule 79.

Table 4-1 below provides a high level description of the justification of each capex category against Rule 79(2).

Table 4-1: Justification of capex categories against NGR

Capex	Justification
Connections and connection driven augmentation	Connections expenditure is justified as this expenditure: • Provides positive economic value to our customers (Rule 79(2)(a)). This is true for both: – New customers – who choose to connect to our network as they consider the value from a gas connection is higher than the cost, made up of the combined connection charge (if any) and ongoing charges (which are always higher than the connection cost). – Existing customers – who will receive material bill reductions as a result of these new connections sharing more of the largely fixed costs of running the gas network. Our 2020-25 connections program will deliver about $300M in bill reductions ($200 per customer) over the 2020-25 period.[78] • Leads to incremental revenue greater than the incremental cost (Rule 79(2)(b)). We ensure that all of our connections (and any required augmentation) results in revenue that at least covers the cost of these new connections. Any additional revenue (above the connection cost) flows through to bill reductions for existing customers. • Is necessary to comply with Rule 119 (Rule 79(2)(c)(iii))

[78] Bill reductions are calculated by subtracting the incremental expenditure from the incremental revenue from these additional connections over the 2020-2050 period. These calculations are provided in RIN supporting document JGN-2-3.15-2-Connections capex forecast - NPV Model-20190630-public

	If the revenue from a connection does not exceed the costs we ask for a capital contribution in accordance with Part 12A of the NGR. This ensures that our connections expenditure (net of contributions) is justified against all three of the outcomes above.
Augmentation	We augment our network for several reasons including: • To cater for higher levels of demand when peak demand grows (Rule 79(2)(c)(iv)). This only forms a small part of our forecast program. • Enable new customers to connect to our network. These expenditure is justified for the same reasons as connections above. For each connection driven augmentation project we show that the incremental revenue is greater than the incremental cost of each project we are proposing (Rule 79(2)(b)).[79] • Improve the integrity of our network (Rule 79(2)(c)(ii)) or manage the safety risks borne by our customers, employees and the general public (Rule 79(2)(c)(i)). This is the case for the two additional secondary mains in northern Sydney which will maintain the safety and integrity of services and comply with our regulatory requirement to keep risks to ALARP. This expenditure will also lower our overall costs in operating the network leading to provide positive economic value to our customers (Rule 79(2)(a)).
Meter replacement	The majority of our metering expenditure is justified as it is required to meet the requirements of the Gas and Electricity (Consumer Safety) Regulation 2018 (Rule 79(2)(c)(iii)). It is also required to maintain the integrity of services (Rule 79(2)(c)(ii))– without this spend we will not be able to continue accurately billing our customers.
Facilities and pipes	This expenditure is primarily driven to maintain the integrity (Rule 79(2)(c)(ii)) and safety (Rule 79(2)(c)(i)) of our ageing network. However, this expenditure will also help reduce costs as it will allow use of cheaper (and more effective) inspection methodologies (Rule 79(2)(a)).
Mains replacement	Our mains replacement program manages our old and deteriorating pipes to ensure the safety (Rule 79(2)(c)(i)), reliability (Rule 79(2)(c)(ii)) and affordability (Rule 79(2)(a)) of our network. Each project is justified on a combination of these drivers, depending on the benefits the project will bring. Some are entirely justified as the value in reducing costs exceeds the cost of the investment. In other cases cost savings only partially offset the investment costs (with the value of the remaining benefits in regards to safety, reliability and quality of supply ensuring that consumer benefits outweigh the costs). Our project justification outlines the customer benefits each investment will bring.
IT and other	This expenditure is generally necessary to maintain the safety (Rule 79(2)(c)(i)) and integrity (Rule 79(2)(c)(ii)) of our network by ensuring that we retain the capability to efficiently operate our network, respond to network incidents and manage the rising risk of cyberattacks.

Our document index[80] includes a list of our proposed capex projects and which rule(s) each project is justified against. This document also identifies all of our supporting documents mapped to each project.

Properly allocated to the reference service

The last criteria is that the capex included must be properly allocated between our reference service and our non-reference services (other pipeline services we provide by means of the covered pipeline). The pipeline services we provide are described in Attachment 4.1.

We allocate our costs via the JGN Cost Allocation Methodology. It prescribes allocation of costs to the reference service and non-reference services provided by means of the pipeline, in accordance with Rule 93(2) of the NGR. The JGN Cost Allocation Methodology is included in Attachment 6.5. We have applied the JGN Cost Allocation Methodology to remove any non-reference service costs from the building block cost stack, and therefore the

79 RIN supporting document JGN-2-3.15-2-Capacity Augmentation Development Plan-NPV Model (1) -50 years-20190630-public

80 Summarised in RIN Attachment 16 - JGN - Document Index - 20190630 - Public.pdf

capex presented in this Attachment only includes that relating to the reference service. For completeness, we have not forecast any capex for our non-reference services.