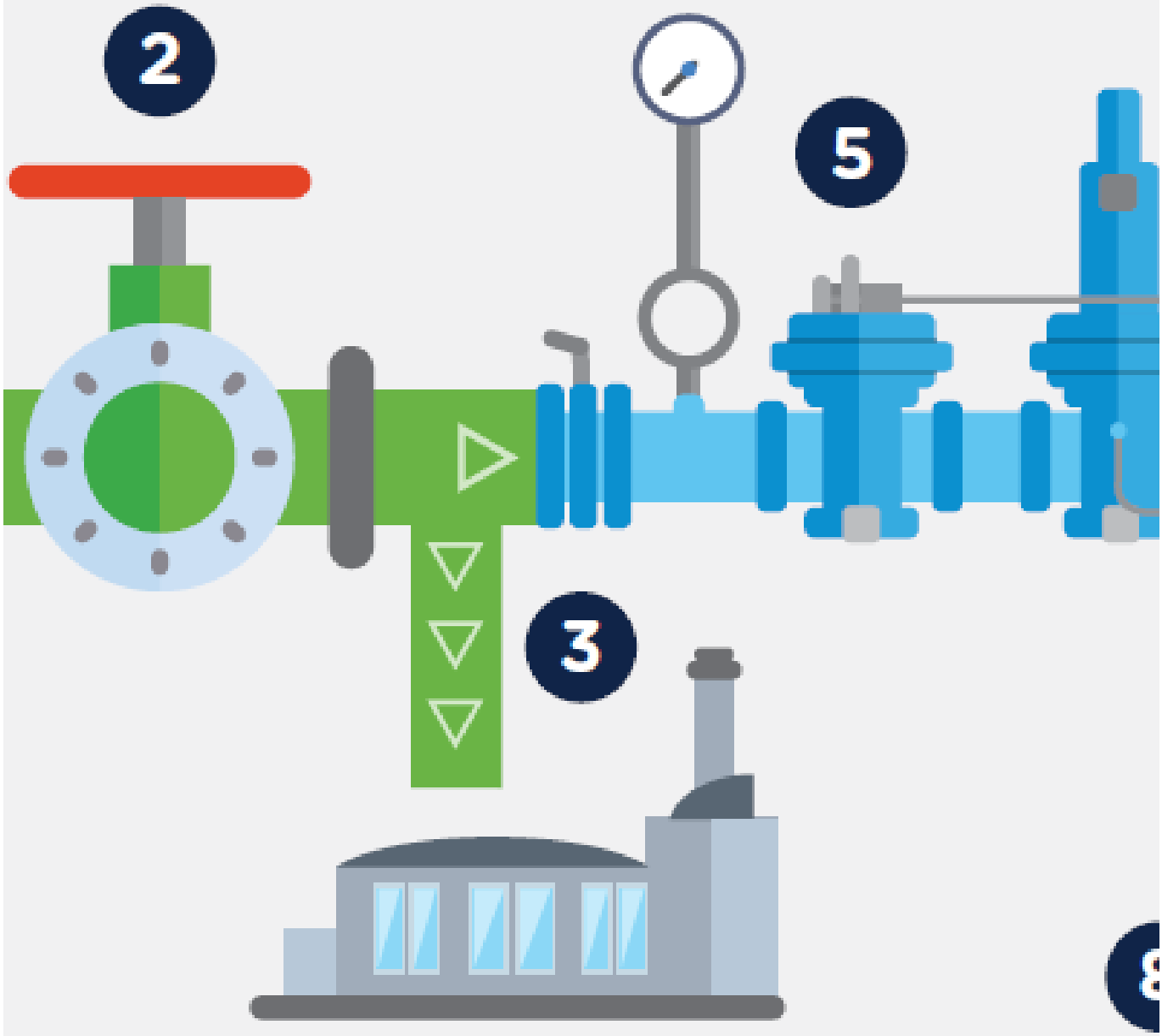
RIIO GD2 Business Plan Appendix

Capacity Management

December 2019



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1 Overview

Scope of this appendix

Capacity Management covers the reinforcement work and network upgrades that are necessary to be undertaken on the distribution and transmission networks to sustain our licence obligations, to maintain supply at appropriate pressure to all of our customers under a 1-in-20 peak day demand. While nationally and regionally we expect annual demand to reduce, there will be localised areas where new customers connecting to our network will increase the peak demand expectation of that local area. Where this occurs, we will need to reinforce the network in order to maintain the 1-in-20 peak day demand. This appendix sets out how much we expect to invest to reinforce the network. This appendix also covers flexible generation connections and how this new type of load impacts on our network.

Impact

By not investing to reinforce and upgrade the network in areas of localised growth, then during an extreme weather event there is a risk that as demand for gas increases, the network is not able to maintain the flow of gas to meet that demand. As a result, pressure in these areas could fall below minimum acceptable levels leading to safety concerns and potential supply interruptions.

These areas of growth in demand will be localised, as across both of our licence areas we are forecasting that demand will reduce over GD2. Based on this, we expect there to be sufficient capacity in the pipes to supply the expected demand under the 1-in-20 conditions, except where there is a demand spike adjacent to a constrained section of the network. In addition to our obligations to provide for new connected loads we must ensure that the gas in our pipes is transported safely, so the integrity of our system needs to be effectively managed.

Our customers and stakeholders have told us that maintaining a safe and reliable supply is important to them and should be our priority for GD2. This is supported by a legislative requirement that we should design systems to meet the Pipeline System Security standard.

Approach to GD2

The SGN distribution and transmission system is built to ensure security of supply for all our customers. Our networks operating at pressures above and below 7bar are designed to meet a peak six-minute demand level that could be experienced under 1-in-20 conditions, supporting a safe, secure and reliable service to those customers and meeting requirements outlined within our Licence Condition.

Where capacity constraints are identified that are likely to impact on SGNs ability to ensure security of supply, Network Planning will look to establish cost-efficient reinforcement and network upgrade strategies to mitigate that risk. Such constraints may arise as a result of a number of factors, but the most common is increased demand levels, often resulting from new connections.

New connections to our networks reduce available capacity and when pressures are predicted to fall below minimum acceptable levels, it is necessary to reinforce or increase pressures to provide additional system capacity. Our GD1 Business Plan outlined the investment required to facilitate new developments in the eight-year period between 2013 and 2021 taking into consideration anticipated load growth during that same period.

Our Business Plan for GD2 will similarly look to identify anticipated reinforcement requirements based upon predicted load growth, informed by broad stakeholder engagement, and historic system performance. The primary challenge associated with this area will be to demonstrate the independence, validity and certainty of predicted growth, and to demonstrate the scale of impact, when overall annual gas demand forecasts indicate a decline in usage. As such, stakeholder engagement is a key element of this investment proposal.

When considering the level of investment required to facilitate future demand, there are a number of factors that influence the final view of the upcoming period. These factors present a degree of uncertainty around the future nature of UK economy, emerging strategies around decarbonisation and our ongoing Real Time Networks project. The recommended strategy would be to implement a volume driver funding mechanism which would de-risk the possibility of underfunding or allocating unnecessary funds in this area.

Our investment proposal, within this appendix, focuses on the following core areas of investment:

- IP/MP grid reinforcement
- LP network reinforcement
- Distribution governor replacement strategy based on capacity grounds
- Transmission pipeline replacements, offtakes and PRS capacity upgrades

The required investment for the above activities has been informed by assessment of likely growth, supported by extensive stakeholder engagement and referenced against historic workloads. We are considering a range of different funding scenarios as detailed in section 6.2 The table below sets out our investment profile for Scotland and Southern regions. We can see that balance in spend in GD2 will change compared to GD1. We propose to spend more on DGs than in GD1 with the opposite true for mains.

The tables below set out the investment profile across the distribution and transmission networks in GD2. It should be noted that the 'governor replacement on capacity grounds' profile spend includes stations feeding at both the medium and low pressure tiers in GD2. Those feeding the medium pressure tier have been identified on a targeted project by project basis. In the case of those feeding the low pressure tier, SGN carried out an exercise whereby we took an extract of our asset base and assessed the data via a scripted analysis governor capacity tool, using anticipated inlet pressures and flows. This approach largely automated identification of units approaching capacity. While still taking cognisance of historical trends, results of this exercise were used as the basis for the projection. Further details of the investment profile and influencing factors can be found in sections 3.3 and 3.5 of this appendix.

Please note that transmission capacity related projects were identified within the general integrity allowances in GD1 and have been reported as such in annual regulatory reporting, hence the reason for no GD1 data in the below table.

Table 1: Growth investment profile (SGN level)

SGN (£m)	13/14	14/15	15/16	16/17	17/18	18/19	19/20	20/21	21/22	22/23	23/24	24/25	25/26
Mains	2.5	5.4	8.6	7.0	12.1	12.8	9.5	8.7	11.9	12.4	11.4	9.9	8.5
Governors	0.5	-	0.8	0.5	0.3	0.1	2.4	3.5	1.6	4.3	2.9	1.0	2.8
Distribution Growth	2.9	5.4	9.4	7.6	12.4	12.9	11.9	12.2	13.5	16.7	14.3	10.9	11.3
LTS Pipeline									2.1	4.0	0.6	–	–
PRS									2.8	8.9	5.1	–	–
Transmission Growth	–	–	–	–	–	–	–	–	4.9	12.9	5.8	–	–
Total	**2.9**	**5.4**	**9.4**	**7.6**	**12.4**	**12.9**	**11.9**	**12.2**	**18.4**	**29.6**	**20.0**	**10.9**	**11.3**

Table 2: Growth investment profile (Scotland level)

Scotland (£m)	13/14	14/15	15/16	16/17	17/18	18/19	19/20	20/21	21/22	22/23	23/24	24/25	25/26
Mains	0.9	1.4	3.6	2.3	4.5	4.9	3.2	3.2	5.1	5.9	5.8	5.0	2.4
Governors	0.2	-	0.3	0.4	0.2	0.1	1.5	1.5	0.4	0.8	1.0	0.4	0.8
Distribution Growth	1.2	1.4	3.9	2.	4.7	5.0	4.8	4.7	5.5	6.6	6.8	5.3	3.2
LTS Pipeline									2.1	4.0	0.6	–	–
PRS									1.6	5.9	0.5	–	–
Transmission Growth	–	–	–	–	–	–	–	–	3.7	9.9	1.2	–	–
Total	**1.2**	**1.4**	**3.9**	**2.7**	**4.7**	**5.0**	**4.8**	**4.7**	**9.2**	**16.5**	**8.0**	**5.3**	**3.2**

Table 3: Growth investment profile (Southern level)

Southern (£m)	13/14	14/15	15/16	16/17	17/18	18/19	19/20	20/21	21/22	22/23	23/24	24/25	25/26
Mains	1.5	4.1	5.0	4.7	7.7	7.9	6.3	5.5	6.8	6.5	5.6	4.9	6.1
Governors	0.3	-	0.5	0.1	0.1	-	0.9	2.0	1.3	3.5	1.9	0.7	2.0
Distribution Growth	1.8	4.1	5.5	4.8	7.8	7.9	7.2	7.5	8.0	10.1	7.4	5.6	8.2
LTS Pipeline									–	–	–	–	–
PRS									1.2	3.0	4.6	–	–
Transmission Growth	–	–	–	–	–	–	–	–	1.2	3.0	4.6	–	–
Total	**1.8**	**4.1**	**5.5**	**4.8**	**7.8**	**7.9**	**7.2**	**7.5**	**9.2**	**13.1**	**12.0**	**5.6**	**8.2**

[BPDT tab 3.02 Scotland and Southern]
[BPDT tab 3.01 Scotland and Southern]

[BP Table 16.6.7 Investment Proposal]

The allowances for Transmission capacity projects in GD1 (in 2009/10 price base) were as follows:

Table 4: Transmission capacity projects in GD1

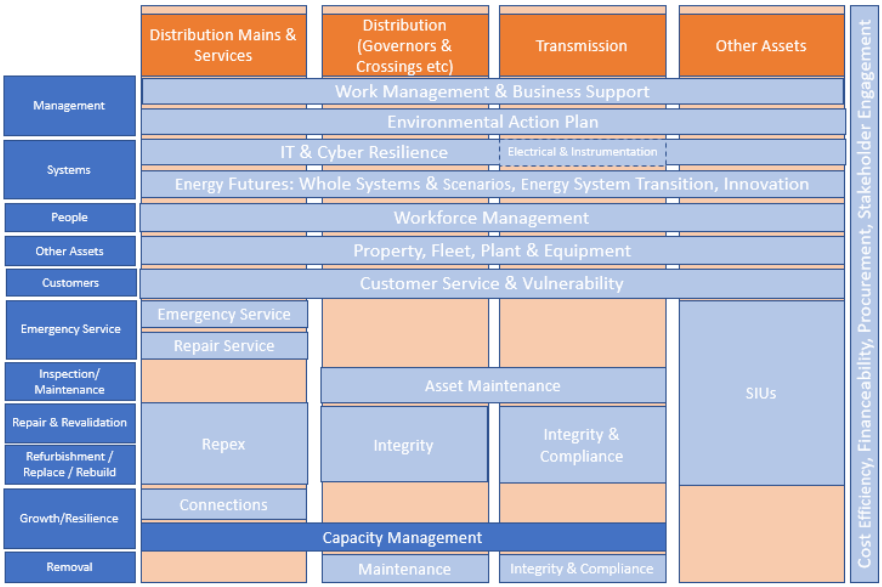
SGN (£m)	Southern	Scotland
Offtakes	2.9	1.7
LTS Pipelines	–	15.6
PRS	12.4	7.9
Total	**15.3**	**25.2**

2 Capacity Management within the Business Plan

The Capacity Management appendix provides an explanation of where we expect to see the capacity of our network increase due to reinforcement work required to deliver energy to our customers at the time that it is required.

New assets are often required to provide additional capacity to allow existing customers to take more gas or to supply new customers. Where only the additional capacity is supplied by the new asset, then the consequences of failure of existing assets remains stable. However, the new assets can reduce the flow on existing assets and, in such a case, the consequences of failure of existing assets can be reduced.

Figure 1: Appendix structure



In this appendix we have set out the main points of investment that we undertook in GD1, what we have learnt from that process and how these have informed the investment that we are proposing to undertake in GD2.

The Capacity Management appendix covers reinforcement investment required under both the transmission and the distribution networks. In practice, the majority of all reinforcement is undertaken on the distribution network to respond to specific geographical constraints.

Over the course of GD1 expenditure on reinforcement was less than [2%] of total expenditure.

All capacity related reinforcement is compliance driven and as such has not been assessed through Cost Benefit Analysis (CBAs), instead for each of the identified projects we have considered alternative options which have been discounted.

This appendix is closely related to the Connections appendix [020] which sets out the expected investment requirements associated with forecast customer growth. The costs that are included in the Connections appendix [020] are the direct costs associated with the connection. The specific reinforcement and network upgrade requirements that may be required as a result of new connections and are not charged to the customer are set out in this appendix.

In addition, this section is also closely linked to the Future of Energy: Whole Systems and Scenarios appendix [007] that sets out how our network is expected to change over time and aligned to Distribution Integrity and Governors appendix [012] which sets out the workload forecast to maintain the safety and resilience of the current assets.

For reference, tables 5, 6 and 7 below feature a list of all identified reinforcement projects >£0.5m. An accompanying Engineering Justification Paper (EJP) has been produced for each. Those shown as being part of our 'Base Growth' submission have been included in our Reinforcement Business Plan Data Template (BPDT), with growth likelihood leading to a requirement for these reinforcements considered to be 'Highly Probable' or 'Probable' (see table 15). Those projects allocated to the 'High growth' are based on growth considered to be of 'Good Prospects' of coming to fruition but have not been included in our Reinforcement BPDT submission.

Table 5: Distribution Engineering Justification Papers Southern

Base Case	Year	(£m)
SGN Cap Man – 007 CPM6595 Bicester MP – EJP Dec19	2021	0.775
SGN Cap Man – 008 CPM6843 Brackley – EJP Dec19	2022	0.909
SGN Cap Man – 009 CPM5288 Mitcham Common CGS – EJP Dec19	2022	1.316
SGN Cap Man – 010 CPM5290 Mitcham Depot CGS – EJP Dec19	2022	1.538
SGN Cap Man – 011 CPM7607 Marden MP – EJP Dec19	2022	1.005
SGN Cap Man – 012 CPM6992 Uckfield – EJP Dec19	2024	0.640
SGN Cap Man – 013 CPM6944 Wivelsfield – EJP Dec19	2024	0.665
High Case	**Year**	**(£m)**
SGN Cap Man – 014 CPM6564 Newbury DPG – EJP Dec19	2023	2.956
SGN Cap Man – 015 CPM7564 Aldermaston – EJP Dec19	2022	1.621
SGN Cap Man – 016 CPM4845 Lympne – EJP Dec19	2023	1.870
SGN Cap Man – 017 CPM5295 Cliffsend CGS – EJP Dec19	2023	1.734
SGN Cap Man – 018 CPM7472 Sturry MP – EJP Dec19	2023	0.783
SGN Cap Man – 019 CPM5293 Burgess Hill DPG – EJP Dec19	2025	0.689

Table 6: Distribution Engineering Justification Papers Scotland

Base Case	Year	(£m)
SGN Cap Man – 001 CPM5070 Luffness Mains – EJP Dec19	2021	0.975
SGN Cap Man – 002 CPM7996 South East Wedge – EJP Dec19	2022	2.259
SGN Cap Man – 003 CPM7459 Aberdeen City – EJP Dec19	2022	0.864
SGN Cap Man – 004 CPM1062 Amisfield Mains – EJP Dec19	2022	0.592
SGN Cap Man – 005 CPM7708 Bridgend – EJP Dec19	2023	1.453
SGN Cap Man – 006 CPM6728 Kingslaw – EJP Dec19	2024	1.397
High Case	**Year**	**(£m)**
-	-	-

Table 7: Transmission Engineering Justification Papers Scotland and Southern

Base Case	Year	(£m)
SGN Trans – 030 Capa – EJP Dec19	2022/23	14.72
High Case	**Year**	**(£m)**
-	-	-

3 GD1 performance and learnings

3.1 Overview of service delivered

The SGN distribution and transmission system is built to ensure security of supply for all our customers. Our networks are designed to meet a peak six-minute demand level that could be experienced under 1-in-20 conditions. New connections to our networks reduce available capacity and when pressures are predicted to fall below minimum acceptable levels it is necessary to reinforce. Our GD1 Business Plan outlined the investment required to facilitate new developments in the eight-year period between 2013 and 2021 taking into consideration anticipated load growth during that same period.

As part of the GD1 submission, while it was recognised that demand for gas may diminish over the GD1 period, it was anticipated that SGN would continue to see a demand for new connections to our networks. The key reason for investment below the anticipated level is linked to the economic recession experienced in the early years of the period.

In addition, the effect was exacerbated by two other locational elements that allowance had been included for within the initial plan

In that submission, it was highlighted that investment in the below 7bar system to facilitate new development was often also heavily affected, not only by scale of growth, but also the location of that growth. At that time two specific potential effects were captured:

- Where new developments were likely to be constructed on the periphery of a village or town (extremity of the gas supply system) this may lead to a disproportionate impact on our network and therefore reinforcement requirement.
- The second element considered where, as a result of lifting of a constraint previously restricting growth in an area (for example an upgrading of sewage facilities or upgrading of road network to nearest major city etc.), that area may suddenly see a disproportionate level of growth focused on one particular town or village.

In both cases it was felt important to recognise that while LDZ-wide growth may reflect a relatively constrained view, that may not be representative of the impact and resultant investment required even with limited growth in non-preferred locations.

In our submission we also pointed out that these effects were more exaggerated in Scotland where the historical development of below 7bar networks is influenced by the rural nature of much of the area covered. In such systems the sensitivity of the networks is often extreme and at the point where those systems reach capacity the level of investment and length of mains to be laid to recover pressure can again be disproportionate to the level of growth which has exhausted the final element of spare capacity.

While much of the above holds true, it is also the case that in a period of economic recession, development of this type is less likely to come to fruition (i.e. expansion sites on the edge of town rather than smaller gap sites within areas, or indeed large infrastructure projects freeing development land). That was clearly the case in the early years of this period, and it is again thought this had a disproportionate impact on expenditure.

3.2 Legislative background

Under the Gas Act 1986 and the associated Gas Transporter Licence conditions, SGN is required to operate a safe and economic gas network. To comply with this legislation, we need to maintain satisfactory pressures under the 1-in-20 demand conditions, ensuring security of supply for existing customers and developing our networks for future anticipated growth.

In addition, SGN is required under the Gas Safety (Management) Regulations (GS(M)R) to set out arrangements for minimising the risk of a gas supply emergency. We must, at all times, monitor performance and develop appropriate plans for the safe operation and economic development of our existing assets.

3.3 GD1 output delivery

The SGN network is divided into three local distribution zones (LDZs): Scotland, South East and South. Each is planned according to demand levels that are not expected to be exceeded more than once every 20 years – the 1-in-20 Pipeline System Security Standard. To determine this, we carry out demand forecasting on an annual basis to monitor changes across a number of key indicators, including the economy, government energy policy, climate and customer behaviour.

Our networks have a finite capacity and are operated to maintain a set of minimum pressures. Increased or redistributed gas usage will through time eventually erode any spare capacity. Where modelling indicates a risk that pressures could fall below acceptable levels, we will develop contractual or physical solutions to maintain the safety and reliability of our network.

We have continued to perform to this standard through-out GD1. For reporting purposes, we deal with South LDZ and South East LDZ as single licence area.

Figure 2: Southern annual firm demand

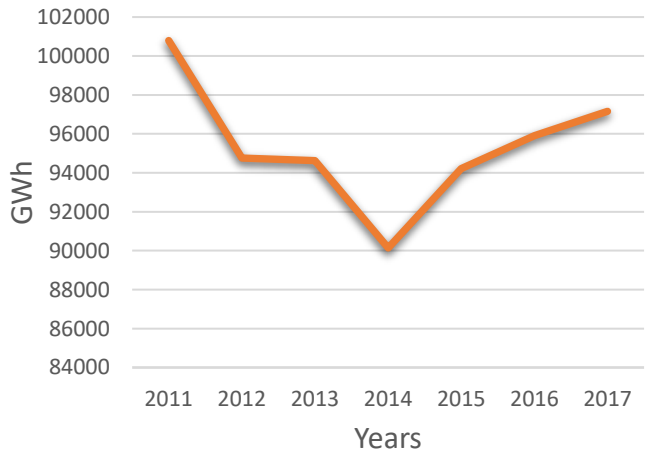


Figure 3: Southern peak hourly firm demand

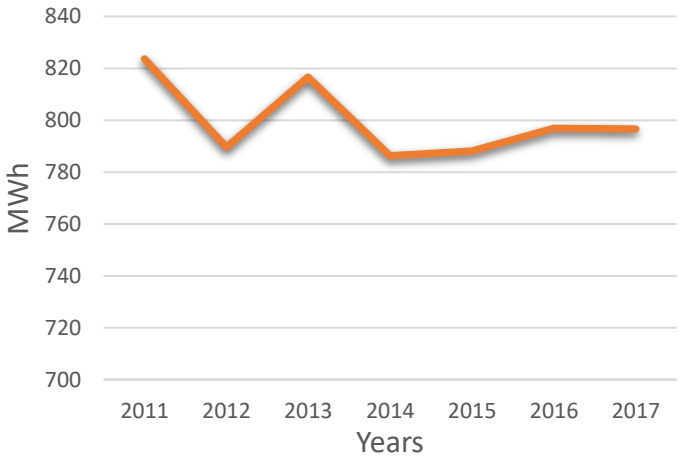


Figure 4: Scotland annual firm demand

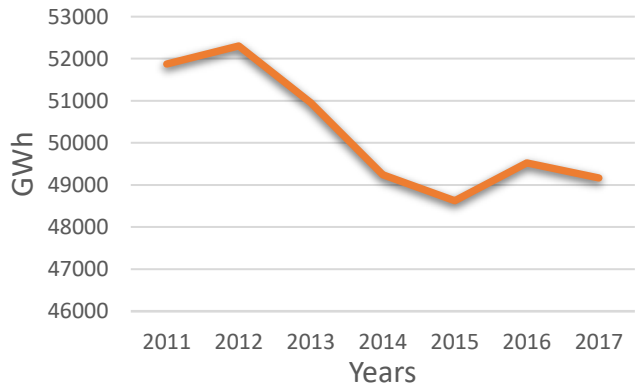
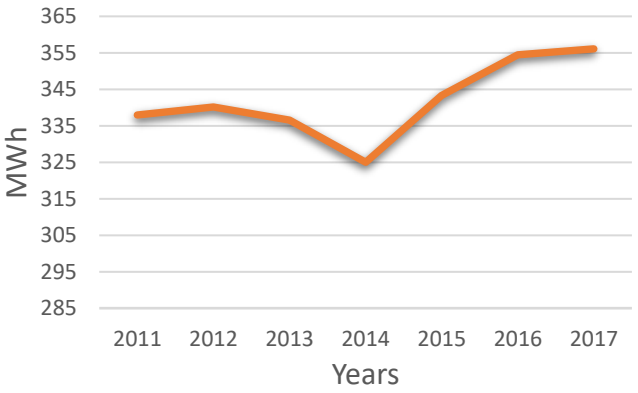


Figure 5: Scotland peak hourly firm demand



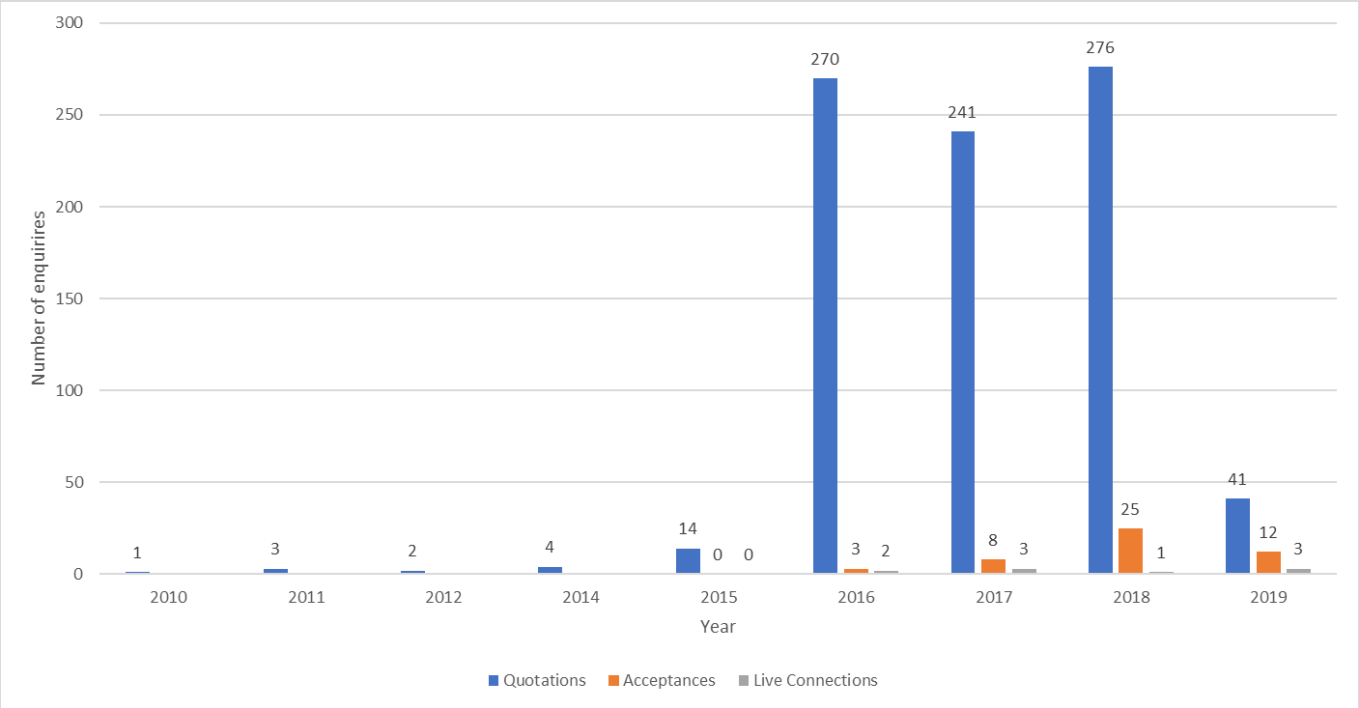
Expenditure to date within GD1 period is significantly below the available allowances. This is broadly due to the early years of the period which coincide with a worldwide economic recession, and it was not until 2015 that consistent evidence of recovery was seen. The above Scotland and Southern annual firm demand charts demonstrate how this trend impacted on gas usage during the period.

As part of the GD1 submission, while it was recognised that demand for gas measured annually may diminish over the GD1 period, it was anticipated that SGN would continue to see a demand for new connections to our below 7bar networks and thereby the 'Peak Hourly' demand would remain relatively stable over the period, as shown in the above Scotland and Southern peak hourly firm demand charts.

Flexible generators (peaking plant)

We have experienced a rapid increase in flexible generator connection enquiries in recent years, ranging from one enquiry in 2010 to 276 enquiries in 2018.

Figure 6: Flexible generation connection enquiries (data up to August 2019)



Flexible generators are relatively small modular electricity generation units typically fuelled by natural gas and designed to help balance the fluctuating power requirements of the electricity grid. Flexible generators are designed to respond to electricity market signals and when on standby these plants can be called upon and ramp up to full capacity in less than two minutes.

The locations of these enquiries are distributed across the South and Scotland. Developers look to optimise locations according to the cost of the gas, electricity connections, the revenue streams they can secure, and the costs of site-based factors such access and land.

New connections to our network reduce the available capacity risking ability of SGN to ensure security of supply. Peaking plant connections carry additional risk due to their unpredictable pattern of operation which is dictated by the electricity market and covers periods of system stress. Peaking Plants are treated like any other new connection where capacity is offered/taken on a 'first come' basis. The cumulative effect will impact those sites (whether a Peaking Plant or any other customer type) regardless but due to the size and nature of Peaking Plants, they have a significant effect on network capacity. Some of them can be the equivalent of a 3000+ new housing development and will have an impact on the level of reinforcement within those particular areas.

Figure 7: Security

An example of typical power plant connected to the SGN network is a modular unit located in the Fareham area contracted to generate 30MWe operating at 42% efficiency and requiring 70MW (70,000 kW) gas input into it. A 70MW input is equivalent to approximately 6,400scm/h taken off our network which equates to 6,400 houses.

Of these enquiries we have so far accepted 48 connection requests, of these 17 are in Scotland and 31 are in Southern.

It important to highlight that a single peaking plant connection may not immediately trigger a reinforcement requirement, but the cumulative load from multiple enquiries in the same area may not only trigger the need for main laying reinforcement, but also a station rebuild. This may include both DPGs (Distribution Pressure Governors) and TRSs (Transmission Regulator Station) station replacements.

Peaking plants and the factors driving their installation is discussed at greater length in the Energy futures: Whole systems and scenarios appendix [007].

Figure 8: Security

3.4 GD1 customer experience

There were several initiatives within the planning sphere that have improved customer experience and resulted in cost efficiencies in the GD1 period.

Review of daily metered sited (Mod 390)

Uniform Network Code Modification number 390 was promoted by SGN and implemented in 2012. This required networks to carry out an annual review of all daily metered sites. Shippers (who transport gas through the network on behalf of the suppliers) could then be provided with reports by the end of April each year, comparing the nominated hourly capacity rates (SHQs) against the highest actual recorded value for the previous 12 months, with consideration given to peak usage over the previous three years. Any site where the SHQ value was either significantly understated or overstated is then highlighted with suggested revised values for the shipper to review and re-nominate if appropriate.

Mod 390 enabled SGN to identify opportunities to free unused/sterilised capacity and, in doing so, reduce the need for unnecessary reinforcement. In the first full year, 2013, we contacted 12 shippers with regards to 146 sites, of these 84 amended SHQ values freeing 477 MWh. In the most recent year the volume has decreased although we still contacted seven shippers regarding 93 sites and freed 83 MWh. Since Mod 390 came into force we have freed over 1180 MWh of capacity. In one example, identifying an industrial site whose peak demand was significantly below their contractual entitlement enabled us to agree a reduction in the site's contractual entitlement, saving the customer and avoiding the need for an expensive reinforcement project that would have cost approximately £1m.

Seasonal loads (Mod 458)

Uniform Network Code Modification number 458 was implemented in 2015. This was a further change initiated by SGN which recognised that some customers may only require capacity for a set period, not for a full year. This modification was implemented to maximise usage during seasonal (off-peak) periods, April to September.

Previously the GDN was required to design the system to meet 1-in-20 winter conditions, and ultimately reinforce the network to meet this increased demand. Following approval, increased capacity available over the summer is offered to customers with specialised requirements, such as grain drying, who are able to connect without the requirement for reinforcement.

We currently have five 'Seasonal Load' contracts allowing unused capacity to be utilised throughout the Spring/Summer period while avoiding potential capacity issues on the network.

Interruptible contracts (Mod 90)

As part of Interruption Reform, also known as the Mod 90 process, SGN has the option to tender for interruptible contracts to offset the need to invest for capacity.

Ofgem directed that from 1 April 2008 Distribution Network Operators (DNOs) revise the operation of interruption capacity as part of the reform of the Uniform Network Code (UNC), allowing DNOs to determine interruptible LDZ capacity requirements within specific geographic zones and to provide network users with the opportunity to request their preferred interruptible terms. The modification introduced a tender arrangement for interruptible LDZ capacity within the DN with offers selected on the basis of economically and efficiently meeting our capacity requirements. From October 2011, all sites were to be considered firm, paying both commodity and capacity charges but with payments made to sites which are offered interruptible contracts based on an option and exercise regime. The option price is a flat payment paid monthly in arrears when the contract comes into effect while the exercise price is paid each time the site is interrupted. These sites help us to manage and operate the gas networks under high gas demand conditions by agreeing to cease using gas when requested to do so as an alternative to reinforcement projects.

Network analysis is used to determine which parts (zones) of our networks will not have sufficient capacity to support all customers at the 1-in-20 peak demand level. If there are any eligible customers (>5.86m kWh per annum) in these zones, then SGN will consider going to tender for interruption capacity, as an alternative to capital investment in reinforcement projects, at either the next annual tender or if it is more urgent by setting up an ad-hoc tender.

SGN publishes details of the eligible zones, zonal requirements, timescales and guidelines each year. Each of the eligible end users within the designated zones are then contacted by letter twice prior to the window inviting tenders. Details are also published by the Joint Office of Gas Transporters. SGN will also contact all shippers who have agreements with eligible customers with the aim that they will also engage eligible users to promote the benefits. (Note – an eligible supply point is an LDZ DM supply point for which the annual quantity is greater than 5,860,000 kWh (200,000 therms).

Reinforcement projects are created against a tender. Partial and whole reinforcements can be created for a single zone or across multiple zones. Whole reinforcements are projects that, if undertaken, completely negate any interruption requirement. The fully exercised (option and exercise) cost of any interruption bid is compared against the corresponding whole reinforcement. Whole reinforcements can only be justified if they can be demonstrated to be more cost effective than acceptance of interruption. Conversely, partial reinforcements represent smaller projects that could be combined with interruption tender bids to fulfil an interruption requirement.

There have been a number of instances where this arrangement has allowed reinforcement to be deferred, or even ultimately cancelled, e.g. in 2008 tenders were accepted for the Northern Transmission system in Scotland LDZ. These allowed SGN to defer a reinforcement project for up to five years until 2016. Similarly, an agreement in Ayrshire allowed a significant reinforcement to be deferred and ultimately cancelled, when applied in conjunction with the Mod 390 initiative.

However, recent experience has highlighted that, when approached, potential customers have placed a high value on the availability of a safe, reliable supply, and the option of interruption is less appealing. They would prefer the certainty of a firm gas supply as opposed to the risk to their business operations from interruption and the need/cost to maintain a secondary alternative fuel supply.

Even so, on an annual basis SGN continues to use the Interruption Tender Process as a possible means to defer investment; each year identifying such opportunities and inviting eligible customers within affected zones to participate.

Going forward we propose to review this process and consult with end users to explore what improvements could be made to re-energise. We still see the potential benefits to be gained, and will continue to support, while at the same time exploring how best to encourage increased engagement.

3.5 GD1 allowances and expenditures

The primary driver for identified investment was the need to meet the anticipated increase in demand in areas of the supply system with insufficient capacity to cater for verified growth. These projects were proposed to deliver additional capacity and as a result facilitate connection of that additional growth, supporting future economic wellbeing of each area.

As part of Ofgem's GD1 Final Proposals, SGN was awarded £126m (£114.8m at 2013/14 prices) to cover specific reinforcement requirements over the eight-year period between 2013 and 2021 – an average of £15.7m a year (£14.3m at 13/14 prices).

In Southern, an allowance of £76.6m at 2018/19 prices was provided for reinforcement of the below 7bar network in order to ensure adequate pressures were maintained under 1-in-20 demand conditions. The allowed expenditure on below 7bar reinforcements over GD1 is set out below alongside the actual and forecast expenditure for the remainder of GD1, with total projected expenditure coming to £46.5m.

Table 8: Southern RIIO-G1 allowances and expenditure

Reinforcement: Mains and Governors (£M 18/19 prices)	13/14	14/15	15/16	16/17	17/18	18/19	19/20	20/21	Total
Allowances	8.1	13.5	13.0	11.4	8.2	7.5	7.5	7.4	76.6
Expenditure (forecast post 17/18)	1.8	4.1	5.5	4.8	7.8	7.9	7.2	7.5	46.5
Variance	6.3	9.4	7.5	6.6	0.4	-0.4	0.3	-0.1	30.1

The allowed reinforcement expenditure, for Scotland below 7bar network over GD1 is set out below alongside the actual and forecast expenditure for the remainder of GD1, with the total equating to £28.3m.

Table 9: Scotland RIIO-G1 allowances and expenditure

Reinforcement: Mains and Governors (£M 18/19 prices)	13/14	14/15	15/16	16/17	17/18	18/19	19/20	20/21	Total
Allowances	5.7	8.0	7.5	6.4	5.8	5.5	5.3	5.3	49.5
Expenditure (forecast post 17/18)	1.2	1.4	3.9	2.7	4.7	5.0	4.8	4.7	28.3
Variance	4.5	6.6	3.6	3.7	1.1	0.5	0.5	0.6	21.2

Reinforcement works of this type are primarily driven by new growth, linked to new housing and construction work mainly in greenfield areas or at the extremities of the network, which has been lower than anticipated and as a result expenditure to date has been below available allowances. The lower than anticipated growth was primarily due to the global recession in the run up to and early years of the GD1 period. It was not until 2015 that we began to see consistent evidence of recovery and even then, full confidence was slow to return and returned at a slower pace in Scotland compared to Southern. As further explained in section 6.8 of this report we are proposing volume driver funding mechanism, that would de-risk any investment in times of economy uncertainty and avoid discrepancies between reinforcement allowances and expenditure in GD2.

During early years of GD1, while new housing construction figures remained relatively stable – albeit at significantly reduced levels compared to pre-recession output – developers tended to favour less risky, smaller-scale, urban developments. This shift in focus from suburban to urban development resulted in a reduced requirement for reinforcement as growth occurred primarily within the most resilient areas of the network. It is only in the last two years that there has been a sustained pick-up in the number of larger, longer term developments coming forward.

The type of development that took place, however, was not the only factor. During this period, SGN also look to enhance our planning processes with a particular emphasis on holistic planning that has resulted in cost reductions and efficiency savings across GD1.

Holistic planning

We are committed to delivering our projects in a cost-effective and efficient manner and to constantly seek new ways to improve performance. System developments and the ability to utilise additional supporting information in our planning systems has increased the level of integration across our planning processes. This has resulted in an increased level of projects delivering more than one objective. The integration of geo-spatial data into our network analysis models has given greater visibility of planned and potential work on a single platform, allowing a far more integrated approach, examples include:

- Greater visibility of planned mains replacement has streamlined the design process and has allowed strategic planners to accommodate their impact within future designs. Allowing work to be planned more efficiently.
- Extracts from Pipe Risk Management (PRM) maps and from our predictive analytics models ensures longer term visibility of future potential replacement works providing an opportunity to advance and integrate activities.
- Visibility on planned or potential District Governor (DG) replacement allows planners take this into account when designing replacement and reinforcement projects, maximising the potential for a project to be designed

that facilitates abandonment.

- Third party information such as local authority development plans, flood plans, and road embargoes helps to support optimum timing/phasing of strategies, helps enhance network validation/strategic plans which in turn and can be factored into everyday abandonment, replacement or reinforcement decisions.

This improved planning capability benefits of each project, reducing the risk of repeated visits to affected areas and thereby minimising disruption.

3.6 GD1 lessons learned

Key lessons learned from GD1 is that it is imperative to understand where growth is likely to occur and what factors influence uncertainty. In early years of GD1 we have seen investment at levels significantly below the available allowances, which was mainly attributed to the economic crisis. We are now proposing volume driver funding mechanism to be implemented in GD2. Such an approach will de-risk the possibility of allocating unnecessarily high level of funding should the anticipated level of growth not be achieved, while equally addressing the risk of underfunding should a significant upturn in the economy occur. We operate responsibly, for the benefit of our customers and we want to avoid unnecessary spend.

As explained in section 3.5, greater emphasis on holistic planning has enabled us to plan efficiently and develop optimum investment in our assets. We have engaged with developers and local authorities and built improved relationships that have allowed a greater understanding of their thoughts and views on infrastructure, growth and energy strategy, but also given opportunities to explore ways in which to develop a more integrated approach to planning to meet such growth. Discussions with local authorities have supported our interpretation of any local development plans to better understand the likelihood and level of certainty associated with any ideas set aside for development, and to establish a clear picture of the current growth and long-term requirements. Collaborative working with local authorities and other utility providers has also provided opportunities to better plan the works causing less disruption to the public. We also have controls and governance in place to monitor requirements and track project delivery, minimising the need to defer works. This innovative approach to project planning allows us to only invest when and where required providing the best value for our customers.

4 GD2 stakeholder insight

We have undertaken a comprehensive programme of engagement and research during the development of our GD2 Business Plan, helping us to understand our customers' and stakeholders' priorities. This is described in more detail in chapter 4 of our Business Plan and the Enhanced Engagement appendix (022). In GD1 we have sought to foster relationships across multiple stakeholder platforms, with a view to developing the most robust possible forecast, not only of predicted growth at local and national level, but of future energy strategies and demand profiles.

This initiative has better informed our view of likely development and level of investment requirements resulting in a portfolio of Strategic Planning Reports to be prepared for each of the intermediate and medium pressure networks.

Following the initial draft of the MPIP reinforcement papers we have sought out and encouraged increased face to face meetings with local authorities, looking for their endorsement of our interpretation of their plans and our investment strategy. In adopting this approach, it was recognised that there was also a clear need to not only involve local authority planning departments, but also those tasked with developing their longer-term energy strategies. Common themes emerging from that engagement have included:

- The importance of working together in a joined-up way
- The desire to share plans; to ensure infrastructure providers are aware of these plans and critically that infrastructure providers have adequate funding to support
- That infrastructure providers will not become a 'locker' to timely construction and delivery of those plans
- The desire for increased co-ordination between infrastructure providers to minimise disruption

We are committed to be heavily involved in GD2 in further supporting local authorities and various groups along with others that can emerge, and in this way establishing a clearer picture on how we need to invest to support future growth.

4.1 Positive impact

We have initiated and undertaken an extensive programme of stakeholder engagement, working closely with local authorities both in Scotland and the south of England to establish a fully informed and independently sourced picture of planned development. These discussions continue to support our interpretation of any plans to better understand the likelihood and level of certainty associated with any areas set aside for development.

A key objective of these reviews is to ensure we continue to deliver gas safely, reliably and efficiently to all our customers, both current and future, by establishing a clear picture of long-term business requirements. Such an understanding is critical for ensuring that larger scale projects can be delivered in a timely manner and avoiding any capacity constraints that would restrict new development. A key message from our local authority stakeholders is they want us, along with all other utility providers, to have a clear vision of, and strategy for, likely growth, and the necessary funding to facilitate and support their plans. These planned developments are considered critical to future economic wellbeing and enhancement of many of these areas.

This initiative has been well received by our local authority stakeholders, most of whom have indicated they greatly value our increased level of engagement. Our ultimate shared objective is to provide assurance that the optimum network investment strategies are being pursued and implemented at the time that they are required.

4.2 Shared future

As part of our commitment to gain an improved understanding of growth and where it is most likely to occur, we have reached out to local authorities to develop improved relationships and better understand their emerging decarbonisation strategies, infrastructure and growth plans. We've sought to explore ways in which we can develop a more integrated approach to planning to meet such growth and establish a clear view of local government decarbonisation strategies.

In addition to creating enhanced relationships with local authority planning departments, and greater understanding of planned change, our engagement has also encouraged the sharing of data across each other's planning platforms, in turn allowing us to integrate data directly into our planning models.

As well as supporting longer-term strategic planning this has also meant day to day activities across a range of processes can be planned in full recognition of the most up to date information around growth and development, further enhancing our aim of achieving the fully holistic approach both driving cost efficiencies and minimising future disruption.

Figure 9 and Figure 10 give examples of Glasgow and Reading which show high level extracts of local authority development maps (in the form of shape files) overlaid and integrated into our gas network analysis models. The second drawing in each case highlights a more granular view of the same data, showing specific areas of those network models where, with the integrated files and data, our analysts have immediate visibility of planned development areas plus associated supporting data. With the information available in this form it helps provide not only an improved strategic view, but also allows consideration to be taken, across the full range of day to day, shorter term, planning activities and decision.

Figure 9: Security

Figure 10: Security

As of December 2019, SGN has in place data sharing agreements covering 109 local authorities, whereby their local development plan data has been shared and directly imported onto our planning platform. Data is shared in a form of shapefiles which contain geo-spatial polygons which are digital representation of defined development areas. This allows geo-spatial polygon identifying development areas to be incorporated into our network analysis models. Local authorities are contacted on an annual basis, allowing polygons to be refreshed in line with the latest available information, informed by Housing Land Audits (HLAs) which are carried out on an annual basis.

A further benefit of engagement stemming from the above has been closer engagement with the wider planning community. This has created opportunities for our employees to be involved in a range of initiatives helping shape opportunities for closer working relationships, greater co-ordination and more integrated approach to longer term strategic planning across all bodies. We see many of the relationships formed and arrangements we have put in place as having positive benefits for all and consider to be long term enduring arrangements. A number of examples are listed below.

Our Planning team involvement in the Glasgow City Region Operational Infrastructure Group is a very good example of a proactive initiative. The Glasgow City Region area covers a third of Scotland's population and generates a third of its economic wealth. At a Strategic Infrastructure Summit, held in September 2017 a joint agreement was reached between eight local authorities covering the west of Scotland and major infrastructure providers operating within the area to best consider how to maximise over £1 billion of City Deal investment in the Glasgow city region. This subsequently led to setting up of the Operational Infrastructure Group (OIG), aimed at meeting a range of objectives, two of which were to:

- Establish a Regional Infrastructure Forum to liaise and collaborate to minimise disruption, and ensure that required utilities are in place to support economic growth
- Align infrastructure investments with partners' investment, through a strategic infrastructure investment plan to ensure that the economic benefits of all infrastructure projects are maximised

The process once again has highlighted the benefits of sharing spatial information relating to anticipated growth and development. It has provided SGN with direct access to an overview of the Spatial Development Strategies of each of the eight councils. SGNs involvement has been influential in developing mechanisms for sharing of data by each organisation across a range of platforms. It has also resulted in building closer relationships with many of the

parties involved, establishing far clearer communication lines between key personnel in each organisation, and resolution of specific issues which extend outside the initially considered scope of the group.

SGN has also been invited to participate in the Scottish Government Initiative – Infrastructure Delivery Group chaired by the Chief Planner of the Scottish Government. The scope includes a wide range of topics across the Planning sphere from the independent review of the planning system to ongoing development of a Planning Bill. The overall aim has been to strengthen the relationship between infrastructure providers and the planning system, gaining an understanding of issues, setting out how they currently engage with the planning system and what the needs are going forward. These include:

- To co-ordinate and align the contribution of infrastructure providers to development planning and delivery
- To encourage better co-ordination of development plan strategies and infrastructure capital investment plans and programmes
- To establish a clearer picture of funding and financing options for infrastructure to support planning delivery
- To support ongoing and future work with local government and the development industry to broker solutions and support delivery
- To support the preparation of National Planning Framework 4

We have also been a key contributor in the consultation process for Greater London Authority – Infrastructure and Co-ordination Initiative aimed at developing options to meet the co-ordination challenge associated with the planned rate of development in London within the coming years, where a requirement for approximately 66,000 new homes per annum has been identified. It is recognised greater co-ordination is needed to support this aim to ensure more efficient delivery for London and Londoners. As part of this engagement, our CEO, John Morea, has also been appointed as a member of the Mayor's High-level Infrastructure Group.

SGN has also worked closely with Croydon Borough Council on one of three pilot projects – Croydon, Tower Hamlets and London Docks – used to trial initiatives looking at the opportunities to improve the identification and management of collaboration of utility works. Croydon Borough in conjunction with project partners developed a web-based product in place to assist in the identification of such opportunities. SGN, Thames Water and Atkins in particular have supported much of this work and identified a number of opportunities in which to trial collaborative working. In parallel with this initiative, SGN has worked with the local authority sharing data and evaluating potential impact of developments planned as part of Croydon Growth Zone, looking to establish both reinforcement and diversionary works with a view to a tailored approach to avoid revisiting any location on more than one occasion.

Customers were asked a question in relation to growing and reinforcing our network in response to customer demand for more gas in our quantitative acceptability testing. Acceptability from domestic customers in Scotland was highest, at 77%; while domestic customers in southern scored this 9% lower at 68%. Results from SME business customers in Scotland and Southern were broadly similar, at 75% and 73% respectively. These results indicate that customers recognise and accept that we need to invest in this area of our business.

4.3 Safety and efficiency

The customer and stakeholder priorities of acting safely, keeping the gas flowing and keeping the costs down are core to guiding the decisions that we are making within our Capacity Management proposals for GD2. Our engagement programme has revealed that customers and stakeholders see these priorities as paramount importance. At our engagement workshops stakeholders have shared their views in relation to Capacity Management investment decisions. Our proposals in relation to network growth were judged to be about right by stakeholders at our Safe and Efficient workshops. Stakeholders acknowledged that the current uncertainty around future energy policy makes forecasting network growth particularly challenging. We want to build on our experience in GD1 where most of the work has been developed round these principles to work with other parties to build optimum solution.

Very occasionally the supply of gas to customers' properties can fail unexpectedly. Currently our target is to restore gas to 90% of affected properties with 24 hours. Our customers view is that we could invest more to reduce the amount of time it takes for us to put gas supplies back on following an unplanned interruption. Domestic customers were prepared to pay £0.57 for a restoration standard of 21 hours rather than 24 hours in our first wave of willingness to pay research. Customers at acceptability testing workshops viewed reduction of average restoration time after an interruption as fairly important, in particular hard to reach/vulnerable customers.

5 GD2 cross sector issues

5.1 Decarbonisation and whole system

In the past, UK gas and electricity networks were almost completely separate, linked only by large scale power stations. Today, gas and electricity networks are already integrating more closely and at different levels. This is in response to increasing consumer choice, the availability of renewable energy technology and accelerating need for decarbonisation.

As the networks continue to integrate, variation of demand and supply on the electricity network will have immediate impact on the gas network. The electricity system has seen considerable change, mainly driven by climate change policies. Traditional large-scale power plants have largely disappeared and have been replaced by intermittent renewable sources of energy like wind or solar. Gas fired power generation plants are contracted to cover periods of shortfall in the electricity market and help to manage fluctuating power requirements of the electricity grid. Any demand swings on the electricity network, affect demand on the gas distribution system as gas peaking plants respond to maintain capacity on the electricity network. While considering the whole system scenario it is important to remember that we not only need to plan to facilitate future connections but also to fulfil our licence obligation by ensuring security of supply to our current customers.

For the whole systems to comply with net-zero decarbonisation targets, it cannot continue to rely on energy from fossil fuels. Policy decisions surrounding the decarbonisation of heat must materialise within the near future, triggering decisions on the future role of the gas industry.

As we have progressed through business planning and in response to direct feedback from the Customer Engagement Group (CEG) we have extended our engagement with local authorities to include the local energy team alongside their Planning Teams. This has enabled us to have significantly improved insight into the local authority decision making process and provide a better reflection of their current thinking and maturity of their plans.

This again is an area where we have, and will continue to build, important, enduring relationships which will allow us to continue to liaise with these groups in the coming years. Some examples of engagement with such stakeholders have included:

- **Scottish Energy Officers Network.** SGN attended the Scottish Energy Officers Meeting in February 2019 at the Stirling City Chambers. A presentation was delivered on GD2 and the potential impacts of housing growth on the SGN network. Most of the Scottish local authorities were represented at the meeting, which included a meaningful Q&A session. The meeting represented a unique opportunity to engage with many local authorities, to make them aware of the work carried out to date and to facilitate further engagement. It also allowed us to gauge how each local authority views gas and any part it plays in their future energy plans.

- **Local Heat and Energy Efficiency Strategy (LHEES) Workshop**. SGN Representatives supported the 'LHEES – Working with Energy Networks' workshop organised by the Scottish Government. It focussed on the requirement on local authorities to develop Local Heat and Energy Efficiency Strategies (LHEES). LHEES are seen as a key link between long term targets and national policies and the delivery of energy efficiency and heat decarbonisation on the ground. SGNs involvement recognised the important role companies such as SGN will play in delivering a low carbon economy, along with the cross-over between local authority planning for energy efficiency and heat decarbonisation, to the investment decisions taken to maintain and improve gas and electricity network

The Scottish Government

infrastructure. We subsequently spoke (in late summer 2019) to the Scottish Government with a view to facilitating a follow up session with a number of local authorities, but the feedback we received was that the plans may not be sufficiently mature to merit such a session. Thereafter, in late autumn we independently contacted all councils' Energy Teams (across Scotland and South) looking to establish a sense of progress. Generally (albeit not all cases), from those contacts we came away with a sense that, where plans had been set out, these were largely aspirational without robust clear delivery plans. Undoubtedly these will emerge, but at this point in time that detail was still to be firmed up.

- **Local Enterprise Partnerships (LEPs) – Coast to Capital, Enterprise M3 and the South East**. SGN was involved in the launch of the Energy Strategy for the South East. It covers an area from Essex to Hampshire so a large area of our Southern patch. The LEPs were tasked to produce it for the Department of Business Energy and Industrial Strategy (BEIS) to help identify local solutions that can help deliver national clean growth and industrial strategy ambitions. Low carbon heating is identified as one of the five priority themes alongside:
  - Energy saving and efficiency
  - Renewable generation
  - Smart energy system
  - Transport revolution

  As a result of our input, the strategy supports the potential that hydrogen in the gas grid could play to reduce heating emissions. It also calls for homes less than 50m from the gas grid to be connected and highlights the potential for our workforce to operate and maintain heat networks. Further engagement is planned using this base, with a view to better understanding the alignment of this strategy with growth plans for the area.

- **Scottish Borders Council Workshop.** In April 2019, SGN arranged a stakeholder engagement workshop at Scottish Borders Council. Representatives from the Council's Energy and Planning teams were present at the event, with Dumfries and Galloway also represented. This workshop was arranged as an open forum to discuss SGN, GD2, growth and decarbonisation. A joint presentation was delivered on GD2 and the potential impacts of housing growth on the SGN network, with meaningful Q&A taking place throughout.

- **Fife Council Event.** Following requests for a meeting similar to the Borders Council meeting, SGN was invited to support an event that Fife Council were planning, targeted primarily at key groups of interest to ourselves. While the content of discussion was similar to that held in the Borders, this featured a far larger group, and was held within the main council auditorium. Once again, the audience was extremely engaged and keenly participated in a Q&A session. One of our key objectives of the day was to gain a commitment from the Head of Planning to provide the necessary support, review our plans and provide us with a level of feedback as to the appropriateness of the plans and the assumptions we have included. That lead to us receiving such an assurance along with a commitment of support around opening up similar opportunities elsewhere.

Such examples demonstrate our commitment to gaining a full understanding of potential impact on future gas usage as the CEG has previously questioned. In addition to the above examples, we continue to reach out on an ongoing basis, and integrate questions around decarbonisation strategy in the wider, day to day interactions we have with local authorities, developers and other stakeholders in this field.

To date, this engagement has highlighted the uncertainty surrounding the longer-term future. While the ultimate aim is clear, the journey is not yet clearly mapped out and even in the case of the LHEES in Scotland, the feeling was that the plans were at a relatively immature stage of development.

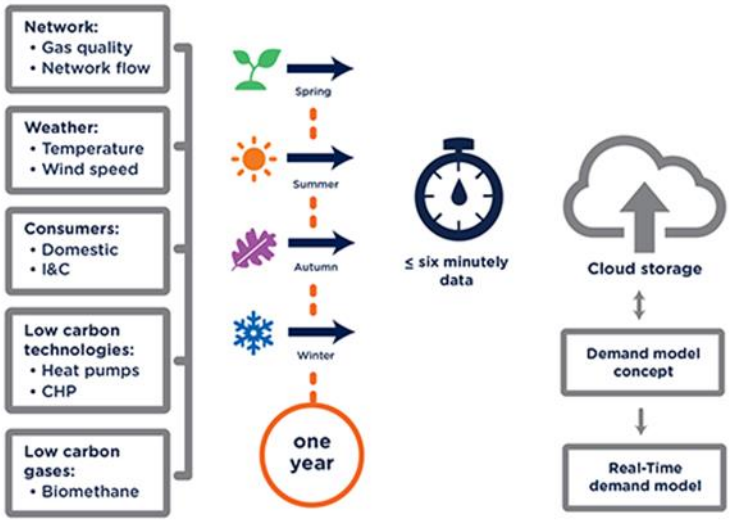
The issue is further complicated by the fact that in some of the emerging initiatives, where innovative approaches are being developed, there is a high degree of resilience being built into those plans. Two such examples of fairly high-profile initiatives at Queens Quay Development in Glasgow and Super Village Durieshill near Plean are planned to be largely carbon-free schemes. At the same time both sites requested gas connection as 'a means of resilience' and hence capacity requires to be available on our network.

In discussion with Highland Council as recently as 1 November the council confirmed that although local authorities are aware of the net-zero targets, they have no firm decarbonisation strategy in place. The Highland Council stressed that until clear directions are released from national government, they require gas connections to all the new properties proposed for construction in the inner Moray Firth area.

These uncertainties, future load growth and the lack of a coherent decarbonisation strategy at this time have prompted our suggestion for a reinforcement volume driver – de-risking these external uncertainties to the benefit to all parties.

5.2 Innovation

Innovation that supports improved network reinforcement and resilience tends to be innovation that is focused on improving data and knowledge about the performance of the network so that it can drive better, more efficient, planning decisions. Two innovations in particular have helped to support this.



Real-time network solution

Our Real-Time Networks project has the potential to make customers' gas supply more secure and affordable. The intention is to demonstrate how a flexible gas network could be more efficient for our evolving energy market and meet changing customer demands. To do this, we are looking to establish Great Britain's customer gas demand by recording how much gas is needed and when. We are currently collecting data from 1,200 gas meters in the south-east of England

Our project has come at an important time with new energy developments being introduced. Experts are looking at using new and unconventional, greener gases such as biomethane, which could potentially be more environmentally friendly. These resources could also improve our security of gas supply by extending the amount of gas we can use. However, first we need to make sure our network is fully prepared for these gases to be introduced.

To deliver gas we use demand and supply calculations. However, these calculations need to be reviewed to ensure their continued relevance due to changes in energy sources (such as solar panels and wind turbines) and customer gas demand (because of more energy efficient homes, for example).

We are looking to adapt our demand and supply calculations to reflect the continuously changing energy needs of Great Britain. This could potentially save gas delivery costs, improve security of supplies, and reduce carbon emissions for the environment and subsequently reduce cost to the customer.

Many of our demand and supply calculations were formulated in the early 80s. These calculations predict the amount of gas used by typical house types. However, we know that all our customers are different and so use gas in their own way. The overall assumption being that not all properties will have the same demand requirements at the same time. However, over the course of the last 30 years, house types and energy requirements have changed

drastically. One element of this project will review these figures to ensure our approach is fully reflective of modern-day use.

As a result, one element, within a wide range of objectives, is to carry out a full review of these formulae calculations and asses their continued relevance. Any changes may as a result have an impact on the level of funding required in this area. Unfortunately, the outcome of these studies will not be fully available until late 2020, and to that end may not influence our initial thoughts. This is one of the factors influencing our thinking around funding arrangements, set out in section 6.8.

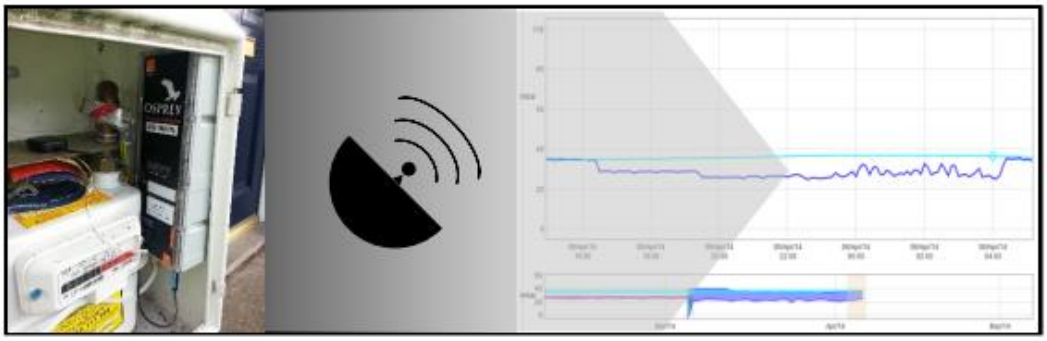
The Abriox Osprey Pressure Validator is an intrinsically safe, battery powered remote monitoring unit that can be installed in bollards posts and meter boxes to monitor gas pressures up to 100mbar. It transmits data automatically or on-demand to a pressure management website for displaying, interpreting and archiving the results and for export into network validation software and other business systems.

Field trials of the Abriox Osprey Pressure Validator were carried out across Southern and Scotland LDZ's LP networks during the winter period of 2013/14 to evaluate the overall suitability of the unit for SGNs data logging needs.

The key driver for this project was to exploit new technology being made available at a juncture where current stocks of loggers are requiring either expensive battery replacement or full unit replacement.

However, during the course of the trial, a key benefit which came to light was in the investigation of any poor pressure and the immediacy with which results were made available to our Planning teams. These loggers avoid the need for repeat site visits to download results and the ability to remotely monitor within a few hours of fitting. This ultimately resulted in benefits to the consumer in being able to establish the root cause of any issue at an early stage and thereafter identification of any enduring solution in a timely manner. Using Abriox loggers for poor pressure investigations, not only enables quick resolution but also allows the system to quickly go back to control and reduces issue re-occurrence ultimately reducing opex cost and, from an environmental perspective, shrinkage associated with increased pressures.

Figure 11: Osprey pressure validator



Osprey pressure validator sends location information via GPS and pressure data via GPRS to the PressureTrac™ web database

The Osprey Pressure Validator is now used extensively across SGN, primarily for poor pressure investigations but also for network analysis model validation. As outlined above, this has resulted in savings against operational expenditure through avoided site visits to download pressure survey results (estimated to be in the region of £860k since 2013) and has allowed Strategic Planners to react in real-time to ongoing incidents. Network analysis model validation ensures that analysis models are a true representation of our network. This accuracy is essential when planning capacity related investment in our network and Osprey Pressure Validator technology has been successfully used as part of this process. It is expected that SGN will continue to invest in this technology during GD2 for use on our low-pressure systems.

Further to the above, SGN successfully trialled the Osprey Pressure Plus Validator in 2016/17 to demonstrate the practicality of installing them across our MP/IP networks. Such loggers have not previously been used on MP/IP networks, nor had the ability to communicate alarm notification to Gas Control. The trial proved that we can

configure the monitoring equipment in this manner, refine alarm notification regimes and define associated process for notification management at Gas Control. SGN will take cognisance of this trial with a view to rolling out during the remainder of GD1 and during GD2.

5.3 Resilience

As detailed in section 6.2 of this report, SGN has identified a number of resilience projects that were considered. However, due to substantial costs of these projects and lack of legislative driver there are no funds included in Capacity Management Appendix to facilitate these works.

6 GD2 activity breakdown

6.1 Approach to GD2

Under the Gas Act 1986 and the associated Gas Transporter Licence conditions, SGN are required to operate a safe and economic gas network. To comply with this legislation, SGN need to maintain satisfactory pressures under the 1-in-20 demand criteria, ensuring security of supply for existing customers and to develop a network that will meet the requirements of future energy solutions.

In addition, SGN is required under the Gas Safety (Management) Regulations (GS(M)R) to set out arrangements for minimising the risk of a gas supply emergency. SGN must therefore at all times monitor performance and develop appropriate plans for the safe operation and economic development of our existing assets.

SGN owns and operates 456 networks in Scotland and 508 networks in the south of England, operating below 7bar, with approximately 71,500km of mains from which SGN supply the majority of the 5.9million customers. In order to maintain current network capacity and cater for future growth in GD2 it will be necessary to reinforce some of the networks to ensure security of supply. The plan is developed to not only ensure we deliver a safe, secure network, and maintain security of supply to all customers, but is underpinned by the assumption that the economy will maintain current growth rates. This scenario was also developed following extensive research of local government forecasts, linked to customer driven development, categorised by level of certainty and when applied used to establish the optimum investment strategy for our networks.

Southern

During GD2 period we anticipate that we will need to add between 68 km and 103 km of additional length to the network to enable the new connections and that this will require to install between 37 to 84 district governor units. This level of workload equates to a forecast investment of between £39m (Base Growth scenario) and £60m (High Growth scenario) or an average investment of between £7.9 and £12.1m/yr.

These costs have been determined by our procurement process – competitive tender and validated against projects that were completed in GD1. Governors are based on the average unit cost of GD1 £85k and the workloads for LP reinforcements are based on historical trend.

As part of our submission we are progressing with Base Growth scenario and all identified projects and associated costs tie back to BPDT tab 3.02.

Table 10: Base case and high growth forecasts for Southern

	Base Growth						High Growth					
Workload	2 1/22	2 2/23	23/24	2 4/25	2 5/26	**Total**	21/22	22/23	23/24	24/25	25/26	**Total**
<180mm (km)	6.97	9.28	7.62	6.29	9.75	**39.91**	10.57	15.28	14.12	10.75	13.36	**64.08**
>180mm (km)	8.21	5.85	5.39	4.15	5.34	**28.94**	9.03	6.67	11.14	4.98	7.51	**39.33**
Governors/PRS/DPG (units)	7	8	8	6	8	**37**	16	17	18	15	18	**84**
Investment (£m)	21/22	22/23	23/24	24/25	25/26	**Total**	21/22	22/23	23/24	24/25	25/26	**Total**
Reinforcement Mains	6.76	6.53	5.57	4.92	6.13	**29.91**	8.21	8.77	12.90	6.70	8.48	**45.06**
Reinforcement Governors	1.27	3.52	1.87	0.67	2.02	**9.35**	2.20	4.38	3.58	1.55	3.65	**15.36**
Total	8.04	10.05	7.45	5.59	8.16	**39.30**	10.39	13.44	16.82	8.42	11.60	**60.42**

When considering Base Growth scenario, reinforcement allowances are on average 18% lower in comparison to average annual allowances in GD1.

In the Southern region we have reviewed a full list of reinforcement projects and identified separately each project with an investment requirement of greater than £0.5m, established the workload that is associated with it and the year in which we expect it to be completed. Named projects are identified in more detail in the supporting project appendix and EJPs. For each of the projects we have set out the costs to be incurred, the basis on which the project has been identified, the stakeholders informed and consulted upon, any technical or operating costs associated with the site. There are seven projects covering the Base Growth scenario which have been included in BPDT 3.02 and requirement of this reinforcement is considered as 'Highly Probable' and 'Probable'. These named projects account for total investment of £6.847m. Of these named projects, the majority (five of the seven) are expected to be complete in the first two years of GD2. That accounts to approximately £5.5m of the proposed £6.847m of identified investment.

There are also a further six named projects that are allocated to 'High growth' scenario which reflect potential reinforcement addition if we see higher than anticipated growth. These projects account for the total investment of £9.653m but have not been included in BPDT.

Table 11:Identified below 7bar named projects Southern

Named Projects	Year	Pipe length	Workload	(£m)
Bicester (CPM6595)	2021	1.66		0.775
Mitcham Common CGS (CPM5288)	2022		Capacity DPG	1.316
Mitcham Depot CGS (CPM5290)	2022		Capacity DPG	1.538
Brackley (CPM6843)	2022	2.05		0.909
Marden MP (CPM7607)	2022	2		1.005
Uckfield (CPM6992)	2024	0.77		0.640
Wivelsfield MP (CPM6994)	2024	0.99		0.665
Total – Base Growth		7.47		6.847
Lympne (CPM4845)	2023	3.075		1.870
Aldermaston (CPM7564)	2022	4.06		1.621
Cliffsend CGS (CPM5295)	2023	0.5	Capacity DPG	1.734
Burgess Hill DPG (CPM5293)	2025		Capacity DPG	0.689
Sturry MP (CPM7472)	2023	1.6		0.783
Newbury DPG (CPM6564)	2023	3.2		2.956
Total – High growth		12.43		9.653
Total		**19.90**		**16.5**

[BTDT tab 3.02 Southern – Base Growth projects only]

[BP 7.5.9. Bespoke output: Named Projects to maintain network capacity]

These named projects (both included in Base and High growth scenarios) account for approximately 17% of the total investment that we expect to make in Southern over the course of GD2. The remaining expenditure is either linked back to development identified in the local plan, or to historical experience for the volume of specific reinforcement and governors required through growth.

For each of the projects we can create a direct link back through the strategic planning reports to the local plans with all IP and MP projects identified and traced through. Where LP projects are less than £0.5m they have been extrapolated on the basis of historical performance and averaged over the GD2 period.

There are two above 7bar Capacity Management named projects which have been included in the 3.01 LTS, storage and entry BPDT Southern. Both projects involve station rebuild and are planned for completion in 2024. In the case of transmission projects above 7bar, it is estimated that 'High' potential growth not accommodated within the Business Plan could amount to the rebuild of a further two PRS, namely Banbury B and Sturry PRS. If the forecasted growth progresses to the delivery stage, the above projects will be funded via proposed reopener mechanism.

Table 12:Identified above 7bar named projects Southern

Named Projects	Year	Workload	(£m)
East Morden PRS	2024	PRS rebuild	4.49
Wavendon PRS	2024	PRS rebuild	4.31
Total – Low growth			**8.80**
Total			**8.80**

Scotland

During GD2, we anticipate that we will need to add between 73km and 80km of additional length to the network to enable the new connections and that this will require to install between 23 and 43 district governor units. This level of workload equates to a forecast investment of between £27.44 and £31.8m or an average investment of between £5.5 and £6.4m/yr.

As part of our submission we are progressing with Base Growth scenario and all identified projects and associated costs tie back to BPDT tab 3.02.

Table 13:Base case and high growth forecasts for Scotland

	Base Growth						High Growth					
Workload	21/22	22/23	23/24	24/25	25/26	**Total**	21/22	22/23	23/24	24/25	25/26	**Total**
<180mm (km)	6.16	5.79	7.29	5.94	5.79	**30.97**	6.66	6.29	7.79	6.66	6.29	**33.69**
>180mm (km)	9.93	9.33	11.32	9.12	2.71	**42.41**	10.24	9.26	11.63	9.43	5.36	**45.92**
Governors/PRS/DPG (units)	4	5	5	4	5	**23**	8	9	9	8	9	**43**
Investment (£m)	21/22	22/23	23/24	24/25	25/26	**Total**	21/22	22/23	23/24	24/25	25/26	**Total**
Reinforcement Mains	5.14	5.87	5.84	4.99	2.40	**24.24**	5.37	6.10	6.05	5.25	3.53	**26.29**
Reinforcement Governors	0.35	0.77	0.99	0.35	0.75	**3.21**	0.81	1.23	1.42	0.81	1.23	**5.5**
Total	5.49	6.64	6.82	5.34	3.15	**27.44**	6.18	7.33	7.47	6.06	4.76	**31.80**

When considering Base Growth scenario, reinforcement allowances are on average 16% lower in comparison to average annual allowances in GD1.

In the Southern region, we have also reviewed a full list of reinforcement projects and identified separately each project with an investment requirement of greater than £0.5m, established the workload that is associated with it and the year in which we expect it to be completed. Named projects are identified in more detail in the supporting project appendix and EJPs. For each of the projects we have set out the costs to be incurred, the basis on which the project has been identified, the stakeholders informed and consulted upon any technical or operating costs associated with the site. There are six projects covering Base Growth scenario which have been included in BPDT 3.02 and requirement of this reinforcement is considered as 'Highly Probable' and 'Probable'. These named projects account for total investment of £7.54m. Of these named projects the majority (five of the six) are expected to be complete in the first three years of GD2. That accounts to approximately £6.143m of the proposed £7.54m of identified investment.

Table 14:Identified below 7bar named projects Scotland

Named Projects	Year	Pipe Length	Workload	(£m)
Luffness Mains (CPM5070)	2021	2.6		0.975
South East Wedge (CPM7996)	2022	2.29		2.259
Aberdeen City (CPM7459)	2022	1.72		0.864
Amisfield Mains (CPM1062)	2022	1.8		0.592
Bridgend (CPM7708)	2023	2.78		1.453
Kingslaw (CPM6728)	2024	2.4		1.397
Total – Base Growth		**13.59**		**7.54**
-	-		-	-
Total – High Growth			-	-
Total		**13.59**		**7.54**

These named projects account for approximately a third of the total growth distribution investment that we expect to make in Scotland over the course of GD2. The remaining expenditure is either linked back to a project identified in the local plan, or to historical experience for the volume of specific reinforcement and governors required through growth.

There are three >7bar Capacity Management named projects which have been included in the 3.01 LTS, storage and entry BPDT Scotland. Two projects involve station rebuild and one is a main laying reinforcement option. All proposed projects are planned for completion in 2023.

In the case of transmission projects above 7bar, it is estimated that 'High' potential growth not accommodated within the Business Plan could amount to the rebuild of a further two PRSs, namely Aberlady and Linlithgow PRS, and a further pipeline reinforcement, T11 – Soutra to Pathhead (length: 6km) at a cost of £16m. The accommodation of 'Medium' and 'Low' potential growth in Scotland could amount to an additional expenditure of up to £100m. If the forecasted growth progresses to the delivery stage, the above projects will be funded via proposed reopener mechanism.

Table 15:Identified above 7bar named projects Scotland

Named Projects	Length	Year	Workload	(£m)
South East Wedge		2022	New PRS	2.77
Dreghorn PRS		2023	PRS rebuild	2.42
Tranent PRS		2023	PRS rebuild	2.83
T8: Pitcairngreen to Huntingtower	4.5km	2023	Pipeline reinforcement	6.71
Total – Low growth				**14.72**
Total				**14.72**

Key in delivering the proposed programme of works is dependent on the sufficient level of highly qualified Network Planning and Operational workforce. From Network Planning perspective, we have a track record of recruiting and developing graduate, young, analytical and problem-solving employees. This well-established model allows us to follow trends of modern technology which then supports a holistic approach to our planning processes. Network Planning has become a place where the rest of SGN feeds from when looking for highly qualified and trained employees. We anticipate that this approach to recruitment and workforce development will continue into GD2.

Operation staff requirement, recruitment and training is covered in Workforce Management appendix [009].

6.1(b) Policy

The SGN future reinforcement requirement is significantly impacted by the government decarbonisation policy. The Climate Change Act commits the UK government by law to reducing greenhouse gas emissions by at least 100% of 1990 levels (net-zero) by 2050. The act requires that emissions of carbon dioxide and other greenhouse gases

are reduced and that climate change risks are prepared for. These emerging strategies are likely to influence numbers of new connections to our networks and level of reinforcement required. In order to mitigate the uncertainty around the impact of the Climate Change Act, we are proposing a volume driver for all our reinforcement allowance.

6.1(c) Scenario and sensitivities

Future level of connections to our network and reinforcement required to facilitate these connections is dependent on a number of factors including future performance of U.K. economy, decarbonisation strategies and potential implementation of innovative technologies including Real Times Networks NIA project.

In order to mitigate the risk of under or over stating the level of required reinforcement we propose to implement a volume driver mechanism.

6.2 GD2 outputs and price control deliverables

The investment proposal is based on GD1 experience and the need to deliver legislative obligations of a safe, secure network, and maintain security of supply to all customers. To establish the funding requirements, we have established a broad programme of work informed by reviewing local authorities' local plans and associated monitoring regimes, identifying for each development a probability of progression – high, medium, low and unlikely – that are defined according to the matrix below.

Table 16: Local development load growth categorisation.

Confidence	Definition	Factors to be considered	Base Growth	High Growth
Highly probable (>90% confidence)	Connection expected in GD2 for all sites	1. Quotation accepted but not yet on stream. 2. Building is in progress. 3. Detailed planning permission granted. 4. Economic conditions indicate that sites for consumers of a particular type are likely to be developed, e.g.: a. Domestic sites where there is a high demand for housing and there is a shortage of land available. b. Interest has been shown in having a connection made to a non-domestic site and economic factors suggest development will go ahead.	✓	✓
Probable (>75% confidence	Connection Likely in GD2 for majority of sites.	1. Outline planning consent has been granted. 2. Recent development has been carried out in the area. 3. The land is a prime site for development, but no connection enquires have yet been received. 4. Adopted Local Plan Site.	✓	✓
Good prospects (>50% confidence)	Connection expected for some sites in GD2	1. Proposed Local Plan Site. 2. No indication of planning permission being granted for the site. 3. The site is outside existing gas supply areas. 4. The site would involve physical problems in delivering a gas supply. 5. The site would require substantial additional infrastructure, e.g. additional roads, schools. 6. Site marked 'reserve' in local plan. 7. Site is known to be contaminated ground. 8. Site has 'protection' orders served over it – e.g. SSSI.		✓
Poor prospects (<50% confidence)	Significant time or investment required to progress	1. Does not meet the above planning criteria 2. Site has been deemed as 'speculative'. 3. The site would require significant additional infrastructure, e.g. additional roads, schools.		

Projects that are identified as 'highly probable' are shovel-ready projects that we are extremely confident that development will occur during GD2. As we move to 'probable', there are projects that where uncertainties remain, but these should be easily lifted, while those identified as good prospects are recognised as having a good chance of being progressed in the next seven years, although some would be expected to occur outside of the GD2 timeline. These probabilities include our understanding that future developments will include gas central heating.

In the Base Growth scenario, we anticipate that a scenario where the economic climate makes it more challenging to progress projects and that some medium projects likelihood projects will falter or be progressed more slowly, but that these will be replaced with low probability projects that are moving rapidly than anticipated.

In the high growth scenario, we anticipate that over the next seven years the majority of projects in highly probable and the probable category will be progressed, and that where good prospect sites don't progress, they will be replaced with other sites that we have not captured, or we have considered under 'poor prospects'.

Having categorised the planned developments captured within the local plan, informed by the annual HLA report, the impact of that growth on our IP/MP networks has been assessed and a Strategic Planning Report developed for each IP/MP grid system.

Bespoke assessment has allowed the sensitivities of each system to be tested against that growth and, where required, optimum reinforcement solutions established – establishing the scale, nature and likely timing of each project.

Assessment of low-pressure networks has not been evaluated to that granularity, primarily because any solution is likely to be far more affected by the unpredictable nature of the position of the final connection to the network – driven primarily by developer and market forces. In that case, investment requirements have been based on recent trends in expenditure associated with reinforcement of the lower pressure tiers.

The workload that is associated with each of these projects is then divided into three categories

- Reinforcement mains <180mm
- Reinforcement mains > 180mm
- Reinforcement for other assets – governors/distributed pressure governors and PRSs (each regulate pressure between different pressure ranges)

Given the experience in GD1 and looking forward to GD2 workloads and associated costs there are clearly a number of factors with varying degrees of uncertainty influencing the final view for the upcoming period. Primarily the level of activity will be market driven and therefore heavily influenced by the nature of the UK economy at that time.

While, under normal conditions there would always be a degree of uncertainty around how the economy may perform looking seven years ahead, in current circumstances, with the UK government still embroiled in Brexit negotiations, the situation has an even greater level of uncertainty than normal, and as such creates a risk of significantly understating or overstating the likely requirement.

Similarly, emerging strategies around decarbonisation, whether at local or national levels, are likely to have a significant influence. Government policy has the potential to impact on the anticipated level of reinforcement outlined in this Business Plan as that is likely to influence, not only the number of new connections to the gas network, but also the boiler and heat loss efficiencies targets on new build properties, thereby impacting annual gas demand. There may then be further indirect impacts through the number of flexible generators connecting to our network or CNG vehicle fuelling facilities.

A third factor relates to innovation and change. In particular the ongoing Real Time Networks NIC project which is currently in flight, but firm conclusions may only be available towards the end of GD1. Among a range of objectives, this project aims to challenge and review current demand estimation practices and may yet have an impact on our modelling of the gas supply system, in turn impacting future investment requirements.

As a result, we believe that while the option to continue to fund this area of activity in a similar manner to previous

price control periods remains, alternative approaches could be considered, which ultimately may prove to be more appropriate for all parties, particularly the wider customer base.

Distribution reinforcement options which have been considered include:

- **Fixed level of funding agreed at start of period.** This approach is in line with previously adopted regimes whereby an agreed level of funding is established at the outset of the Regulatory period. That level remains unchanged throughout giving parties full clarity of funding arrangements from the outset. However, such an approach is not agile enough to reflect any upturn or downturn in the economy, changes to government policy, or any level of innovation which may result in a significant change in levels of gas usage. This arrangement could therefore lead to poor calibration of funding.
- **Funding agreed based on a volume driver for the entirety of the price control.** A second option would be to implement a volume driver mechanism for the entirety of the price control period, with an annual retrospective report on the level of reinforcement installed, demonstrating the basis for the requirements and that those investments were the most cost-effective solutions to address the respective constraint. This would de-risk funding calibration, however, this would impact on the DN's ability for longer term planning of more complex reinforcement projects (which during GD1 has brought about significant efficiency benefits) and lead to a more reactive approach to delivering reinforcements. In those cases where a significant lead time was required this could lead to SGN becoming a blocker to delivering large construction projects timeously.

Transmission reinforcement option under consideration:

- **Fixed level of funding and reopener for the entirety of the price control.** It is proposed that the fixed level of funding is agreed to cover transmission named projects listed in table 12 and table 15, and this allowance would remain unchanged for the duration of the price control. In order to cater for uncertainty associated with level of future growth reopener mechanism is recommended for the entire period.

We do not anticipate any price control deliverables or use-it-or-lose-it mechanisms being used.

As detailed in section 6.1 we have developed a holistic approach to all our planning activities which ensure that optimum fully efficient investment decisions are achieved at all time. When planning to facilitate Capacity Management we are mindful of full range of activities to be delivered by the business. This approach significantly reduces the risk of 'planning in silos' and creating the opportunity to establish overall fully optimised decisions mindful of the potential interaction of new connections, mains replacement, mains diversions, governor replacement, pressure management initiatives, third party injections and long-term development plans on the system. We have developed tools allowing significant levels of supporting information to our network analysis tool, ensuring full visibility on a single platform at any time.

That information is aimed at enhancing not only longer-term strategic planning activities, but also shorter-term day to day decisions, and means that when evaluating an issue associated with a particular process, we have visibility of a range of data which help inform what other activities are likely to arise in the same area in the near future. In this way we can foresee synergies and ensure the optimum fully informed solution is established, avoiding unnecessary costs at a future date.

As outlined in section 5.2, Real Time Networks (RTN) and Abriox Osprey Pressure Validator are the two innovation projects that support network capacity management. Although outcome of the RTN project is uncertain, if successful it is likely to provide a clearer view of the demand and drive efficiencies to reduce cost to customer. Abriox loggers allow quick resolution of poor pressure investigation, not only enable the system to go back quickly to normal operation but also minimises the re-occurrence allowing reduction in opex costs.

6.3 Bespoke outputs

We also identified two bespoke outputs that could have been delivered in GD2 but upon further review these options have not been progressed and no funds have been included to facilitate.

Output 1 – improved resilience

SGN has identified areas of the network that we think are particularly vulnerable as there is a large population of region dependent on a single feed where. While it is unlikely to materialise, the impact of an incident that required the flow to be stopped along that section of pipe would have significant consequence for a large number of customers downstream. Examples include:

- Milton Keynes (Southern) – a 6.4km extension of the network to connect two parts of a single feed system to create a significantly more resilient network in that area. Currently it would not be possible to isolate a problem in the event of an incident and as a result and depending on the location a large number of customers could be off supply while the incident is resolved. This would require an investment of £10.36m.
- Livingston (Scotland) – a 10.6km extension to the network and construction of a new DPG to reduce the reliance on Livingston PRS and DPG which are both single source stations. In the event of an incident at either of these the impact would be on customers that are downstream from that PRS and DPG and this could be for an extended period over winter. This would require an investment of £13.58m.
- Coldstream-Eyemouth – a 13.2km extension to reduce reliance on a single source IP main from Berwick-upon-Tweed. This would require an investment of £4.64m
- Greenock – a 1.3km extension with a new PRS to reduce the reliance on Greenock PRS and DPG, both of which are single source stations. In the event of an incident affecting either of these the impact would be on customers that are downstream from that PRS and DPG and this could be for an extended period over winter. This would require an investment of £1.99m.

However, due to the specific nature of these projects and lack of a legislative driver, each will require to pass an individual CBA. It was clear at an early stage that this would be a challenge, with the payback on the Livingston project taking 50 years to break even, and on that basis, it was determined we would not seek funding for these works.

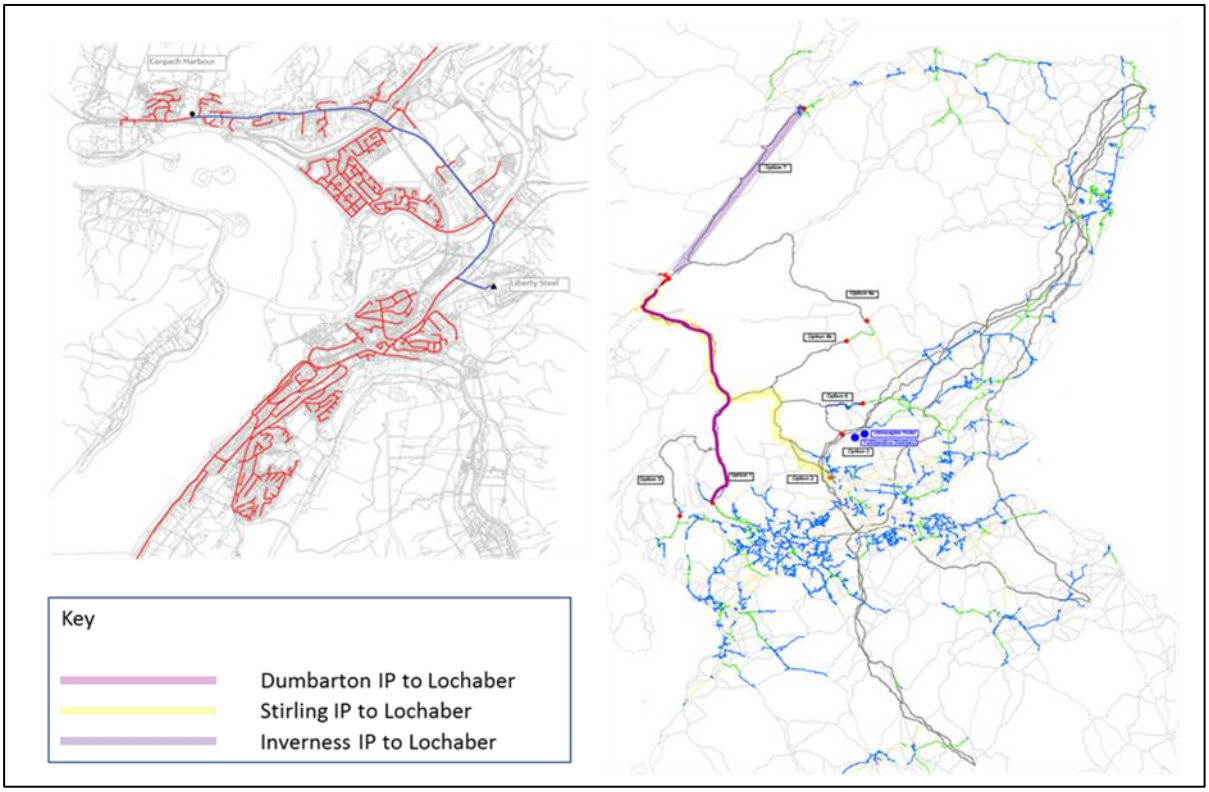
Output 2 – network extensions

The Network team carried out a review to identify network extensions and design appropriate reinforcement where they significantly impact SGNs existing distribution system. Such system extensions at this time are purely customer driven.

Furthermore, in the case of network extensions, the majority of any such costs would be deemed ‘connection’ and under the current charging regime there seems limited appetite from stakeholders to progress such scenarios. A provisional evaluation was carried out with regards areas lying outside the gas supply area, but indicative costs, that would have predominantly had to have been met by customers, suggested limited appetite and for that reason no funds have been included in this section.

The one significant community where an interest has been shown and discussions were held at the highest level involves extending the gas network to Fort William. Considered options involved between 107 to 155km of pipeline installation through rural and mountainous terrain. A full feasibility study has been carried out around several options, and is shown below as an example, but at this stage there is no intention from key stakeholders to fund or progress with the project.

Figure 12: Fort William gas network options



6.4 Investment in existing assets

Our distribution system is built to ensure security of supply for all our customers meeting the requirements outlined within our Licence Condition.

As outlined in section 4 of this document, SGN has informed the plan by extensive research of local government growth plans to establish a full picture of local development. This engagement has provided us with confidence that the sites identified will progress to development, and subsequently reinforcement will be required.

Failure to reinforce the network will restrict the delivery of these developments.

Once a firm connection request has been received and requirement for a reinforcement project has been identified, SGN considers a range of options based on empirical and logical analysis constructs to ensure the best engineering and investment solution is developed. In addition, cognisance will be given to the phasing and level of certainty of any development driver to ensure that we invest appropriately, 'just in time' and avoid the risk of 'stranded assets'.

Every reinforcement investment, as part of the ongoing project approval process, no matter the cost, will be supported by a documented project summary identifying the driver for the reinforcement, the range of options considered along with the projected cost of each option, and setting out the rationale for the preferred, recommended solution.

All our investment is compliance driven and as such has not been assessed through CBAs, instead we have demonstrated alternative options which have been discounted.

6.5 Engineering Justification Papers

The below table summarises EJPs raised to support the Capacity Management appendix. EJPs are available for all 'named' projects estimated to cost in excess of £0.5m and previously detailed in section 6.1.

Table 17: Distribution EJPs Southern

Base Case	Year	(£m)
SGN Cap Man – 007 CPM6595 Bicester MP – EJP Dec19	2021	0.775
SGN Cap Man – 008 CPM6843 Brackley – EJP Dec19	2022	0.909
SGN Cap Man – 009 CPM5288 Mitcham Common CGS – EJP Dec19	2022	1.316
SGN Cap Man – 010 CPM5290 Mitcham Depot CGS – EJP Dec19	2022	1.538
SGN Cap Man – 011 CPM7607 Marden MP – EJP Dec19	2022	1.005
SGN Cap Man – 012 CPM6992 Uckfield – EJP Dec19	2024	0.640
SGN Cap Man – 013 CPM6944 Wivelsfield – EJP Dec19	2024	0.665
High Case	**Year**	**(£m)**
SGN Cap Man – 014 CPM6564 Newbury DPG – EJP Dec19	2023	2.956
SGN Cap Man – 015 CPM7564 Aldermaston – EJP Dec19	2022	1.621
SGN Cap Man – 016 CPM4845 Lympne – EJP Dec19	2023	1.870
SGN Cap Man – 017 CPM5295 Cliffsend CGS – EJP Dec19	2023	1.734
SGN Cap Man – 018 CPM7472 Sturry MP – EJP Dec19	2023	0.783
SGN Cap Man – 019 CPM5293 Burgess Hill DPG – EJP Dec19	2025	0.689

Table 18:Distribution EJPs Scotland

Base Case	Year	(£m)
SGN Cap Man – 001 CPM5070 Luffness Mains – EJP Dec19	2021	0.975
SGN Cap Man – 002 CPM7996 South East Wedge – EJP Dec19	2022	2.259
SGN Cap Man – 003 CPM7459 Aberdeen City – EJP Dec19	2022	0.864
SGN Cap Man – 004 CPM1062 Amisfield Mains – EJP Dec19	2022	0.592
SGN Cap Man – 005 CPM7708 Bridgend – EJP Dec19	2023	1.453
SGN Cap Man – 006 CPM6728 Kingslaw – EJP Dec19	2024	1.397
High Case	**Year**	**(£m)**
-	-	-

Table 19:Transmission EJPs Scotland and Southern

Base Case	Year	(£m)
SGN Trans – 030 Capa – EJP Dec19	2022/23	14.72
High Case	**Year**	**(£m)**
-	-	-

6.6 Investment in new assets

As outlined in section 6.1, the primary driver for identified investment in GD2 is the need to meet the anticipated increase in demand in areas of the supply system with insufficient capacity. We are proposing to invest £39.30m in Southern and £27.44m in Scotland (Base Growth scenario) in new assets to facilitate the identified growth. The reinforcement projects that underpin the Capacity Management appendix are designed to deliver additional capacity and as a result, support future economic growth in the area.

6.7 Cost efficiency

It should be noted that traditionally reinforcement projects unit costs when compared with corresponding replacement unit costs are higher. This is mainly down to the fact that majority of the replacement projects are delivered by insertion techniques while reinforcement projects involve installing new assets using open-cut techniques.

For the purposes of this Capacity Management appendix, all IP/MP projects have been costed and validated against known costs for similar, completed projects. The costs are in line with SGN procurement document based on Ofgem guidance.

Forecasted costs were provided from SGN Finance System – TM1 Proxy. The system uses schedule rates and the output costs vary based on selected input factors such as, but not limited to, the following:

- Depot/geographical location
- Material
- Diameter
- Project length
- Pressure tier (low/medium/intermediate pressure)
- Year of work

- Surface category

There have been no external costs incurred in assessing the options considered.

The costs are broken down into three main categories – labour, materials and other costs. Other costs would include costs accumulated in delivering the project, such as cost of connections, cost of servitudes and pressure reduction installations. Schedule rates are not available beyond the end of GD1 and therefore costs were increased year-on-year throughout GD2 based on the rate of inflation from historical averages over the last five years.

As it would be unknown at this time which contractor (including internal) would deliver the projects, 'average' rates were applied to determine labour and material costs for each category. Depot average rates are described by Finance Systems as 'the average CIPS (Contractor Invoice and Payments System) rate per depot for any given CIPS schedule'. Unit rates were calculated for each GD2 project costed and as an average from what was spent in 2018/19. These unit costs were compared to ensure a reasonable degree of comparative accuracy could be ascertained. The costs are in line with SGN procurement document based on Ofgem guidance.

Please refer to Procurement and Native Competition appendix [010] for further information.

6.8 Managing uncertainty

As detailed in section 6.2 of this Capacity Management appendix, there is a high level of uncertainty around growth in demand on our network. In considering funding options, the key recurring factor is the level of uncertainty we face at this particular point in time. Two years forward, things may be much clearer, but at this moment, this is not the case.

Because the level of uncertainty is so great, particularly in relation to the economy and future energy policy, at this point we would recommend adoption of a volume driver mechanism to cover much of this expenditure.

Our current thinking is that SGN will outline an anticipated view of investment to help define an initial annual financial allowance, based on a forecast of likely activity. Thereafter we would retrospectively report annually on the level of reinforcement installed (length by diameter band) and any associated district governors (split by capacity band), quantifying the actual level of activity and, as necessary, making available, evidence of the constraint which the reinforcement addresses, and that the most cost-effective solution has been developed and installed.

It is our view that the vast majority of this activity could be funded as a volume driver based upon an agreed unit cost for a range of diameter bands, but for any IP related work activity these projects would be of such a bespoke nature that a separate arrangement would be required, with the intention these be part of the proposed transmission reopener mechanism.

In order to ensure the unit costs to be applied as part of this mechanism are market tested and fully reflective of the most current, fully efficient prices, SGN propose to initiate a tender event in early 2020 and base the final detailed proposal on the resultant costs.

It is envisaged that the adopted proposal would group activity in the following banding with proposed unit rates against each.

Table 20:Proposed unit rates

Low Pressure and Medium Pressure Main laying	SCOTLAND	SOUTHERN
≤75mm	tbc	tbc
>75mm to 125mm	tbc	tbc
>125mm to 180mm	tbc	tbc
>180mm to 250mm	tbc	tbc
>250mm to 355mm	tbc	tbc
>355mm to 500mm	tbc	tbc
>500mm to 630mm	tbc	tbc
>630mm	tbc	tbc

Similarly, for district governors we would propose a three-tier arrangement based upon governor capacity, with a unique rate for each designated capacity band. Again, this is because of the extreme range in costs that can be experienced depending on the size of unit required and volumes that may arise. As a result, it is proposed that the volume driver be structured as follows.

Table 21:Volume driver structure

Category	Unit Size	Unit Cost (£/unit)
Small DG	<200scmh	tbc
DG	200 to 500scmh	tbc
Large DG	>500scmh	tbc
IP fed	All	Reopener

Currently the figures contained within the BPDT can be summarised as follows for MP and LP related investment (at SGN level).

Table 22:Summarised MP and LP related investment

Category	Unit Cost (£/unit)
<= 180mm	249
>180mm	468
DGs	104,018

In addition, for IP related work costs are as follows.

Table 23:IP related work

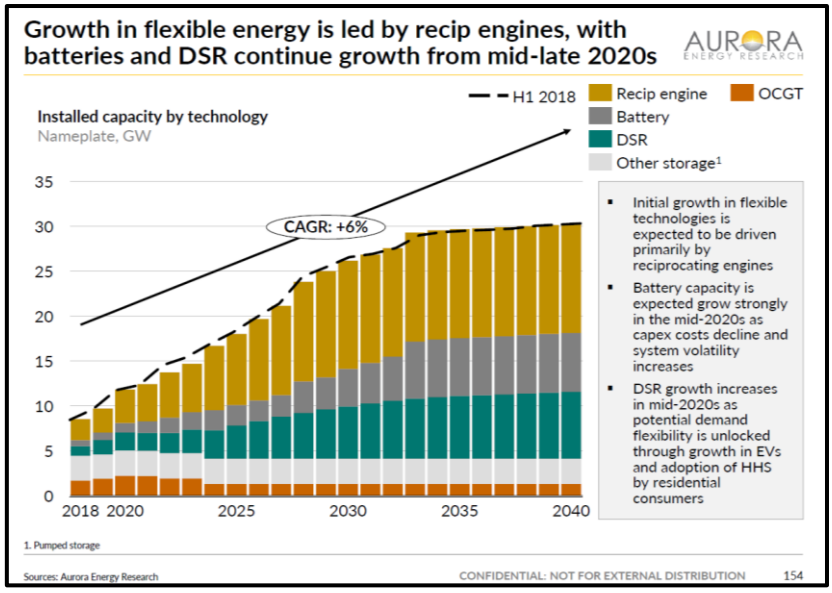
Category	Unit Cost (£/unit)
<= 180mm	459
>180mm	620
DGs	736,870

While these tables reflect numbers currently used to populate the BPDT, we do not believe they are of a sufficient granularity and, when considered in light of the range of uncertainties mentioned, are best suited for use to define the basis of the volume driver. Hence, this is why we propose at this stage to run a tender event, to establish a far more robust, informed, granular, fully efficient set of numbers that can be applied to any profile of work that may be generated as a result of those unpredictable conditions.

Ultimately the main benefits of adopting this proposal would be that, from the outset of the price control period, it would totally de-risk the possibility of allocating unnecessary funding should the anticipated level of growth not be achieved, while equally addressing the possibility of underfunding should an unexpected, significant upturn in the economy be experienced. On that basis this would be the most fiscally prudent course of action. At the same time, we recognise that certain elements due to their bespoke nature do not lend themselves to this approach, i.e. any IP related works, and for that reason have set that group outside of the main funding mechanism

One further significant uncertainty, not previously mentioned, but which could have a major impact in this area is that relating to power generation peaking plants. Our current proposal has been developed, by extrapolating the current level of reinforcement witnessed, predominantly in Southern, to facilitate these connections. This is an emerging workstream and for that reason we have also included an additional allowance in Scotland.

The below figures reflect a forecast provided by the independent consultancy Aurora Energy Research on the potential growth of flexible generation (referred to as Recip Engine) which shows the greatest increase in capacity over the coming years through to 2030, where it reduces slightly. Although market research clearly shows flexible generation as a growing market, it is very challenging to predict locations of the future connections and specific reinforcement required.



6.9 Competition

Reinforcement costs included in our GD2 Capacity Management submission are based on unit costs build into TM1 Proxy. Unit costs used are our contractor rates that are competitively tendered to get the best price for our customers, as explained in Procurement and Native Competition appendix [10].

6.10 Real price effects

The main factors that are likely to increase the project cost are future contactor rates. Historically projects delivered by contractors had higher unit cost to projects delivered by direct labour. With the metallic mains population gradually reducing we may require less direct labour with a shift towards employing more contractors to deliver the main laying projects.

The below charts present historical trends and future estimate of the length of main laying delivered by direct labour and contractors in Scotland, showing a clear trend towards the above scenario.

Figure 13: Commercial Confidentiality

Figure 14: Commercial Confidentiality

The costs in this appendix are based on average contracted unit rates at depot level and historical programmes to support the costs put forward.

It is important to highlight that all reinforcement work in Southern is delivered by contractors. The main factors influencing future project costs are contractor rates. Contractor rates are subject to tender process carried out by the Procurement team and further details of this process could be found in the Procurement and Native Competition appendix [10].

6.11 Financial summary

For the purposes of the Business Plan submission on 9 December, we have made our current forecast on the following basis

- That cost pressures between 2018/19 and the start of the price control 2021/22 will be equal to CPI
- The forecast used in the table below are based on the Base Growth forecasts
- We have assumed reinforcement that facilitate flexible generation
- These figures assume a volume driver is implemented for the duration of GD2 period
- We have not assumed resilience projects in the current figures
- We have not included any costs associated with network extension on the basis that it is considered unlikely to be appetite from our stakeholders to progress with the project

Capacity Management appendix impacts on:

[BPDT tab 3.02 Scotland and Southern]
[BPDT tab 3.01 Scotland and Southern]

As part of our GD2 proposal, we require £76.92m to cover cost of distribution reinforcement over the five-year period 2021 to 2026. We have allocated 80% of the proposed spend to main laying projects while 20% cover cost governor installations.

In Scotland, the average expenditure during GD1 is forecasted to be £3.53m, while the investment proposed for GD2 averages at £5.48m per annum. 2022/23 and 2023/24 will see the highest spend in the GD2 period as delivery of most of the identified named projects are scheduled for these years.

In Southern, the average expenditure during GD1 is forecasted to be £5.5m, while the investment proposed for GD2 averages at £9.8m per annum. 2021/22 and 2022/23 will see the highest spend in the GD2 period as delivery of most of the identified named projects are scheduled for these years.

Table 24:Growth investment profile (SGN level)

SGN (£m)	13/14	14/15	15/16	16/17	17/18	18/19	19/20	20/21	21/22	22/23	23/24	24/25	25/26
Mains	2.5	5.4	8.6	7.0	12.1	12.8	9.5	8.7	11.9	12.4	11.4	9.9	8.5
Governors	0.5	-	0.8	0.5	0.3	0.1	2.4	3.5	1.6	4.3	2.9	1.0	2.8
Distribution Growth	2.9	5.4	9.4	7.6	12.4	12.9	11.9	12.2	13.5	16.7	14.3	10.9	11.3
LTS Pipeline									2.1	4.0	0.6	-	-
PRS									2.8	8.9	5.1	-	-
Transmission Growth	-	-	-	-	-	-	-	-	4.9	12.9	5.8	-	-
Total	**2.9**	**5.4**	**9.4**	**7.6**	**12.4**	**12.9**	**11.9**	**12.2**	**18.4**	**29.6**	**20.0**	**10.9**	**11.3**

Table 25:Growth investment profile (Scotland level)

Scotland (£m)	13/14	14/15	15/16	16/17	17/18	18/19	19/20	20/21	21/22	22/23	23/24	24/25	25/26
Mains	0.9	1.4	3.6	2.3	4.5	4.9	3.2	3.2	5.1	5.9	5.8	5.0	2.4
Governors	0.2	-	0.3	0.4	0.2	0.1	1.5	1.5	0.4	0.8	1.0	0.4	0.8
Distribution Growth	1.2	1.4	3.9	2.7	4.7	5.0	4.8	4.7	5.5	6.6	6.8	5.3	3.2
LTS Pipeline									2.1	4.0	0.6	-	-
PRS									1.6	5.9	0.5	-	-
Transmission Growth	-	-	-	-	-	-	-	-	3.7	9.9	1.2	-	-
Total	**1.2**	**1.4**	**3.9**	**2.7**	**4.7**	**5.0**	**4.8**	**4.7**	**9.2**	**16.5**	**8.0**	**5.3**	**3.2**

Table 26:Growth investment profile (Southern level)

Southern (£m)	13/14	14/15	15/16	16/17	17/18	18/19	19/20	20/21	21/22	22/23	23/24	24/25	25/26
Mains	1.5	4.1	5.0	4.7	7.7	7.9	6.3	5.5	6.8	6.5	5.6	4.9	6.1
Governors	0.3	-	0.5	0.1	0.1	-	0.9	2.0	1.3	3.5	1.9	0.7	2.0
Distribution Growth	1.8	4.1	5.5	4.8	7.8	7.9	7.2	7.5	8.0	10.1	7.4	5.6	8.2
LTS Pipeline									-	-	-	-	-
PRS									1.2	3.0	4.6	-	-
Transmission Growth	-	-	-	-	-	-	-	-	1.2	3.0	4.6	-	-
Total	**1.8**	**4.1**	**5.5**	**4.8**	**7.8**	**7.9**	**7.2**	**7.5**	**9.2**	**13.1**	**12.0**	**5.6**	**8.2**

Note 1: Transmission capacity related projects were identified within the general integrity allowances in GD1 and have been reported as such in annual regulatory reporting. The allowances for Transmission capacity projects in GD1 (in 2009/10 price base) were as follows:

SGN (£m)	Southern	Scotland
Offtakes	2.9	1.7
LTS Pipelines	-	15.6
PRS	12.4	7.9
Total	**15.3**	**25.2**

6.12 Assurance

Our Business Plan, including appendices, has been subject to a rigorous assurance process which is detailed in chapter 3 of the Plan and the Board Assurance Statement.

Our Network Director was appointed as the Sponsor for the Capacity Management appendix and the associated EJPs and BPDTS, which have been through the following levels of review and assurance:

First line

This was undertaken at project level by the team producing the document, as a regular self-check or peer review.

Second line

This was undertaken independently within the organisation to review and feedback on product development, including a GD2 workshop on Capital Expenditure (capex). Internal Audit reviewed the third line assurance work conducted by Ove Arup and Partners against scope.

Both Senior Manager and Director sign-off was obtained and our GD2 Executive Committee: (1) considered the appropriateness of assurance activity for the appendix; and (2) provided assurance to SGNs Board that the Business Plan meets Ofgem's assurance requirements.

Third line

This was undertaken by external advisors and groups providing critical challenge during the development of products within the Business Plan. In addition to the feedback and challenge provided by the Customer Engagement Group (CEG) and Customer Challenge Group (CCG) this appendix was developed after consultation with and advice from:

Advisor/Group	Contribution
Ove Arup and Partners	Consultancy support to enable development of an evidence based high quality Business Plan draft by acting as an expert challenge group through independent peer reviews against Ofgem Business Plan Guidance.
IGT Stakeholders	Consultation on capacity management

Fourth line

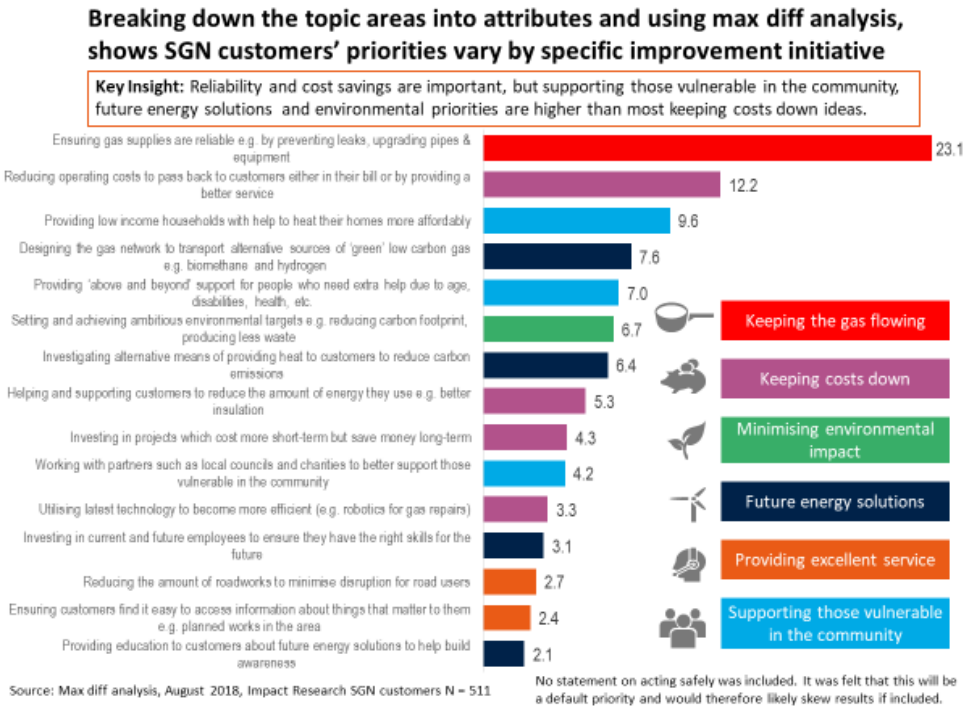
This was undertaken by independent and impartial external providers, who provided a detailed and comprehensive report to both the Executive Committee and Board of Directors:

Advisor/Group	Contribution
Ove Arup and Partners ('Clean' Team)	Review of appendix against Ofgem's assurance requirements
PwC	Business Plan Data Template review: Capacity and Storage Assets, Capacity and Demand and Capacity Output

7 Stakeholder annex

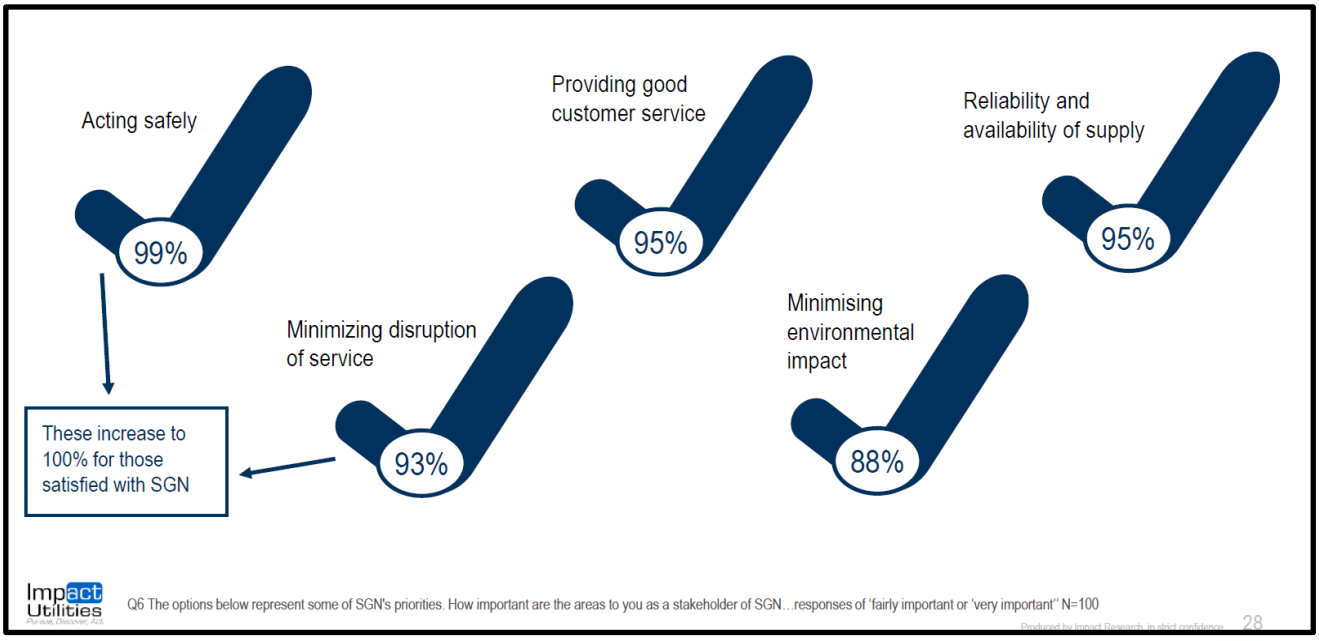
We asked our stakeholders and customers for future investment priorities for SGN. The below graph shows SGNs investment priorities ranked in relation to their perceived importance. Keeping the gas flowing are paramount for both groups. This is seen as business-as-usual activity, and therefore customers are satisfied that SGN is taking care of it.

Figure 15: Results of investment prioritisation exercise



Data based on prioritisation exercise (max diff analysis) which was conducted with 511 customers in August 2018.

Figure 16: Results of the stakeholders' prioritisation exercise



According to our stakeholders 'Reliability and availability of supply' should be one of the top five priorities for SGN.

Our objective is to ensure we continue to deliver gas safely, reliably and efficiently to all our customers, both current and future, by establishing a clear picture of long-term business requirements. Such an understanding is critical for ensuring that larger scale projects can be delivered in a timely manner and avoiding any capacity constraints that would restrict new development. A key message from our local authority stakeholders is they want us, along with all other utility providers, to have a clear vision of, and strategy for, likely growth, and the necessary funding to facilitate and support their plans. These planned developments are considered critical to future economic wellbeing and enhancement of many of these areas.

We asked local authority representatives about their experience of engagement with SGN and how they value working with us, below are a few examples of the responses received.

"Thanks for this and your continued support. SGN are definitely ahead of the game. If we can get others to share the level of data, you have provided and then work together to spot those opportunities that would be fantastic."
Greater London Authority – Infrastructure and Co-ordination Initiative

"I can't thank you enough for SGN's support, enthusiasm and commitment in relation to the work we have done to date. I appreciate the examples of benefits of the approach SGN have initiated and I also know that Scottish Water have also brought projects forward on the back of the joint working."
West of Scotland Operational Infrastructure Group

"In advance of the meeting, Peter Morgan (Network Support Manager, SGN) shared SGN's Strategic Planning Reports for the three relevant areas (Reading, Aldershot and Newbury), seeking feedback to confirm growth assumptions. Peter was very engaged at the forum and his attendance was essential, helping all attendees to understand the level of development certainty SGN need to plan/deliver network reinforcements. Overall, the meeting was productive, and all attendees made a commitment to continue to communicate going forward where appropriate."
Thames Valley Berkshire Utilities Stakeholder Forum

"We found the meeting extremely useful and appreciated SGN staff being able to come to Newtown St Boswells HQ to meet with us. We were able to include staff from a range of service areas and feedback after the meeting was very positive.
"Your explanations of the role of SGN as distribution transporter, the levels of gas infrastructure and their management and potential expansion, as well as details of the process around setting tariffs and customer engagement in planning for GD2, were all very helpful. Of key interest are the potential futures changes to gas supply as decarbonisation options are explored and implemented. We are most keen to develop this level of strategic dialogue with SGN, which will help support our Local Development Plan work, key infrastructure planning and help identify economic development opportunities as the role of the South of Scotland Enterprise agency evolves."
Scottish Borders Council

8 Glossary

All acronyms and associated descriptions can be found within the Glossary appendix.

9 Project appendices list

Annex Redacted