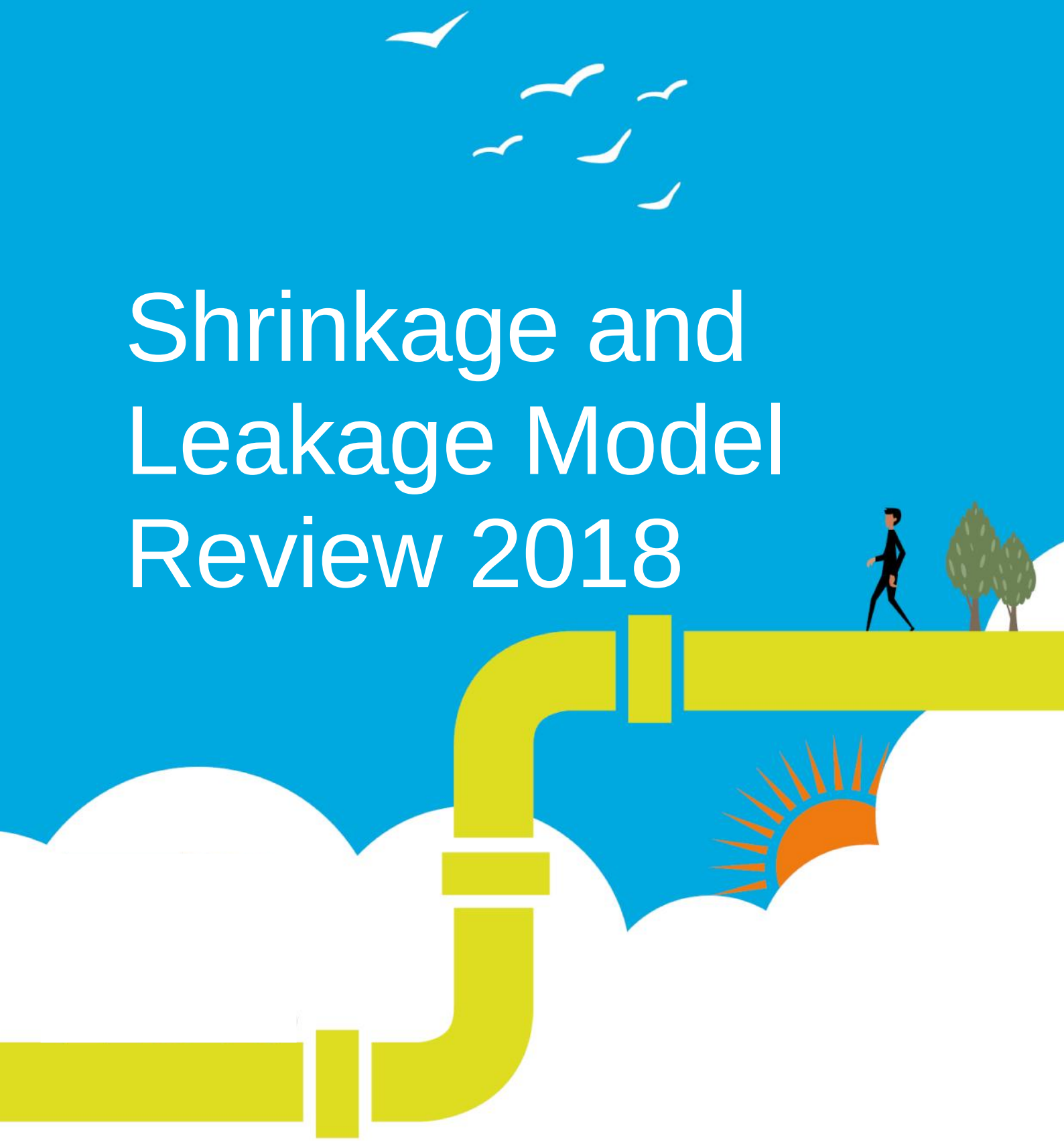
Shrinkage and Leakage Model Review 2018



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1 Executive Summary

Gas Distribution Networks (GDNs) review the Shrinkage and Leakage Model (SLM) on an annual basis and consult on the outcome of that review with other GDN operators, gas shippers and other interested parties.

The outcome of this consultation will be submitted to the authority by 31 December 2018.

The purpose of the SLM Review is to assess how the SLM can better achieve the objective set out in Special Condition 1F Part E of the Licence. This requires the SLM to be designed to facilitate the accurate calculation and reporting of gas shrinkage and gas leakage in each GDN operated by a Licensee.

As a result of the joint GDN review and feedback from key stakeholders, it is proposed to focus on the following areas:-

Our Commitment	2019 Approach	Potential Impact on Shrinkage Modelling
We will review the current Theft of Gas methodology	The current calculation for determining theft of gas is a static percentage of demand on system. The current methodology allows GDNs to make gains or losses dependent on gas demand. We will review the current methodology and suggest possible alternative measurement techniques through discussion with the wider industry.	On completion of this project if an alternative measurement of theft is used, it is anticipated the estimate for theft of gas will change.
We will review the current methodology applied to medium pressure mains assets	GDNs have commissioned a project with Newcastle University to provide an independent review of the current calculation and suggest alternatives. Once complete, we will share our findings with interested parties	If the project determines a relationship between MP pressure and leakage then we will look to add a pressure factor into the MP model
We will continue to investigate the opportunity of reflecting the benefits of Remediated Pipes in the SLM.	We have engaged with DNV GL and ULC Robotics to assist with developing and finalising the calculation and capture process. Following on from this process we will seek to engage with the wider industry to finalise the overall proposal.	Remediation is a process for maintaining our pipe assets with minimal impact on our customers. Future Shrinkage calculations should reflect any benefits arising from remediated mains in order to improve the accuracy of the SLM.
We will review the suitability of the existing Own Use Gas calculation within the SLM.	We will continue to investigate the results of low carbon preheating trials and determine if they can be used as a basis for revising the Own Use Gas (OUG) calculation.	Whilst the results of the low carbon preheating trials have still to be fully reviewed, it is anticipated that the estimates of OUG will change.

Table 1 – Summary of 2019 Commitments

2 Background

GDN's have an obligation under Special Condition 1F Part E of the Licence to review the SLM on an annual basis and to consult on the outcome of that review with other GDN operators, gas shippers and other interested parties.

The outcome of this consultation will be submitted to the authority by 31 December 2018.

The purpose of the SLM Review is to assess how the SLM can better achieve the objective set out in Special Condition 1F.13 of the Licence. This requires the SLM to be designed to facilitate the accurate calculation and reporting of gas shrinkage and gas leakage from each GDN operated by a Licensee.

We value all feedback and representations; responses to this document are encouraged and should be received no later than 20th December 2018. Communication should be directed to Shahin Ali or via the Joint Office (contact details below).

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3 Overview of Shrinkage

Shrinkage refers to the gas which is lost from the transportation network. Under the Uniform Network Code (UNC), GDNs are responsible for purchasing gas to replace the gas lost through Shrinkage.

GDNs estimate Shrinkage using an industry approved methodology and engineering model. The model applies pre-determined leakage rates but is updated annually for a number of activity-based factors. The methodology used to determine Shrinkage quantities continues to evolve; this document details the GDN's collective thoughts of how we can continue to improve the methodology and accuracy of the calculations. As part of this consultation, and throughout the annual lifecycle of the Shrinkage process, GDNs are always interested in understanding where shippers and other interested parties believe elements of the methodology can be improved and would welcome this feedback.

Shrinkage is comprised of three elements (leakage, theft of gas and own use gas), of which leakage contributes around 95% of the total quantity. Detail of how each element is calculated is found later in this document.

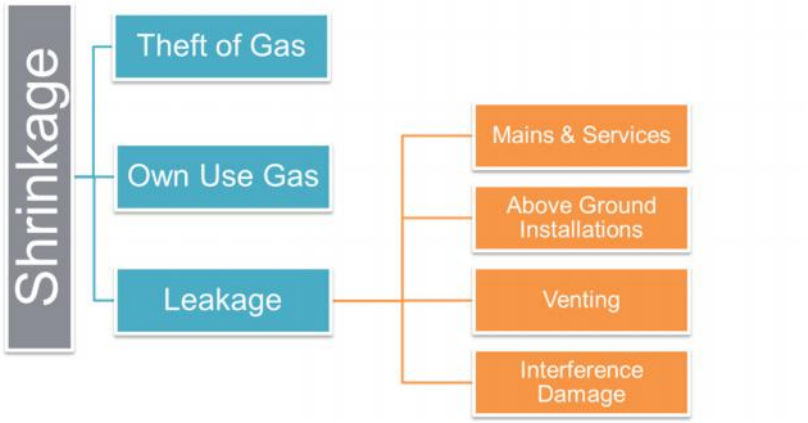

Figure 1: Breakdown of shrinkage and leakage

The Joint Office of Gas Transporters regularly host Shrinkage Forums throughout the year, the forum is open to all interested parties and attendance is strongly encouraged for those persons with an interest in gas distribution shrinkage. The Shrinkage Forum is an opportunity to connect with colleagues from the gas distribution and shipper community and share opinions, ideas and increase understanding. Highlights and actions resulting from the 2018 forums are detailed in Section 8 of this report.

Further information relating to the Shrinkage Forum can be found at: www.gasgovernance.co.uk/SF

4 Overview of the Shrinkage and Leakage Model

Our stakeholders told us that there was a knowledge gap in the industry of the methods used to determine shrinkage volumes. This section details each of the components of shrinkage which includes leakage assumptions, % influence of each component on the total volume, the calculation methods and our commitments to increasing accuracy in each area.

Table 2 provides a high level indication of the volume of data GDNs process annually* in order to provide an accurate Shrinkage assessment for the purposes of Shrinkage purchase and incentive calculation.

No. of Networks	Length of Pipes (Low and Medium Pressure)	No. of Above Ground Installations (AGIs)	No. of Services
2,346	233,147km	110,100	21,676,000

Table 2 – Summary of the volumes of key data used to calculate shrinkage

**The figures in Table 2 are taken from the 2017/18 leakage calculations*

Table 2 demonstrates the large volume of data GDNs update, review and process annually in order to provide an accurate Shrinkage assessment. As well as processing large volumes of data, GDNs adhere to rigorous Data Assurance Guidelines (DAG) procedures which require strict internal approval processes. The procurement, processing and validation of this large volume of data results in lead times of approximately 4 months each year(April-July) to produce the final Leakage and Shrinkage figures. These are subject to detailed internal scrutiny and formal approval processes prior to being sent to Ofgem as part of the GDN's Regulatory Reporting Pack (RRP) and is used to compile the annual Assessment and Adjustment report[1] published at the end of July.

Low Pressure Mains & Service Leakage

Weighting: circa 78% of leakage.

Background: Leakage from low pressure mains is estimated by applying the leakage rates determined from the National Leakage Tests (NLT) programme to the mains asset records. Leakage from low pressure services is estimated by applying the leakage rates determined from the NLT, which provided an average leakage rate for each service classification.

LP Mains Calculation method: Asset length (km) x annual leakage rate x average system pressure correction[2] x Monoethylene Glycol[3] correction (where applicable).

LP Mains Rates: 11 rates from 25 categories based on materials and diameters

LP Service Calculation method: No. of services by category x annual leakage rate x average system pressure correction

LP Service Rates: 4 rates/categories (steel and PE service connections to PE or metallic mains)

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[1] https://www.gasgovernance.co.uk/Shrinkage/Assessment-and-Adjustment

[2] Leakage rates were determined at 30mbarg pressure so require correction if pressures are greater or lower than this amount. The lower the average system pressure the less an asset will leak.

[3] Lead yarn joints leak less if Monoethylene Glycol is saturated in the gas, MEG treatment only impacts spun cast and pit cast assets. The higher the MEG saturation the greater the leakage reduction.

Figure 3 (see Section 7) demonstrates that the NLT, commissioned by the UK GDNs, remains world leading in both scale and accuracy. The tests involved sampling 849 Low Pressure pipes and 6,054 services. There is no evidence to suggest that the resulting leakage rates have materially changed since these tests. GDN's continue to invest in replacing metallic mains, which targets pipes most susceptible to degradation, progressively reducing the overall population of the highest leakage pipes year on year. As such, the significant additional investment and disruption required to repeat the NLT would, in our view, represent poor value for money for the customer.

Medium Pressure Mains Leakage

Weighting: circa 8% of leakage.

Background: Medium pressure (MP) leakage is estimated by applying the LP leakage rates at 30mbarg to the MP mains asset profile. The rationale for this is that the number of public reported escapes per km of MP main is of a similar order to that of the LP system. Therefore, it is inferred that the mains must be leaking at a similar rate. Systems operating at higher pressures are constructed and tested to an appropriately higher level of integrity.

Unlike Low Pressure mains the calculation method for Medium Pressure mains takes no cognisance of the actual average operating pressures of the respective grids. To review the accuracy of the calculation, we will investigate the value of a pressure related factor. This could facilitate a mechanism for achieving and reflecting leakage reduction through intelligent pressure management. To achieve this, it would be necessary to establish MP specific leakage rates; however, isolating sections of the MP system to undertake pressure decay tests is difficult due to the strategic importance of these mains to security or supply, even under low demand periods. Cadent Gas raised a NIA project which confirmed a correlation between MP leakage and system pressures.

In our commitments for 2018 we described our intentions to commence further investigatory work in this area of leakage modelling (see Section 9 for details). We are currently engaging with industry experts at Newcastle University to understand if there is a better and more concise methodology to report Medium Pressure leakage. The scope of this project is to assess the suitability of the MP leakage rates currently used and determine whether the implementation of a pressure correction factor will increase the accuracy of the calculation. This review coincides with feedback received from DNV GL as part of the AUG Expert review that considered MP Leakage may be an area of potential underestimation within the SLM.

Calculation method: Asset length (km) x annual leakage rate.

Rates: 6 rates from 25 categories based on materials and diameters

Above Ground Installation Leakage

Weighting: circa 8% of leakage.

Background: Leakage for AGI's is estimated by multiplying the number of AGI assets by the pre-determined leakage rate calculated for the asset type. The five types of AGI's are;

1. Holder Station (Largely phased out)
2. NTS Offtake (Reduce pressure from above 70 bar to Local Transmission)
3. Local Transmission (Reduce pressures from up to 69 bar to lower pressure tiers)
4. District Governor (Supply gas to lower pressure tiers. Outlet pressure 25-75 mbar)
5. Service Governor (Commonly feed individual premises)

The leakage rates for AGIs were determined by Advantica in 2003 and are documented in the Above Ground Installation Shrinkage report. The programme established average leakage rates for the five types of AGI's. Table 3 below provides a summary of findings.

Asset Type	Leakage m3/year/site	Number surveyed
Holder station	7,692	24
NTS offtake	31,075	67
Local Transmission	6,485	145
District Governor	407	246
Service Governor	8	54

Table 3 – AGI Leakage Rates and Sites Surveyed

The AGI sample plan included a total of 536 sites across the UK and utilised 2 leakage measurements techniques, Fugitive Measurement Device (FMD) and Area Survey Vehicle (ASV), the latter was only used for holder stations.

To ensure that the AGI Shrinkage report 2003 was valid (a similar test had not been previously carried out), the University of Nottingham were engaged to carry out an independent validation of the technique involved and concluded that the FMD is a valid, practical method for making measures of fugitive emissions from the Gas Distribution System. The University of Newcastle were also engaged to validate the statistical analysis carried out within the report and concluded there is no evidence of any bias and the data had been correctly analysed.

The cost of completing the extensive study into AGI Shrinkage was in the region of £1m[4]. The conclusions which were drawn are still considered valid due to similar network operating procedures that are still in use today. The AGI's which are in service today are of similar nature compared to what was in use in 2003.

Calculation method: Asset quantity x annual leakage rate.

Rates: 5 leakage rates (Holder Stations, NTS offtakes, Local Transmission Stations, District Governors, Service Governors)

Above Ground Installation Venting

Weighting: circa 5.5% of leakage.

Background: AGI Venting rates were determined as part of a 1994 Watt Committee Report, the derivation of this value is unknown and is a single fixed value for each LDZ.

Calculation method: Fixed annual leakage volume per LDZ.

Rates: Fixed annual leakage volume per LDZ.

Interference Damage

Weighting: circa 0.5% of leakage.

Background: Interference damage is the gas escaping into the atmosphere as part of an unplanned incident usually caused by third party damage. Interference damage is split into two categories, above and below 500kg of gas released and is calculated using assumed leakage rates per incident together with an average response and repair time (for below 500kg incidents).

[4] https://www.gasgovernance.co.uk/sites/default/files/ggf/Shrinkage%20and%20Leakage%20Model%20Review%20No%201%20WWU.pdf

GDNs have a licence obligation to attend at least 97% of uncontrolled gas escapes within 1 hour and 97% of controlled gas escape within 2 hours (where the risk to the customer is deemed lower). These targets have been consistently outperformed in recent years and include incidents of interference damage. For interference damage, the source of the leak is generally more obvious due to the nature of the incidents and so can be made safe more quickly.

Calculation method: Multiple scenarios
>500kg interference damages: An assessment is made of each >500kg incident and included in the model.
<500kg interference damages (Mains): Number of incidents split 95:5 between low pressure and medium pressure incidents. Different leakage rate and response time for low pressure and medium pressure.
<500kg interference damages (Services): Number of incidents split 50:50 between severed and punctured services. Different leakage rate and response time for severed and punctured services.

Number of incidents x leakage rate x predetermined response/fix time

Theft of Gas

Weighting: circa 4% of shrinkage.

Background: Shrinkage includes the element of Theft of Gas (ToG) deemed 'transporter responsible'. This is currently estimated by applying a fixed 0.02% factor to throughput. However, the absolute level of theft, by its nature, is impossible to establish and the current assumption can be considered conservative and likely to overestimate the total quantity of transporter responsible gas. GDN data from 2010 on detected ToG cases, provided to the Shrinkage Forums in August[5] and September[6] 2011, indicated that levels were several times lower than the current throughput factor suggests. However, GDNs have no statistically robust basis to suggest that the current assumed level of transporter responsible theft is any higher or lower than the current assumption as a percentage of throughput.

Furthermore, during 2016/17, a specific LDZ experienced an uncontrolled increase in demand as a result of a large industrial connection which inflated the value of the ToG. GDNs believe that this particular circumstance could affect the accuracy of the SLM and as a consequence we may consider suggestions to avoid such situations occurring in the future.

Calculation method: 0.02% of throughput

Own Use Gas

Weighting: circa 2% of shrinkage.

Background: Own Use Gas (OUG) refers to gas used by the transporter for operational purposes, primarily pre-heating, but which does not pass through a meter. This is currently estimated by applying a fixed 0.0113% factor to throughput.

In our commitments for the coming year we describe our intentions to continue investigatory work in this area of leakage modelling (see Section 10 for details). We will continue to investigate the results of low carbon preheating trials and determine if they can be used as a basis for revising the OUG calculation. We will also consult industry experts to understand if other methods of calculating OUG are available.

Calculation method: 0.0113% of throughput.

[5] https://www.gasgovernance.co.uk/sf/100811
[6] https://www.gasgovernance.co.uk/SF/280911

5 Shrinkage Components Timeline

The timeline below demonstrates the continued evolution of shrinkage methodology and our commitments to address each of the elements.

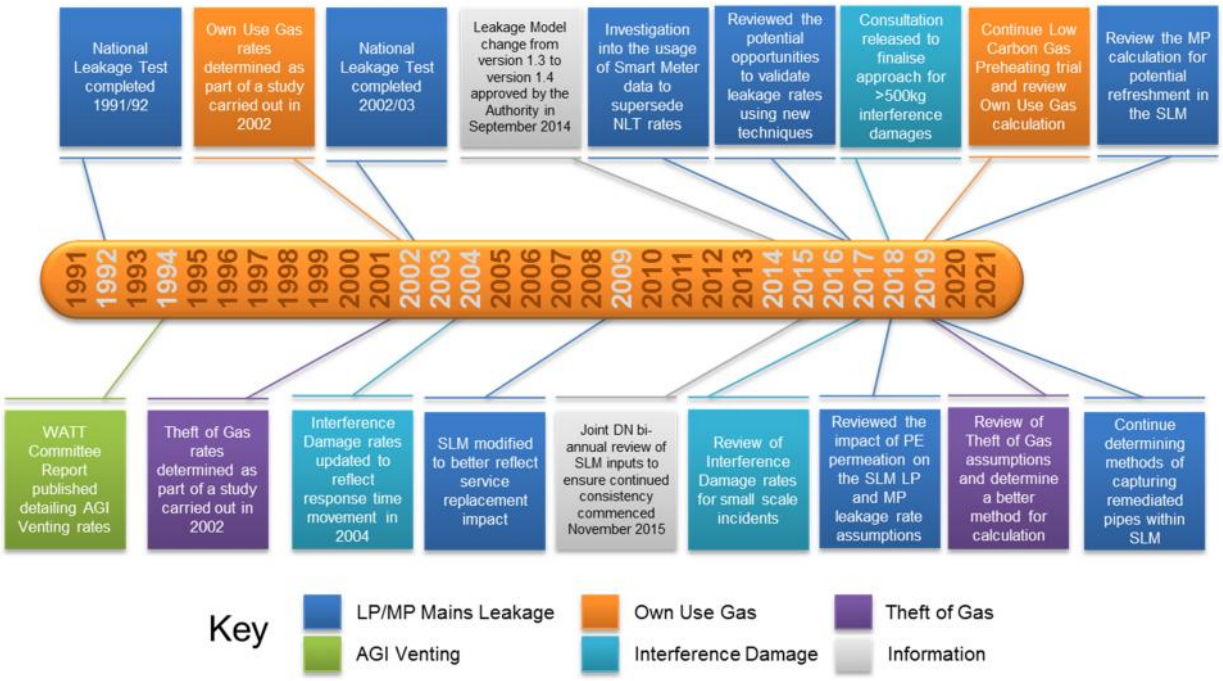


Figure 2 – Shrinkage Component Timeline

6 Shrinkage Reduction Successes

Shrinkage forms the majority of a gas distribution network companies' business carbon footprint and accounts for around 1% of Great Britain's total greenhouse gas emissions. As such, reducing losses aligns with achieving the UK government's emissions target and contributes to reducing customer bills.

Each GDN continues to see incremental improvements in shrinkage reduction; we have made progress in a number of areas which have seen a positive impact in reducing Shrinkage:

- We continue to see the biggest reduction in our year on year emissions coming from the delivery of the mains replacement programme which replaces ageing metallic pipes with polyethylene. Since the start of RIIO GD1, GDNs have abandoned over 20,000km of metallic mains.

- Behind our mains replacement programme, the second greatest influence on Shrinkage is system pressure. We are continuing to work to enhance the capabilities of our pressure management systems, however there is a limit to which such improvements can be made because customers must receive gas at an appropriate pressure to operate their appliances. We have implemented pressure profiling systems that automatically manage low pressure governor settings in line with customer requirements. This ensures networks run at the optimum levels to minimise lost gas, while at the same time achieving security of supply.

- A continuous review of established profiling systems is carried out to ensure they remain relevant to other changes taking place on the LP network. This is demonstrated by network length covered by self-learn profiling. Approximately 70% of the GDNs network length is on profile control.

- Installation of new, and the replacement of any obsolete clocking systems to allow differential within day pressure settings on those networks where it may not be economically justified to install profile control.

- Pro-active management of network pressures through adjusting district governor settings seasonally.

- Reinforced governance around the management of temporary modifications to pressure settings for operational works.

- Within each of our networks we still have a significant amount of low pressure iron mains that have lead and yarn joints. These joints can be treated using MEG which, in turn can reduces the rate at which gas leaks from them. A proportion of lead yarn jointed pipe is replaced annually with polyethylene pipe as part of our Mains Replacement programme. We are committed to the ongoing treatment of lead and yarn joints as this positively impacts gas Leakage and contributes to keeping our customers safe.

- Introduction of more sophisticated management information to help support the management of networks, allow early identification of underperforming areas and actions to resolve any issues.

7 Previous Commitments Review

The information within this section provides an update on the 2017 GDN commitments

Project Name: Capture of Remediated Mains in the Model

Project Lead: SGN

Shrinkage Component: Low Pressure Mains Leakage Calculation

Our 2017 Commitment: We will continue to investigate the opportunities to reflect the benefits of Remediated Pipes in the Shrinkage and Leakage Model.

Leakage from low pressure mains is estimated by applying the leakage rates determined from the NLT programme to the mains asset records. Currently mains leakage is calculated as:

Asset length (km) x annual leakage rate x average system pressure correction x Monoethylene Glycol correction (where applicable)

Reason for Review: World leading innovation, driven by the Gas industry, has led to the development and increasing utilisation of robotics to remediate larger diameter metallic mains, rather than replacing the asset. The continuing use of robotics to anaerobically seal the joints of these mains will inevitably reduce leakage from the asset. Therefore, in order to improve the accuracy of the SLM, SGN are seeking to develop proposals to suitably reflect the associated benefits of mains remediation.

Over the past 12 months, SGN have been investigating the feasibility of applying a comparative 'correction factor' to the existing leakage rates of individual mains assets within the model, based on a developmental remediation capture report, produced by DNV GL. It is intended to assemble a standardised, auditable framework, capable of encapsulating the extent of treated mains within the asset repository.

This ongoing proposal seeks to adjust the mains calculation to incorporate a 'remediation correction factor', as outlined below.

Asset length (km) x annual leakage rate x average system pressure correction Monoethylene Glycol correction (where applicable) ***x remediation correction (where applicable)***

Through our policy and innovation teams we have engaged with DNV GL and ULC Robotics to assist with developing and finalising the calculation and capture process. Following on from this process we will seek to engage with the wider industry in order to finalise the overall proposal.

Incorporated into our 2018 commitments (see Section 10), SGN will continue to pursue a comprehensive mains remediation summary, which encapsulates all compulsory, associated supporting evidence, enabling an industry wide consultation on a modification to the SLM.

Anticipated baseline Impacts: It is not anticipated that there will be any adjustment to the current baselines, resulting from this proposed modification.

Project Name: Calculation of Medium Pressure Leakage

Project Lead: Northern Gas Networks LTD

Shrinkage Component: Medium Pressure Leakage Calculation

Our 2017 Commitment: We will further investigate the accuracy of the existing MP Leakage calculation.

The GDNs identified the Medium Pressure calculation as an opportunity for review. This has since been corroborated by the DNV GL review identifying the Medium Pressure calculation as an area of interest and was discussed at the Shrinkage Forum on 30th August 2017.

A NIA project identified a correlation between pressure and leakage in medium pressure assets. We have continued to explore the results of this NIA project and the potential impact on Leakage modelling.

In quarter 4 of 2018 we started a project with experts at Newcastle University and work is currently underway to evaluate the rates used in the SLM. The objectives are to evaluate the accuracy of the current methodology, and if required, to determine and produce a more accurate calculation of the level of leakage for MP networks and how this changes in relation to operating pressures. If deemed appropriate, an improved methodology will be implemented for use within the GDNs' SLM.

As part of our 2018 Commitments (see Section 10) we will continue to investigate the calculations of Medium Pressure leakage in the SLM.

Project Name: Calculation of Own Use Gas (OUG)

Project Lead: Northern Gas Networks LTD & SGN

Shrinkage Component: Own Use Gas Calculation

Our 2017 Commitment: We will review the suitability of the existing Own Use Gas calculation within the SLM.

Own Use Gas is driven by consumer gas demand, and by being a factor of throughput cannot be targeted for reduction by gas distribution networks. As technology evolves and more efficient equipment becomes available, it was proposed to review this calculation and determine if an activity based calculation would be more appropriate. Furthermore, GDNs currently experience windfall gains and losses as a result of fluctuating throughput.

Northern Gas Networks are in the process of investigating Low Carbon Gas Preheating[7]. This involves installing and monitoring the operational efficiency of a representative sample of preheating technologies. All 12 sites will be commissioned by winter 2017/18, with the majority installed already. To determine a robust data sample we would need to operate each of the 12 sites through a full heating season, with expected timescales for initial data analysis to be early 2018 and the final report and analysis due in June 2018.

SGN have also conducted a field trial to compare two different preheat technologies; a new installation using Pro-Heat's 99kW Immersion Tube Preheater, contrasted against an existing 100 kW single phase water bath heater installed in 1976. Both units are being tested and monitored over a period of continuous operation to measure thermal efficiency and system fuel efficiency.

The data thus far has confirmed significant variances, with Immersion Tube technology out-performing the water bath heater in all areas, giving significantly better thermal efficiencies, lower CO2 emissions, and reduced energy losses (with associated lower fuel consumption). Pro-Heat has since been adopted by SGN as an approved technology, and work is now underway to fully convert Lochmaben to Immersion Tube preheating.

[7] https://www.northerngasnetworks.co.uk/ngn-you/the-future/preheating/

Figure 4: Pro-Heat Immersion Tube Preheater at Lochmaben (Existing Water Bath Heater in background)

As part of our 2018 commitments, we will continue to monitor the data from our low carbon pre-heating trials and investigate the potential impact on the Own Use Gas calculations in the model. We will evaluate the future outputs of both the NGN and SGN innovation projects into alternative pre-heating technology, with a view to determining if there are any potential implications to improve the accuracy of the Own Use Gas calculation in the leakage model.

Project Name: Investigate impact of PE Permeation

Project Lead: Wales & West Utilities

Shrinkage Component: Mains and Services

Our 2017 Commitment: GDNs will review the calculations within the model to determine whether PE permeation is inclusive within the current leakage rates.

The GDN.s carried out a review of the current leakage rates and whether they include the impact of permeation. The view of GDNs is that the decay tests previously carried out include the impact of permeation and as a result, the impact of permeation is already included within the current leakage rates.

The report published following the National Leakage Test 2002/3[8] (NLT) describes the method used to carry out the 849 leakage tests on different sections of gas mains and services. The report details the test procedure and confirms that the

[8] Report on the 2002/3 National Leakage Test Programme, Kirsty Nelson, Advantica Limited

sections of mains and services which were being tested were subject to being capped and isolated, with the rider from an upstream section of the network not under test conditions, would be connected to the test section in order to maintain pressure and prevent depressurisation. The leakage test method which was used was the Pressure Decay Method. This method measures the decrease in pressure within the pipe which is a consequence of gas exiting the pipe irrespective of the route i.e. gas escaping through joints, permeation etc.

The pressure in the main was not allowed to decay prior to the leakage test being carried out therefore ensuring that the test conditions matched those the pipe would see in service. As a result, the GDNs are certain that permeation of gas through the wall of PE pipes was captured during the NLT 2002/3 and subsequently the current leakage rates which are used in the SLM include gas permeation.

8 Shrinkage Forum Review

During 2018 there have been 2 Shrinkage Forums[9], facilitated by the Joint Office of Gas Transporters, with a further 2 meetings scheduled for November and December 2018. These meetings have been attended by all GDNs, representatives from the Shipper community and other interested parties.

The purpose of these meetings is to provide an opportunity for GDNs and Gas Shippers to meet on a regular basis to review and discuss matters directly relevant to the evaluation of shrinkage to include:-

- Review of annual shrinkage forecasts
- Review of actual shrinkage performance against forecasts
- Review and recommend any projects which will improve the accuracy of the evaluation of shrinkage
- Review the output of the annual Shrinkage and Leakage Model report which is a Licence Condition for GDNs
- Review the output of the biennial Shrinkage and Leakage Smart Metering report which is a Licence Condition for GDNs

Over the course of 2018 we engaged with members of the AiGT to share our knowledge on the reporting of Shrinkage and Leakage gas.

Over the past 12 months, several points have been raised and discussed in the Shrinkage forum. We have summarised some of the key points of discussion below however detailed minutes can be found on the joint office website.

1. ***Shippers requested a copy of the model and also a "briefing pack" which explains the processes and assurances undertaken to facilitate the accurate calculation of Shrinkage gas.***

At the March 2018 forum, the GDNs submitted a briefing pack[10] to the forum. The pack included a methodology statement and the data and control framework to educate shippers on the steps taken to ensure that Shrinkage gas is accurately reported

2. ***Shippers requested an explanation of how the GDNs manage the pressure on their networks***

GDNs recognised that there is a lack of information available to shippers which explains how we manage our pressures. The GDNs opened a discussion around pressure management at the Shrinkage forum to educate any interested parties on this subject and also answer any questions arising from the presentation delivered by the GDNs.

3. ***GDNs have worked with Independent gas Transporters (IGT) to help them understand how we report Shrinkage and consider adopting a similar methodology***

GDNs have worked with members of the Association of Independent Gas Transporters to educate them on the current GDN methodology of assessing and reporting Shrinkage gas. The GDNs will continue to work with members of the AiGT in 2018 in the view of improving Shrinkage reporting reducing the impact of IGT shrinkage on Unidentified Gas.

[9] https://www.gasgovernance.co.uk/Shrinkage

[10] https://www.gasgovernance.co.uk/sites/default/files/ggf/book/2018-03/Shrinkage%20Briefing%20Pack%20%28Joint%20GDN%29.pdf

4. Promotion of the Shrinkage Forum

To encourage participation from industry in the Shrinkage forum, the GDNs have used other distribution working groups under the Unified Network Code to promote the Shrinkage forum. This will allow further feedback in shaping how GDNs manage Shrinkage gas now, and going forward into the next pricing period.

9 Our Commitments

The outcome of the joint GDNs SLM review is detailed below (this expands on Table 1 contained in the Executive Summary)

Project Name: MP Leakage

Project Lead: Northern Gas Networks Ltd

Shrinkage Component: Medium Pressure Calculation

Potential Shrinkage Impact Assessment Checklist:

Shrinkage Calculation Methodology	Impact on Shrinkage Baselines
Yes	Unknown

Brief Overview: Medium pressure (MP) leakage is estimated by applying the LP leakage rates at 30mbarg to the MP mains asset profile. The rationale for this is that the number of public reported escapes per km of MP main is of a similar order to that of the LP system. Therefore, it is inferred that the mains must be leaking at a similar rate. Systems operating at higher pressures are constructed and tested to an appropriately higher level of integrity.

Reason for Review: Unlike Low Pressure mains, the calculation of leakage from Medium Pressure mains does not include an average system pressure correction. To improve the calculation a pressure related calculation of leakage may be more appropriate, which would also facilitate a mechanism for achieving and reflecting leakage reduction through effective pressure management.

GDNs are engaging with Newcastle University to review and understand if there is a better and more concise methodology to report Medium Pressure leakage. This will include considering methods to validate the current rate assumptions used within the leakage model to determine suitability together with a pressure correction factor.

Anticipated Baseline Impacts: Unknown

Project Name: Capture of Remediated Mains in the Model

Project Lead: SGN

Shrinkage Component: Low Pressure Mains Leakage

Potential Shrinkage Impact Assessment Checklist:

Shrinkage Calculation Methodology	Impact on Shrinkage Baselines
Yes	No

Brief Overview: Leakage from low pressure mains is estimated by applying the leakage rates determined from the NLT programme to the mains asset records.

Currently mains leakage is calculated as:

Asset length (km) x annual leakage rate x average system pressure correction x Monoethylene Glycol correction (where applicable)

Reason for Review: In recent years, innovation within the industry has led increasingly to the use of robotics to remediate large diameter metallic mains, rather than replacing the asset. The use of robotics to anaerobically seal joints of large diameter metallic mains will reduce leakage from the asset. In order to improve the accuracy of the SLM, SGN will develop proposals to better reflect the benefits of mains remediation.

SGN are investigating the viability of applying a 'correction factor' to the existing leakage rates of individual mains assets within the model, based on a detailed remediation capture report currently being developed by DNV GL. This will provide a standardised, auditable framework to capture treated mains within our asset repository.

The proposal is to adjust the mains calculation to include a 'remediation correction factor' as outlined below:

Asset length (km) x annual leakage rate x average system pressure correction ***x*** *Monoethylene Glycol correction (where applicable) x* ***remediation correction (where applicable)***

SGN are currently finalising the overall remediation capture process and ensuring all associated supporting evidence (required for the above change) is available, with a view to developing an industry consultation on a modification to the SLM.

Anticipated Baseline Impacts: It is not anticipated that there will be any adjustment to the current baselines as a result of this proposed modification.

Project Name: Own Use Gas

Project Lead: Northern Gas Networks & SGN

Shrinkage Component: Own Use Gas Calculation

Potential Shrinkage Impact Assessment Checklist:

Shrinkage Calculation Methodology	Impact on Shrinkage Baselines
Yes	Yes

Brief Overview: Own Use Gas makes up approximately 2% of all Distribution Network Shrinkage and is calculated as a factor (0.0113%) of LDZ throughput. Own Use Gas is gas that is used as part of the operational requirements of the distribution networks at pressure reduction stations i.e. pre-heating.

Reason for Review: Own Use Gas is driven by consumer gas demand, and by being a factor of throughput cannot be targeted for reduction by gas distribution networks. As technology evolves and more efficient equipment becomes available it is proposed to review this calculation and determine if an activity based calculation (possibly using flow and temperature data) would be more appropriate. As discussed in Previous Commitments, SGN are committed to an ongoing innovation project, encompassing a comparison between old water bath pre-heaters and immersion tube pre-heaters. SGN will continue to monitor the efficiency data from this low carbon pre-heating trial, which may positively impact on the current OUG calculations in the future.

Anticipated Baseline Impacts: If an activity based calculation is deemed to be more appropriate then it is likely that the estimate of Shrinkage will change, resulting in a change to baselines.

Project Name: Theft of Gas

Project Lead: Wales & West Utilities

Shrinkage Component: Theft of Gas Calculation

Potential Shrinkage Impact Assessment Checklist:

Shrinkage Calculation Methodology	Impact on Shrinkage Baselines
Yes	No

Brief Overview: Under the current methodology, Theft of Gas (TOG) is calculated as a factor of total customer demand. As consumer demand varies from year to year which is driven by variables such as weather and improved efficiency of gas appliances, so will the levels of Transporter responsible theft. The GDNs will review the current calculation to determine if there are any improvements that can be made.

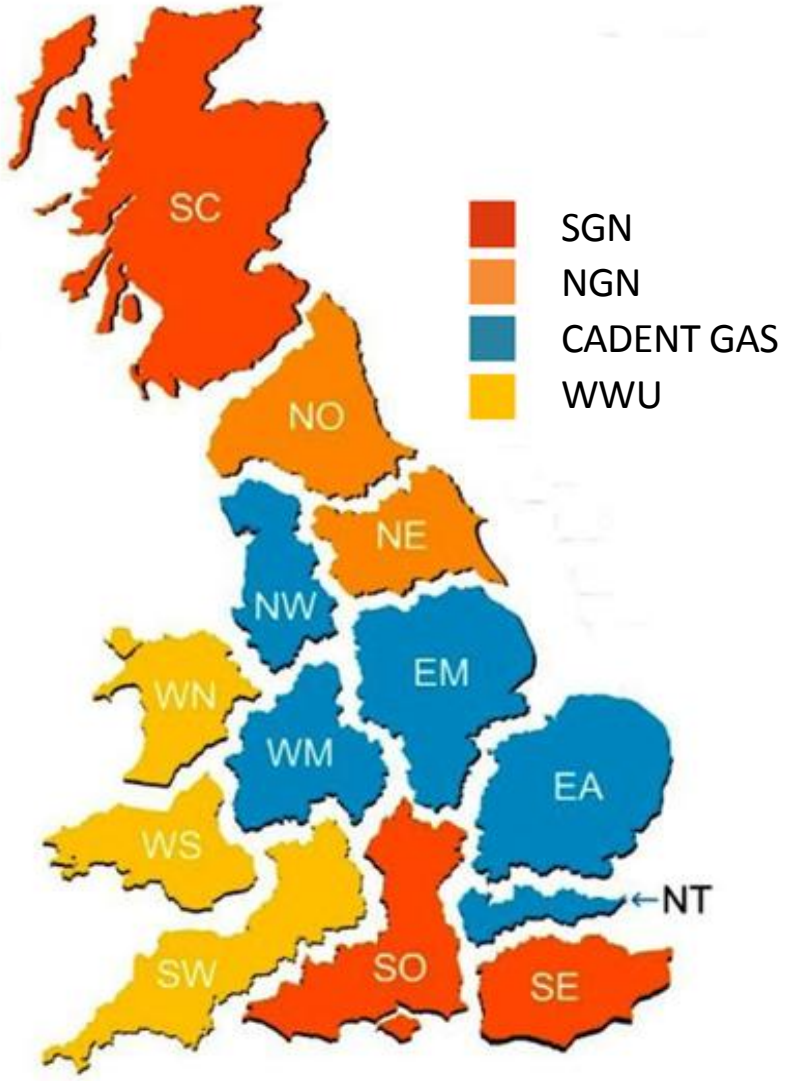
Reason for Review: TOG is estimated and calculated as 0.02% of overall demand on the network. In recent years we have experienced changes in total gas demand on the network which as a result, has had an impact on the transporter responsible TOG. Changes in gas demand due to changing weather conditions, increased appliance efficiency and increased demand on our growing networks have influenced the levels of TOG. The GDNs purchase gas which is lost on our networks due to TOG and also are incentivised to reduce these levels of theft resulting in windfall gains and losses. This commitment will review the current methodology and review any possible alternate method of measuring TOG.

Anticipated Baseline Impacts: Dependent upon the output from the review

10 Appendix A - LDZ Performance

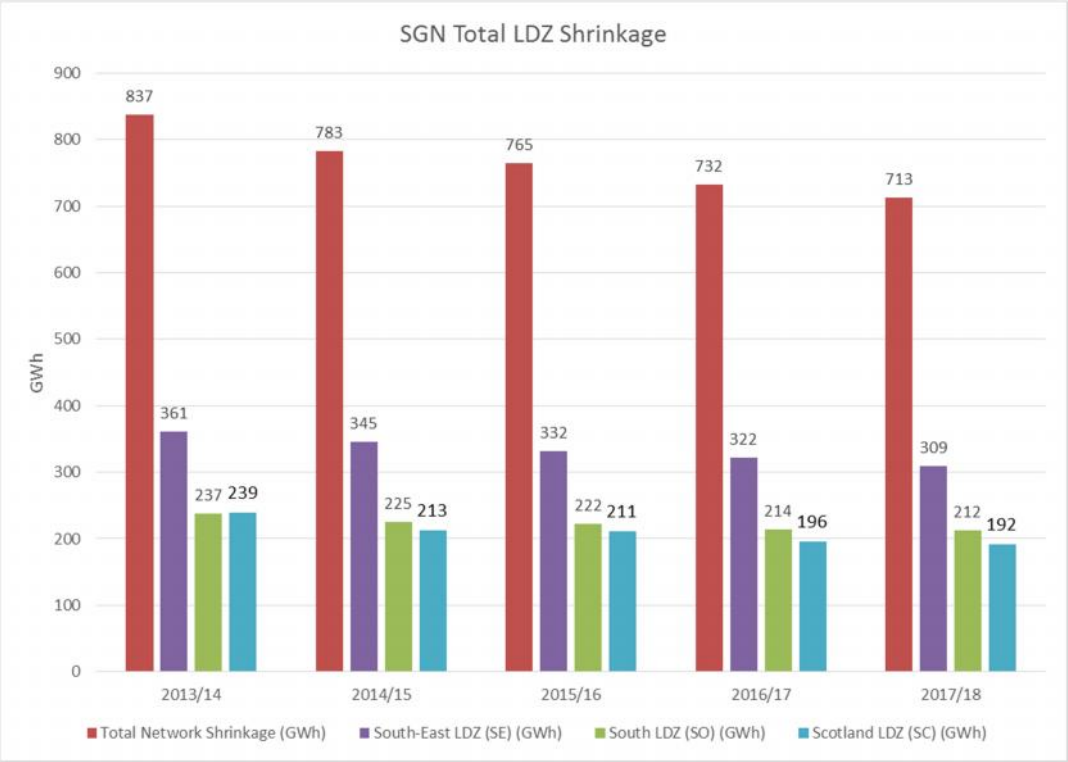
The performance breakdown contained within the following pages demonstrates the main components of Shrinkage for each Local Distribution Zone (LDZ). The introduction of these performance measures is an outcome of the feedback received during the 2017/18 SLM review stakeholder consultation and August 2018 Shrinkage Forum. The performance breakdown will be updated annually and published within future SLM review consultation documents.

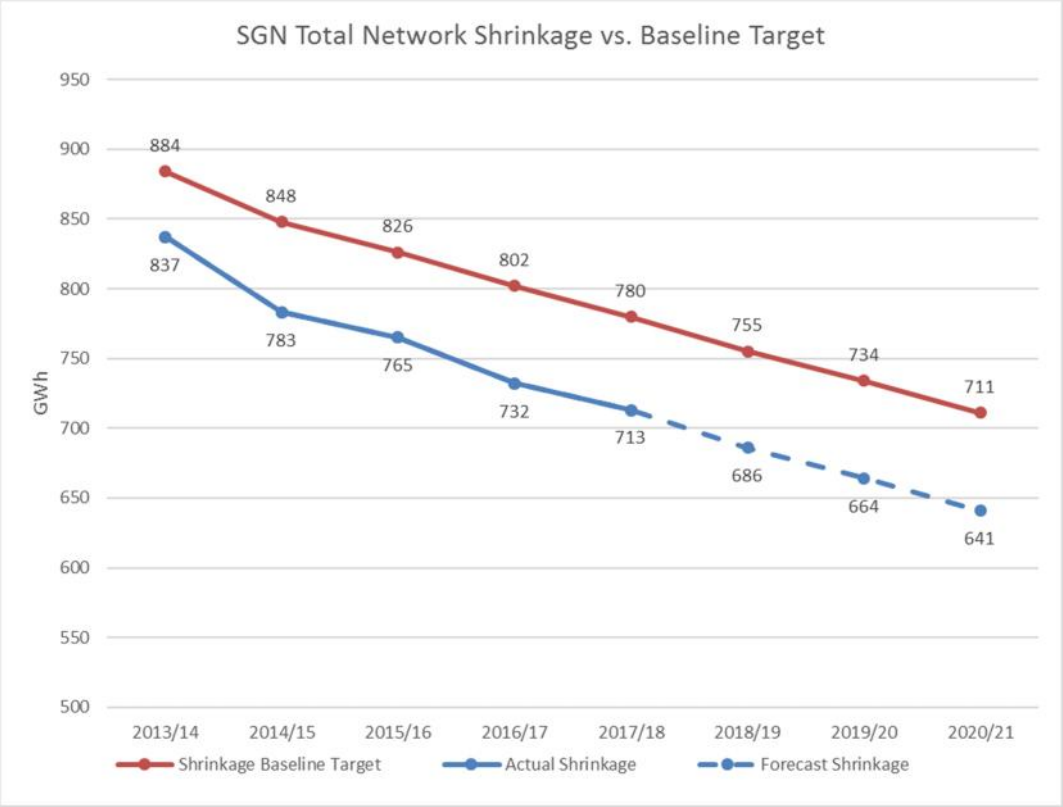
The network map below shows the geographic location of each LDZ colour coded by network owner.



SGN

- Total Network Shrinkage was reduced by approx. 2.5% in 2017/18 from 2016/17.
- Average system pressure increased by 0.5%, metallic pipe length was reduced by 5.6%.
- Total Shrinkage has been reduced by approximately 15% comparing 2017/18 to 2013/14.





SE LDZ Performance

Component	2016-17	Drivers of Change	2017-18	Difference
LP Leakage	255 GWh (84%)	463km of Mains Replacement ASP increasing 0.1mbar MEG up 2.5%	245 GWh (84%)	-10.7 GWh (-4%)
MP Leakage	14 GWh (5%)		14 GWh (5%)	-0.1 GWh (-1%)
Other (AGI's, OUG, Theft & Interference)	34 GWh (11%)	Demand up 0.6% AGIs & Interference Down	33 GWh (11%)	-1.3 GWh (-4%)
Total	303.7 GWh (100%)	Replacement & ASP Largest Drivers	291.6 GWh (100%)	-12.1 GWh (-4%)

SO LDZ Performance

Component	2016-17	Drivers of Change	2017-18	Difference
LP Leakage	142 GWh (70%)	244km of Mains Replacement ASP increased by 0.4mbar	139 GWh (70%)	-3 GWh (-2%)
MP Leakage	28 GWh (14%)		28 GWh (14%)	0 GWh (0%)
Other (AGI's, OUG, Theft & Interference)	32 GWh (16%)	Demand up 2.1% AGIs & Interference Up	33 GWh (16%)	0.4 GWh (1%)
Total	202.4 GWh (100%)	Replacement & ASP Largest Drivers	199.7 GWh (100%)	-2.7 GWh (-1%)

SC LDZ Performance

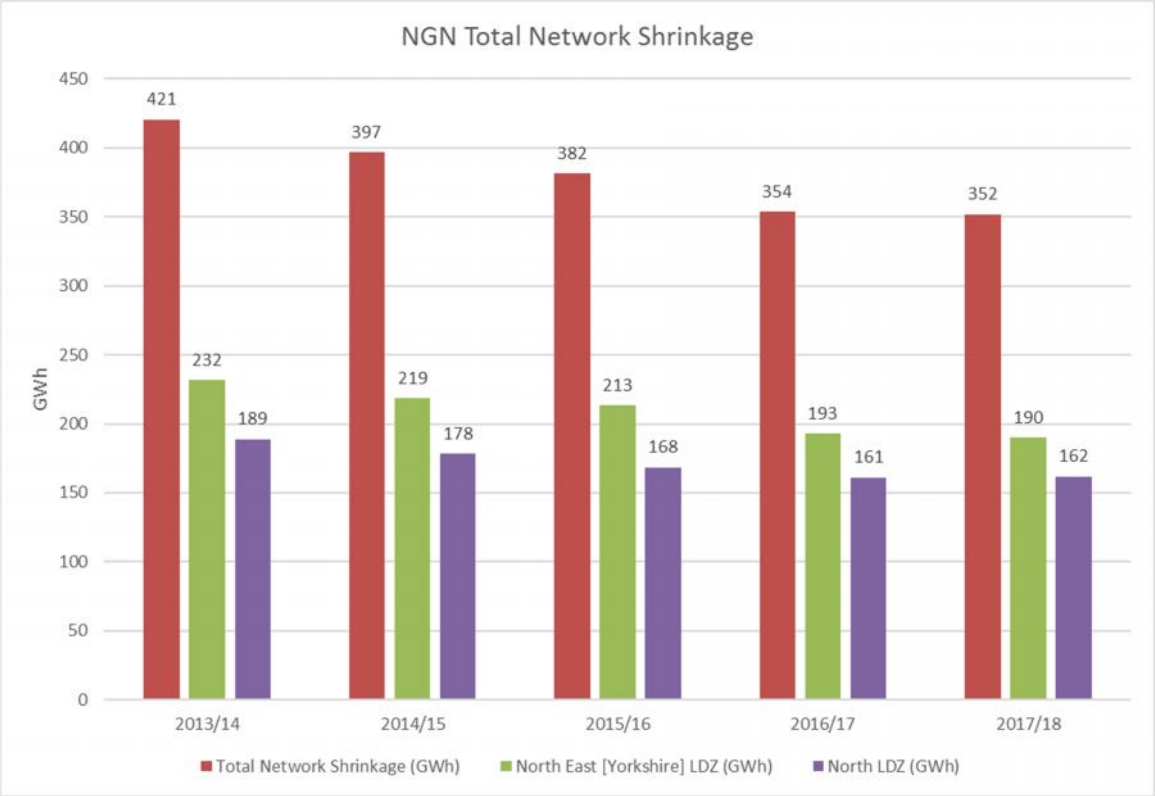
Component	2016-17	Drivers of Change	2017-18	Difference
LP Leakage	130 GWh (72%)	245km of Mains Replacement ASP level with 16/17 MEG down 8%	125 GWh (71%)	-4.7 GWh (-4%)
MP Leakage	16 GWh (9%)		16 GWh (9%)	0.1 GWh (1%)
Other (AGI's, OUG, Theft & Interference)	35 GWh (19%)	Demand up 1.4% AGIs & Interference Up	36 GWh (20%)	0.5 GWh (1%)
Total	180.6 GWh (100%)	Mains Replacement & MEG Largest Drivers	176.3 GWh (100%)	-4.3 GWh (-2%)

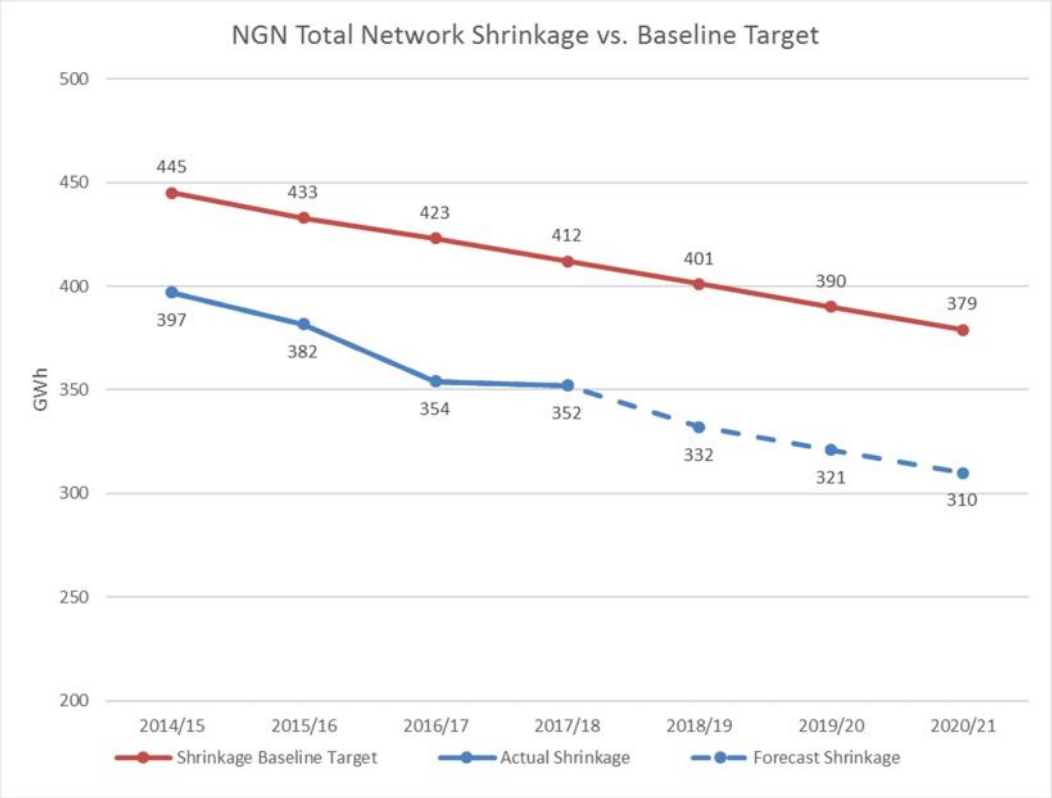
SGN Network Performance

Component	2015-16	Drivers of Change	2016-17	Difference
LP Leakage	528 GWh (77%)	952km of Mains Replacement ASP increasing 0.2mbar. MEG down 5.4%	509 GWh (76%)	-18.3 GWh (-3%)
MP Leakage	58 GWh (8%)		58 GWh (9%)	0.4 GWh (-1%)
Other (AGI's, OUG, Theft & Interference)	101 GWh (15%)	Demand up 1.25% AGIs & Interference Down	101 GWh (15%)	-0.5 GWh (0%)
Total	687 GWh (100%)	Replacement & ASP Largest Drivers	732 GWh (100%)	-19.2 GWh (-2.5%)

Northern Gas Networks

- Total Network Shrinkage was reduced by 0.5% in 2017/18 from 2016/17.
- Average system pressure was reduced by 3%, metallic pipe length was reduced by 5% and MEG Saturation increased by 5%.
- Average system pressure reducing by more than forecast and good performance in other shrinkage components resulted in lower than forecast total shrinkage in 2016/17.
- Total Shrinkage has been reduced by approximately 19.5% comparing 2017/18 to 2013/14.





NE LDZ Performance

Component	2016-17	**Drivers of Change**	2017-18	Difference
LP Leakage	135 GWh (70%)	335km of Mains Replacement ASP increased 0.72mbar to 30.8mbar MEG down to 21%	132 GWh (70%)	3 GWh (1.4%)
MP Leakage	16 GWh (9%)		16 GWh (9%)	0 GWh (0.4%)
Other (AGI's, OUG, Theft & Interference)	41 GWh (21%)	Demand up 5.6%	42 GWh (22%)	1 GWh (1.7%)
Total	193 GWh (100%)	Replacement & ASP Largest Drivers	190 GWh (100%)	3 GWh (1.4%)

NO LDZ Performance

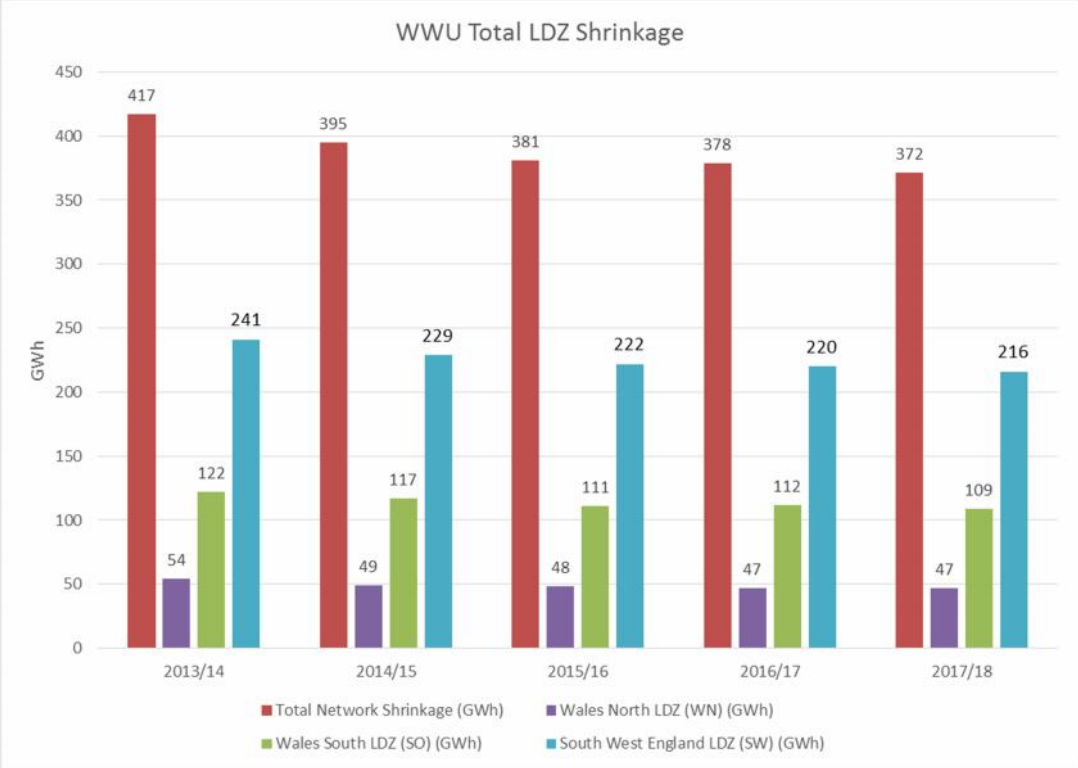
Component	2016-17	Drivers of Change	2017-18	Difference
LP Leakage	112 GWh (69%)	238km of Mains Replacement ASP increased 0.68mbar to 31.9mbar MEG down to 25%	111 GWh (69%)	1 GWh (0.2%)
MP Leakage	9 GWh (6%)		9 GWh (6%)	0 GWh (0.9%)
Other (AGI's, OUG, Theft & Interference)	40 GWh (25%)	Demand up 6.3%	41 GWh (25%)	1 GWh (2.5%)
Total	161 GWh (100%)	Replacement & ASP Largest Drivers	162 GWh (100%)	1 GWh (0.5%)

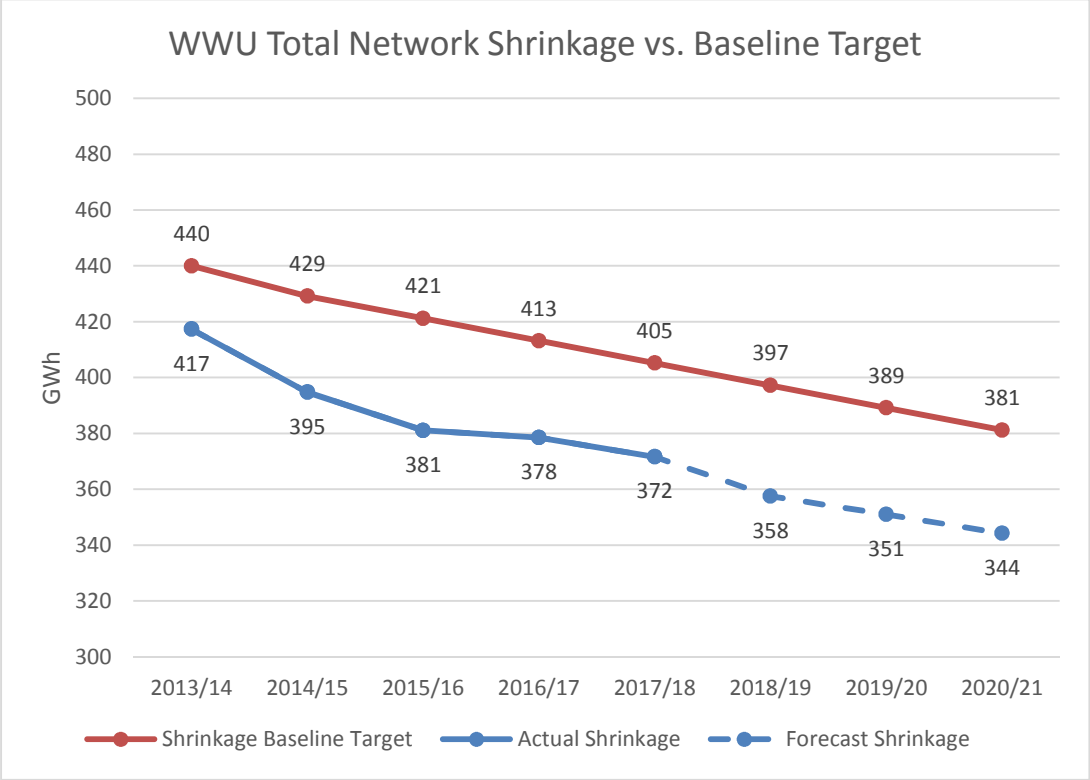
NGN Network Performance

Component	2016-17	Drivers of Change	2017-18	Difference
LP Leakage	247 GWh (70%)	573km of Mains Replacement ASP increased 0.71mbar to 31.3mbar MEG down to 23%	244 GWh (69%	3 GWh (1.4%)
MP Leakage	26 GWh (7%)		26 GWh (7%)	0 GWh (0.05%)
Other (AGI's, OUG, Theft & Interference)	81 GWh (23%)	Demand up 5.9%%	83 GWh (23%)	2 GWh (1.7%)
Total	354 GWh (100%)	Replacement & ASP Largest Drivers	352 GWh (100%)	2 GWh (0.5%)

Wales & West Utilities

- Total Network Shrinkage was reduced by 2% in 2017/18 from 2016/17.
- Total Shrinkage has been reduced by approximately 11% comparing 2017/18 to 2013/14.
- Currently forecasting a 17.5% reduction in Shrinkage by 2021 compared to levels in 2013/14.





WN LDZ Performance

Component	2016-17	Drivers of Change	2017-18	Difference
LP Leakage	21 GWh (45%)	No Change	21 GWh (45%)	0
MP Leakage	3 GWh (6%)		3 GWh (6%)	0
Other (AGI's, OUG, Theft & Interference)	23 GWh (49%)	No Change	23 GWh (49%)	0
Total	47 GWh (100%)	No Change	47 GWh (100%)	0

WS LDZ Performance

Component	2016-17	Drivers of Change	2017-18	Difference
LP Leakage	70 GWh (63%)	Mains Replacement/ASP	67 GWh (61%)	-3 GWh (-4%)
MP Leakage	10 GWh (9%)		10 GWh (9%)	0 GWh (0%)
Other (AGI's, OUG, Theft & Interference)	32 GWh (29%)	No Change	32 GWh (29%)	0 GWh (0%)
Total	112 GWh (100%)	Replacement & ASP Largest Drivers	109 GWh (100%)	-3 GWh (-3%)

SW LDZ Performance

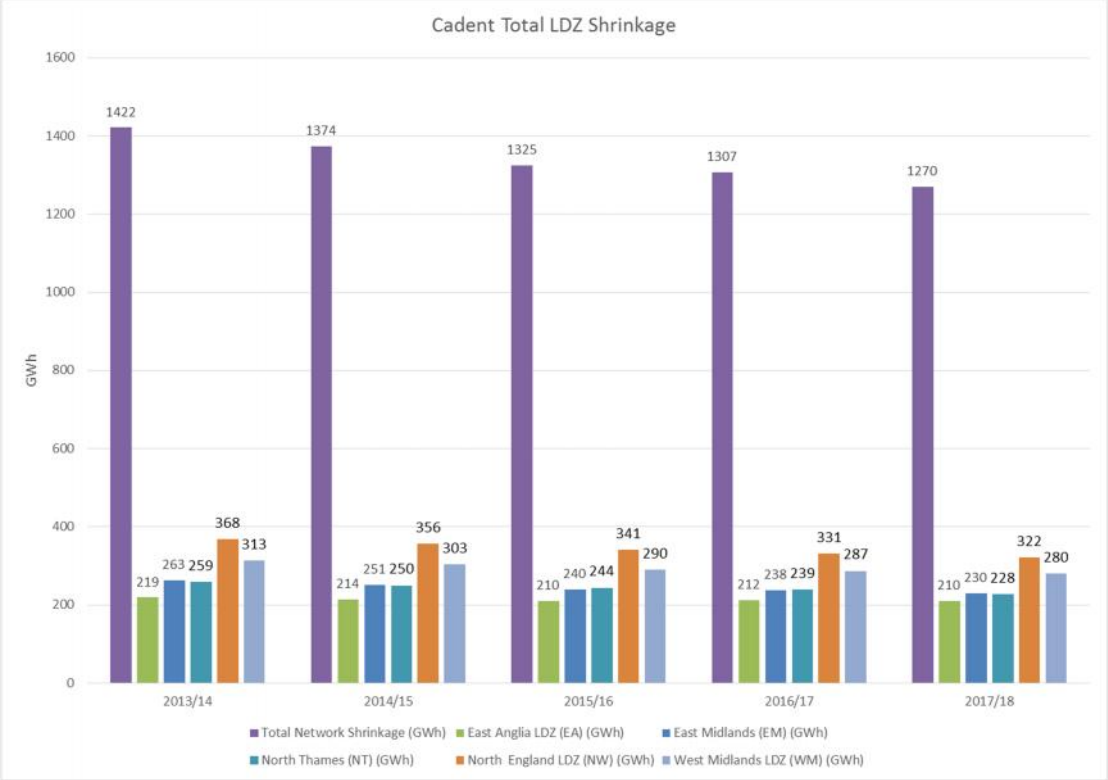
Component	2016-17	Drivers of Change	2017-18	Difference
LP Leakage	161 GWh (73%)	Mains Replacement/ASP	157 GWh (73%)	-2 GWh (-2%)
MP Leakage	19 GWh (9%)		19 GWh (9%)	0 GWh (0%)
Other (AGI's, OUG, Theft & Interference)	40 GWh (18%)	No Change	40 GWh (18%)	0 GWh (0%)
Total	220 GWh (100%)	Mains Replacement & ASP Largest Drivers	216 GWh (100%)	-4 GWh (2%)

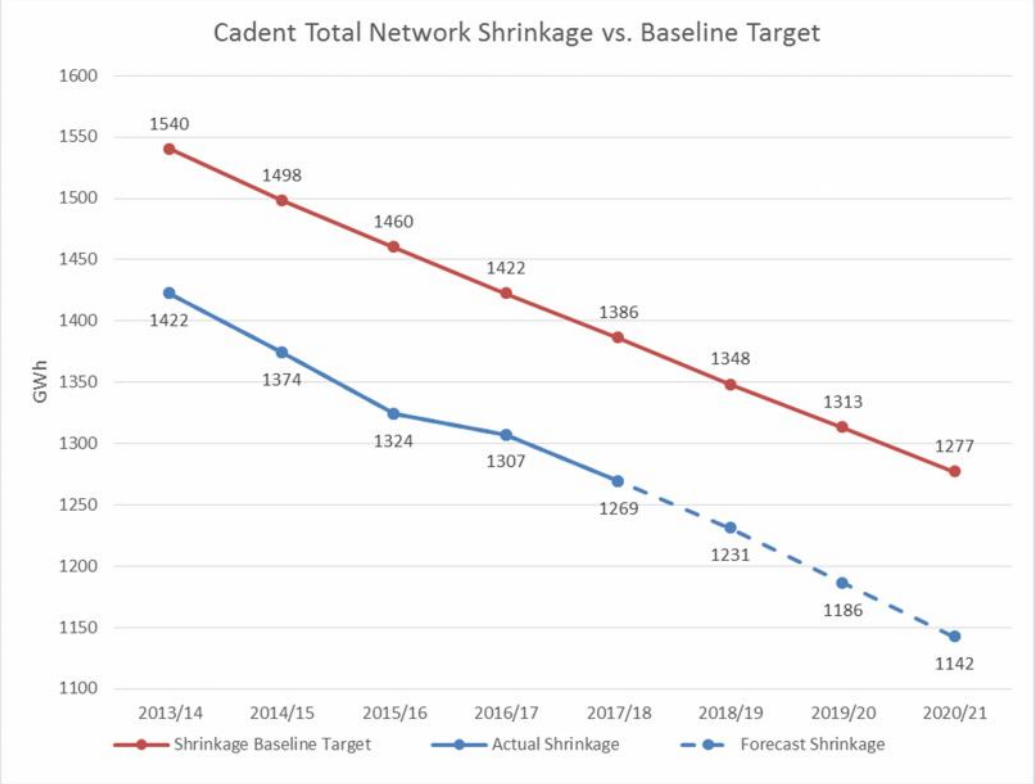
WWU Network Performance

Component	2016-17	Drivers of Change	2017-18	Difference
LP Leakage	252 GWh (67%)	952km of Mains Replacement ASP increasing 0.2mbar. MEG down 5.4%	245 GWh (66%)	-7 GWh (-3%)
MP Leakage	32 GWh (8%)		32 GWh (9%)	0 GWh (-1%)
Other (AGI's, OUG, Theft & Interference)	94 GWh (25%)	Increase due to consumer demand increase	95 GWh (26%)	1 GWh (0%)
Total	378 GWh (100%)	Replacement & ASP Largest Drivers	372 GWh (100%)	-6 GWh (-2%)

Cadent

- Total Network Shrinkage was reduced by 3% in 2017/18 from 2016/17.
- Average system pressure increased, impacting Shrinkage by 5.7GWh
- MEG saturations remained static, however, increases in treated lengths reduced emissions by 4GWh





EA LDZ Performance

Component	2016-17	Drivers of Change	2017-18	Difference
LP Leakage	144 GWh (68%)	153km of Mains Replacement ASP increasing 0.2mb MEG down 10%	142GWh	-2GWh
MP Leakage	15 GWh (7%)		15GWh	0GWh
Other (AGI's, OUG, Theft & Interference)	53 GWh (25%)	Static Performance	53GWh	0GWh
Total	212 GWh (100%)	Replacement & ASP Largest Drivers	210GWh (100%)	-2GWh

EM LDZ Performance

Component	2016-17	Drivers of Change	2017-18	Difference
LP Leakage	139 GWh (58%)	369km of Mains Replacement ASP increasing 0.3mb MEG up 10%	131GWh	-8GWh
MP Leakage	42 GWh (18%)		41GWh	-1GWh
Other (AGI's, OUG, Theft & Interference)	57 GWh (24%)	Up 1GWh	58GWh	+1GWh
Total	238 GWh (100%)	Replacement & ASP Largest Drivers	230GWh (100%)	-8GWh

NT LDZ Performance

Component	2016-17	Drivers of Change	2016-17	Difference
LP Leakage	172 GWh (72%)	343km of Mains Replacement ASP increasing 0.2mb MEG static	160GWh	-12GWh
MP Leakage	21 GWh (9%)		20GWh	-1GWh
Other (AGI's, OUG, Theft & Interference)	46 GWh (19%)	Up 2GWh	48GWh	+2GWh
Total	239 GWh (100%)	Replacement & ASP Largest Drivers	228GWh (100%)	-9GWh

NW LDZ Performance

Component	2016-17	Drivers of Change	2016-17	Difference
LP Leakage	252 GWh (76%)	415km of Mains Replacement ASP increasing 0.1mb MEG down 4%	242GWh	-10GWh
MP Leakage	15 GWh (5%)		15GWh	0GWh
Other (AGI's, OUG, Theft & Interference)	64 GWh (19%)	Up 1GWh	65GWh	+1GWh
Total	331 GWh (100%)	Replacement & ASP Largest Drivers	322GWh (100%)	-9GWh

WM LDZ Performance

Component	2016-17	Drivers of Change	2016-17	Difference
LP Leakage	215 GWh (75%)	315km of Mains Replacement	208GWh	-7GWh
MP Leakage	20 GWh (7%)	ASP increasing 0.1mb MEG up 1%	20GWh	0GWh
Other (AGI's, OUG, Theft & Interference)	52 GWh (18%)	Static Performance	52GWh	0GWh
Total	287 GWh (100%)	Replacement & ASP Largest Drivers	280GWh (100%)	-7GWh

Cadent Network Performance

Component	2016-17	Drivers of Change	2016-17	Difference
LP Leakage	922 GWh (71%)	1600km of Mains Replacement	884GWh	-38GWh
MP Leakage	113 GWh (9%)	ASP increasing 0.2mb MEG static	111GWh	-2GWh
Other (AGI's, OUG, Theft & Interference)	272 GWh (20%)	Up 2GWh	274GWh	+2GWh
Total	1307 GWh (100%)	Replacement & ASP Largest Drivers	1269GWh (100%)	-38GWh