Shrinkage and Leakage Model Review 2019

Joint Distribution Network Publication

Shrinkage & Leakage Model Review
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Shrinkage & Leakage Model Review

1. Executive Summary

The Shrinkage & Leakage Model Review process is an opportunity for Gas Distribution Networks (GDNs) and interested stakeholders to consult and review (on an annual basis) the components and assumptions used within the Shrinkage and Leakage Model (SLM).

The outcome of this consultation will be submitted to the authority by 31 December 2019.

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, it is proposed a continuation of focus in the following keys areas, with no new commitments being added:

	Approach / Description	Potential Impact on SLM
Priority 1 **Stakeholder Feedback** ***Medium Pressure Leakage does not include a pressure correction factor.***	An independent review has been commissioned with Newcastle University whereby the options for reviewing this element are being assessed. The outcome will be shared through the Shrinkage Forum	If a realistic and equitable solution is found that adds accuracy to the SLM this will be released for consultation with an expected change made to the Medium Pressure calculation of lost gas.
Priority 2 **Accuracy Improvement** ***Internal pipe remediation is used with no method of reflecting the Leakage impact in the SLM.***	Having previously engaged with DNV GL and ULC Robotics to assist with developing the calculation and capture process, SGN intend to consult with the wider industry with a view to presenting a modification to the model, which will allow the positive impact of remediation, on leakage, to be represented.	Remediation allows maintenance of pipe assets to be undertaken with reduced disruption to our customers. SLM calculations should reflect any difference in assessed leakage from using this method, with no mechanism allowing this to be captured currently.
Priority 3 **Review of Calculation** ***Own Use Gas is calculated as a percentage of throughput***	The Low Carbon Preheating Trials being undertaken as part of an innovation project will potentially assist in determining whether a better method of calculating Own Use Gas is available.	The Low Carbon Preheating Trials are still to be fully completed, it is anticipated that on completion and review the Own Use Gas calculation would change from a factor of throughput to an activity or formula based calculation.
Priority 4 **Review of Calculation** ***Theft of Gas is calculated as a percentage of throughput***	Theft of Gas is calculated as a factor of throughput and fluctuates based on network demand and the addition or removal of consumer load requirements.	Feedback from industry together with GDPR2 will influence how this priority will be driven. Current consensus indicates the incentive mechanism should be amended.

Table 1 – Summary of 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 2019.

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 2019. Communication should be directed to Matt Marshall or via the Joint Office (contact details below).

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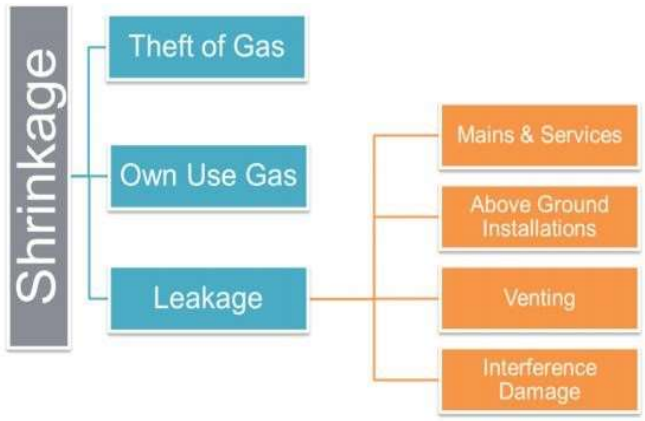
Shrinkage & Leakage Model Review

3. Overview of Shrinkage

Shrinkage refers to the gas which is emitted 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 predetermined leakage rates and 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 request feedback from shippers and other interested parties on how we can continuously improve elements of the SLM.

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.



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. This Forum facilitates discussions relating to the measurement of Shrinkage gas and allows for opinions and ideas to be shared.

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

Shrinkage & Leakage Model Review

4. Overview of the SLM

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, improving the SLM.

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	233,000km	110,000	21,500,000

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

**The figures in Table 2 are taken from the 2018/19 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 and 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).

[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.

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)

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. We have now engaged with industry experts at Newcastle University, educating them in the mechanics of the SLM, and 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. Stakeholders have told us in previous consultations that this is an area that requires review.

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;

- Holder Station (Largely phased out)
- NTS Offtake (Reduce pressure from above 70 bar to Local Transmission)
- Local Transmission (Reduce pressures from up to 69 bar to lower pressure tiers)
- District Governor (Supply gas to lower pressure tiers. Outlet pressure 25-75 mbar)
- 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 (m^3/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)

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

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).

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.

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

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. Our current view is that this component would be useful to investigate, as detailed within our commitments, to determine if a better methodology for estimating theft exists, however, by its nature it is difficult to quantify an unknown.

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. 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.

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5. Shrinkage Component Timeline

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

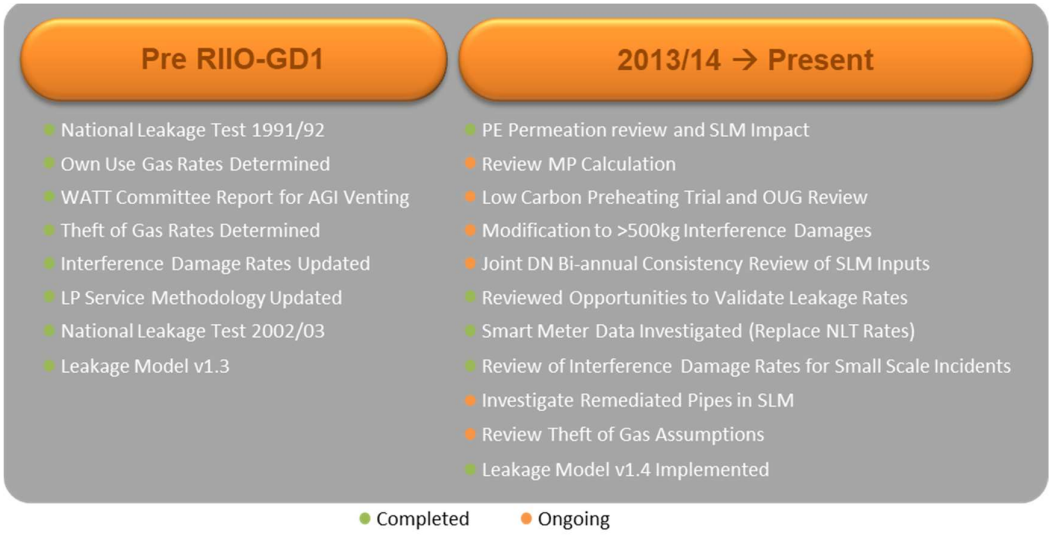


Figure 2 – Shrinkage Component Timeline

6. Shrinkage Reduction Success

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 several 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 23,500km 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.
- 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. Our Focus Areas

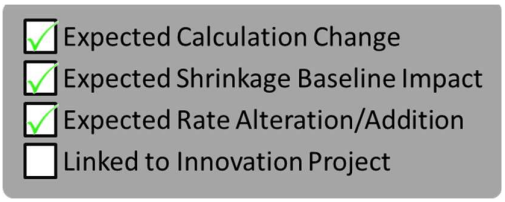
The outcome of the Joint GDNs SLM review is detailed below (this expands on Table 1 contained in the Executive Summary).

Project Name: Medium Pressure Leakage

Project Lead: Northern Gas Networks Ltd.

Shrinkage Component: Medium Pressure Calculation.

Potential Shrinkage Impact Assessment Checklist:



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. The findings and output from this will be shared externally via the Shrinkage Forum.

Anticipated Baseline Impacts: Unknown.

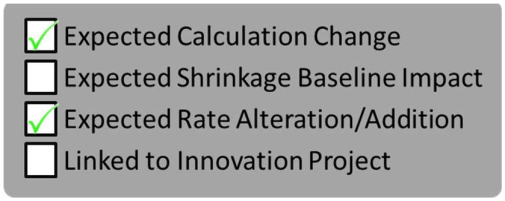
Expected Completion: Unknown – Investigatory work has commenced with specialist support.

Project Name: Capture of Remediated Mains

Project Lead: SGN.

Shrinkage Component: Low Pressure Mains.

Potential Shrinkage Impact Assessment Checklist:



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.

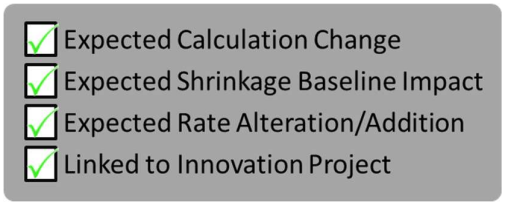
Expected Completion: Release of industry consultation late 2019/early 2020.

Project Name: Own Use Gas

Project Lead: Northern Gas Networks and SGN.

Shrinkage Component: Own Use Gas Calculation.

Potential Shrinkage Impact Assessment Checklist:



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. Northern Gas Networks and SGN are committed to an ongoing innovation project, looking into efficiencies of both old water bath pre-heaters and new immersion tube preheating technology. Northern Gas Networks and SGN will continue to monitor the outputs from this low carbon pre-heating trial, which may positively impact on the current OUG calculations in the future.

SGN's Pro Heat Immersion Pre-Heater trial at Lochmaben continues, although the original trial unit is due to be upgraded, with fabrication of the new unit underway, and a second unit is to be manufactured to fully replace the original Water Bath Heater, which has been used as a back-up until now.

The original trial at Lochmaben has yet to produce any concrete data, as due to technical issues at high flow, the existing Water Bath Heater has been utilised in tandem. It is expected that when both the upgraded immersion heaters are commissioned, Lochmaben will become a fully Pro Heat site in 2020.

The trial has now also been extended to encompass sites with less flow and therefore a lower heat demand, with Pro Heat working with our Innovation team to develop the ACE (Advanced Condensing Exchanger) unit. This is now ready for manufacture and installation at Godstone Hill PRS, with the trial set for later in 2019.

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.

Expected Completion: Unknown, reliant on innovation project trials.

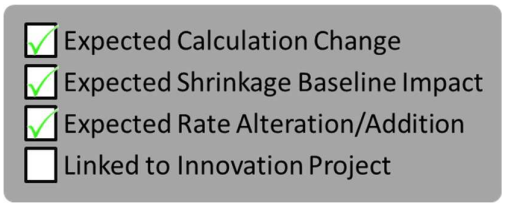
Link to Supporting Information: https://www.sgn.co.uk/Innovation-NIA/Innovation-NIA-Other-Projects/

Project Name: Theft of Gas

Project Lead: Wales & West Utilities.

Shrinkage Component: Theft of Gas Calculation

Potential Shrinkage Impact Assessment Checklist:



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 driven by large industrial customers 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. Feedback has been asked from the shippers and interested parties through the Shrinkage forum for review by the GDNs.

The nature of theft is that if it was known it would be eradicated so determining a refreshed methodology would be difficult to do and volumes difficult to substantiate.

Anticipated Baseline Impacts: Dependent upon the output from the review.

Expected Completion: Unknown.

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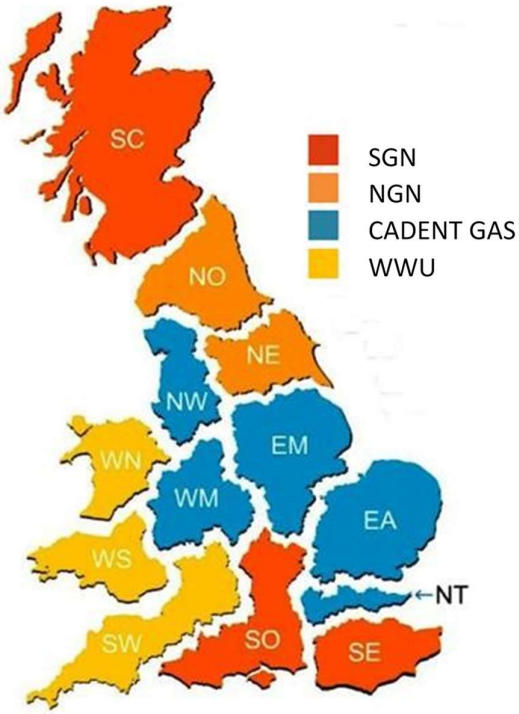
8. LDZ Performance

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 a previous SLM Review stakeholder consultation and August 2018 Shrinkage Forum.

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

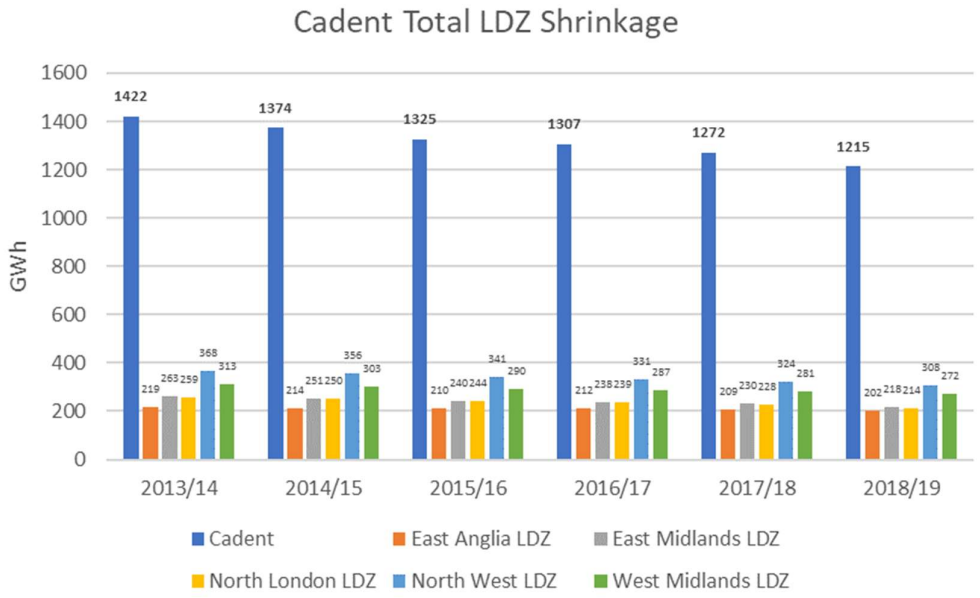


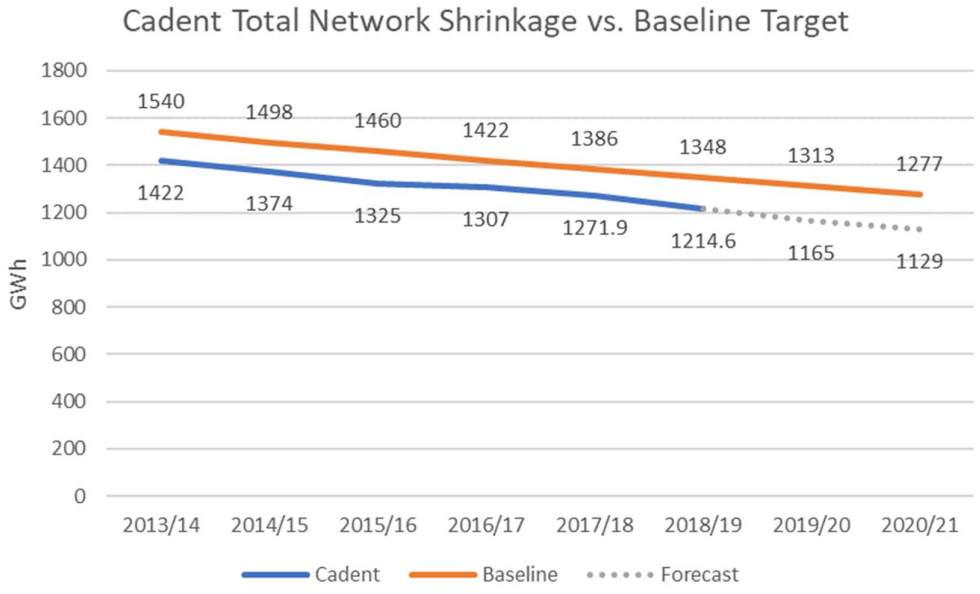
Cadent Performance

Total Network Shrinkage was reduced by 57.3 GWh in 2018/19 from 2017/18.

Average system pressure reduced by 0.3mbar, metallic pipe length reduced by 1752km.

Total Shrinkage has been reduced by approximately 4.5% comparing 2018/19 to 2017/18.





Cadent Network Performance

Component	2017/18	Drivers of Change	2018/19	Difference
LP Leakage	884 GWh 70%	1752km of metallic low pressure mains removed. ASP decreased by 0.3mb, MEG saturation increased by 3.9%. Demand decreased by 2.5% which means OUG and TOG decreased by the same margin compared to 2017/18.	830.4 GWh 68%	-53.6 GWh -6.1%
MP Leakage	111.4 GWh 9%		110.1 GWh 9%	-1.3 GWh -1.2%
Other (AGI's, OUG, Theft & Interference)	276.5 GWh 22%		274.1 GWh 23%	-2.4 GWh -0.9%
Total	1271.9 GWh 100%		1214.6 GWh 100%	-57.3 GWh -4.5%

East Anglia LDZ Network Performance

Component	2017/18	Drivers of Change	2018/19	Difference
LP Leakage	141.9 GWh 68%	366km of metallic low pressure mains removed. ASP decreased by 0.4mb. Demand decreased by 1.7% which means OUG and TOG decreased by the same margin compared to 2017/18.	134.7 GWh 67%	-7.2 GWh -5.1%
MP Leakage	15.2 GWh 7%		15.1 GWh 7%	-0.1 GWh -0.7%
Other (AGI's, OUG, Theft & Interference)	52.3 GWh 25%		52.5 GWh 26%	0.2 GWh 0.4%
Total	209.4 GWh 100%		202.3 GWh 100%	-7.1 GWh -3.4%

East Midlands LDZ Network Performance

Component	2017/18	Drivers of Change	2018/19	Difference
LP Leakage	131.1 GWh 57%	298km of metallic low pressure mains removed. ASP decreased by 0.6mb, MEG saturation decreased by 4.4%. Demand decreased by 2.5% which means OUG and TOG decreased by the same margin compared to 2017/18.	120.7 GWh 55%	-10.4 GWh -7.9%
MP Leakage	41 GWh 18%		40.6 GWh 19%	-0.4 GWh -1.0%
Other (AGI's, OUG, Theft & Interference)	57.6 GWh 25%		57 GWh 26%	-0.6 GWh -1.0%
Total	229.7 GWh 100%		218.3 GWh 100%	-11.4 GWh -5.0%

North London LDZ Network Performance

Component	2017/18	Drivers of Change	2018/19	Difference
LP Leakage	160.4 GWh 71%	377km of metallic low pressure mains removed. ASP decreased by 0.2mb, MEG saturation increased by 9%. Demand decreased by 5.6% which means OUG and TOG decreased by the same margin compared to 2017/18.	148.8 GWh 69%	-11.6 GWh -7.2%
MP Leakage	20.3 GWh 9%		19.9 GWh 9%	-0.4 GWh -2.0%
Other (AGI's, OUG, Theft & Interference)	46.8 GWh 21%		45.6 GWh 21%	-1.2 GWh -2.6%
Total	227.5 GWh 100%		214.3 GWh 100%	-13.2 GWh -5.8%

North West LDZ Network Performance

Component	2017/18	Drivers of Change	2018/19	Difference
LP Leakage	242.4 GWh 75%	400km of metallic low pressure mains removed. ASP decreased by 0.1mb, MEG saturation increased by 5.7%. Demand increased by 0.1% which means OUG and TOG increased by the same margin compared to 2017/18.	227.5 GWh 74%	-14.9 GWh -6.1%
MP Leakage	14.9 GWh 5%		14.7 GWh 5%	-0.2 GWh -1.3%
Other (AGI's, OUG, Theft & Interference)	66.8 GWh 21%		66.1 GWh 21%	-0.7 GWh -1.0%
Total	324.1 GWh 100%		308.3 GWh 100%	-15.8 GWh -4.9%

West Midlands LDZ Network Performance

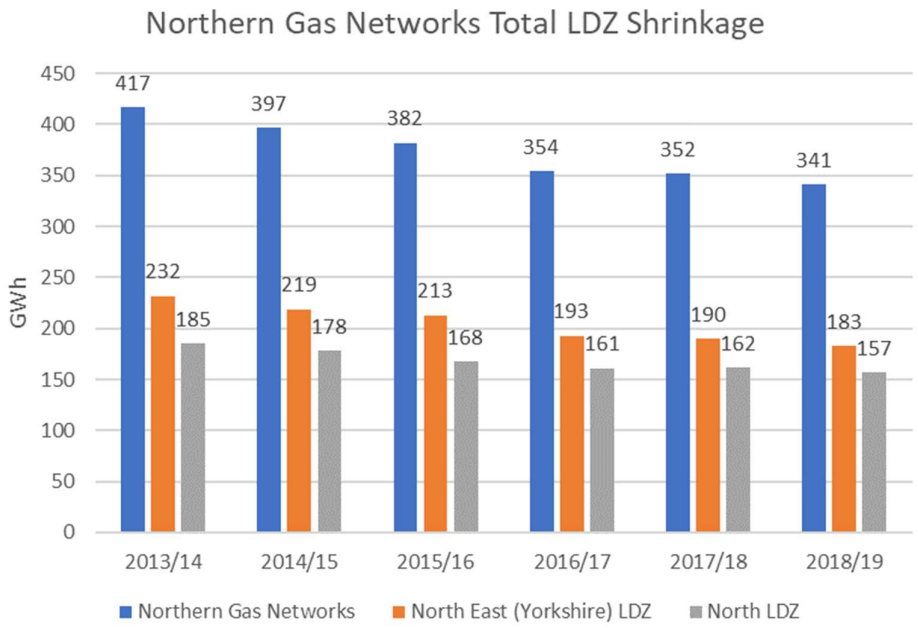
Component	2017/18	Drivers of Change	2018/19	Difference
LP Leakage	208.2 GWh 74%	311km of metallic low pressure mains removed. ASP decreased by 0.1mb, MEG saturation increased by 0.6%. Demand decreased by 3.8% which means OUG and TOG decreased by the same margin compared to 2017/18.	198.7 GWh 73%	-9.5 GWh -4.6%
MP Leakage	20 GWh 7%		19.9 GWh 7%	-0.1 GWh -0.5%
Other (AGI's, OUG, Theft & Interference)	52.8 GWh 19%		53 GWh 20%	0.2 GWh 0.4%
Total	281 GWh 100%		271.6 GWh 100%	-9.4 GWh -3.3%

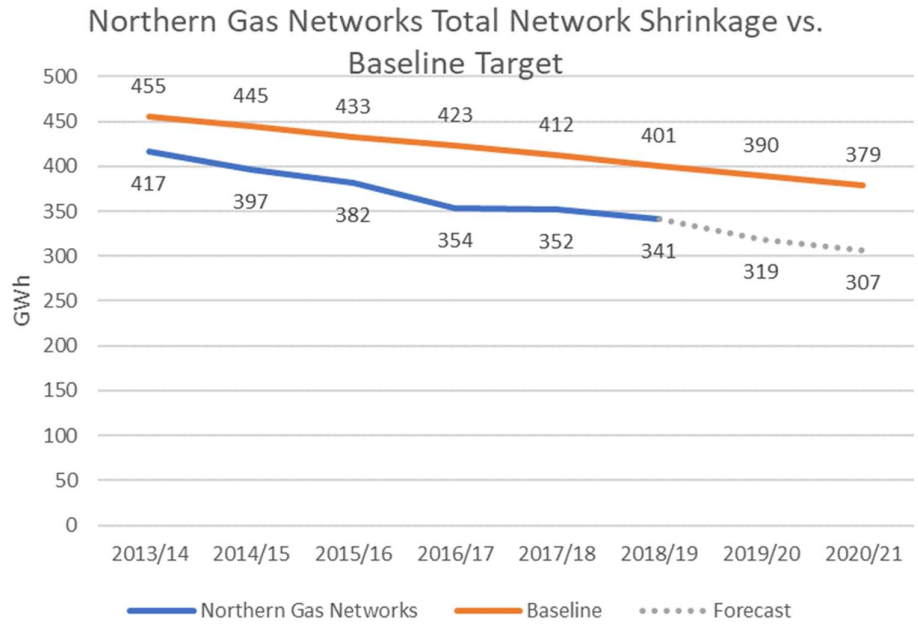
Northern Gas Network Performance

Total Network Shrinkage was reduced by 11.7 GWh in 2018/19 from 2017/18.

Average system pressure increased by 0.6mbar, metallic pipe length reduced by 538km.

Total Shrinkage has been reduced by approximately 3.3% comparing 2018/19 to 2017/18.





Northern Gas Networks Network Performance

Component	2017/18	Drivers of Change	2018/19	Difference
LP Leakage	243.7 GWh 69%	538.4km of metallic low pressure mains removed. ASP increased by 0.6mb, MEG saturation decreased by 0.7%. Demand decreased by 8.9% which means OUG and TOG decreased by the same margin compared to 2017/18.	234.3 GWh 69%	-9.4 GWh -3.9%
MP Leakage	25.7 GWh 7%		25.4 GWh 7%	-0.3 GWh -1.2%
Other (AGI's, OUG, Theft & Interference)	82.8 GWh 24%		80.8 GWh 24%	-2 GWh -2.4%
Total	352.2 GWh 100%		340.5 GWh 100%	-11.7 GWh -3.3%

North East (Yorkshire) LDZ Network Performance

Component	2017/18	Drivers of Change	2018/19	Difference
LP Leakage	132.3 GWh 70%	334.9km of metallic low pressure mains removed. ASP increased by 0.7mb, MEG saturation decreased by 1.9%. Demand decreased by 8.9% which means OUG and TOG decreased by the same margin compared to 2017/18.	126.3 GWh 69%	-6 GWh -4.5%
MP Leakage	16.3 GWh 9%		16.1 GWh 9%	-0.2 GWh -1.2%
Other (AGI's, OUG, Theft & Interference)	41.7 GWh 22%		40.7 GWh 22%	-1 GWh -2.4%
Total	190.3 GWh 100%		183.1 GWh 100%	-7.2 GWh -3.8%

North LDZ Network Performance

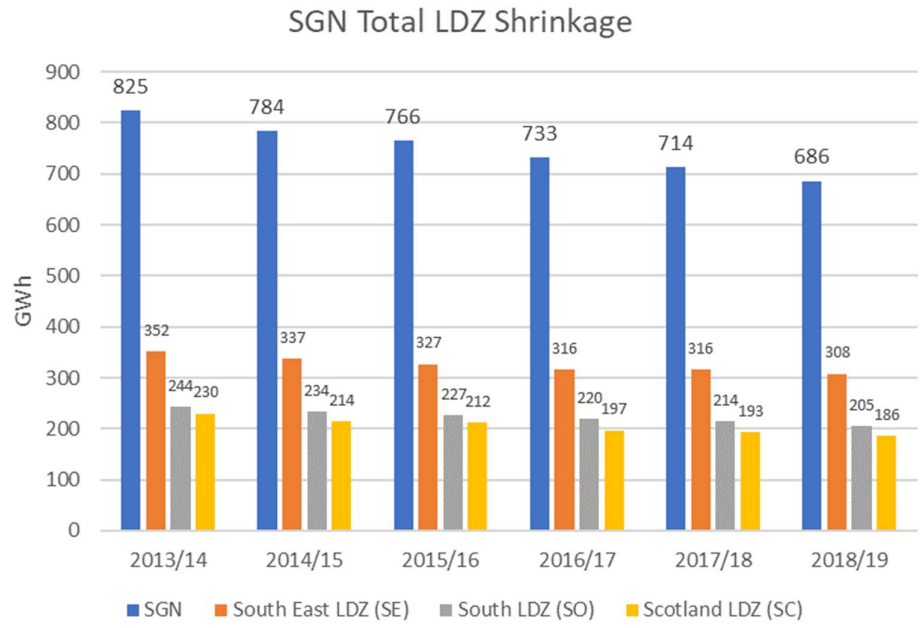
Component	2017/18	Drivers of Change	2018/19	Difference
LP Leakage	111.4 GWh 69%	203.6km of metallic low pressure mains removed. ASP increased by 0.5mb, MEG saturation increased by 0.5%. Demand decreased by 9% which means OUG and TOG decreased by the same margin compared to 2017/18.	108 GWh 69%	-3.4 GWh -3.1%
MP Leakage	9.4 GWh 6%		9.3 GWh 6%	-0.1 GWh -1.1%
Other (AGI's, OUG, Theft & Interference)	41.1 GWh 25%		40.1 GWh 25%	-1 GWh -2.4%
Total	161.9 GWh 100%		157.4 GWh 100%	-4.5 GWh -2.8%

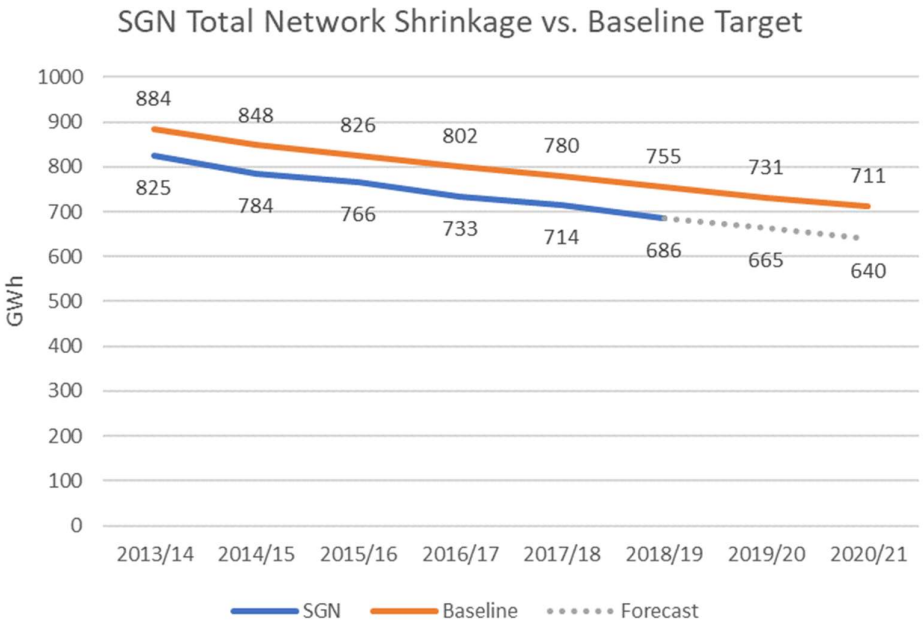
SGN Network Performance

Total Network Shrinkage was reduced by 28.5 GWh in 2018/19 from 2017/18.

Average system pressure reduced by 0.06mbar, metallic pipe length reduced by 911km.

Total Shrinkage has been reduced by approximately 3.8% comparing 2018/19 to 2017/18.





SGN Network Performance

Component	2017/18	Drivers of Change	2018/19	Difference
LP Leakage	509.3 GWh 69%	911km of iron mains replacement in 18/19. Overall ASP reduced by 0.06mbar. MEG saturation decreased Demand decreased by 6.5% and therefore OUG and ToG were reduced by the same margin.	487.3 GWh 68%	-22 GWh -4.3%
MP Leakage	57.5 GWh 8%		56.8 GWh 8%	-0.7 GWh -1.2%
Other (AGI's, OUG, Theft & Interference)	175.6 GWh 24%		169.8 GWh 24%	-5.8 GWh -3.3%
Total	742.4 GWh 100%		713.9 GWh 100%	-28.5 GWh -3.8%

South East LDZ (SE) Network Performance

Component	2017/18	Drivers of Change	2018/19	Difference
LP Leakage	244.6 GWh 76%	427km of iron mains replacement in 18/19. ASP increased by 0.14mbar. MEG saturation decreased Reduction in Interference Damage Incidents. Reduction in demand and therefore OUG & ToG	234 GWh 76%	-10.6 GWh -4.3%
MP Leakage	14.3 GWh 4%		14.2 GWh 5%	-0.1 GWh -0.7%
Other (AGI's, OUG, Theft & Interference)	61.3 GWh 19%		58.3 GWh 19%	-3 GWh -4.9%
Total	320.2 GWh 100%		306.5 GWh 100%	-13.7 GWh -4.3%

South LDZ (SO) Network Performance

Component	2017/18	Drivers of Change	2018/19	Difference
LP Leakage	139.4 GWh 63%	216km of iron mains replacement in 18/19. ASP reduced by 0.08mbar. Reduction in Interference Damage incidents. Reduction in demand and therefore OUG & ToG	134.3 GWh 62%	-5.1 GWh -3.7%
MP Leakage	27.6 GWh 12%		27.2 GWh 13%	-0.4 GWh -1.4%
Other (AGI's, OUG, Theft & Interference)	55.8 GWh 25%		53.8 GWh 25%	-2 GWh -3.6%
Total	222.8 GWh 100%		215.3 GWh 100%	-7.5 GWh -3.4%

Scotland LDZ (SC) Network Performance

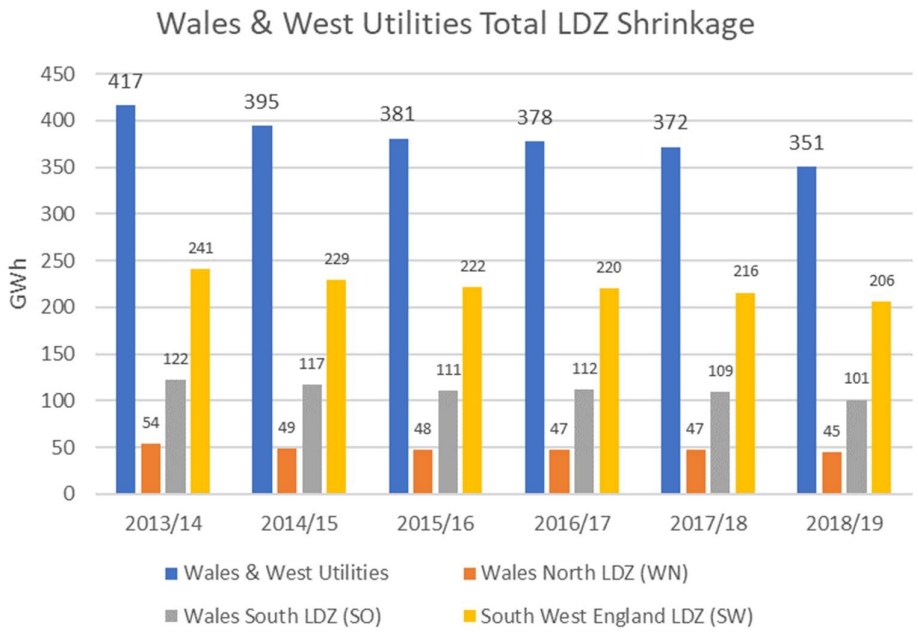
Component	2017/18	Drivers of Change	2018/19	Difference
LP Leakage	125.2 GWh 63%	268km of iron mains replacement in 18/19. ASP reduced by 0.12mbar. MEG saturation decreased One PRS abandoned in 18/19. Reduction in demand and therefore OUG & ToG	119 GWh 62%	-6.2 GWh -5.0%
MP Leakage	15.6 GWh 8%		15.4 GWh 8%	-0.2 GWh -1.3%
Other (AGI's, OUG, Theft & Interference)	58.7 GWh 29%		57.8 GWh 30%	-0.9 GWh -1.5%
Total	199.5 GWh 100%		192.2 GWh 100%	-7.3 GWh -3.7%

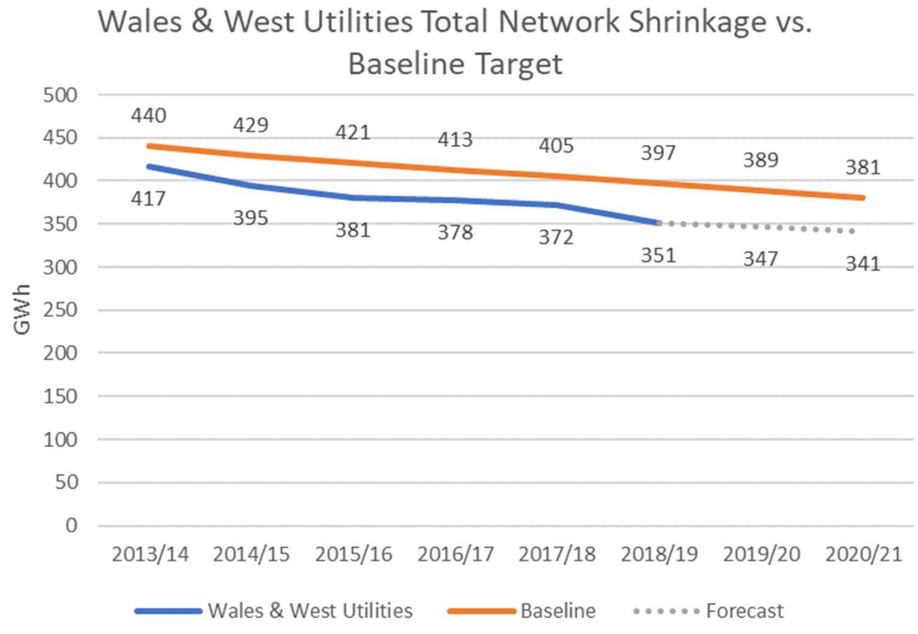
Wales & West Utilities Network Performance

Total Network Shrinkage was reduced by 21 GWh in 2018/19 from 2017/18.

Average system pressure reduced by 1.2mbar, metallic pipe length reduced by 358km.

Total Shrinkage has been reduced by approximately 5.6% comparing 2018/19 to 2017/18.





Wales & West Utilities Network Performance

Component	2017/18	Drivers of Change	2018/19	Difference
LP Leakage	245 GWh 66%	357.5km of metallic low pressure mains removed. ASP decreased by 1.2mb. Demand decreased by 8.9% which means OUG and TOG decreased by the same margin	226 GWh 64%	-19 GWh -7.8%
MP Leakage	32 GWh 9%		32 GWh 9%	0 GWh 0.0%
Other (AGI's, OUG, Theft & Interference)	95 GWh 26%		93 GWh 26%	-2 GWh -2.1%
Total	372 GWh 100%		351 GWh 100%	-21 GWh -5.6%

Wales North LDZ (WN) Network Performance

Component	2017/18	Drivers of Change	2018/19	Difference
LP Leakage	21 GWh 46%	36.2km of metallic low pressure mains removed. ASP decreased by 0.9mb. Demand decreased by 4.2% which means OUG and TOG decreased by the same margin	18 GWh 42%	-3 GWh -14.3%
MP Leakage	3 GWh 7%		3 GWh 7%	0 GWh 0.0%
Other (AGI's, OUG, Theft & Interference)	22 GWh 48%		22 GWh 51%	0 GWh 0.0%
Total	46 GWh 100%		43 GWh 100%	-3 GWh -6.5%

Wales South LDZ (SO) Network Performance

Component	2017/18	Drivers of Change	2018/19	Difference
LP Leakage	67 GWh 61%	119.4km of metallic low pressure mains removed. ASP decreased by 1.8mb. Demand decreased by 12.9% which means OUG and TOG decreased by the same margin	60 GWh 59%	-7 GWh -10.4%
MP Leakage	10 GWh 9%		10 GWh 10%	0 GWh 0.0%
Other (AGI's, OUG, Theft & Interference)	32 GWh 29%		31 GWh 31%	-1 GWh -3.1%
Total	109 GWh 100%		101 GWh 100%	-8 GWh -7.3%

South West England LDZ (SW) Network Performance

Component	2017/18	Drivers of Change	2018/19	Difference
LP Leakage	157 GWh 72%	201.8km of metallic low pressure mains removed. ASP decreased by 0.9mb. Demand decreased by 6.2% which means OUG and TOG decreased by the same margin	148 GWh 72%	-9 GWh -5.7%
MP Leakage	19 GWh 9%		19 GWh 9%	0 GWh 0.0%
Other (AGI's, OUG, Theft & Interference)	41 GWh 19%		39 GWh 19%	-2 GWh -4.9%
Total	217 GWh 100%		206 GWh 100%	-11 GWh -5.1%