Shrinkage and Leakage Model Review 2020

Joint Distribution Network Publication

Shrinkage & Leakage Model Review
Contents

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 2020. 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 was commissioned with Newcastle University. 7 options were recommended for GDN consideration to potentially improve medium pressure leakage estimation and these ideas will be explored in 2021.	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***	SGN have developed a joint GDN consultation document with the intention to share with the Authority, stakeholders and the wider industry in the coming days. We will then attempt to address any concerns related to the proposed process, with a view to progressing this modification early in the new year.	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 were undertaken but are yet to produce any concrete data. The proposed trial extension has currently been interrupted by this year's COVID restrictions.	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***	We will continue to investigate any alternative methods of calculating Theft of Gas within the Shrinkage model and propose any of these alternatives to the Shrinkage forum.	It's likely that any change to the methodology will impact the quantity of Shrinkage gas reported and therefore will have to be accounted for in the baselines for reporting.
Priority 5 **Research** ***Gas venting***	Research around the different processes used for gas venting and how the environmental impacts of it can be improved.	A review of how we can adjust the model to include any results will take place. This may lead to a modification around the AGI venting calculation.

Table 1 Summary of commitments

Shrinkage & Leakage Model Review

2. Background

GDNs 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 2020.

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 15th December 2020. Communication should be directed to Emma Buckton or via the Joint Office (contact details below).

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Northern Gas Networks

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Alternatively

Joint Office: enquiries@gasgovernance.co.uk

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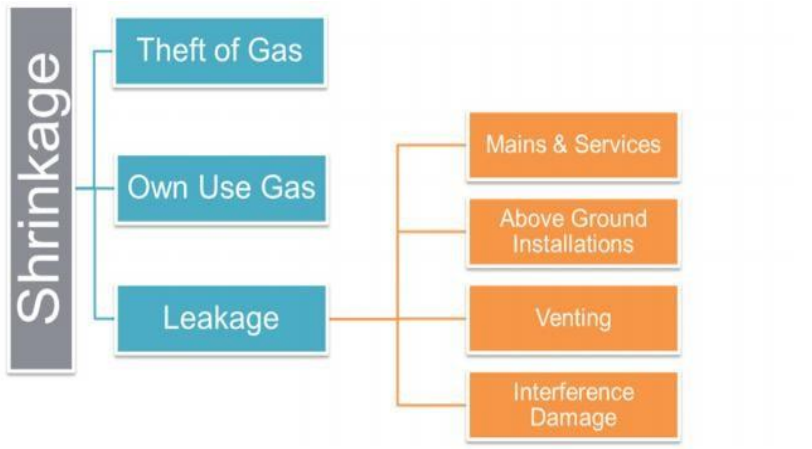
3. Overview of Shrinkage

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:
https://www.gasgovernance.co.uk/SF

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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
2,338	241,016km	108,773	21,205,976

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

The figures in **Table 2 are taken from the 2019/20 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.

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

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)

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. GDNs 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.

We have now engaged with industry experts at Newcastle University to understand if there was 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

[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.

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 AGIs is estimated by multiplying the number of AGI assets by the pre-determined leakage rate calculated for the asset type. The five types of AGIs 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 AGIs 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).

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.

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

<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. 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.

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

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

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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.

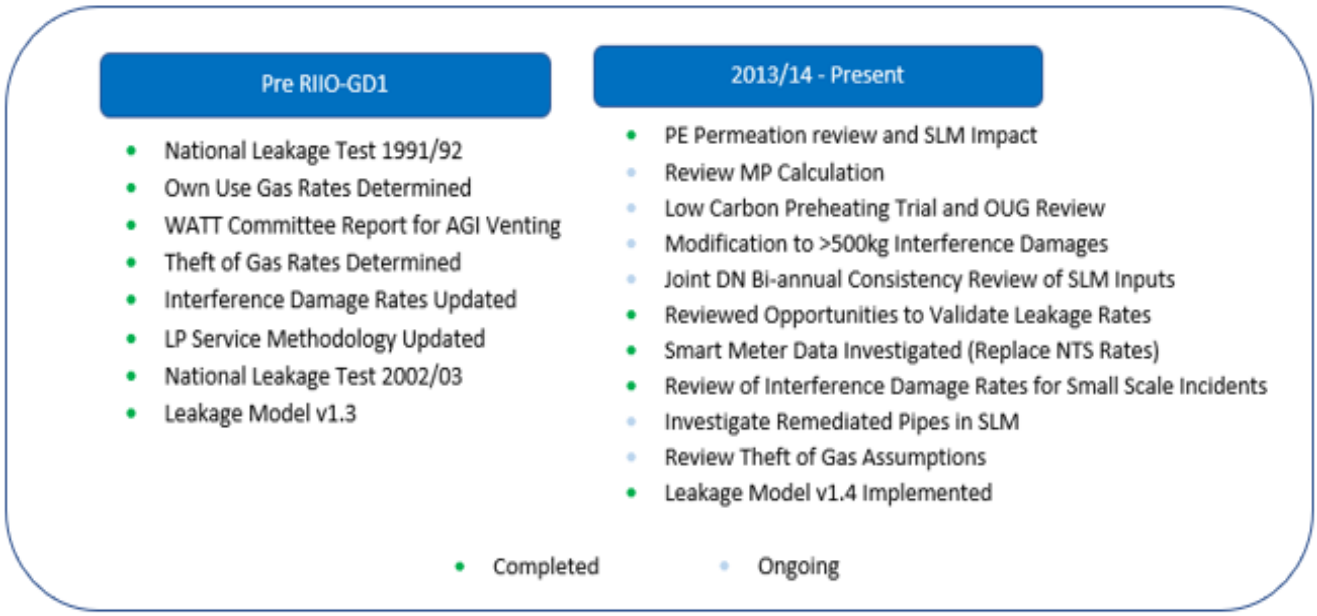

Figure 2 Shrinkage Component Timeline

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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 26,300km 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 reduce 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.

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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:

- [x] Expected Calculation Change
- [x] Expected Shrinkage Baseline Impact
- [x] Expected Rate Alteration/Addition
- [ ] Linked to Innovation Project

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 engaged with Newcastle University to review and understand if there is a better and more concise methodology to report Medium Pressure leakage. The project aimed to identify the strengths in the current approach and the opportunities for further improvement, and to make recommendations based on these findings. 7 options were recommended for GDN consideration to potentially improve medium pressure leakage estimation and we will explore these ideas in 2021.

Anticipated Baseline Impacts: Unknown.

Expected Completion: Preliminary investigatory work has completed with specialist support. Options for improvement will be explored in 2021.

Project Name: Capture of Remediated Mains

Project Lead: SGN.

Shrinkage Component: Low Pressure Mains.

Potential Shrinkage Impact Assessment Checklist:

- [x] Expected Calculation Change
- [ ] Expected Shrinkage Baseline Impact
- [x] Expected Rate Alteration/Addition
- [ ] Linked to Innovation Project

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)

The consultation document is now complete and has been agreed with all GDN's. It is anticipated that the paper will go out to consultation with stakeholders and the wider industry, for a period of 28 days, over the coming weeks. SGN look forward to working with interested parties to address any concerns or queries around the proposed process, with a view to raising a modification to the SLM, which would allow the reduction in Leakage, associated with remediated large diameter metallic mains, to be reflected in the LRMM.

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 2020/early 2021.

Project Name: Own Use Gas

Project Lead: Northern Gas Networks and SGN.

Shrinkage Component: Own Use Gas Calculation.

Potential Shrinkage Impact Assessment Checklist:

- ☑ Expected Calculation Change
- ☑ Expected Shrinkage Baseline Impact
- ☑ Expected Rate Alteration/Addition
- ☑ Linked to Innovation Project

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.

The Pro Heat Immersion Pre-Heaters installed at the Lochmaben site continue to experience technical issues at high flow, but both heaters are now operating in tandem, with very little requirement for use of the traditional water bath heater on site.

Unfortunately, the original trial at Lochmaben has yet to produce any concrete data, and the proposed trial extension, originally seeking to encompass sites with lower flows/heat demand, utilising the Advanced Condensing Exchanger (ACE), has been interrupted by this year's COVID restrictions and has not advanced significantly.

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.

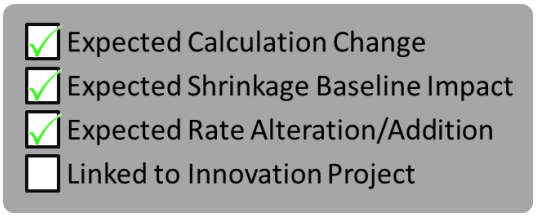
Link to Supporting Information: Search Results | Smart Grid Projects | ENA Smarter Networks Portal

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: Following consultation with Shippers and interested parties at the Shrinkage forums, a response was submitted by EON[7] which supported any exploratory work being conducted around the link between theft and shrinkage gas.

As GD1 comes to a close, GDNs were in discussions with Ofgem to help determine how the incentive process would better work in GD2. Draft determinations from Ofgem pointed towards a major change in how Shrinkage performance is measured in GD2 and will be split between reputational and financial rewards and penalties. Whilst overall Shrinkage will be rewarded with a reputational incentive, the financial reward/penalty will be based on Average system pressure movement and MEG saturation levels. This would mean that Shrinkage performance related to Theft of Gas would have a reputational incentive only.

[7] https://www.gasgovernance.co.uk/sf/240320

Following Ofgem's final determinations for GD2, we will continue to work on a review of the current theft of gas methodology and aim to provide alternative methods of calculating theft of gas.

Project Name: Gas Venting Research

Project Lead: Northern Gas Networks Ltd and Wales and West Utilities
Shrinkage Component: AGI venting

Potential Shrinkage Impact Assessment Checklist:

- ☑ Expected Calculation Change
- ☑ Expected Shrinkage Baseline Impact
- ☑ Expected Rate Alteration/Addition
- ☑ Linked to Innovation Project

Brief Overview: For UK gas distribution networks, gas venting remains a necessary part of normal operations for maintenance and safety purposes which can be either manual or automatic. Gas venting results in unburned natural gas being released into atmosphere. This has an environmental impact as the main constituent of natural gas, methane, has approximately 28 times the global warming potential of carbon dioxide (based on the IPCC Fifth Assessment Report (AR5) over a 100-year period). Depending on the source of venting, various quantities of gas will be released and there is limited understanding of the environmental impact this causes. Additionally, vented gas results in shrinkage.

Reason for Review: Currently there are varying methods to different degrees of sophistication, to quantify and forecast the extent and impact of venting. The objectives are: Stage 1: Identify and detail current venting processes and equipment which release gas. Include literature review of previous projects and identify the lessons learned. Provide an assessment of the frequency at which gas is released (considering variation through periods of high and low demand). Provide a detailed understanding of the volume of gas being vented annually from equipment and operations. Provide an assessment of the environmental impact of current venting processes.

Stage 2: Identify safe, environmentally friendly, alternative processes and technologies that could be adopted by the networks.

Stage 3: Quantify the benefits associated with the options identified and highlight the most appropriate.

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

Expected Completion: April 2021

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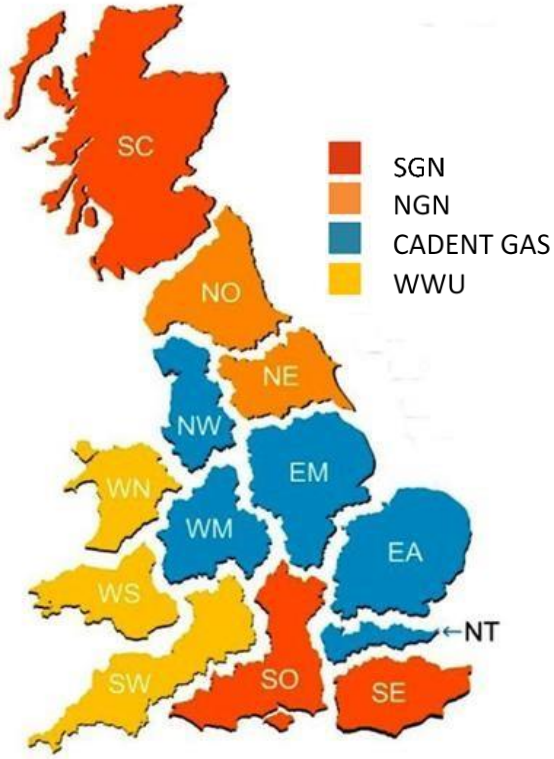
8. LDZ Performance

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.

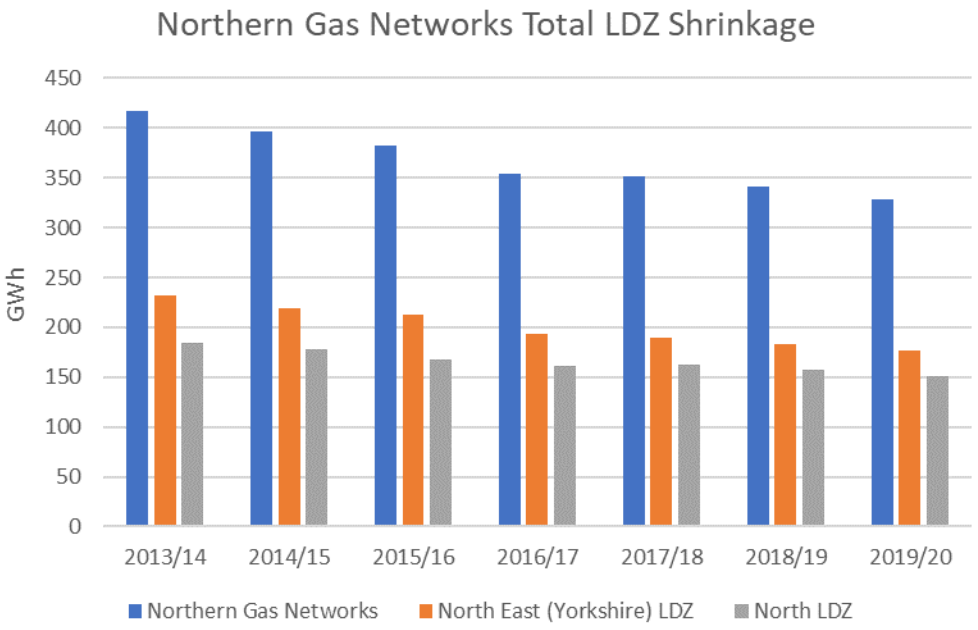


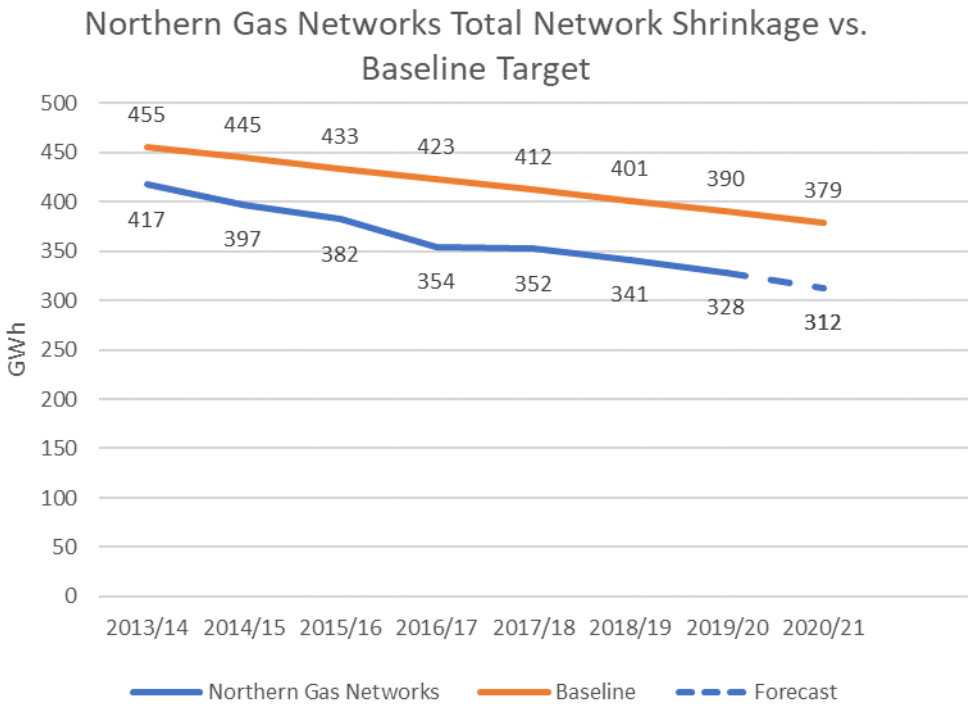
Northern Gas Network Performance

Total Network Shrinkage was reduced by 12.2 GWh in 2019/20 from 2018/19.

Average system pressure decreased by 0.3mbar, metallic pipe length reduced by 534km.

Total Shrinkage in 2019/20 has reduced by approximately 3.6% compared to 2018/19.





Northern Gas Networks Network Performance

Component	2018/19	Drivers of Change	2019/20	Difference
LP Leakage	234.3 GWh 69%	534km of metallic low pressure mains removed. ASP decreased by 0.3mb, MEG saturation decreased by 4%. Demand increased by 4.1% which means OUG and TOG increased by the same margin compared to 2018/19.	220.85 GWh 67%	-13.5 GWh -5.7%
MP Leakage	25.4 GWh 7%		25.42 GWh 8%	0 GWh 0.1%
Other (AGI's, OUG, Theft & Interference)	80.8 GWh 24%		82.07 GWh 25%	1.3 GWh 1.6%
Total	340.5 GWh 100%		328.34 GWh 100%	-12.2 GWh -3.6%

North East (Yorkshire) LDZ Network Performance

Component	2018/19	Drivers of Change	2019/20	Difference
LP Leakage	126.3 GWh 69%	309.7km of metallic low pressure mains removed. ASP increased by 0.1mb, MEG saturation decreased by 3%. Demand increased by 4.3% which means OUG and TOG increased by the same margin compared to 2018/19.	119.49 GWh 69%	-6.8 GWh -5.4%
MP Leakage	16.1 GWh 9%		16.1 GWh 9%	0 GWh 0.0%
Other (AGI's, OUG, Theft & Interference)	40.7 GWh 22%		38.72 GWh 22%	-2 GWh -4.9%
Total	183.1 GWh 100%		174.31 GWh 100%	-8.8 GWh -4.8%

North LDZ Network Performance

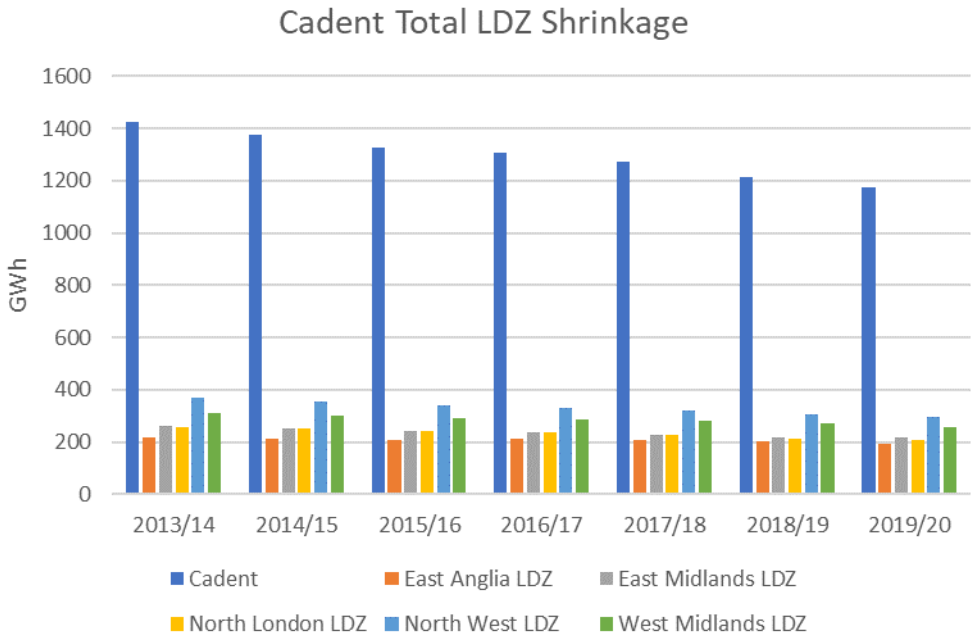
Component	2018/19	Drivers of Change	2019/20	Difference
LP Leakage	108 GWh 69%	224.3km of metallic low pressure mains removed. ASP decreased by 0.7mb, MEG saturation decreased by 5%. Demand increased by 3.7% which means OUG and TOG increased by the same margin compared to 2018/19.	101.35 GWh 71%	-6.7 GWh -6.2%
MP Leakage	9.3 GWh 6%		9.31 GWh 7%	0 GWh 0.1%
Other (AGI's, OUG, Theft & Interference)	40.1 GWh 25%		31.83 GWh 22%	-8.3 GWh -20.6%
Total	157.4 GWh 100%		142.49 GWh 100%	-14.9 GWh -9.5%

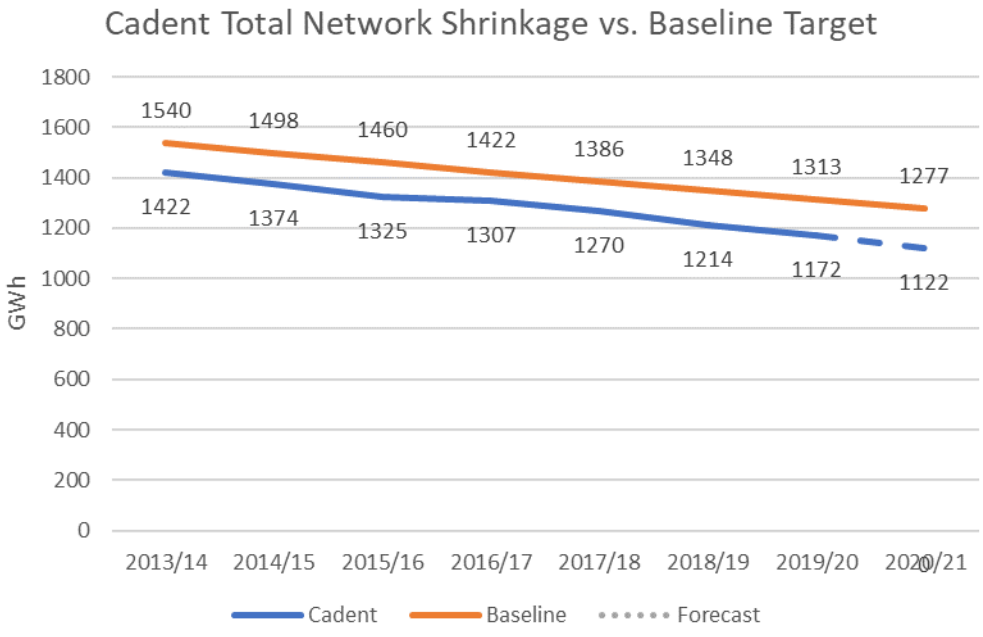
Cadent Performance

Total Network Shrinkage was reduced by 42.9GWh in 2019/20 from 2018/19.

Average system pressure increased by 0.2mbar, metallic pipe length reduced by 1017.1km.

Total Shrinkage in 2019/20 has reduced by approximately 3.5% compared to 2018/19.





Cadent Network Performance

Component	2018/19	Drivers of Change	2019/20	Difference
LP Leakage	830.4 GWh 68%	System Pressures increased by 0.2mb causing a 4.5GWh increase in Shrinkage. Gas Conditioning saturations improved (34% to 36%) contributing a 6GWh reduction in Shrinkage.	786.5 GWh 67%	-43.9 GWh -5.3%
MP Leakage	110.1 GWh 9%		108.3 GWh 9%	-1.8 GWh -1.6%
Other (AGI's, OUG, Theft & Interference)	274.1 GWh 23%		276.9 GWh 24%	2.8 GWh 1.0%
Total	1214.6 GWh 100%		1171.7 GWh 100%	-42.9 GWh -3.5%

East Anglia LDZ Network Performance

Component	2018/19	Drivers of Change	2019/20	Difference
LP Leakage	134.7 GWh 67%	System Pressures increased by 0.3mb due to increased gas demand. East Anglia LDZ does not use MEG in the distribution system.	126.9 GWh 65%	-7.8 GWh -5.8%
MP Leakage	15.1 GWh 7%		14.8 GWh 8%	-0.3 GWh -2.0%
Other (AGI's, OUG, Theft & Interference)	52.5 GWh 26%		52.5 GWh 27%	0 GWh 0.0%
Total	202.3 GWh 100%		194.2 GWh 100%	-8.1 GWh -4.0%

East Midlands LDZ Network Performance

Component	2018/19	Drivers of Change	2019/20	Difference
LP Leakage	120.7 GWh 55%	System Pressures increased by 0.2mb due to increased gas demand. Gas Conditioning saturations decreased by 8% compared to the previous year.	117.5 GWh 55%	-3.2 GWh -2.7%
MP Leakage	40.6 GWh 19%		39.9 GWh 19%	-0.7 GWh -1.7%
Other (AGI's, OUG, Theft & Interference)	57 GWh 26%		58.1 GWh 27%	1.1 GWh 1.9%
Total	218.3 GWh 100%		215.5 GWh 100%	-2.8 GWh -1.3%

North London LDZ Network Performance

Component	2018/19	Drivers of Change	2019/20	Difference
LP Leakage	148.8 GWh 69%	System Pressures increased by 0.3mb due to increased gas demand. Gas Conditioning saturations increased by 1% compared to the previous year.	140.3 GWh 68%	-8.5 GWh -5.7%
MP Leakage	19.9 GWh 9%		19.4 GWh 9%	-0.5 GWh -2.5%
Other (AGI's, OUG, Theft & Interference)	45.6 GWh 21%		46.4 GWh 23%	0.8 GWh 1.8%
Total	214.3 GWh 100%		206.1 GWh 100%	-8.2 GWh -3.8%

North West LDZ Network Performance

Component	2018/19	Drivers of Change	2019/20	Difference
LP Leakage	227.5 GWh 74%	System Pressures remained static compared to the previous year. Gas Conditioning saturations remained static compared to the previous year.	215.8 GWh 73%	-11.7 GWh -5.1%
MP Leakage	14.7 GWh 5%		14.5 GWh 5%	-0.2 GWh -1.4%
Other (AGI's, OUG, Theft & Interference)	66.1 GWh 21%		67 GWh 23%	0.9 GWh 1.4%
Total	308.3 GWh 100%		297.3 GWh 100%	-11 GWh -3.6%

West Midlands LDZ Network Performance

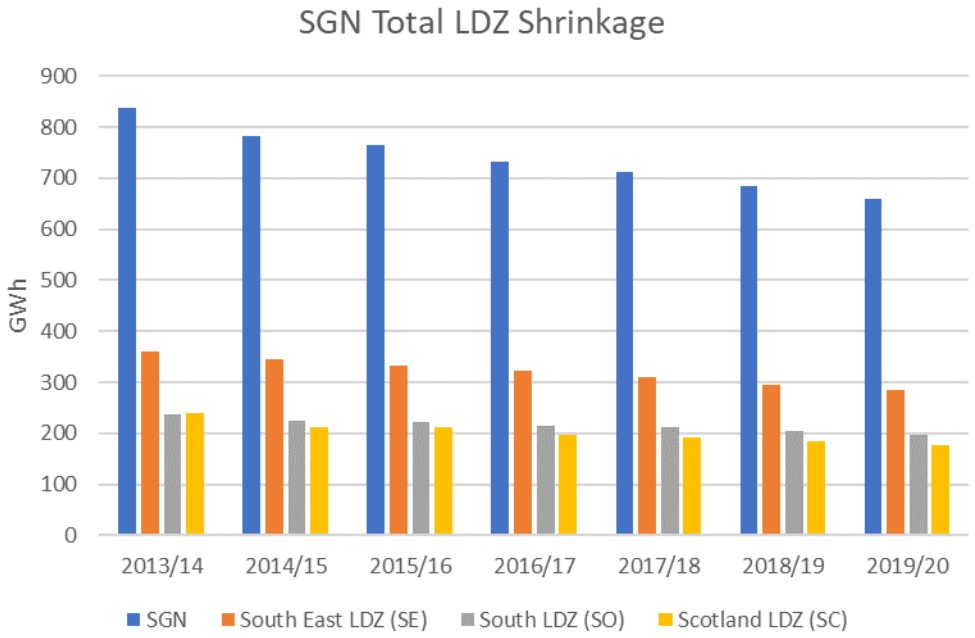
Component	2018/19	Drivers of Change	2019/20	Difference
LP Leakage	198.7 GWh 73%	System Pressures decreased by 0.2mb compared to the previous year. Gas Conditioning saturations increased by 9% compared to the previous year.	185.9 GWh 72%	-12.8 GWh -6.4%
MP Leakage	19.9 GWh 7%		19.7 GWh 8%	-0.2 GWh -1.0%
Other (AGI's, OUG, Theft & Interference)	53 GWh 20%		53 GWh 20%	0 GWh 0.0%
Total	271.6 GWh 100%		258.6 GWh 100%	-13 GWh -4.8%

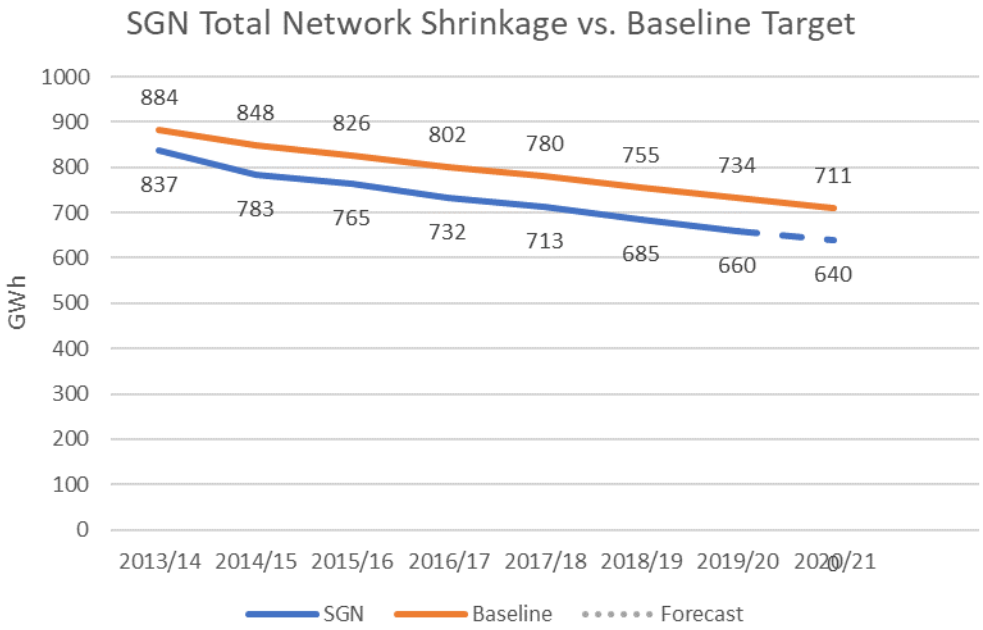
SGN Network Performance

Total Network Shrinkage was reduced by 26.4GWh in 2019/20 from 2018/19.

Average system pressure decreased by 0.3mbar, metallic pipe length reduced by 844km.

Total Shrinkage in 2019/20 has reduced by approximately 3.8% compared to 2018/19.





SGN Network Performance

Component	2018/19	Drivers of Change	2019/20	Difference
LP Leakage	487.3 GWh 71%	844km of metallic low pressure mains removed. ASP decreased by 0.3mb, MEG saturation decreased by 0.8%.	462.6 GWh 70%	-24.7 GWh -5.1%
MP Leakage	56.8 GWh 8%		56.3 GWh 9%	-0.5 GWh -1.0%
Other (AGI's, OUG, Theft & Interference)	141.9 GWh 21%	Demand increased by 4.3% which means OUG and TOG increased by the same margin compared to 2018/19.	140.8 GWh 21%	-1.1 GWh -0.8%
Total	686.1 GWh 100%		659.7 GWh 100%	-26.4 GWh -3.8%

South East LDZ (SE) Network Performance

Component	2018/19	Drivers of Change	2019/20	Difference
LP Leakage	234 GWh 79%	374km of metallic low pressure mains removed. ASP decreased by 0.4mb, MEG saturation decreased by 2.4%.	222.1 GWh 78%	-12 GWh -5.1%
MP Leakage	14.2 GWh 5%		14 GWh 5%	-0.2 GWh -1.4%
Other (AGI's, OUG, Theft & Interference)	47.8 GWh 16%	Demand increased by 4.1% which means OUG and TOG increased by the same margin compared to 2018/19.	48.4 GWh 17%	0.6 GWh 1.2%
Total	296 GWh 100%		284.4 GWh 100%	-11.6 GWh -3.9%

South LDZ (SO) Network Performance

Component	2018/19	Drivers of Change	2019/20	Difference
LP Leakage	134.4 GWh 65%	223km of metallic low pressure mains removed. ASP increased by 1.3mb, MEG saturation remained the same by 0%.	128.3 GWh 65%	-6.1 GWh -4.5%
MP Leakage	27.2 GWh 13%		26.9 GWh 14%	-0.3 GWh -1.1%
Other (AGI's, OUG, Theft & Interference)	43.6 GWh 21%	Demand decreased by 0.7% which means OUG and TOG decreased by the same margin compared to 2018/19.	42.5 GWh 21%	-1.1 GWh -2.5%
Total	205.1 GWh 100%		197.7 GWh 100%	-7.5 GWh -3.6%

Scotland LDZ (SC) Network Performance

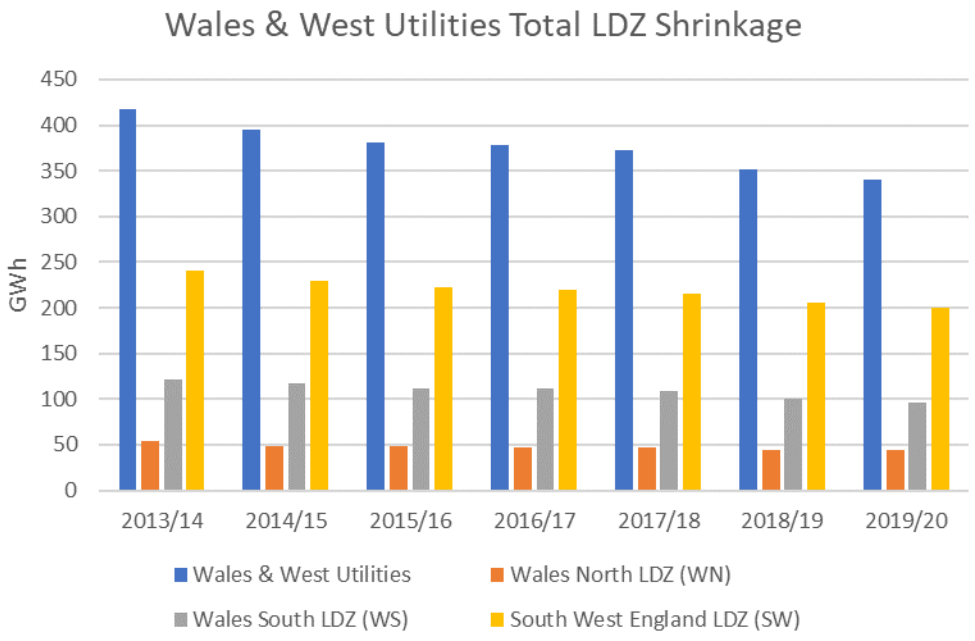
Component	2018/19	Drivers of Change	2019/20	Difference
LP Leakage	119 GWh 64%	247km of metallic low pressure mains removed. ASP decreased by 0.1mb, MEG saturation decreased by 0.6%.	112.3 GWh 63%	-6.7 GWh -5.6%
MP Leakage	15.4 GWh 8%		15.3 GWh 9%	-0.1 GWh -0.4%
Other (AGI's, OUG, Theft & Interference)	50.6 GWh 27%	Demand increased by 8.2% which means OUG and TOG increased by the same margin compared to 2018/19.	50 GWh 28%	-0.6 GWh -1.1%
Total	184.9 GWh 100%		177.6 GWh 100%	-7.3 GWh -4.0%

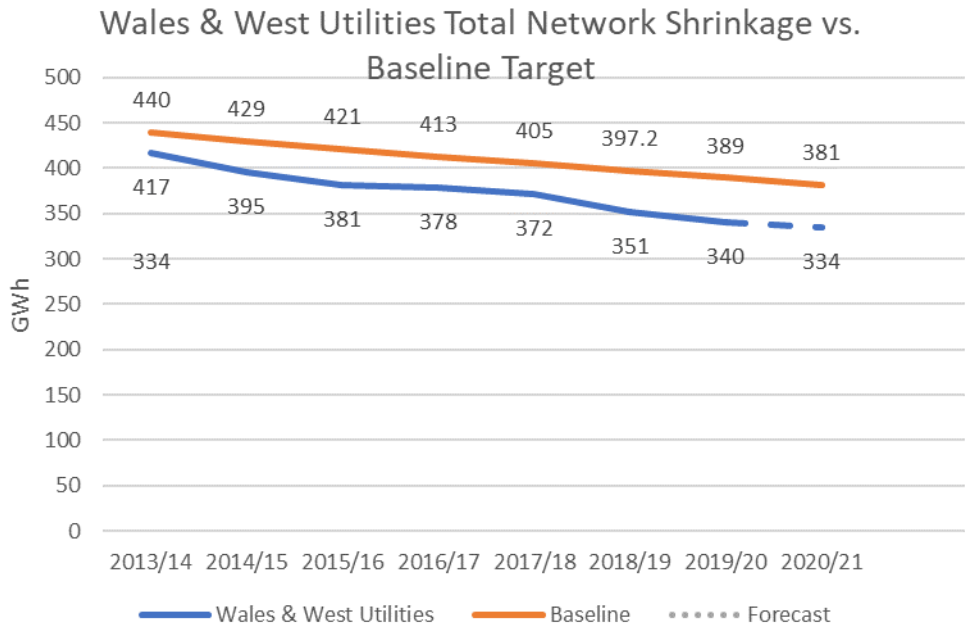
Wales & West Utilities Network Performance

Total Network Shrinkage was reduced by 10.3GWh in 2019/20 from 2018/19.

Average system pressure stayed the same and metallic pipe length reduced by 413.7km.

Total Shrinkage in 2019/20 reduced by approximately 2.9% compared to 2018/19.





Wales & West Utilities Network Performance

Component	2018/19	Drivers of Change	2019/20	Difference
LP Leakage	225.24 GWh 64%	413.7km of metallic low pressure mains removed. ASP decreased by 0mb. Demand increased by 1.8% which means OUG and TOG increased by the same margin compared to 2018/19.	214.81 GWh 63%	-10.4 GWh -4.6%
MP Leakage	31.86 GWh 9%		31.48 GWh 9%	-0.4 GWh -1.2%
Other (AGI's, OUG, Theft & Interference)	93.22 GWh 27%		93.7 GWh 28%	0.5 GWh 0.5%
Total	350.32 GWh 100%		339.99 GWh 100%	-10.33 GWh -2.9%

Wales North LDZ (WN) Network Performance

Component	2018/19	Drivers of Change	2019/20	Difference
LP Leakage	17.41 GWh 40%	38.9km of metallic low pressure mains removed. ASP increased by 0.3mb. Demand increased by 5.6% which means OUG and TOG increased by the same margin compared to 2018/19.	17.41 GWh 40%	0 GWh 0.0%
MP Leakage	3.43 GWh 8%		3.43 GWh 8%	0 GWh 0.0%
Other (AGI's, OUG, Theft & Interference)	22.78 GWh 52%		22.78 GWh 52%	0 GWh 0.0%
Total	43.62 GWh 100%		43.62 GWh 100%	0 GWh 0.0%

Wales South LDZ (WS) Network Performance

Component	2018/19	Drivers of Change	2019/20	Difference
LP Leakage	60.21 GWh 60%	123.6km of metallic low pressure mains removed. ASP decreased by 0.5mb. Demand decreased by 3.1% which means OUG and TOG decreased by the same margin compared to 2018/19.	55.72 GWh 58%	-4.5 GWh -7.5%
MP Leakage	9.68 GWh 10%		9.49 GWh 10%	-0.2 GWh -2.0%
Other (AGI's, OUG, Theft & Interference)	31.07 GWh 31%		30.83 GWh 32%	-0.2 GWh -0.8%
Total	100.96 GWh 100%		96.04 GWh 100%	-4.9 GWh -4.9%

South West England LDZ (SW) Network Performance

Component	2018/19	Drivers of Change	2019/20	Difference
LP Leakage	147.62 GWh 72%	251.2km of metallic low pressure mains removed. ASP increased by 0.2mb. Demand increased by 5.1% which means OUG and TOG increased by the same margin compared to 2018/19.	141.68 GWh 71%	-5.9 GWh -4.0%
MP Leakage	18.75 GWh 9%		18.56 GWh 9%	-0.2 GWh -1.0%
Other (AGI's, OUG, Theft & Interference)	39.37 GWh 19%		40.09 GWh 20%	0.7 GWh 1.8%
Total	205.74 GWh 100%		200.33 GWh 100%	-5.4 GWh -2.6%