Shrinkage and Leakage Model Review

Joint Distribution Network Publication
February 2024

Cadent Your Gas Network
Northern Gas Networks
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Executive Summary

The Shrinkage and Leakage Model Review consultation is an opportunity for Gas Distribution Networks (GDNs) and interested stakeholders to review and feed back on an annual basis, the components and assumptions used within the Shrinkage and Leakage Model (SLM) to ensure that it maintains or improves the accuracy of Shrinkage and Leakage calculations. The outcome of this consultation will be submitted to the Authority by 31st March 2024 in accordance with Special Condition 4.4 Part D.

Summary of 2024 commitments

Commitment	Description
Digital Platform for Leakage Analytics (DPLA)	To review all elements of fugitive emissions which will help to inform a few of the previous year's projects (Profiling Shrinkage, Pipe Remediation Review and AGI Venting) as part of this project aims to trial suitable methane leak detection and quantification technologies. The outputs from this project will be a new modelling tool which combines network data and data collected from suitable technologies to predict, monitor and report on gas emissions.
Independent Shrinkage Expert	To participate in the development of MOD0843 - Establishing the Independent Shrinkage Charge and the Independent Shrinkage Expert.
Own Use Gas Review	Continued investigation into the refresh of the Own Use Gas model and methodology assumptions.

We welcome representations from all interested parties. Responses to this document should be received no later than **15th March 2024** to Julie Chou (Wales & West Utilities) and the Joint Office using the following contact information:

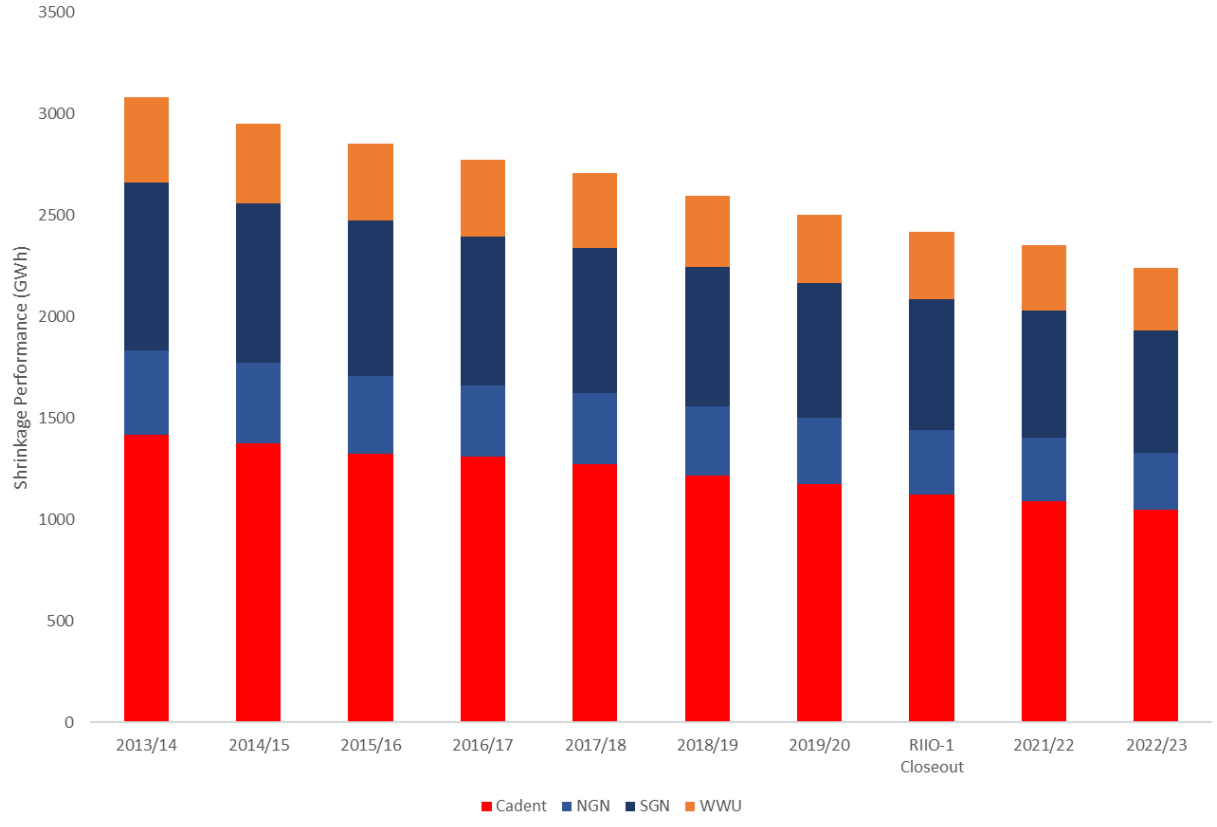
Julie Chou, Asset Officer: julie.chou@wwutilities.co.uk

Joint Office: enquiries@gasgovernance.co.uk

Overview of Shrinkage

GDN Shrinkage consists of leakage, own use gas and theft of gas. In each regulatory year, GDNs assess shrinkage for the previous period using an industry approved methodology and model. The model contains leakage rates and assumptions derived from national leakage tests. Model input data is refreshed annually to reflect the latest changes in network asset populations, events and operations. Leakage accounts for 98.9% of the environmental impact of shrinkage.

The chart below shows the total shrinkage (GWh) since 2012/13 with a reduction of 980GWh to date. The largest contributing factor to emissions reduction is the continuation of the mains replacement programme where old metallic pipes are replaced with low leakage polyethylene. GDNs continue to invest in managing system pressures and gas conditioning where it is effective to reduce leakage further. However, there is a limit to how far this can be achieved due to factors outside of a GDN's control (e.g. weather) without compromising the security of supply to gas consumers.



Projects update

Digital Platform for Leakage Analytics

This Strategic Innovation Fund (SIF) collaborative project led by Cadent Gas aims to create a leakage analytics platform by combining network data with data collected from methane leak detection and quantification technologies. This platform would enable GDNs to predict, monitor and report on emissions from their network and so has the potential to revolutionise the reporting methodology for each of the fugitive emissions elements of shrinkage. Not only would it improve the accuracy of reporting, but it will also deliver valuable actionable insights for networks to reduce gas loss during transportation. As an example, the information collected (e.g. location of leaks and quantity) could be used to prioritise and allocate resources to physically remediate leaks. The project partners are Cadent, SGN, NGN, WWU, NGG and Guidehouse (as technical experts).

To date, Cadent have exported all the required data to support building a model. Guidehouse are currently working through validating the data and using this data to build a new Hybrid-Hydraulic model. Leak detection technology shortlisting is coming to an end, the providers have been reviewed and selected for trials on best fit criteria for the project.

The aims for the next 12 months will be for Cadent to field test a selection of methane detection technologies on their network. Some examples include sensors mounted on vehicles which assess leakage rates at an asset level and fixed methane detection sensors surveying for leaks continuously at above ground installations (AGIs). Further information on timelines will be shared in the March Shrinkage Forum.

As the platform relies heavily on data to deliver meaningful results, the GDNs will focus on data preparation to ensure interoperability following the learnings from Cadent. This would support the roll out of the analytics platform and aligns with GDN digitalisation strategies. There is also another separate SIF project called ‘Intelligent Gas Grid’ led by SGN with WWU and NGN as collaborating partners. Part of this project looks at the use of machine learning to detect anomalies on the network based on pressure data. The knowledge gained from this project will be shared with DPLA.

Pipe Remediation Review

This project reviewed the impact of using the Cast Iron Joint Sealing Robot (CISBOT) to reduce leaks from mains pipes and the required changes to the shrinkage and leakage model to reflect its use. Leakage from iron mains is primarily through lead yarn joints and this remediation technique was shown to reduce this. SGN considered releasing a modification consultation relating to the use of robotics on the pipe network and have recently commissioned industry experts DNV to conduct a study into the impact of joint remediation on pipe leakage which concluded that CISBOT-treated mains exhibited 50% less leakage than the current SLM leakage rate for above 12” Cast Iron. However, the GDNs are of the view that in the event of a successful deployment of the DPLA project, current mains leakage rates would effectively be superseded by the new methods of reporting. For example, the use of advanced methane detection technology would report real time emissions and capture the benefits of robotics as part of that assessment. As such SGN have decided to await the initial results from the Cadent led field trials for DPLA and are also looking into the possibility of trialling advanced methane detection technology on the network, prior to making any decision on bringing a modification to the current mains leakage calculation within the SLM to consultation.

Own Use Gas review

GDNs have shared data with DNV to update the original Own Use Gas model developed in 2002/3. DNV have conducted analyses using the original model with updates and GDNs are undertaking on site visits to validate assumptions. At the same time, an independent third-party review is being conducted by Newcastle University.

The next phase of the project is for DNV to build a new Own Use Gas model using modern systems which will be faster to run and refreshed with the latest assumptions derived from data.

Independent Shrinkage Expert

The GDNs have been and continue to be engaged in discussions regarding the UNC Modification 0843 - Establishing the Independent Shrinkage Charge and the Independent Shrinkage Expert. The model proposer put forward a detailed proposal document and framework which has been developed through several meetings over the course of the year with other shippers, GDNs, the Joint Office and the Central Data Service Provider. The Workgroup Report is due to be presented to Panel. However, the GDNs maintain that with the ongoing progress of the DPLA project, there is no cost benefit to gas consumers or actionable results that would help to reduce emissions by the implementation of an Independent Shrinkage Expert.

Shrinkage Profiling

In 2008, UNC Modification 0203 “Revision to DN Shrinkage Regime” was raised. This was where Ofgem proposed setting a fixed volumetric allowance for Shrinkage for each LDZ, stating that throughput-based purchases could lead to windfall gains or losses, concluding that there is little correlation between shrinkage and throughput.

Recently, it has been proposed via the Shrinkage Forum that shrinkage gas should be profiled throughout the year as this has an impact on daily unidentified gas (UIG) calculations. The DPLA technology trials could provide outputs that will identify any day-to-day shrinkage fluctuations and associated materiality. The outputs could help to determine whether it would be appropriate to replace the existing procurement process with an approach based on real time leakage data. The DPLA project will capture and review the approach to profiling daily shrinkage as part of the regulatory considerations workstream.

Gas Venting

GDNs continue to seek alternative solutions and replace pneumatic systems which vent gas as part of the gas transportation process. The DPLA technology trials will help inform on the appropriate next steps to accurately report on leakage from AGIs.

Calculating Shrinkage

Low pressure mains and services leakage

The latest National Leakage Tests (NLTs) were undertaken in 2002/3 which involved pressure testing 849 low pressure pipes and 6,054 services.

LP Mains Calculation:

$$LP\ Mains\ Leakage = L * Rate * ASP\ correction * (MEG\ correction\ (where\ applicable))$$

where L is mains length (km), Rate is mains leakage rate (scm per annum at 30mbar), ASP correction is the Average System Pressure correction and MEG correction is the Monoethylene Glycol correction.

LP Mains Rates:

11 rates from 25 categories based on material and diameter band.

LP Services Calculation:

$$LP\ Services\ Leakage = No.of\ services * Rate * ASP\ correction$$

where Rate is the services leakage rate (scm per annum at 30mbar) and ASP correction is the Average System Pressure correction.

LP Service Rates:

4 rates (steel and PE service connections to PE or metallic mains)

Medium pressure leakage

MP Leakage is calculated by applying assumptions on the leakage rates derived from the NLTs.

Medium Pressure Mains Calculation:

$$MP\ Mains\ Leakage = L * Rate$$

Above ground installation (AGI) leakage

AGI leakage rates were derived from a national test in 2002/3 for 5 asset types.

AGI Leakage Calculation:

$$AGI\ Leakage = Number\ of\ AGIs * Rate$$

AGI Leakage Asset Types:

Holder Stations, NTS Offtakes, LTS Offtakes, District and Service Governors

AGI Leakage Rates:

Ranges from 8 to 31,075 m^3/year/site

Above ground installation venting

Gas is vented during normal operations and as part of routine maintenance. A fixed annual leakage volume was derived from the Watt Committee Report 1994 which was later allocated by local distribution zone (LDZ).

Third party damage

>500kg:

An assessment is made of each incident and included in the SLM as number of incidents.

<500kg Mains:

Number of incidents are split between low and medium pressure with different leakage rates applied.

<500kg Services:

Number of incidents are split between severed and punctured services with different leakage rates applied to each.

Own use gas

Own use gas is gas that is used during transportation which is primarily for gas pre-heating. At pressure reduction sites, gas is heated before the pressure is decreased to prevent the gas reaching freezing temperatures. This is to avoid damage to components and ground heave. The quantity of gas was estimated to be 0.0113% of total gas throughput based on the study and model developed by Advantica (now DNV) in 2002.

OUG Calculation:

$$OUG = 0.0113\% * Throughput$$

Theft of gas

Theft of gas in this context is the gas attributed to theft that is the responsibility of GDNs (or in other words, upstream of the emergency control valve). As this is difficult to quantify, GDN theft of gas was agreed to be 0.02% of total gas throughput.

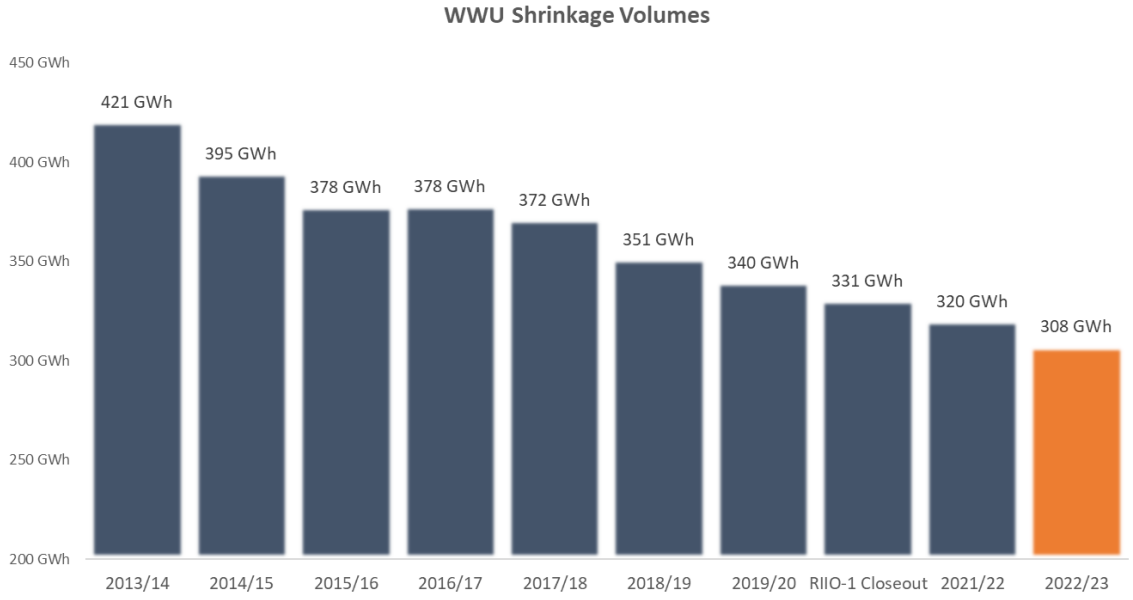
TOG Calculation:

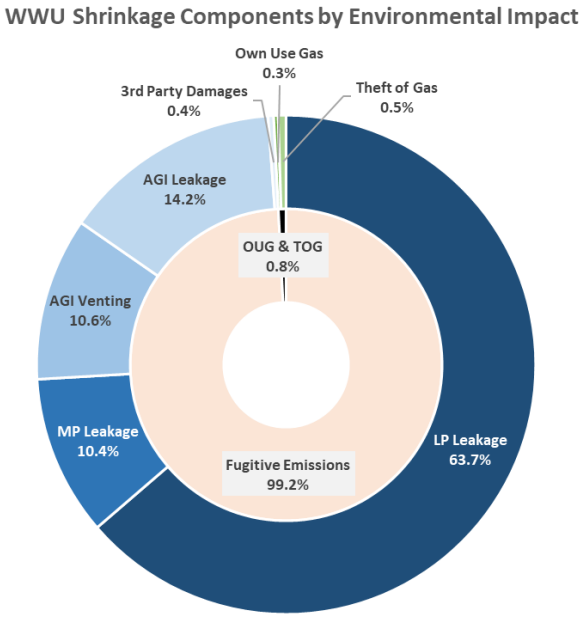
$$TOG = 0.02\% * Throughput$$

Shrinkage Performance

This section shows a breakdown of shrinkage volumes by GDN since 2013/14.

WWU Performance





Wales & West Utilities Network Performance

Component	2021/22	Drivers of Change	2022/23	Difference
LP Leakage	197.3 GWh 62%	System pressures increased by 0.07mb causing increased emissions. Low Pressure metallic mains length decreased by 397.9km. MEG is not used within this Distribution Network. Demand decreased by -12.3% impacting OUG and TOG by the same amount.	187.4 GWh 61%	-9.9 GWh -5.0%
MP Leakage	30.9 GWh 10%		30.6 GWh 10%	-0.3 GWh -1.0%
Other (AGI's, OUG, Theft & Interference)	92.1 GWh 29%		89.7 GWh 29%	-2.4 GWh -2.6%
Total	320.3 GWh 100%		307.7 GWh 100%	-12.6 GWh -3.9%

Wales North LDZ (WN) Network Performance

Component	2021/22	Drivers of Change	2022/23	Difference
LP Leakage	16 GWh 38%	System pressures increased by 0.631mb causing increased emissions. Low Pressure metallic mains length decreased by 32.5km. MEG is not used within this LDZ Demand decreased by -12.6% impacting OUG and TOG by the same amount.	15.7 GWh 38%	-0.3 GWh -2.2%
MP Leakage	3.2 GWh 8%		2.7 GWh 7%	-0.6 GWh -17.0%
Other (AGI's, OUG, Theft & Interference)	22.9 GWh 54%		22.6 GWh 55%	-0.4 GWh -1.6%
Total	42.2 GWh 100%		40.9 GWh 100%	-1.3 GWh -3.0%

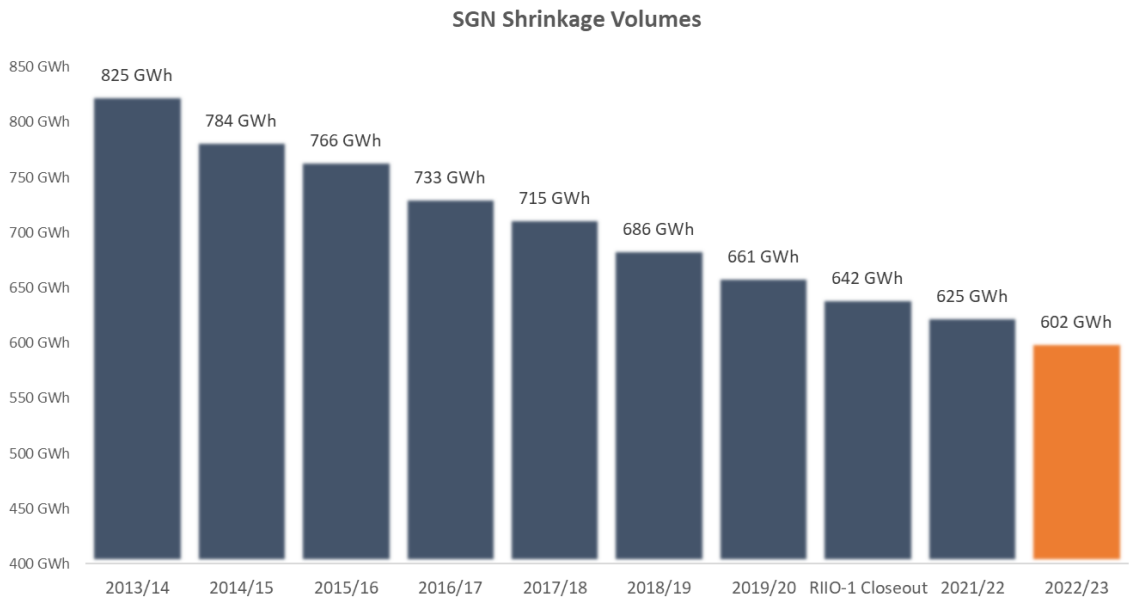
Wales South LDZ (WS) Network Performance

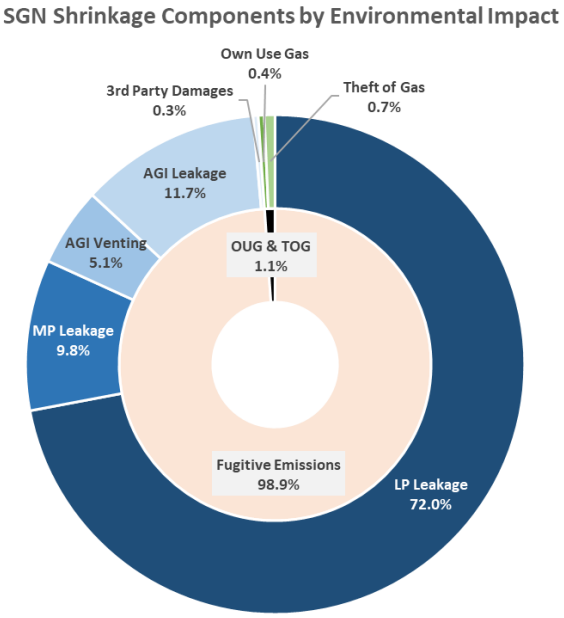
Component	2021/22	Drivers of Change	2022/23	Difference
LP Leakage	50.7 GWh 57%	System pressures increased by 0.011mb causing increased emissions. Low Pressure metallic mains length decreased by 88.8km. MEG is not used within this LDZ Demand decreased by -11.7% impacting OUG and TOG by the same amount.	48.7 GWh 56%	-1.9 GWh -3.8%
MP Leakage	9.2 GWh 10%		9.3 GWh 11%	0.1 GWh 1.0%
Other (AGI's, OUG, Theft & Interference)	29.4 GWh 33%		28.6 GWh 33%	-0.8 GWh -2.8%
Total	89.3 GWh 100%		86.6 GWh 100%	-2.6 GWh -3.0%

South West England LDZ (SW) Network Performance

Component	2021/22	Drivers of Change	2022/23	Difference
LP Leakage	130.6 GWh 69%	System pressures increased by 0.003mb causing increased emissions. Low Pressure metallic mains length decreased by 276.5km. MEG is not used within this LDZ Demand decreased by -12.3% impacting OUG and TOG by the same amount.	123 GWh 68%	-7.6 GWh -5.8%
MP Leakage	18.5 GWh 10%		18.6 GWh 10%	0.1 GWh 0.5%
Other (AGI's, OUG, Theft & Interference)	39.7 GWh 21%		38.5 GWh 21%	-1.2 GWh -3.1%
Total	188.9 GWh 100%		180.1 GWh 100%	-8.7 GWh -4.6%

SGN Performance





SGN Network Performance

Component	2021/22	Drivers of Change	2022/23	Difference
LP Leakage	428.3 GWh 69%	System pressures decreased by 0.04mb causing decreased emissions. Low Pressure metallic mains length decreased by 772.2km. MEG saturations increased 8.2% Demand decreased by -5.3% impacting OUG and TOG by the same amount.	408.5 GWh 68%	-19.8 GWh -4.6%
MP Leakage	55.7 GWh 9%		55.4 GWh 9%	-0.3 GWh -0.5%
Other (AGI's, OUG, Theft & Interference)	139.4 GWh 22%		138.3 GWh 23%	-1.1 GWh -0.8%
Total	623.4 GWh 100%		602.2 GWh 100%	-21.2 GWh -3.4%

South East LDZ (SE) Network Performance

Component	2021/22	Drivers of Change	2022/23	Difference
LP Leakage	205.7 GWh 77%	System pressures decreased by 0.139mb causing decreased emissions. Low Pressure metallic mains length decreased by 334.1km. MEG saturations decreased 1.1% Demand decreased by -6.2% impacting OUG and TOG by the same amount.	196.8 GWh 76%	-8.9 GWh -4.3%
MP Leakage	13.8 GWh 5%		13.7 GWh 5%	-0.1 GWh -0.8%
Other (AGI's, OUG, Theft & Interference)	48.3 GWh 18%		47.3 GWh 18%	-1 GWh -2.0%
Total	267.8 GWh 100%		257.8 GWh 100%	-10 GWh -3.7%

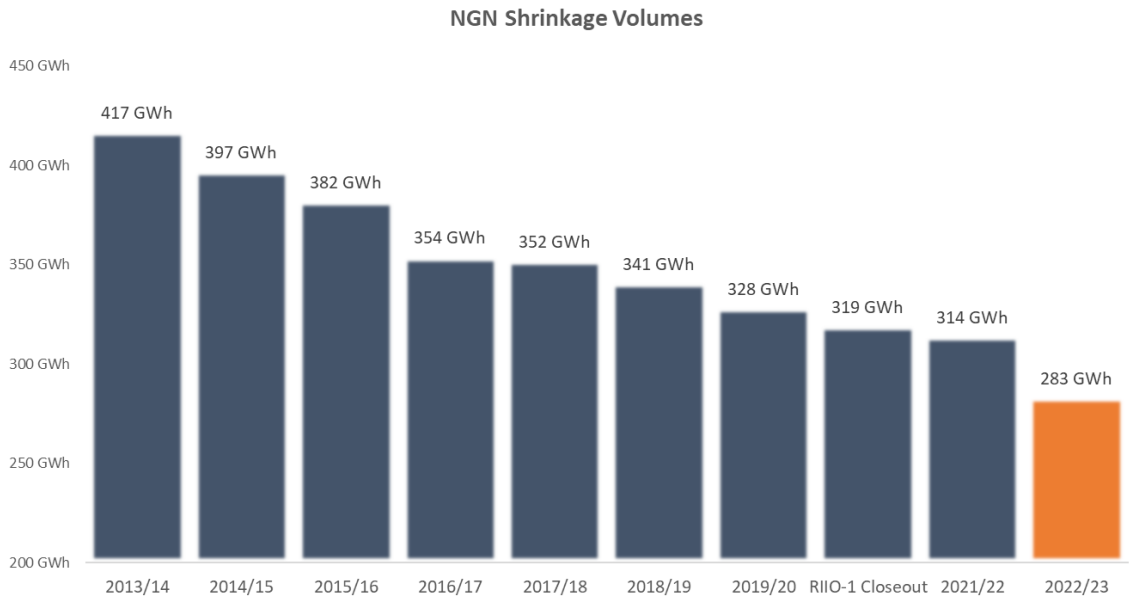
South LDZ (SO) Network Performance

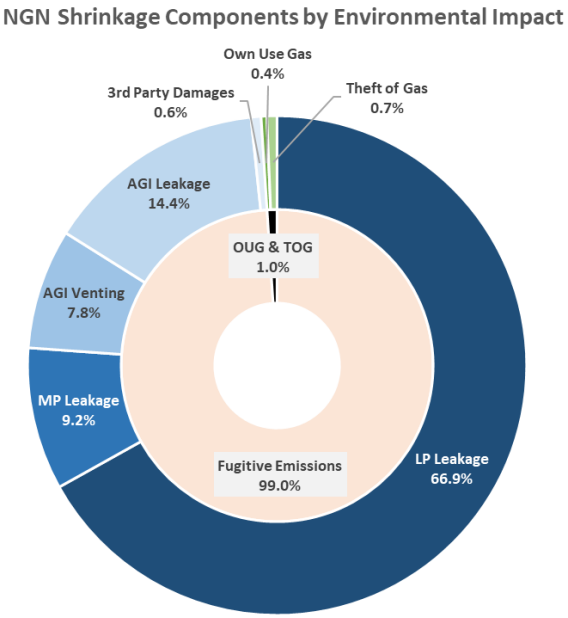
Component	2021/22	Drivers of Change	2022/23	Difference
LP Leakage	119.5 GWh 64%	System pressures increased by 0.043mb causing increased emissions. Low Pressure metallic mains length decreased by 191.4km. MEG saturations increased 0% Demand decreased by -8.3% impacting OUG and TOG by the same amount.	115.5 GWh 63%	-4.1 GWh -3.4%
MP Leakage	26.6 GWh 14%		26.5 GWh 14%	-0.1 GWh -0.3%
Other (AGI's, OUG, Theft & Interference)	42.1 GWh 22%		42.1 GWh 23%	0 GWh 0.0%
Total	188.2 GWh 100%		184.1 GWh 100%	-4.1 GWh -2.2%

Scotland LDZ (SC) Network Performance

Component	2021/22	Drivers of Change	2022/23	Difference
LP Leakage	103 GWh 62%	System pressures decreased by 0.007mb causing decreased emissions. Low Pressure metallic mains length decreased by 246.7km. MEG saturations increased 9.8% Demand decreased by -2.3% impacting OUG and TOG by the same amount.	96.2 GWh 60%	-6.8 GWh -6.6%
MP Leakage	15.2 GWh 9%		15.1 GWh 9%	-0.1 GWh -0.7%
Other (AGI's, OUG, Theft & Interference)	49.1 GWh 29%		48.8 GWh 30%	-0.3 GWh -0.7%
Total	167.3 GWh 100%		160.1 GWh 100%	-7.2 GWh -4.3%

NGN Performance





Northern Gas Networks Network Performance

Component	2021/22	Drivers of Change	2022/23	Difference
LP Leakage	207.3 GWh 66%	System pressures decreased by 1.82mb causing decreased emissions. Low Pressure metallic mains length decreased by 464km. MEG saturations increased 22.3% Demand decreased by -11.9% impacting OUG and TOG by the same amount.	179.1 GWh 63%	-28.2 GWh -13.6%
MP Leakage	25 GWh 8%		24.7 GWh 9%	-0.3 GWh -1.2%
Other (AGI's, OUG, Theft & Interference)	81.7 GWh 26%		79.6 GWh 28%	-2.1 GWh -2.6%
Total	314 GWh 100%		283.4 GWh 100%	-30.6 GWh -9.7%

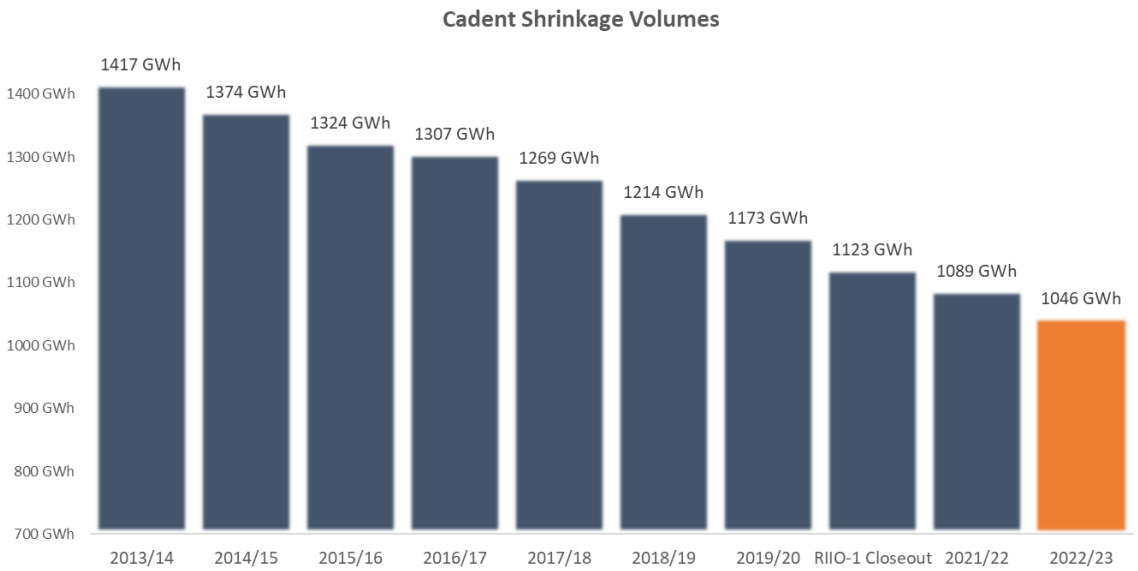
North East (Yorkshire) LDZ Network Performance

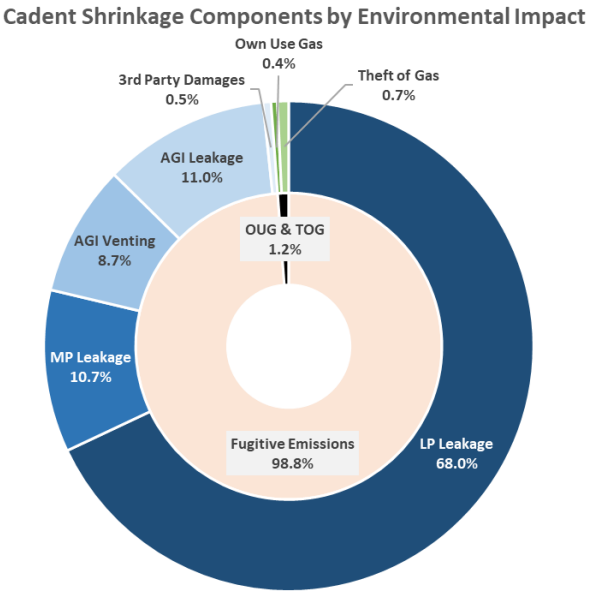
Component	2021/22	Drivers of Change	2022/23	Difference
LP Leakage	112.6 GWh 66%	System pressures decreased by 2.335mb causing decreased emissions. Low Pressure metallic mains length decreased by 245.5km. MEG saturations increased 13.2% Demand decreased by -12.1% impacting OUG and TOG by the same amount.	96.3 GWh 63%	-16.4 GWh -14.5%
MP Leakage	16.1 GWh 9%		16 GWh 10%	-0.1 GWh -0.7%
Other (AGI's, OUG, Theft & Interference)	41.2 GWh 24%		40.1 GWh 26%	-1.1 GWh -2.7%
Total	169.9 GWh 100%		152.4 GWh 100%	-17.6 GWh -10.4%

North LDZ Network Performance

Component	2021/22	Drivers of Change	2022/23	Difference
LP Leakage	94.7 GWh 66%	System pressures decreased by 1.211mb causing decreased emissions. Low Pressure metallic mains length decreased by 218.5km. MEG saturations increased 30.2% Demand decreased by -11.7% impacting OUG and TOG by the same amount.	82.8 GWh 63%	-11.9 GWh -12.6%
MP Leakage	8.9 GWh 6%		8.7 GWh 7%	-0.2 GWh -1.9%
Other (AGI's, OUG, Theft & Interference)	40.5 GWh 28%		39.5 GWh 30%	-1 GWh -2.4%
Total	144.1 GWh 100%		131 GWh 100%	-13 GWh -9.0%

Cadent Performance





Cadent Network Performance

Component	2021/22	Drivers of Change	2022/23	Difference
LP Leakage	705.4 GWh 65%	System pressures increased by 0.11mb causing increased emissions. Low Pressure metallic mains length decreased by 1593.1km. MEG saturations increased 4.8% Demand decreased by -6.5% impacting OUG and TOG by the same amount.	666.9 GWh 64%	-38.5 GWh -5.5%
MP Leakage	106.6 GWh 10%		104.9 GWh 10%	-1.7 GWh -1.6%
Other (AGI's, OUG, Theft & Interference)	276.8 GWh 25%		273.9 GWh 26%	-2.9 GWh -1.0%
Total	1088.8 GWh 100%		1045.7 GWh 100%	-43.1 GWh -4.0%

East Anglia LDZ Network Performance

Component	2021/22	Drivers of Change	2022/23	Difference
LP Leakage	115.6 GWh 63%	System pressures increased by 0.53mb causing increased emissions. Low Pressure metallic mains length decreased by 302.5km. MEG is not used within this LDZ Demand decreased by -6.6% impacting OUG and TOG by the same amount.	111.1 GWh 62%	-4.5 GWh -3.9%
MP Leakage	14.6 GWh 8%		14.5 GWh 8%	-0.1 GWh -0.5%
Other (AGI's, OUG, Theft & Interference)	53.2 GWh 29%		53.8 GWh 30%	0.6 GWh 1.2%
Total	183.4 GWh 100%		179.5 GWh 100%	-3.9 GWh -2.1%

East Midlands LDZ Network Performance

Component	2021/22	Drivers of Change	2022/23	Difference
LP Leakage	99.6 GWh 51%	System pressures increased by 0.306mb causing increased emissions. Low Pressure metallic mains length decreased by 280.2km. MEG saturations increased 7.5% Demand decreased by -7% impacting OUG and TOG by the same amount.	94.5 GWh 50%	-5.1 GWh -5.1%
MP Leakage	39.3 GWh 20%		39.4 GWh 21%	0.1 GWh 0.4%
Other (AGI's, OUG, Theft & Interference)	58.3 GWh 30%		56.9 GWh 30%	-1.4 GWh -2.3%
Total	197.2 GWh 100%		.926634240547 G 100%	-6.3 GWh -3.2%

North London LDZ Network Performance

Component	2021/22	Drivers of Change	2022/23	Difference
LP Leakage	131.1 GWh 67%	System pressures decreased by 0.036mb causing decreased emissions. Low Pressure metallic mains length decreased by 283.2km. MEG saturations increased 6% Demand decreased by -6.2% impacting OUG and TOG by the same amount.	122.6 GWh 67%	-8.5 GWh -6.5%
MP Leakage	18.6 GWh 10%		16.9 GWh 9%	-1.7 GWh -8.9%
Other (AGI's, OUG, Theft & Interference)	45.3 GWh 23%		44.4 GWh 24%	-0.9 GWh -2.0%
Total	195 GWh 100%		183.9 GWh 100%	-11.1 GWh -5.7%

North West LDZ Network Performance

Component	2021/22	Drivers of Change	2022/23	Difference
LP Leakage	186.7 GWh 70%	System pressures increased by 0.01mb causing increased emissions. Low Pressure metallic mains length decreased by 423.3km. MEG saturations increased 9.5% Demand decreased by -7% impacting OUG and TOG by the same amount.	174.5 GWh 68%	-12.2 GWh -6.5%
MP Leakage	14.5 GWh 5%		14.6 GWh 6%	0.1 GWh 0.4%
Other (AGI's, OUG, Theft & Interference)	67.2 GWh 25%		67.1 GWh 26%	-0.1 GWh -0.2%
Total	268.4 GWh 100%		256.2 GWh 100%	-12.2 GWh -4.6%

West Midlands LDZ Network Performance

Component	2021/22	Drivers of Change	2022/23	Difference
LP Leakage	172.4 GWh 70%	System pressures decreased by 0.164mb causing decreased emissions. Low Pressure metallic mains length decreased by 304km. MEG saturations decreased 2.4% Demand decreased by -5.5% impacting OUG and TOG by the same amount.	164.2 GWh 70%	-8.2 GWh -4.8%
MP Leakage	19.6 GWh 8%		19.5 GWh 8%	-0.1 GWh -0.7%
Other (AGI's, OUG, Theft & Interference)	52.8 GWh 22%		51.7 GWh 22%	-1.1 GWh -2.1%
Total	244.8 GWh 100%		235.3 GWh 100%	-9.5 GWh -3.9%