Shrinkage Leakage Model Review

Published 18th November 2016

Gas Distribution Networks have an obligation under Special Condition 1F Part E of the License to review the Shrinkage and Leakage Model on an annual basis and to consult on the outcome of that review with other GDN operators, gas shippers and interested parties.

Joint Gas Distribution Network submission

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Executive Summary

Gas Distribution Networks (GDN's) have an obligation under Special Condition 1F Part E of the Licence to review the Shrinkage and Leakage Model (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 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 in, or from each, GDN operated by a Licensee.

In the August and October Shrinkage Forums the GDN's representatives described the process of the SLM review and requested that the industry supply feedback of what they would like included. Although our licence obligation is to review the SLM to increase reporting accuracy, as a result of stakeholder feedback in 2015/16 we extended the publication to include extra elements. For the 2016/17 review, we have included additional information by way of a dashboard of measures by LDZ, Shrinkage Forum review, review of previous commitments and a review of the joint GDN workshops held during 2016.

The outcome of the joint GDN's SLM review is as follows:

Our Commitment	Further Detail	Owner	Next Steps
We will review the methods of Leakage Measurement and explore opportunities for any improvements.	GDN's will continue to explore options to determine the most appropriate method of leakage measurement	All GDN's	We will consider the following methods of leakage measurement:- 1. Pressure Decay Test 2. Partial Pressure Decay Tests 3. Pressure Variation method 4. Atmospheric study 5 Plus others
We will investigate the opportunity of reflecting the benefits of Remediated Pipes in the model.	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 leakage model, we will develop proposals to better reflect the benefits of mains remediation.	SGN	We will investigate the viability of applying a 'correction factor' to the existing leakage rates of individual mains assets within the model, based on a remediation capture report currently being developed by DNV GL. This will also provide a

			standardised, auditable framework to capture treated mains within our asset repository.
We will continue to investigate the calculations of Medium Pressure leakage in the model.	The Leakage Model takes account of average system pressure in low pressure calculations. This correction factor is not applicable for medium pressure. In 2016 an NIA project identified a correlation between pressure and leakage in medium pressure assets.	NG	We will explore the results of the NIA project that identified a correlation between pressure and leakage and the potential impact on leakage modelling.
We will continue to investigate the results of low carbon preheating trials on the Own Use Gas calculations in the model	During 2017 we will consider the outputs of both the NGN trial study and the SGN Innovation project into alternative pre-heating technology.	NGN & SGN	We will determine if there are any implications to the accuracy of the own use gas calculation in the leakage model.
We will review the calculations of <500kg Interference damage in the model.	Review 'below 500kg' interference damage calculation to improve the accuracy of the SLM	All GDN's	We will undertake a study to review the assumptions that are used in calculating the below 500kg interference damage leakage. If appropriate we will consider a modification to the SLM.
We will review the calculation of Theft Of Gas in the model.	Review calculation of theft upstream of the ECV	All GDN's	We will undertake a study to review the assumptions that are used in calculating theft of gas upstream of the ECV. If appropriate we will consider a modification to the SLM.
We will continue to hold Joint GDN Workshops during 2017.	Joint GDN Workshops to ensure consistency of approach in the application of the leakage model.	All GDN's	We will undertake quarterly Joint GDN best practise workshops

We will continue to increase industry awareness of shrinkage.	As part of GDN's attendance at Shrinkage Forums a detailed presentation on the workings of the SLM was provided.	All GDN's	We extend an open invitation to shippers to come visit each GDN's Shrinkage team.

The outcome of this consultation will be submitted to the authority on 31 December 2016.

Background

Gas Distribution Networks (GDN's) have an obligation under Special Condition 1F Part E of the Licence to review the Shrinkage and Leakage Model (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 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.

During the August 2016 and October 2016 Shrinkage Forums, the GDN representatives described the SLM review process and requested that the industry provide feedback of what they would like included. Although our licence obligation is to review the SLM to increase reporting accuracy, as a result of stakeholder feedback in 2015/16, we extended the publication to include some extra elements. . For the 2016/17 review, we have included additional information by way of a dashboard of measures by LDZ, Shrinkage Forum review, review of previous commitments and a review of the joint GDN workshops held during 2016.

We value all feedback and representations; responses to this document are encouraged and should be received no later 16th December 2016. Communication should be directed to John Morrison or via the Joint Office (contact details below).

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Joint Office: enquiries@gasgovernance.co.uk

We are specifically interested to understand the following:

1. What is the area(s) of shrinkage that is of particular interest to you and that you feel requires review or mention as part of this annual review process that isn't sufficiently captured within this document?

2. Is there any feedback you would like to share regarding this or previous Shrinkage Leakage Model Review documents?

Overview of Shrinkage

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

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

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

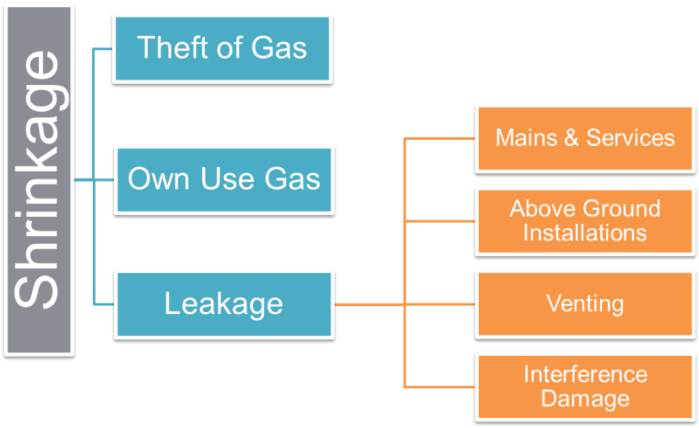


Figure 1: Breakdown of shrinkage also demonstrating the component parts of leakage

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

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

Components of Shrinkage

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

In 2002/03 a National Leakage Test (NLT) project was commissioned to repeat the leakage tests undertaken in 1992, these rates are used to determine leakage from low pressure mains and services and medium pressure mains. The leakage rates were determined using the pressure decay method, which was chosen as the leakage is deduced from an accurately measured drop in pressure. The project involved sampling 849 pipes and the results showed that in most cases the leakage rate for particular groups of mains were lower than found in 1992, principally in polyethylene, spun cast and pit cast iron material types.

Low Pressure Mains Leakage

Weighting: circa 60% of leakage.

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

Calculation method: Asset length (km) x annual leakage rate x average system pressure correction[1] x Monoethylene Glycol[2] correction (where applicable).

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

Low Pressure Service Leakage

Weighting: circa 18% of leakage.

Background: 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.

Calculation method: No. of services by category x annual leakage rate x average system pressure correction[1]

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

Medium Pressure Mains Leakage

Weighting: circa 8% of leakage.

[1] 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.
[2] 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.

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 does not include an average system pressure correction. To improve the accuracy of the calculation a pressure related calculation of leakage may be better, which would also facilitate a mechanism for achieving and reflecting leakage reduction through effective 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.

National Grid raised a Network Innovation Allowance (NIA) project to investigate the relationship between pressure and leakage on MP systems and to identify the appropriate methodology for estimating leakage from the UK's MP gas supply network. This project confirmed that there is a correlation between MP leakage and system pressure. Further analysis will be progressed to determine an appropriate method for reflecting this within the leakage model calculation methodology.

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

Rates: 6 rates

Above Ground Installation Leakage

Weighting: circa 8% of leakage.

Background: The leakage from AGIs was determined via the NTL programme, which established average leakage rates for five types of AGI.

Calculation method: Asset quantity x annual leakage rate.

Rates: 5 leakage rates (gas holders, NTS offtakes, LTS offtakes, 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.

GDN's have initiated site surveys (of which some are now complete) in support of a project raised by National Grid to review venting rates of the most commonly used pneumatic control equipment. A modification is being formulated that, if accepted by the industry, would allow the venting estimation to move to an activity based calculation.

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 escape 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).

National Grid Gas Distribution have released two consultations in relation to the modification of the interference damage >500kg calculation method. Work continues to develop the final proposal detailing the proposed mechanics of the modification which will be published shortly.

Calculation method: Multiple scenarios
>500kg interference damages: An assessment is made of each >500kg incident and included in the model.
<500kg interference damages (Mains): No. 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): No. of incidents split 50:50 between severed and punctured services. Different leakage rate and response time for severed and punctured services.

No. incidents x leakage rate x predetermined response/fix time

Theft of Gas

Weighting: circa 4% of shrinkage.

Background: Shrinkage includes an element of theft 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.

Calculation method: 0.02% of throughput.

Own Use Gas

Weighting: circa 2% of shrinkage.

Background: Own Use Gas 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.

Northern Gas Networks have made significant progress investigating Low Carbon Gas Preheating. This involves installing and monitoring the operational efficiency of a representative sample of preheating technologies. 8 sites are currently live with data being reported for the past few months; the final 4 sites are currently under construction. To

determine a robust data sample we would need to operate each of the 12 sites through a full heating season, with expected timescales for initial data analysis to be early 2017.

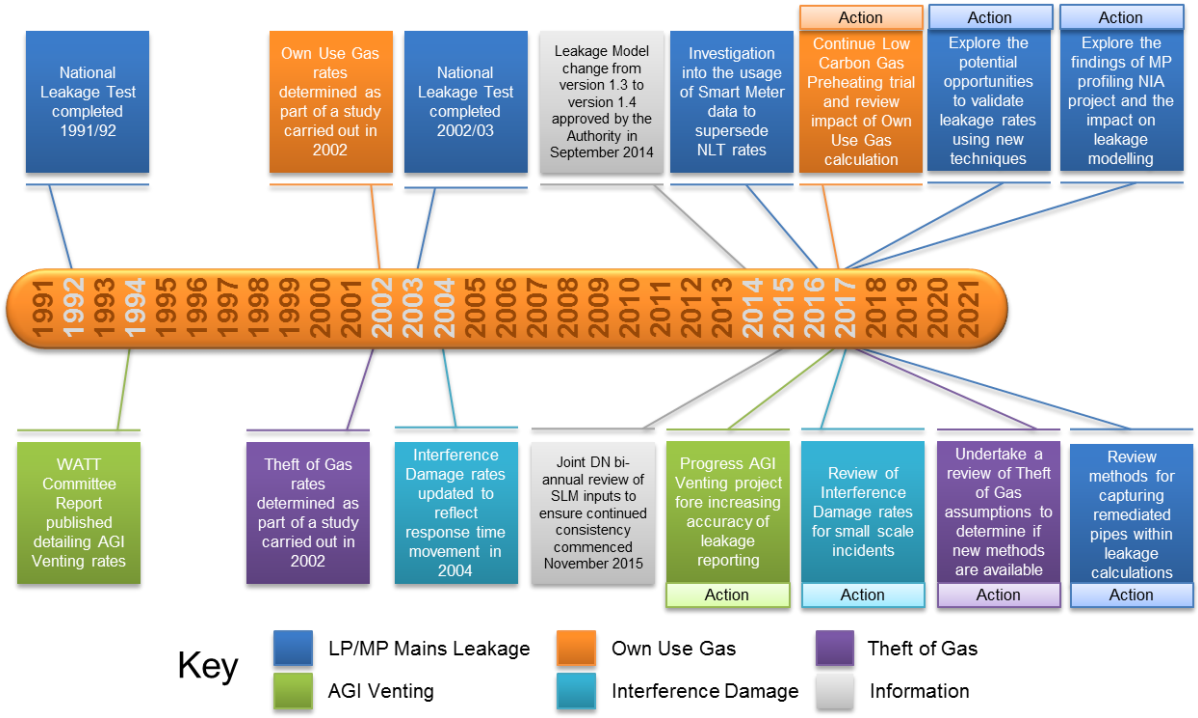
SGN have undertaken an Innovation project to review ProHeat's Immersion Tube preheating as an alternative to replacing bath type preheaters with modular preheat packages. Immersion Tube technology has better thermal efficiency over a range of loads than current single phase water bath preheating systems and also has a much lower environmental impact.

During 2017, GDN's will consider the output from these two studies and their implications for the SLM.

Calculation method: 0.0113% of throughput.

Shrinkage Components Timeline

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



Shrinkage Reduction Successes

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

Each GDN continues to see incremental improvements in shrinkage reduction; the main component of this is from our mains replacement programme; however we have made progress in a number of areas which have seen a positive impact in reducing Shrinkage:

- Implementation of 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. Furthermore, continuous review of established profiling systems is carried out to ensure they remain relevant to other changes taking place on the LP network.

- 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 full pressure profiling.

- Focused approach to improving levels of mono-ethylene glycol saturations with the associated impact of reduction in Leakage from impacted material joint types.

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

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

- Optimisation of pressures on all-PE networks.

- Three joint GDNs workshops have been held during 2015/16 to improve best practice, progress any SLM modifications and prepare material for Shrinkage Forum meetings

Previous Commitments Review

The table below provides an update on commitments the GDNs gave in the 2015 SLM.

Our Commitment	Further Detail
We will investigate opportunities to use Smart Meter data to calculate leakage.	Wales and West Utilities led our investigations into the use of Smart Meter data for leakage calculation. The output from these investigations are captured within our Report which can be found at: http://www.gasgovernance.co.uk/smsl
We will propose a modification to AGI Venting calculations as a result of a successful asset collection exercise.	National Grid have led on the development of the modification to the AGI Venting methodology within the Leakage Model. A consultation document is being developed that will be published in 2017.
We will continue to investigate the correlation between medium pressure leakage and system pressure.	National Grid raised a Network Innovation Allowance project to investigate the relationship between pressure and leakage on MP systems and to identify the appropriate methodology for estimating leakage from the UK's MP gas supply network. This project confirmed that there is a correlation between MP leakage and system pressure.
We will continue to investigate improvements to Own Use Gas and the associated modelling impact of using low carbon gas preheating equipment.	NGN are trialling different forms of gas Pre Heating results expected in early 2017. SGN have trialled ProHeat's Immersion Tube preheating as an alternative to replacing bath type preheaters. Results expected in 2017.
We will develop proposals to better reflect the benefits of mains remediation in the model.	SGN have developed a methodology to capture treated mains within the asset repository and have commissioned DNV GL to produce a remediation capture report in order to record the level of sealant coverage at each joint on an individual asset basis.
We will hold a periodic joint GDN session to ensure continuity in accuracy of reporting.	The GDN's have held three sessions, a review of these is included within this document (section: Joint Distribution Network Best Practice Sessions).
We will offer opportunities to increase industry awareness of shrinkage calculations.	At the October 2016 Shrinkage Forum GDN's provided Shippers with a detailed presentation on the SLM. We continue to offer opportunities for discussions that would assist in the understanding of Shrinkage calculations.

We will propose, as part of the 2016/17 SLMR, our future plans for reviewing Interference Damage rates.	We have prioritised the Interference damage with the greatest impact i.e. Above 500kg and have a draft proposal for a modification to the SLM and we will continue to review the below 500kg instances.
We will add more transparency of key milestones in those projects with the potential to impact the Shrinkage Leakage Model methodology.	The GDN's published a key milestone timeline for the AGI Venting modification and discussed during presentations at Shrinkage Forums the progress of other Shrinkage projects.
We will implement a reporting dashboard detailing the movements in the main components of the Shrinkage Leakage Model calculations.	Annual reporting measures are and will be included in future SLMR documents. The outputs for 2015/16 are captured within the appendix of this document (See Appendix - LDZ Performance).

Energy UK Gas Retail Group Study Into The effect Of Shrinkage on Domestic Customers

During 2015 the Gas Retail Group commissioned Imperial College to investigate the effect of shrinkage on domestic customers and to consider the accuracy of the SLM recommending areas for investigation.

For details of the full report please refer to the Office of Gas Transporters website:

http://www.gasgovernance.co.uk/sites/default/files/GRG%20shrinkage%20study%20FINAL.pdf

In May 2015, representatives of each GDN attended an overview session with members of the Gas Retail Group and Imperial College. The session was primarily to allow the Distribution Networks to understand the content of the report and discuss the findings.

For details of the GDN response to this report please refer to the Office of Gas Transporters website.

Shrinkage Forum Review

During 2016 there have been 5 Shrinkage Forums, facilitated by the Joint Office of Gas Transporters, with a further meeting scheduled for December 2016. These meetings have been attended by all GDN's, various representatives from the Shipping community and other interested parties.

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

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

Presentations and updates undertaken by GDN's at the 2016 Shrinkage Forums include:

- Network Innovation presentation – Opening up the Gas Market
- Future Billing Methodology NIC project
- MEG Strategy update
- AGI Venting Controller presentation
- Low Carbon Gas Preheating Project Progress Report
- Shrinkage Overview presentation
- Draft Shrinkage Forum Terms of Reference

Joint GDN Best Practice Sessions

The GDN's made a commitment in 2015/16 to increase collaboration in Shrinkage related matters. The GDN's held three sessions during 2015/16 which have driven the following outputs:

1. **Review of all inputs into the leakage model to ensure consistency of working**

The GDN's reviewed all the inputs that feed into the SLM that determines our annual output position. The review focused on determining that a standard and consistent process is applied in each GDN. The areas of review included all elements of the data input process. The findings concluded that each GDN is populating SLM in a consistent way.

2. **Security of Leakage Model**

The GDN's have discussed best practice in securing the SLM to avoid erroneous data entry or corruption of formulae. Each GDN has a number of security measures in place. The GDN's are currently reviewing the feasibility of an independent audit of the model calculations.

3. **Modification discussions**

The GDN's have used the sessions to review any SLM modifications and ensure that for all proposals there is a combined and consolidated view of the best method of progression and a single view of the best approach.

Over the last year the GDN's have contributed a significant amount of material for discussion and presentation at Shrinkage Forums, this has primarily come from discussion at the Joint Distribution Network best practice sessions.

4. **Energy UK Gas Retail Group Study Into the Effect of Shrinkage on Domestic Customers**

These sessions have facilitated a detailed review and response to the Energy UK Gas Retail Group Study into The Effect of Shrinkage on Domestic Customers report (link provided within this report).

The relationships between the GDN's has been strengthened by the introduction of the joint workshops and facilitated opportunities for best practice sharing, for example, in the areas of MEG saturation.

Our Commitments

The outcome of the joint GDNs SLM review is as follows (this replicates the table in the Executive Summary):

Our Commitment	Further Detail	Owner	Next Steps
We will review the methods of Leakage Measurement and explore opportunities for any improvements.	GDN's will continue to explore options to determine the most appropriate method of leakage measurement	All GDN's	We will consider the following methods of leakage measurement:- 5. Pressure Decay Test 6. Partial Pressure Decay Tests 7. Pressure Variation method 8. Atmospheric study 5 Plus others
We will investigate the opportunity of reflecting the benefits of Remediated Pipes in the model.	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 leakage model, we will develop proposals to better reflect the benefits of mains remediation.	SGN	We will investigate the viability of applying a 'correction factor' to the existing leakage rates of individual mains assets within the model, based on a remediation capture report currently being developed by DNV GL. This will also provide a standardised, auditable framework to capture treated mains within our asset repository.
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We will continue to hold Joint GDN Workshops during 2017.	Joint GDN Workshops to ensure consistency of approach in the application of the leakage model.	All GDN's	We will undertake quarterly Joint GDN best practise workshops
We will continue to increase industry awareness of shrinkage.	As part of GDN's attendance at Shrinkage Forums a detailed presentation on the workings of the SLM was provided.	All GDN's	We extend an open invitation to shippers to come visit each GDN's Shrinkage team.

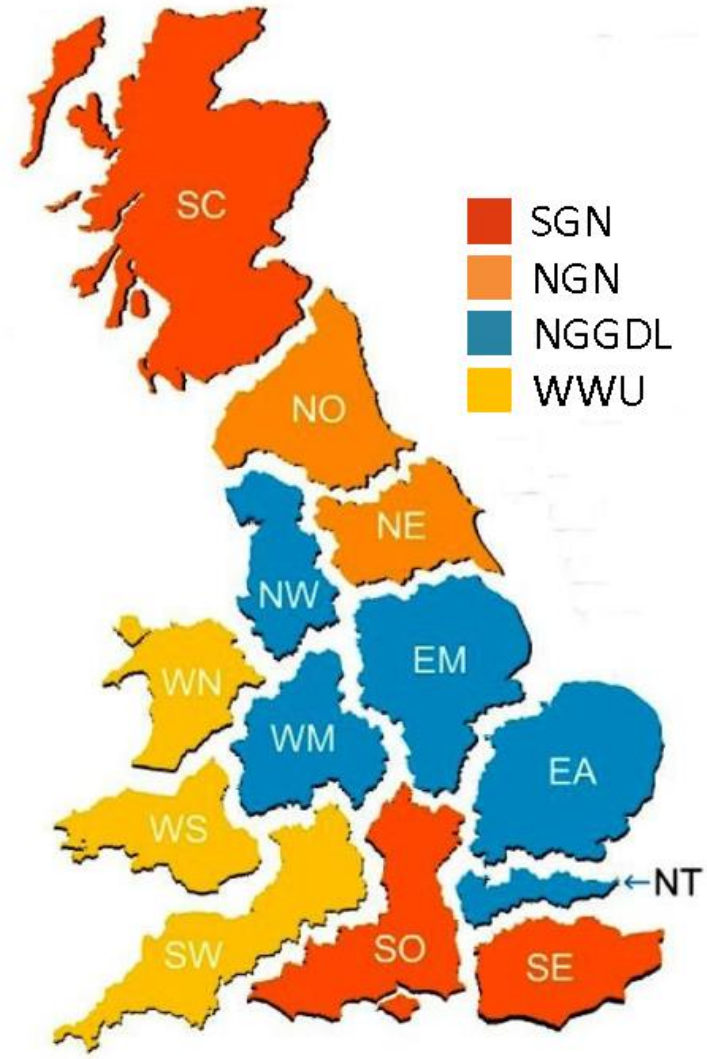
The outcome of this consultation will be submitted to the authority on 31 December 2016.

Appendix – LDZ Performance

The performance breakdown contained within the following pages demonstrates the main components of Shrinkage for each local distribution zone. The introduction of these performance measures is as a result of feedback received during the 2015/16 SLMR stakeholder consultation. These measures have been developed in conjunction with attendees at Shrinkage Forums throughout 2015/16.

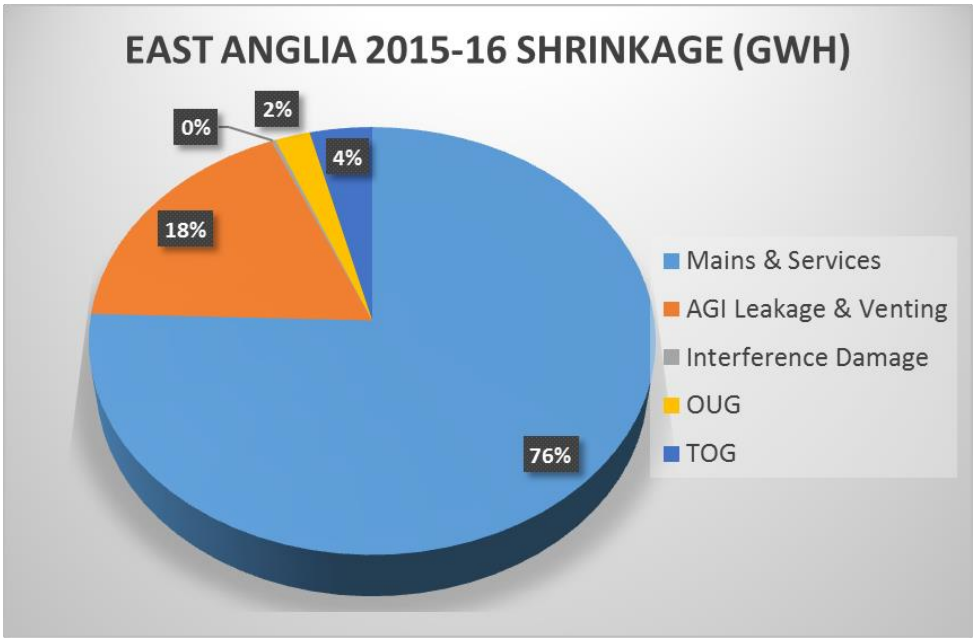
The performance breakdown will be updated annually and published within future SLMR consultation documents.

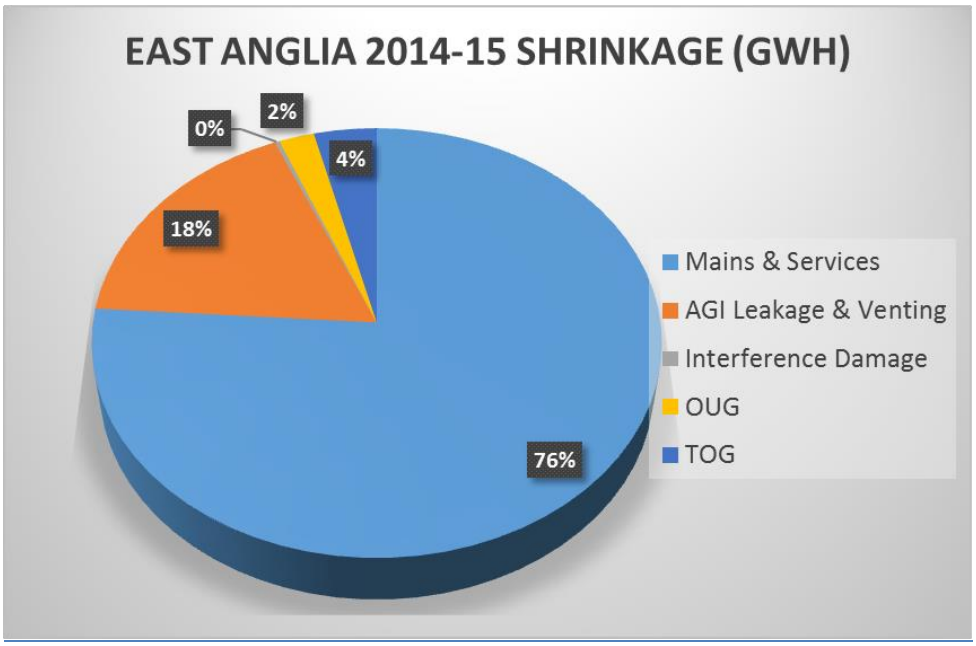
The network map below shows the geographic location of each LDZ colour coded by network owner.



EA LDZ Performance

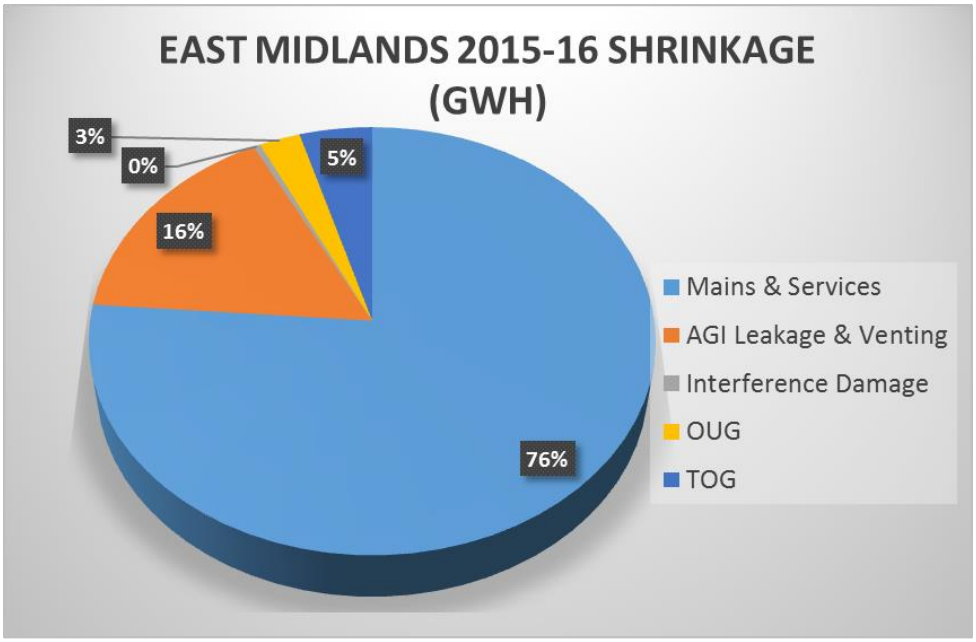
	2014-15 Shrinkage (GWh)	2015-16 Shrinkage (GWh)
Mains & Services	161.5	158.0
AGI Leakage & Venting	37.3	38.0
Interference Damage	0.6	0.6
OUG	4.7	4.6
TOG	8.3	8.2
Total	212.4	209.3

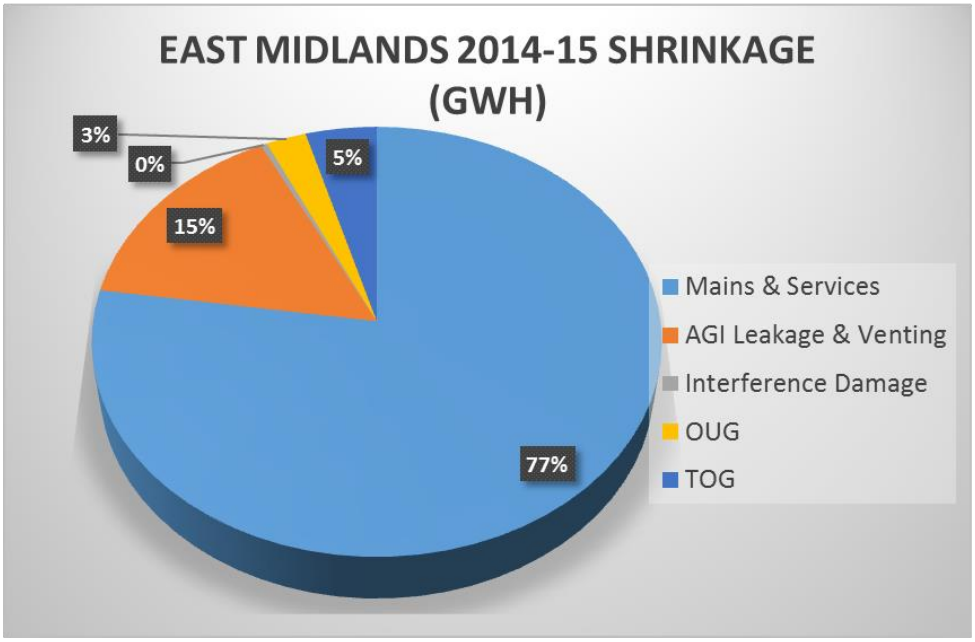




EM LDZ Performance

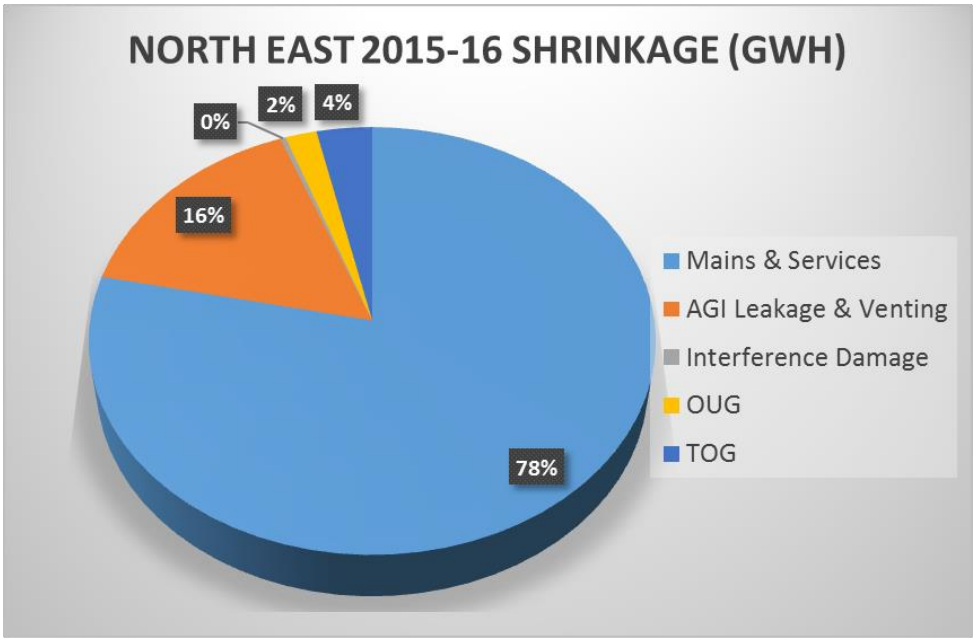
	2014-15 Shrinkage (GWh)	2015-16 Shrinkage (GWh)
Mains & Services	193.4	183.1
AGI Leakage & Venting	38.3	39.0
Interference Damage	1.0	1.0
OUG	6.3	6.2
TOG	11.1	10.9
Total	250.0	240.2

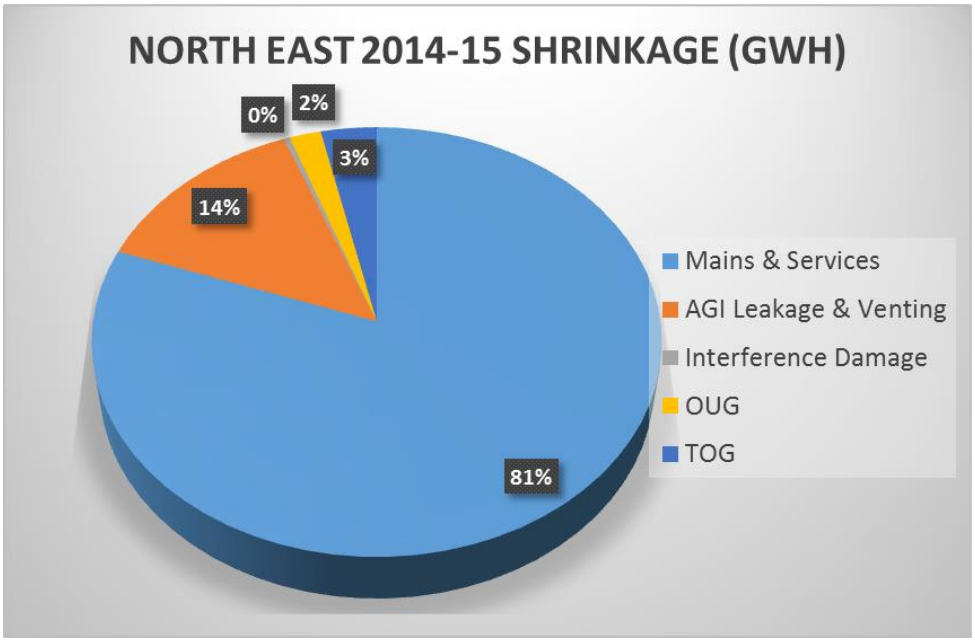




NE LDZ Performance

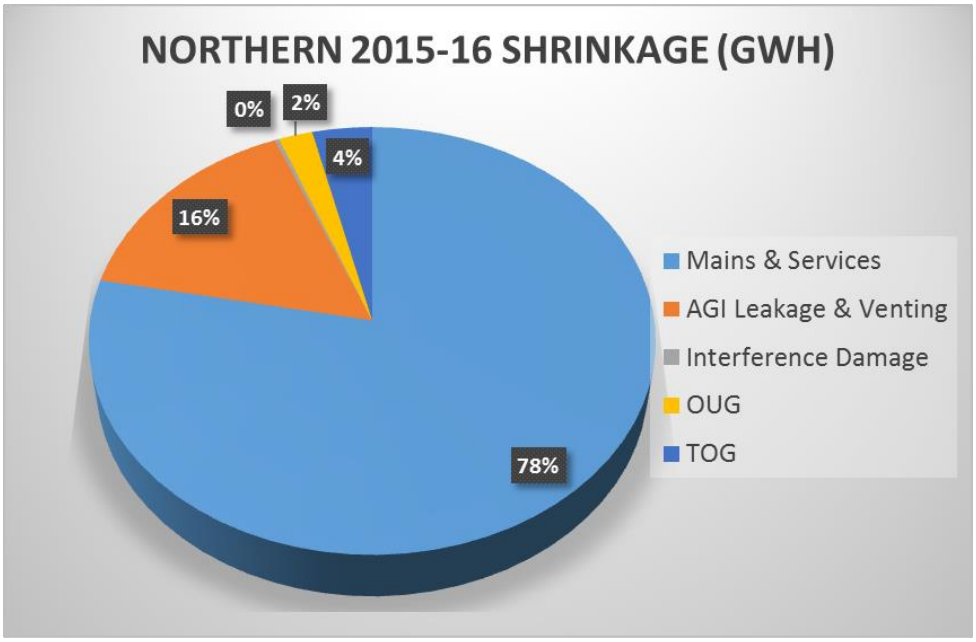
	2014-15 Shrinkage (GWh)	2015-16 Shrinkage (GWh)
Mains & Services	176.1	167.1
AGI Leakage & Venting	30.0	33.8
Interference Damage	0.8	0.7
OUG	4.3	4.2
TOG	7.6	7.4
Total	218.7	213.2

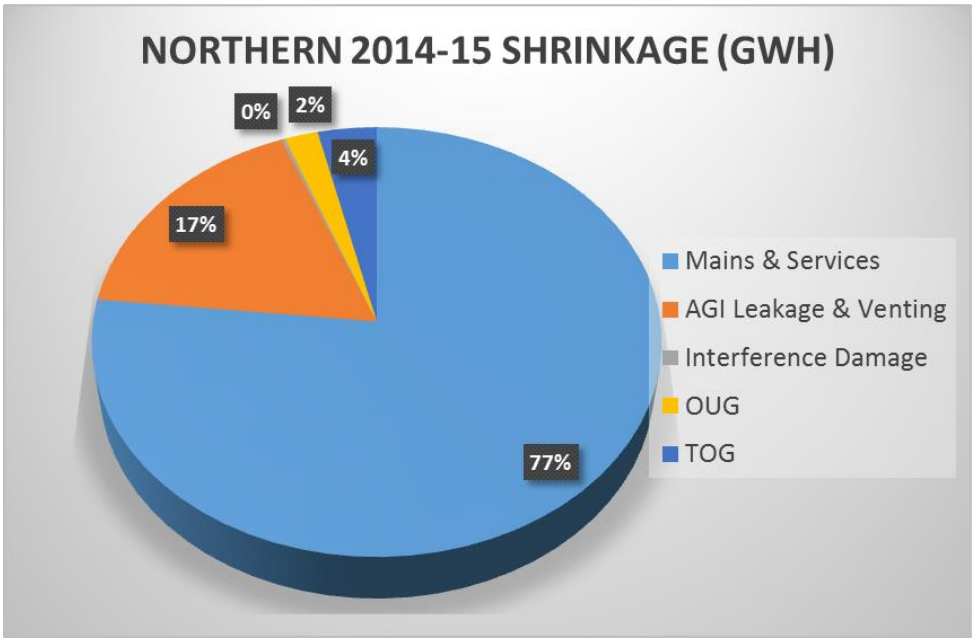




NO LDZ Performance

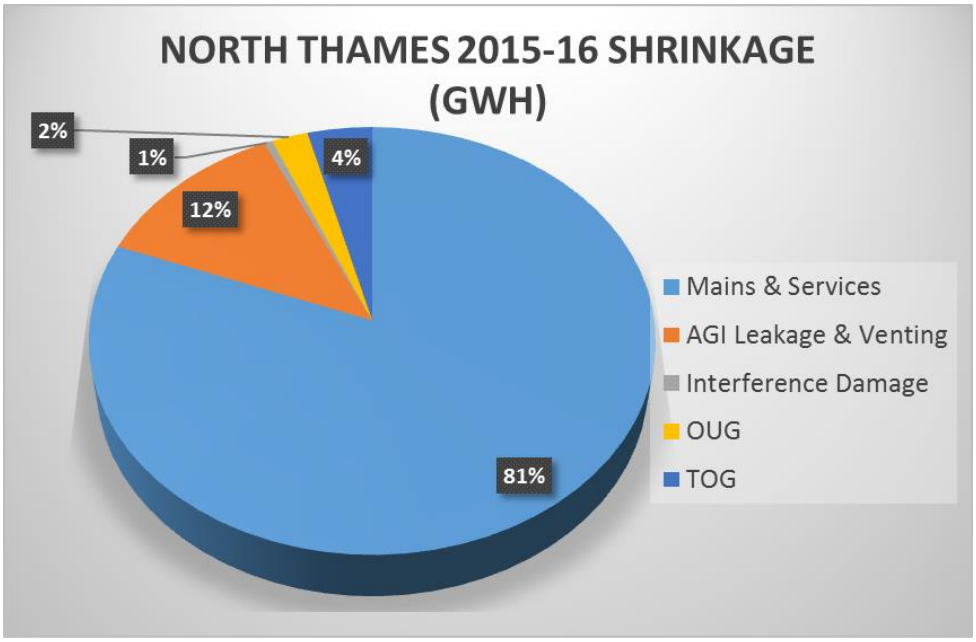
	2014-15 Shrinkage (GWh)	2015-16 Shrinkage (GWh)
Mains & Services	136.7	131.5
AGI Leakage & Venting	30.9	26.6
Interference Damage	0.4	0.5
OUG	3.7	3.6
TOG	6.5	6.3
Total	178.3	168.4

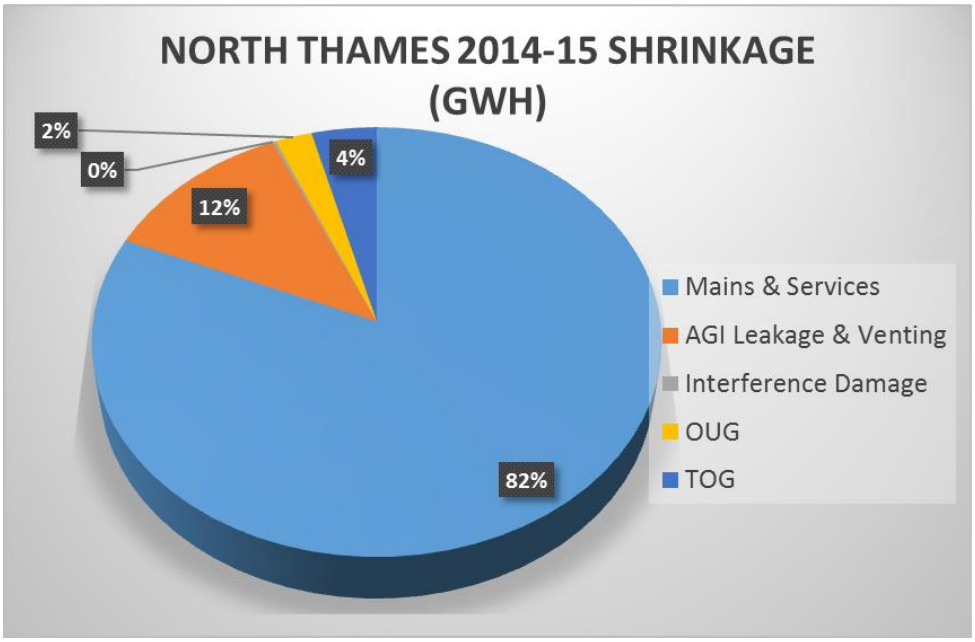




NT LDZ Performance

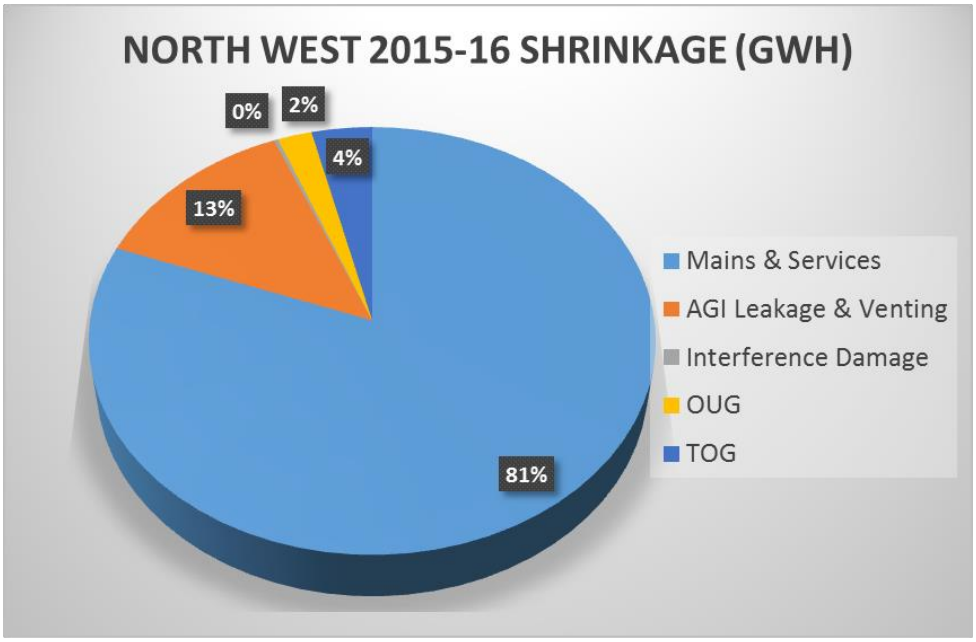
	2014-15 Shrinkage (GWh)	2015-16 Shrinkage (GWh)
Mains & Services	202.7	197.6
AGI Leakage & Venting	29.9	30.0
Interference Damage	0.5	1.2
OUG	5.7	5.6
TOG	10.1	9.9
Total	248.9	244.4

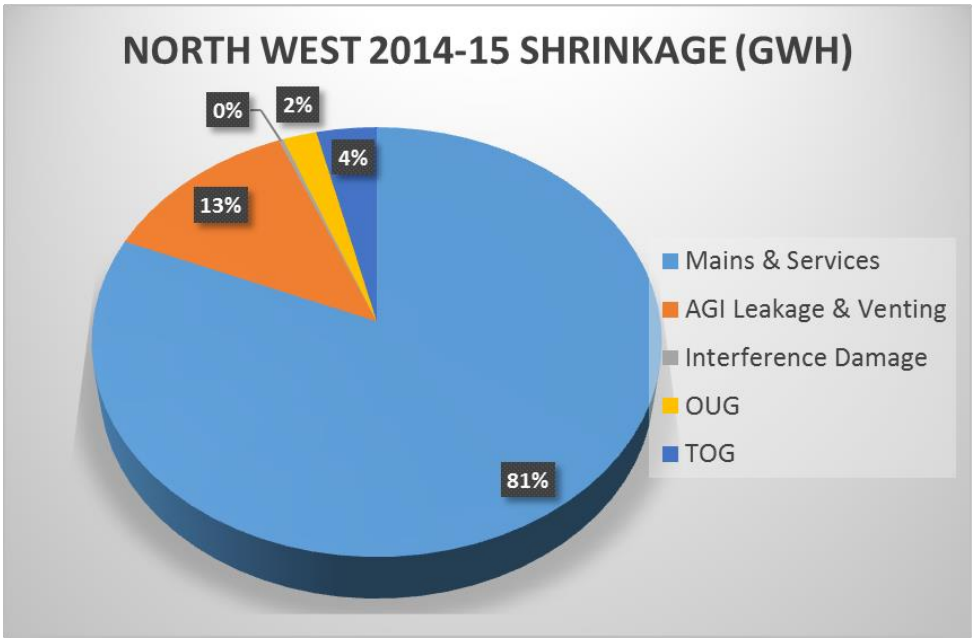




NW LDZ Performance

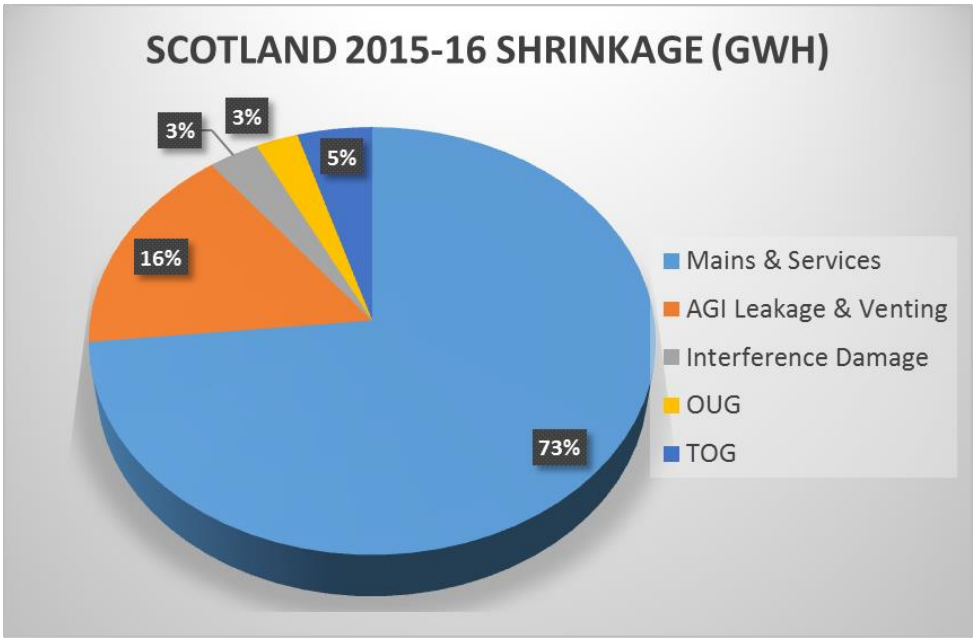
	2014-15 Shrinkage (GWh)	2015-16 Shrinkage (GWh)
Mains & Services	289.5	278.3
AGI Leakage & Venting	44.5	45.1
Interference Damage	1.0	0.9
OUG	7.5	7.4
TOG	13.3	13.1
Total	355.9	344.7

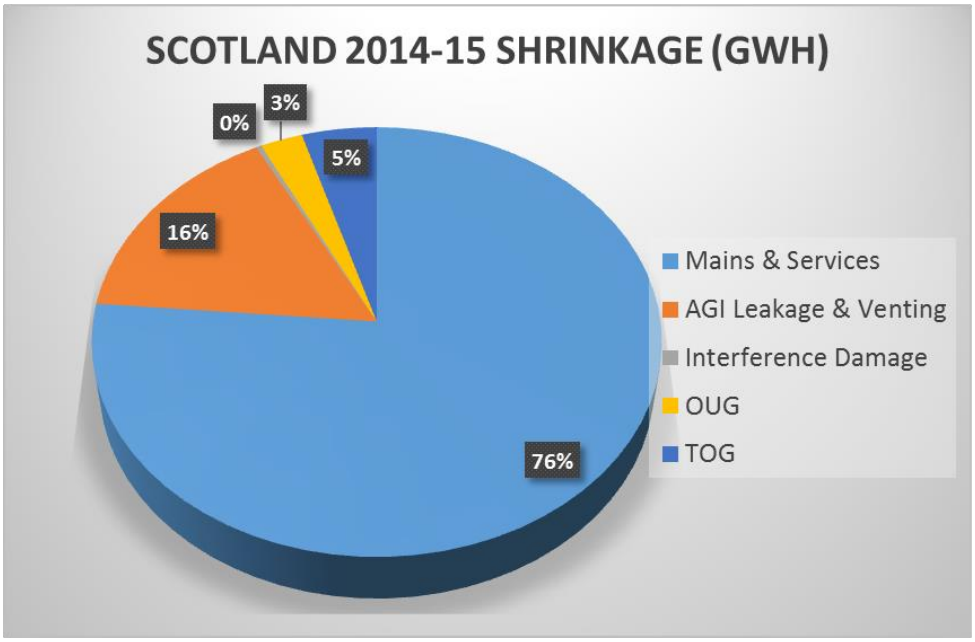




SC LDZ Performance

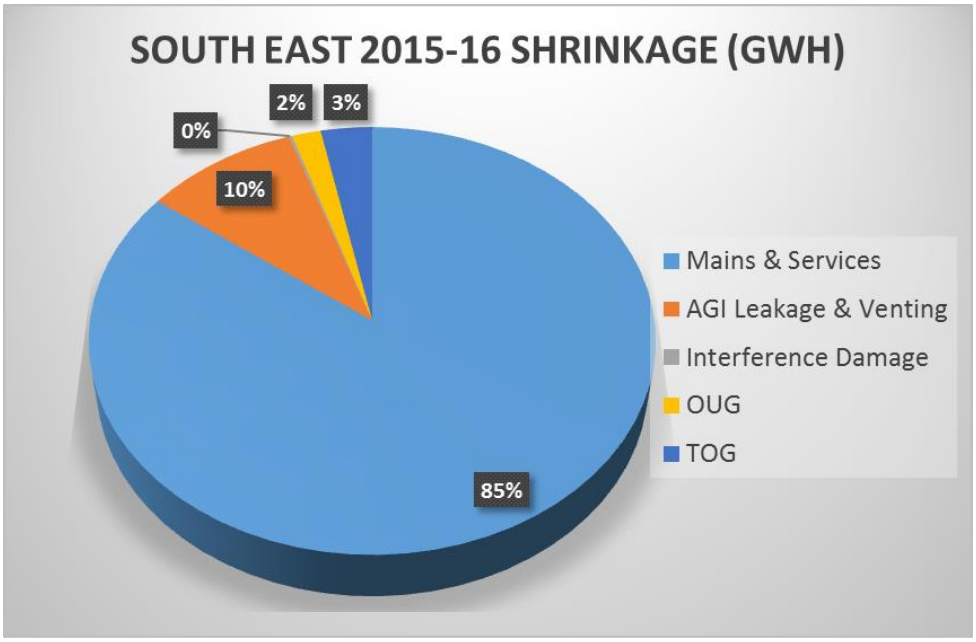
	2014-15 Shrinkage (GWh)	2015-16 Shrinkage (GWh)
Mains & Services	162.9	155.0
AGI Leakage & Venting	34.5	34.5
Interference Damage	0.7	6.7
OUG	5.6	5.6
TOG	9.9	10.0
Total	213.6	211.8

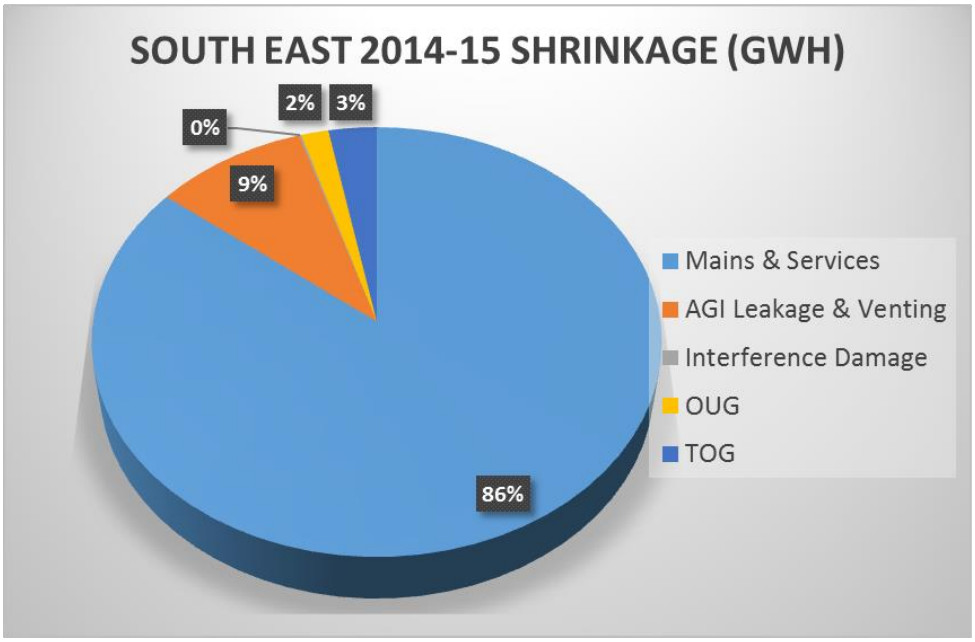




SE LDZ Performance

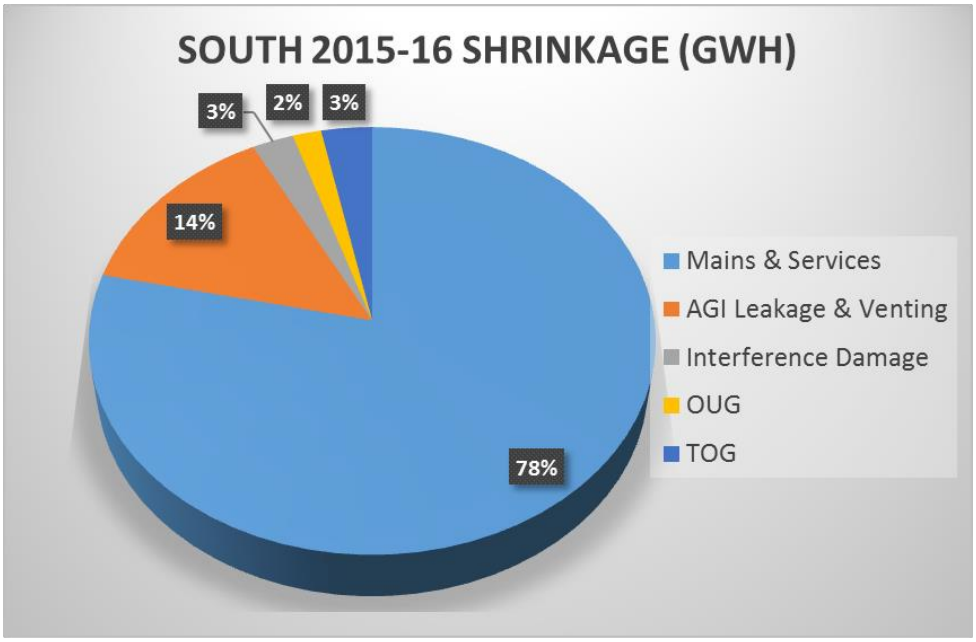
	2014-15 Shrinkage (GWh)	2015-16 Shrinkage (GWh)
Mains & Services	296.5	282.9
AGI Leakage & Venting	32.1	31.9
Interference Damage	0.5	0.7
OUG	5.9	6.0
TOG	10.4	10.7
Total	345.4	332.2

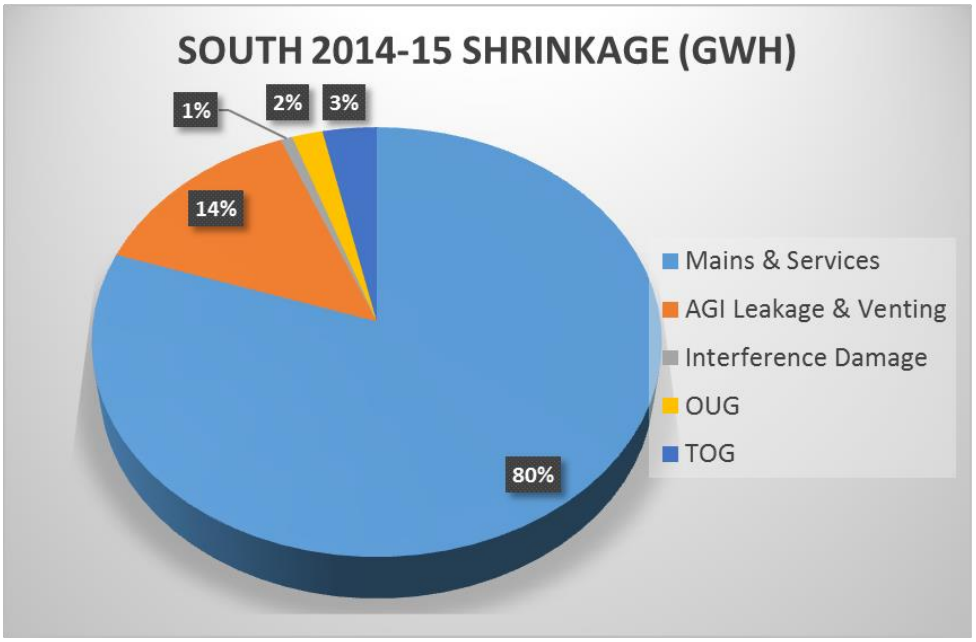




SO LDZ Performance

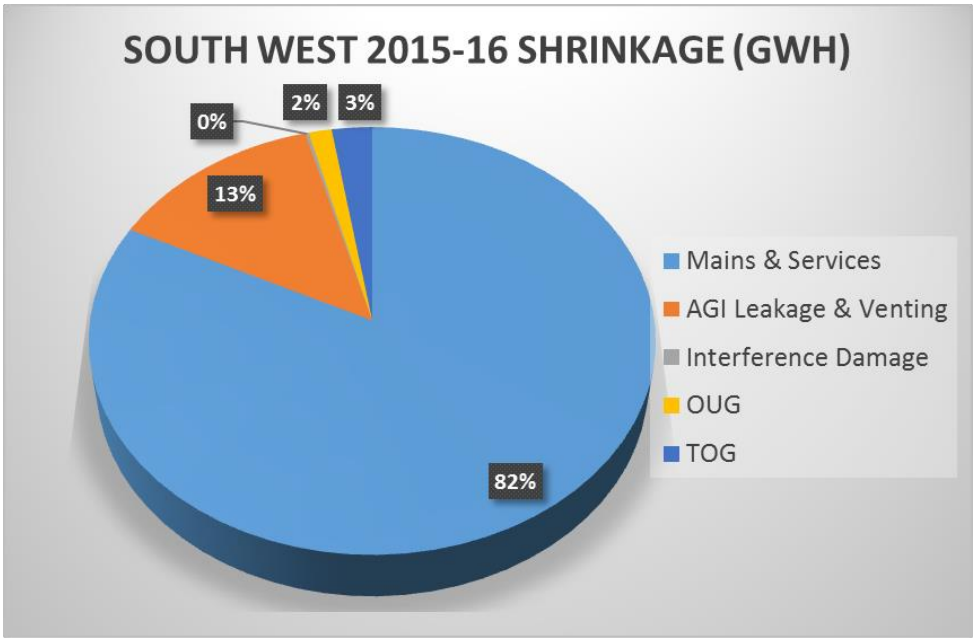
	2014-15 Shrinkage (GWh)	2015-16 Shrinkage (GWh)
Mains & Services	181.4	174.7
AGI Leakage & Venting	30.3	30.4
Interference Damage	1.7	5.8
OUG	4.3	4.0
TOG	7.5	7.1
Total	225.2	222.0

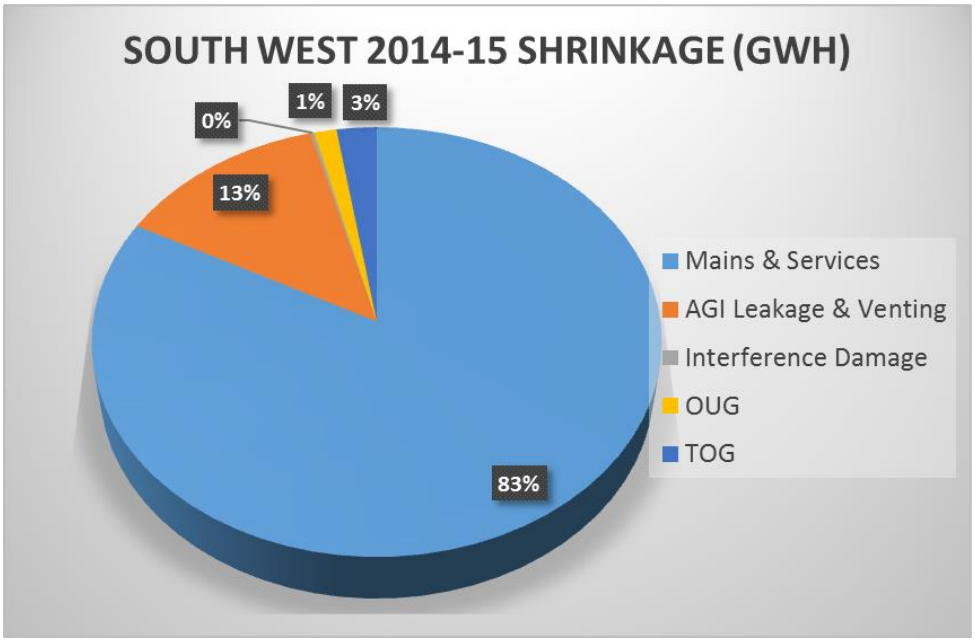




SW LDZ Performance

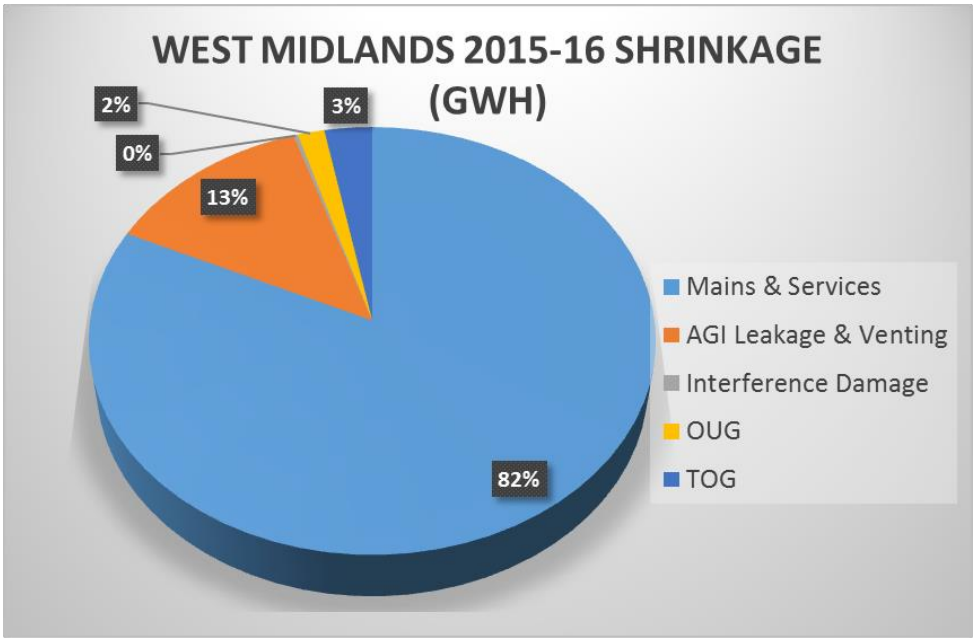
	2014-15 Shrinkage (GWh)	2015-16 Shrinkage (GWh)
Mains & Services	189.2	182.7
AGI Leakage & Venting	30.0	29.8
Interference Damage	0.5	0.5
OUG	3.2	3.2
TOG	5.7	5.6
Total	228.6	221.8

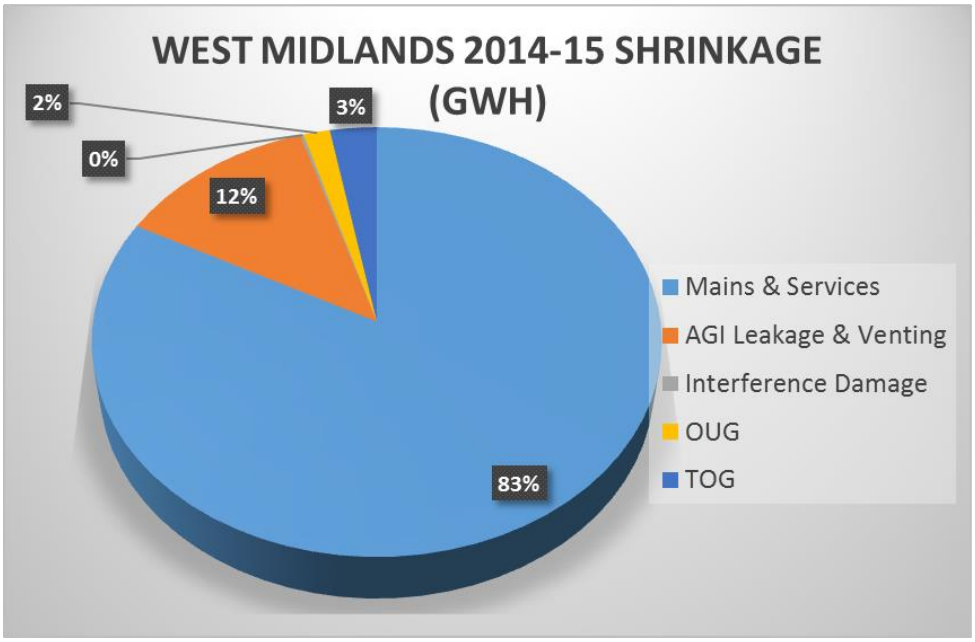




WM LDZ Performance

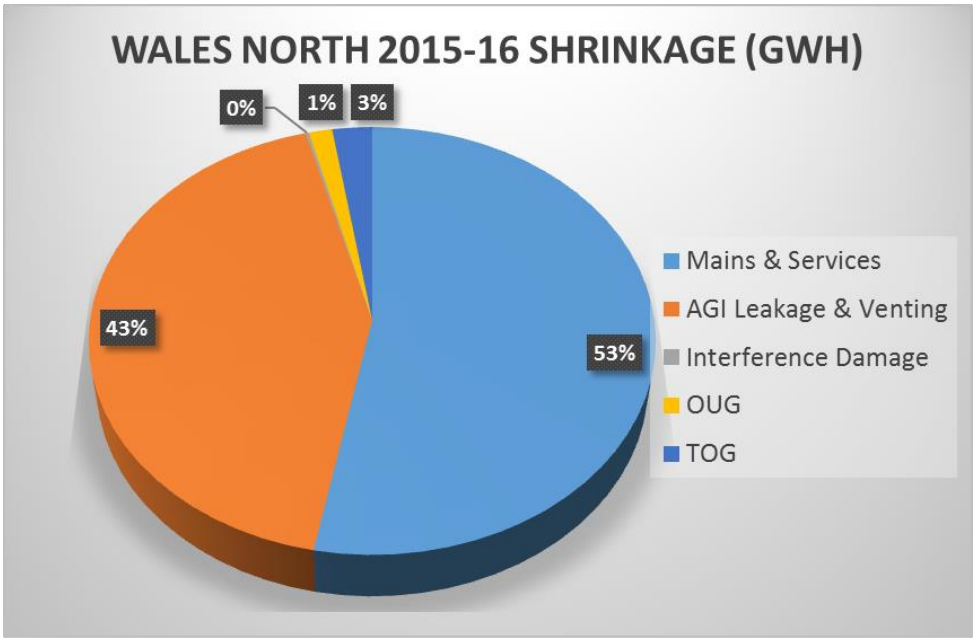
	2014-15 Shrinkage (GWh)	2015-16 Shrinkage (GWh)
Mains & Services	250.5	237.8
AGI Leakage & Venting	37.8	37.9
Interference Damage	0.6	0.7
OUG	5.0	4.9
TOG	8.8	8.7
Total	302.7	290.1

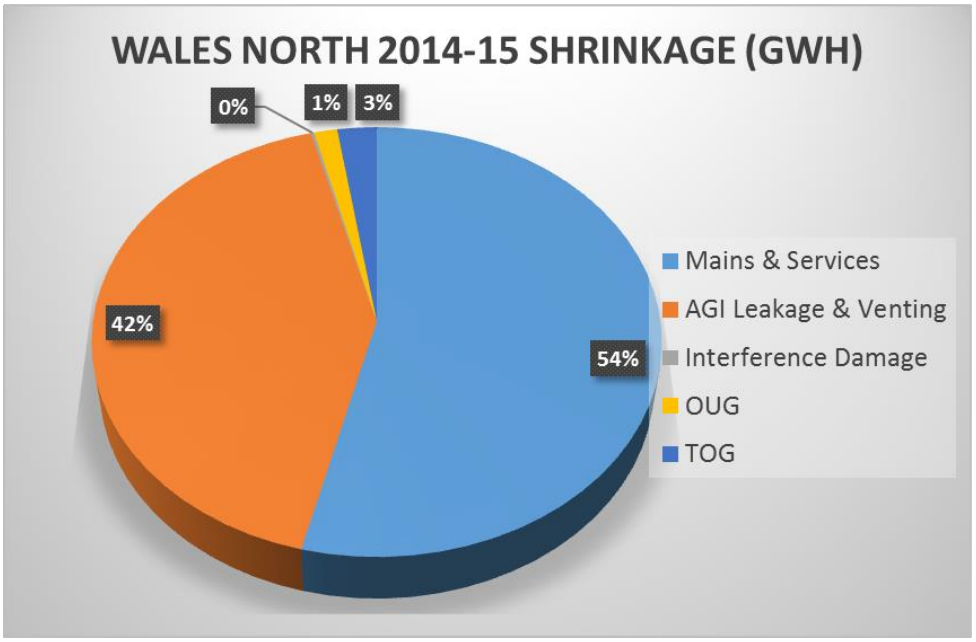




WN LDZ Performance

	2014-15 Shrinkage (GWh)	2015-16 Shrinkage (GWh)
Mains & Services	26.4	25.5
AGI Leakage & Venting	20.6	20.6
Interference Damage	0.1	0.1
OUG	0.7	0.7
TOG	1.2	1.2
Total	49.0	48.1





WS LDZ Performance

	2014-15 Shrinkage (GWh)	2015-16 Shrinkage (GWh)
Mains & Services	86.8	81.2
AGI Leakage & Venting	22.2	22.4
Interference Damage	0.2	0.2
OUG	2.8	2.7
TOG	5.0	4.8
Total	117.0	111.3