Tech talk 6: Annual emissions estimates from in-field methane surveys

26th November 2025

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1.
Introduction

Digital Platform for Leakage Analytics (DPLA) aims to significantly reduce gas network leaks and emissions in a cost-effective way

Aim: develop and demonstrate a functional Minimum Viable Product (MVP) for how **data, analytics and models can be used to identify and locate gas leaks in the gas distribution network**.

Core functionality: **data-driven leakage modelling**, unlocking proactive leak detection capabilities, combined with testing the application of novel gas sensor technologies.

Mission: reduce **carbon emissions**, realise **customer benefits** and **improve safety** in a **cost-effective way**

Funding: DPLA is one of SIF (Strategic Innovation Fund) projects for the Gas Transmission and Distribution sectors in the UK and it has been developed according to the following phases:

Discovery
- March-April 2022
- Feasibility studies

Alpha
- August 2022-February 2023
- Experimental development

Beta
- September 2023 to November 2025
- Build, operation and/or demonstration

Project partners:

Cadent Your Gas Network — **Lead Network**

Guidehouse Outwit Complexity — **Delivery Partner**

national gas transmission, Northern Gas Networks, WALES&WEST UTILITIES, SGN Your gas. Our network. — **Network Partners**

Throughout the project Beta phase six Tech Talk webinars have been delivered on a range of topics

The first three talks in the series focus on emerging technologies and sectors which are adjacent or related to the Digital Platform for Leakage Analytics (DPLA).

The later three talks focus on specific technologies which have been developed or implemented as part of the DPLA

Emerging technologies

A wide-ranging overview of emerging technologies and how they might relate to the DPLA project.

Undertaken at the start of the Beta phase (Jan 24)

Digital twins

An introduction into Digital twins including what they are, some of their different applications and how they relate to DPLA.

Gas & Water

A summary of leak detection across the Gas and Water industries. Including where the sectors are different, similar and potential areas for collaboration.

Machine learning for leak detection

An overview of the probabilistic machine learning model developed during the DPLA project Beta phase, how it works, the results obtained and how the outputs will feed into the platform.

Leak detection technologies

An overview of the advanced methane leak detection (ALD) technologies available, how they work, selection for trials within DPLA and how selected technologies will feed into the platform.

Emissions estimates

An overview of the statistical process developed to calculate emissions estimates from periodic infield surveys, why this is necessary and how the outputs feed into the DPLA platform.

This project presents substantial financial, environmental, safety, and consumer benefits

- **Financial** benefits due to lower gas leakage volumes, achieved by targeting larger leaks sooner, leading to lower volumes of gas lost per year and lower shrinkage costs
- **Environmental** benefits as in a 10-year period DPLA could facilitate up to a 58% reduction in methane emissions from pipes and Above Ground Installations (AGIs)
- **Customer** benefits linked to the monetary and social value of the volume of natural gas that would have leaked from the network

Additional benefits and use cases:

Provide Leak Alerts

Proactive Emergency Intervention

Reduce the risk to humans and properties

Improve Network Understanding

Condition Based Monitoring

Improve the understanding of the state of network assets by proactively detecting leaks rather than relying on models alone

Improved Asset Replacement and Maintenance

Leverage improved understanding of the network and leakage hotspots to tailor and better target maintenance cycles and AGI replacement

Accurate Modelling of the Network Leakage

Gas Leakage Regulatory Reporting

Provide more accurate annual reports of gas leakage compared to the current Shrinkage and Leakage Model (SLM)

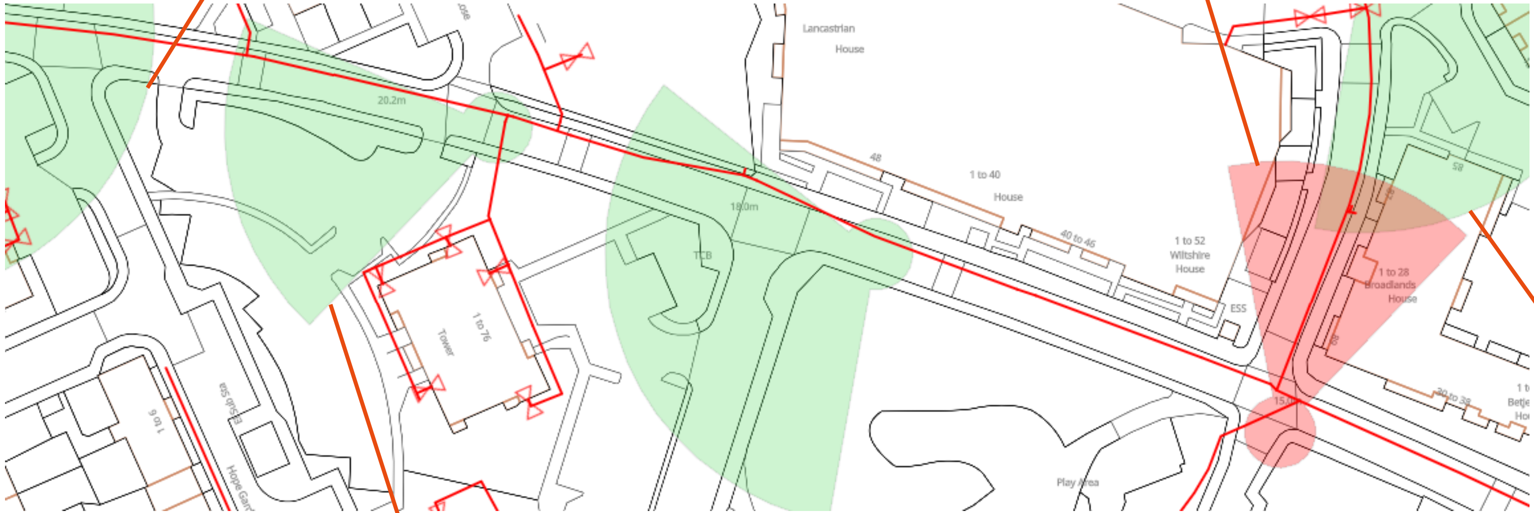
Regulatory Performance and Revenue Generation

Measure accurately network performance in reducing shrinkage/leakage and develop a fair incentive mechanism

Leak indications from periodic surveys need to be analysed and combined to provide total emissions estimates

Vehicle-based ALD systems periodically survey the network. Detected leak indications are processed into a standard DPLA format and displayed in the UI

Leak indications are colour coded according to severity to enable proactive response and effective prioritisation



Indications have geospatial coordinates to map where they were recorded. However, they are not linked to any given asset.

Surveys covering different parts of the network take place at different times throughout the year providing periodic snapshots. These somehow need to be combined to estimate the total annual emissions

There are multiple sources of uncertainty which need to be accounted for in estimating total emissions from surveys

Sampling uncertainty

Surveys measure emissions at a single point in space and time so are unable to cover or monitor all assets over the period in which they are emitting.

Intermittent sampling introduces **sampling variability** which refers to the idea that two random samples can produce different estimates.

Measurement uncertainty

Measurement error is introduced by the sensors used for methane detection. These **sensors will never be perfectly accurate in detecting or quantifying a leak**.

The skewed underlying distribution for emission rates also means that leaks are more likely to be over rather than underestimated.

Error on individual measurements propagates through calculating the cumulative emissions.

Model uncertainty

Modelling error is introduced through assumptions made when direct measurements are converted into estimates of an individual quantified leak rate.

Measurement and modelling errors can be impacted by multiple external factors (weather and external inputs, complex sampling environment, sensor limitations, etc.) but combine with sampling errors to create uncertainty in cumulative emissions estimates.

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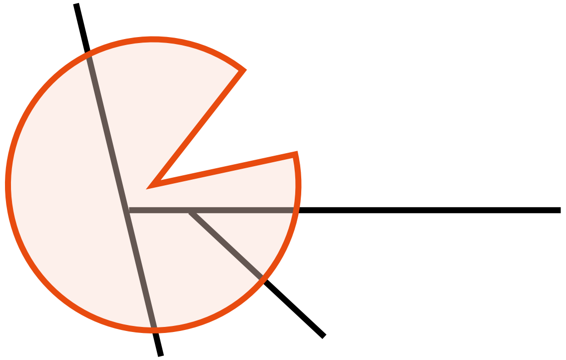
2.
Snapping overview

To understand asset-level leakage and calculate annual emissions estimates, indications first must be attributed to given assets

Indication in

Indication with associated emission rate and buffer area which overlaps assets (often multiple).



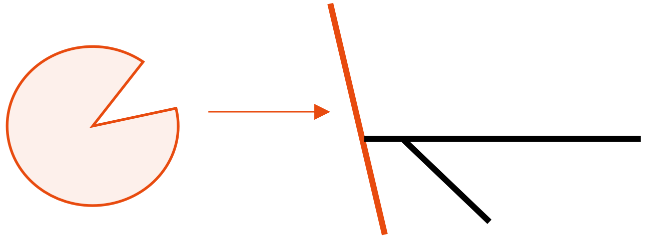
Weightings

All assets which intersect with the indication buffer are assigned a weighting based on specific asset parameters.

These weightings tell us which asset is the most likely to have caused a leak indication.

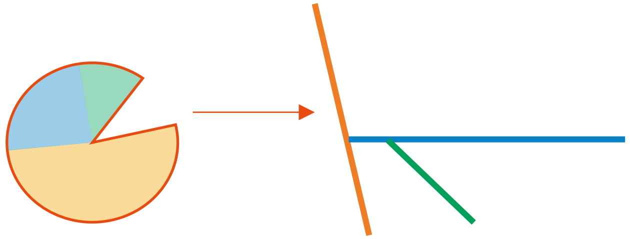
Output 1: single assignment

For each indication, the most likely asset it comes from.



Output 2: multiple assignment

Indications split proportionally across assets according to their weightings to provide an asset-level leak rate



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3.
Emissions calculation

The cumulative statistics process enables key DPLA benefits to be unlocked

Goals

Our aim is to realise key DPLA benefits through collected in-field methane detection data.

Once measured indications have been attributed to assets, they then need to be aggregated to estimate total emissions.

Improved Asset Replacement and Maintenance

Gas Leakage Regulatory Reporting

Challenge

This is challenging because:

- Different areas of the network are surveyed at different snapshots in time
- Some areas may be surveyed more frequently than others
- Environmental conditions vary throughout the year and can impact measurements
- Leak size distributions across distribution networks are skewed meaning that measured emission rates are more likely to be overestimated

Solution

We have developed a data-driven statistical process which:

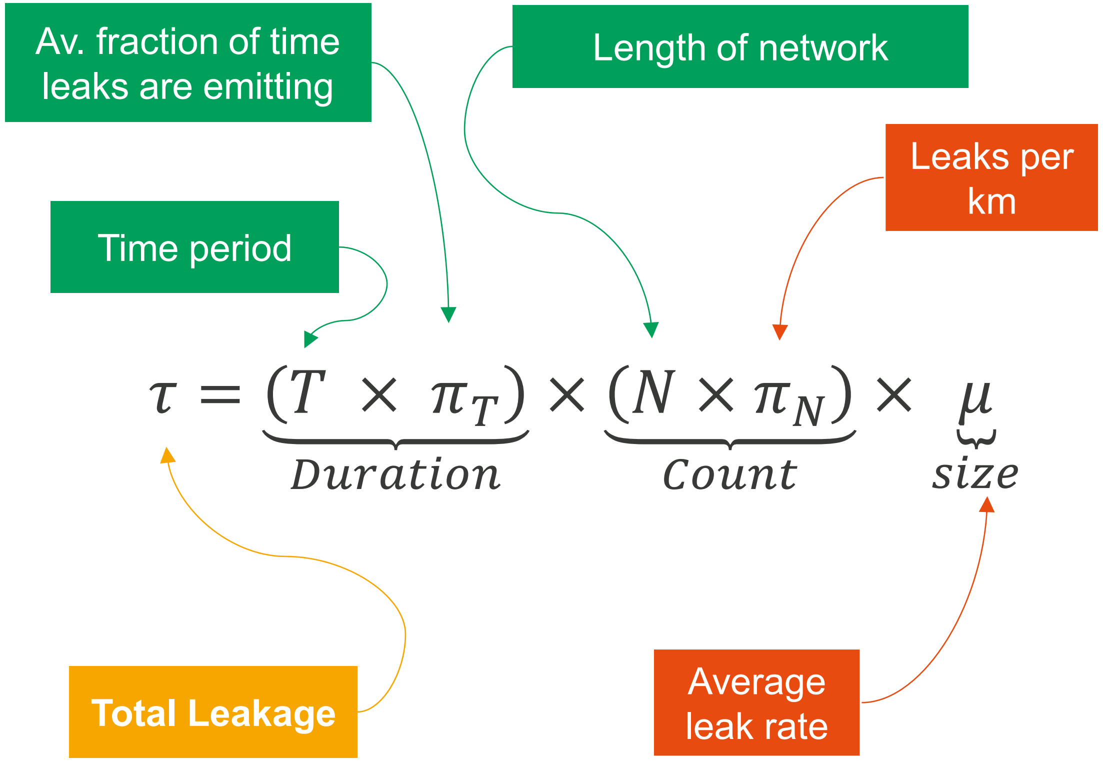
- Follows the methodology and guidance laid out in the Veritas protocols
- Appropriately assesses uncertainty and allows it to be propagated through each step
- Allows annual emissions estimates to be calculated and compared to the current SLM
- Can be applied to any survey-based leak detection technology which complies with the DPLA format

The Veritas Protocols propose a high-level methodology to calculate emissions estimates, with uncertainty, which adhere to international reporting standards

There are two main industry standards guiding the use of in-field detection technologies in gas distribution networks:

1. **OGMP 2.0** provides a reporting framework and describes different kinds of technologies alongside how they should be used to best measure emissions. For example, what level of sensor coverage is required for a representative sample.
2. **The Veritas Protocols** describe the end-to-end processes to construct statistically relevant emission inventories, essentially adding further detail under the OGMP 2.0 standard.

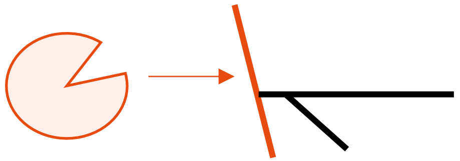
The DPLA cumulative statistics process automates the statistical methodology laid out in the Veritas Protocols to provide emissions estimates in the DPLA platform.



Calculating π_N and μ in the Veritas equation is challenging and relies on the raw measured emission rates, assigned to assets through the snapping process

Calculating leaks per km (π_N)

The number of leaks per km for each material type is calculated using the **single assignment** output from the snapping process. The number of indications assigned to assets of a given material is divided by the total length of assets of that material which have been surveyed.

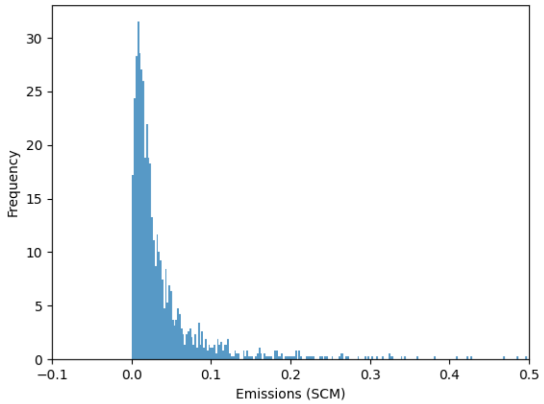


$$\frac{\text{Number of indications assigned to material type}}{\text{Length of surveyed assets of that material type}} = \pi_N$$

(per material)

Calculating average leak rate (μ)

The average leak rate calculation also relies on the **single assignment** output. This gives a range of emission rates for each material type. Different values for the average leak rate are sampled from this range to calculate a range of values for the total emissions.



→ $\{\mu_1, \cdots, \mu_N\}$

(per material)

For each material, the mean of the outputs from the Veritas equation gives the total emissions estimate

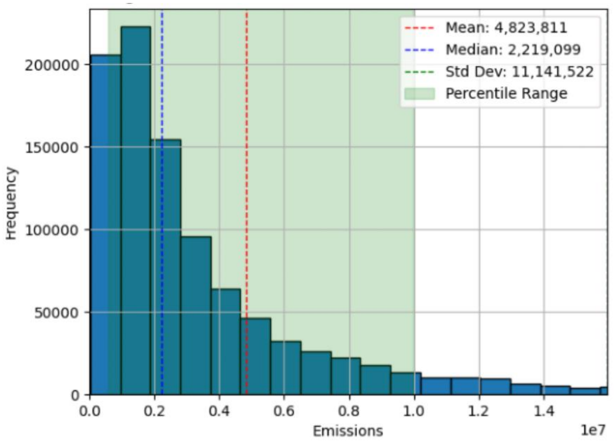
Inputs	
Leak rate data ($\boldsymbol{\mu}$)	**=** single assignment measured indications $\{\mu_1, \cdots, \mu_N\}$
Leaks per km ($\boldsymbol{\pi_N}$)	= number indications/network length surveyed
Fraction of time emitting ($\boldsymbol{\pi_T}$)	= 1
Network length (**N**)	= km of pipes in network
Total time (**T**)	= 365 days

Output distribution

Leak rates (μ) are sampled from the input data to calculate n samples of the total annual emissions (τ):

$$\tau_1 = \mu_1 \times 1 \times \pi_N \times N \times T$$

τ is calculated n times to build a distribution:



Output

The reported output τ is the mean of the output distribution i.e. the average of all the generated samples:

$$\boldsymbol{\tau = mean(\tau_1 \cdots \tau_N)}$$

The process is repeated for each material type and surveyed area.

The output distribution provides a range of possible values allowing for the uncertainty to be calculated and reported.

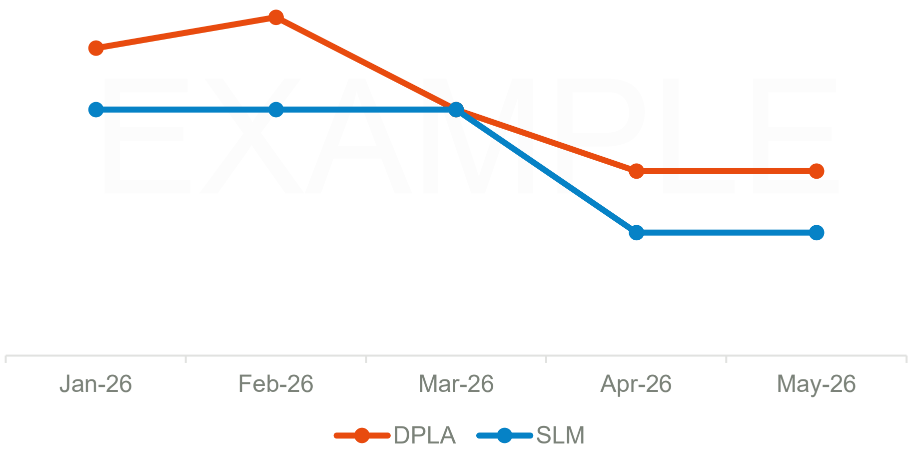
Values for estimated annual emissions will be updated monthly and displayed in the DPLA dashboard for monitoring and reporting

Emissions reporting dashboard

Process will run each month with a rolling window filtering indication data.

An emissions estimate will be displayed for each material over time and broken down to each diameter category. This will be compared to outputs from the SLM.

Example: Material level annual emissions

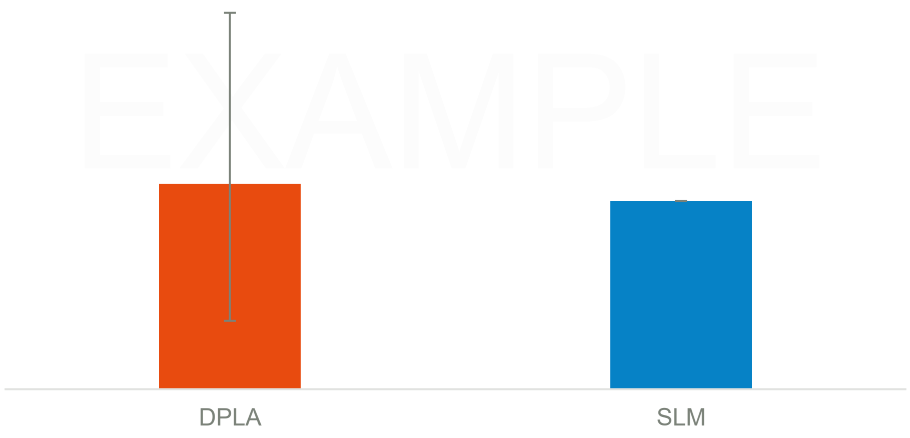


Annual emissions reporting

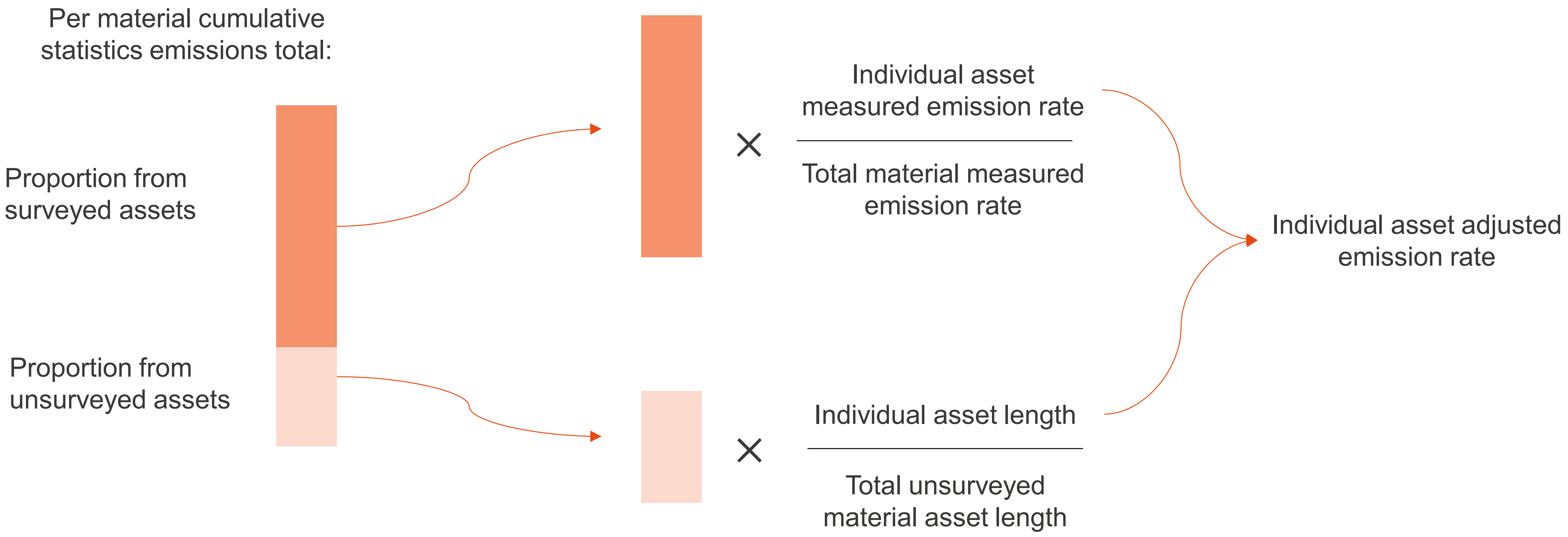
Process will run for the reporting year allowing total emissions estimates (and material level totals), alongside their uncertainties to feed into regulatory reporting.

The goal is for the outputs of this process to eventually replace the SLM.

Example: Annual emissions comparison 2026



We also use the material-level annual emissions estimates to scale individual asset level emission rates for asset planning and management



Next steps include monitoring the cumulative statistics outputs over time and expanding the process to new regions and technologies

Output monitoring

As data is collected, annual emissions estimates, and asset level leak rates will be updated every month in the dashboard.

These outputs can be visualised, compared to the SLM and analysed for trends.

Regional expansion

To date the process has been developed on trial data collected from the North London region.

As vehicle-based Advanced Leakage Detection technologies are rolled out across the rest of the Cadent network, the cumulative statistics process will be as well.

AGI cumulative statistics

The developed process covers survey-based technologies on medium and low-pressure assets.

A selection of Above Ground Installations will be continuously monitored by fixed methane sensors.

An equivalent process will be developed to estimate annual emissions contributions from AGIs.

Incorporating leak repair time

The emissions calculation step assumes that each sampled emission rate would be representative for the full year.

In future iterations of the process this could be adjusted to account for larger leaks being repaired faster and therefore emitting for less time.

Key takeaways

Challenge

It is challenging to calculate emissions from periodic surveys due to the different sources of uncertainty, surveys representing snapshots in space and time, and indications not being directly linked to assets.

Solution

We have developed a statistical process to calculate network emissions at total, material, and individual asset level. This process has been developed in line with international reporting standards and tested using historic trial data.

Next steps

Next steps include monitoring the outputs of our process in the DPLA platform over time, comparing them to the current Shrinkage Leakage Model and building on the developed process.