UNC Workgroup 0754R

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correla
ON BEHALF OF xoserve

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Useful Links

- Uniform Network Code Section H
- Demand Estimation Methodology
- Demand Modelling Approach (2021 version)
- UIG Task Force Findings
- NDM Algorithm Consultation Material
- UNC Request for 0754R Workgroup

Glossary

- For those not familiar with all the industry abbreviations please find full name of those used in this presentation below:
  - LDZ: Local Distribution Zone
  - UIG: Unidentified Gas
  - DM: Daily Metered
  - NDM: Non-Daily Metered
  - ALP: Annual Load Profile
  - DAF: Daily Adjustment Factor
  - PLF: Peak Load Factor
  - EUC: End User Category
  - CWV: Composite Weather Variable
  - SNCWV: Seasonal Normal Composite Weather Variable
  - WCF: Weather Correction Factor
  - DESC: Demand Estimation Sub Committee
  - CDSP: Central Data Services Provider
  - AUGE: Allocation of Unidentified Gas Expert
  - UNC: Uniform Network Code

Outline of Request – Background / Rationale

Background – Unidentified Gas (UIG)

- Following the implementation of the Project Nexus suite of process and systems changes in June 2017, the arrangements for daily allocation of gas changed, introducing the new concept of daily Unidentified Gas (UIG) as the balancing factor in each LDZ

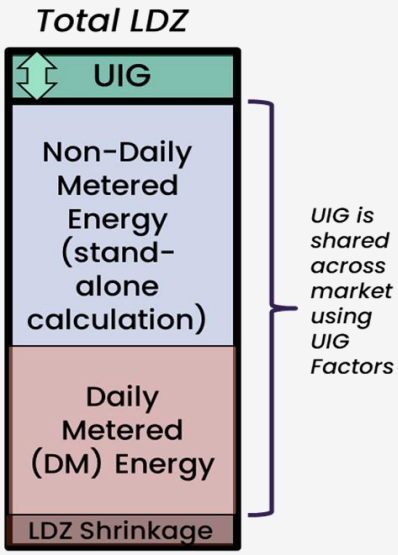
- Since then, the level and variability of daily UIG has been unpredictable and this has caused industry participants considerable issues

- Following approval of a UNC Modification and Change Proposal in July 2018 Xoserve set up an Unidentified Gas Task Force (UIG TF) in order to investigate all the possible causes and provide recommendations

- One area the Task Force investigated, in conjunction with an external analytics consultancy, was the use of Machine Learning as either a replacement of or support to the Algorithm which estimates the daily view of NDM demand

- As a large percentage of LDZ demand is estimated using the Algorithm (rather than being daily metered), the limitations of the Algorithm can be a big contributor to UIG

NDM Algorithm and UIG



- UIG = daily Balancing Figure
- UIG is dependent on all the other data inputs
- Most days NDM Energy is the largest part of LDZ throughput
- NDM Algorithm has a big influence – but so do the AQs
- UIG shared on basis of daily Throughput and Weighting Factors
- AUGE determines Weighting Factors each year for sharing UIG

NDM Algorithm - UIG Task Force

- The Unidentified Gas (UIG) Task Force undertook several phases of Machine Learning investigation
- Aims were to better understand drivers of UIG and identify options to reduce levels/volatility of daily UIG
- As the Balancing Figure in each LDZ each day, UIG is dependent on all the inputs to the calculation i.e. measurements and estimates of LDZ, DM, NDM and Shrinkage
- All recommendations produced by the UIG Task Force can be viewed here
- Those specific to Machine Learning and the NDM Algorithm are 13.2.5, 13.2.6, 13.2.7 and 13.2.8

Role of DESC

- **Demand Estimation Sub Committee** (DESC) is responsible for the NDM Algorithm (UNC Section H)
- The NDM Algorithm is now a stand alone 'bottom up' estimate of NDM demand meaning its accuracy and performance is more open to scrutiny and review
- DESC now has an obligation to review the NDM Algorithm formula every three years (UNC H 2.2.2). At the end of September 2020 a third complete Gas Year under the current NDM Algorithm was completed i.e. Gas Years 2017/18, 2018/19 and 2019/20
- DESC is aware that significant changes to the NDM Algorithm, such as the introduction of Machine Learning could have wider industry impacts

DESC Improvements

- In recent Gas Years DESC have implemented changes to the approach to producing the End User Category(EUC) Demand Models which have resulted in an increase in accuracy of the NDM Allocation process
- Headlines from a recent DESC meeting included:
    - Gas Year 2019/20 saw the introduction of additional EUCs for Bands 1 and 2 (0-293 MWh pa). This change facilitated the use of more suitable profiles for Domestic, Industrial & Commercial and Prepayment supply points. View more here (slide 22 onwards)
    - Gas Year 2020/21 has seen the introduction of a revised Composite Weather Variable (CWV) formula, which now includes the use of a Solar Radiation term.

      The new approach helps to 'explain' more of the demand reactions thus boosting the accuracy of the demand models. This was demonstrated recently at DESC via simulated figures of UIG for Gas Year 2019/20. View more here (slide 26)

NDM Algorithm Consultation

- The DESC Obligation to review the NDM Algorithm combined with UIG Task Force recommendations required the industry to move forward
- Prior to initiating a Workgroup, the CDSP co-ordinated an industry consultation to help inform the scope of any next steps in this area
- Main Consultation Objectives:
    - Find out the level of support for making improvements to NDM Algorithm
    - Establish if industry wished to retain existing formula and its component parameters
    - Seek views on the future direction of the NDM sector of the GB gas market

Headline Conclusions from Consultation:

- Strong support from all respondents to seek improvements to the performance of the NDM Algorithm
- Qualified support for Machine Learning (M/L). Most responses happy to consider an option where M/L is used to improve the existing parameters (i.e. ALPs/DAFs) but NOT to move to a fully 'Blackbox' approach
- Any significant changes from the current approach to Demand Modelling which results in the use of advanced analytical techniques (e.g. Machine Learning) should be proven using simulation and/or parallel running with clear benefits to the industry demonstrated
- Strong support from most respondents to continue with the current NDM Algorithm and to retain ALPs and DAFs. Very clear that these are 'embedded' across the industry for not just NDM allocation but several other processes
- Responses suggest there will continue to be a requirement to estimate NDM demand for several years to come and so investigating alternative options would not be wasted effort
- Full results from the industry consultation are available here

Rationale for Workgroup 0754R:

- Supports DESC's UNC obligation to review the NDM Algorithm
- UIG Task Force findings will be explored and progressed
- Clear industry support for investigating advanced analytical approaches
- A Workgroup maintains focus and increases visibility across the industry
- Improved NDM Allocation will result in a reduction in UIG volatility and subsequent Meter Point reconciliation/UIG volumes

Outline of Request – Scope

NDM Supply Meter Point Demand Formula ("NDM Algorithm")

Formula (NDM Algorithm)	UNC Section H 2.2.1
Calculated in System	Gemini
Comments	- UNC Modification to change - Actual and Forecast mode

Formula (CWV)	UNC Related Document (DEM) & Section 11 NDM Algorithms Booklet
Calculated in System	UK Link and Demand Estimation Modelling Suite
Comments	- DESC Decision to change

NDM Supply Meter Point Demand$_t$ =

$$(AQ / 365) * ALP_t * (1 + [DAF_t * WCF_t])$$

$$WCF_t = CWV_t - SNCWV_t$$

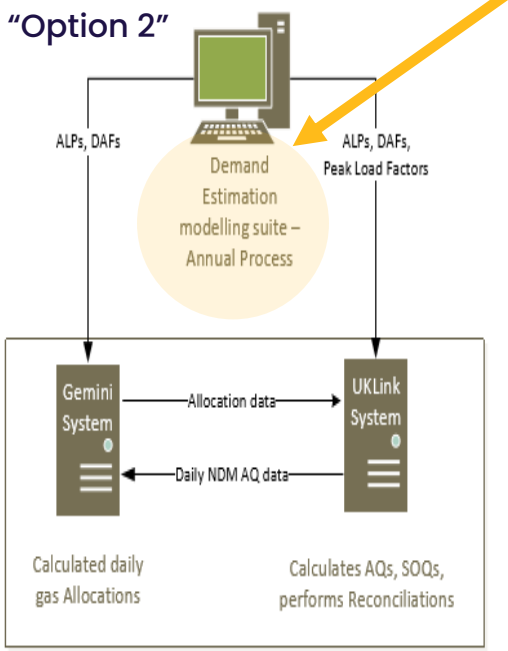
Formula (AQ)	UNC Section H 3.2.1
Calculated in System	UK Link
Comments	- Aggregate AQ sent to Gemini - Formula also uses ALP,DAF,WCF - UNC Modification to change

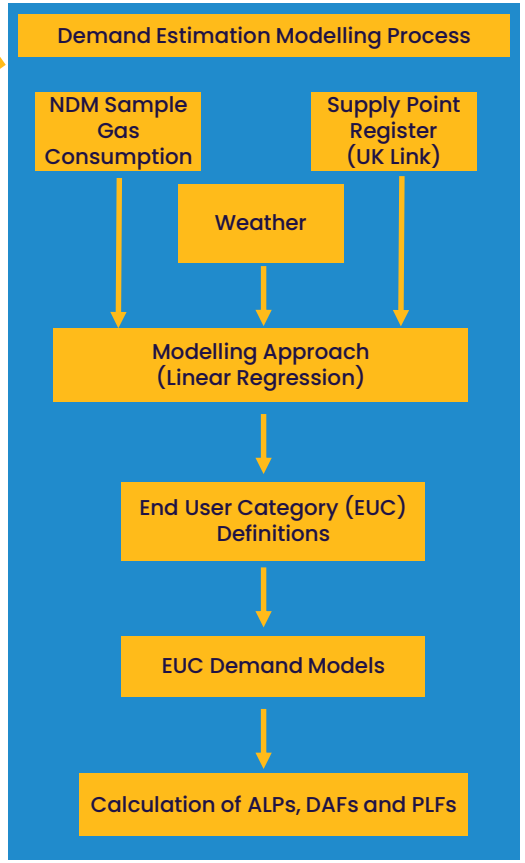
Formula (ALP & DAF)	UNC Related Document (DEM)
Calculated in System	Demand Estimation Modelling Suite
Comments	- DESC Decision to change

Formula (SNCWV)	5 Year Review
Calculated in System	Demand Estimation Modelling Suite
Comments	- DESC Decision to change

Scope

- The results of the NDM Algorithm Consultation made it clear that a more radical approach to using advanced analytics (e.g. Machine Learning), as set out in the options paper, was not supported
- "Option 2" as described in the paper which retained ALPs, DAFs and PLFs was preferred – see high level context diagram opposite
- The proposed scope of this review is to consider how we can use different advanced analytical techniques to improve processes which produce the EUC Demand Models that are required to create the key parameters of ALP, DAF and PLF
- Therefore out of scope for this Workgroup are any options which remove the following parameters: ALP, DAF, PLF, CWV and SNCWV





Current State Overview

Linear Regression between NDM Sample Demand and Daily Composite Weather Variable

EUC Demand Models (39 per LDZ)

Model Smoothing, the process of averaging [3] individual models, is applied to create the final form of the EUC demand model.

$(SND_t = P_t * (C_1 + C_2 * SNCWV_t), WSENS_t = P_t * C_2)$

P_t is a multiplicative factor which is set equal to 1 for a non-holiday Monday to Thursday and potentially a different value on a weekend (Friday, Saturday and Sunday) or holiday day.

C_1 is the constant from the (non-holiday) Monday to Thursday regression of daily demand against daily CWV.

C_2 is the slope of this regression line, which represents the weather sensitivity of demand for (non-holiday) Mondays to Thursdays.

Annual Load Profiles

The ALP_t shall be determined as:

$$ALP_t = \frac{SNDE_t}{\frac{\left[\sum_{t=1}^{N} SNDE_t\right]}{N}}$$

where

ALP_t is the ALP on day t;

$SNDE_t$ is Seasonal Normal Demand for the EUC for day t;

N is the number of days in the Gas Year;

Daily Adjustment Factor

The DAF_t shall be determined as:

$$DAF_t = \frac{WVCE_t}{SNDE_t}$$

where

DAF_t is the DAF on day t;

$WVCE_t$ is the value of the Weather Variable Coefficient in the Demand Model for the EUC (i.e. the sensitivity to weather);

$SNDE_t$ is the value of the seasonal normal demand for the EUC.

Peak Load Factor

The Peak Load Factor (PLF) for the EUC is calculated as:

$$\frac{\text{Aggregate AQ from the EUC model}}{\text{1 in 20 peak demand from the EUC model} * 365}$$

where

An aggregate AQ is derived from the smoothed EUC demand model by setting the composite weather variable to its seasonal normal level in the model and summing the resulting demand values over the 365 days of the forecast year (excluding any February 29th).

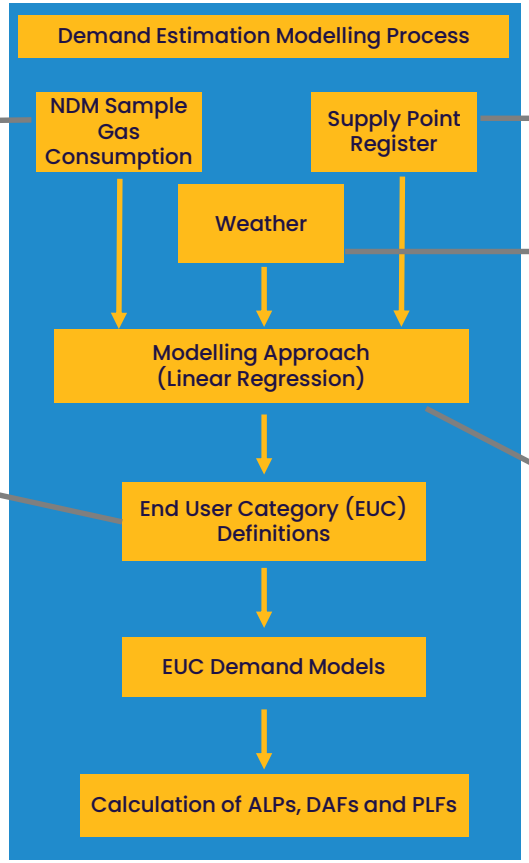
For NDM EUCs a 1 in 20 peak day demand estimate is derived from each gas demand EUC model by simulation, using the smoothed EUC demand model in conjunction with the database of historic daily composite weather variable values for the appropriate LDZ.

Outline of Request – Areas to Investigate

Potential areas for Workgroup to Investigate

Investigate use of advanced analytics to…

1. Improve the validation processes of NDM sample gas consumption to identify erroneous supply meter points (UIG TF 13.2.8)
2. Improve the 'infilling' of missing data



Investigate use of additional data items on Supply Point Register for use in derivation of EUC definitions and production of Demand Models

Investigate use of advanced analytics to enhance further the weather vs demand relationship (UIG TF 13.2.5)

Investigate use of advanced analytics to review the appropriateness of the existing EUC definitions

Investigate use of advanced analytics to trial alternative approaches for producing more accurate EUC demand models (UIG TF 13.2.6 & 13.2.7)

UIG TF Reference links on this slide relate to the UIG Task Force Findings which should provide useful reference material for this Workgroup

Health Warning:
It should be noted that the % improvements in UIG quoted in the material will have been based on a more comprehensive adoption of M/L techniques as opposed to the industry's 'compromise' position of retaining ALPs & DAFs (i.e. "option 2")

Success Criteria

- Objective of Workgroup is to investigate alternative advanced analytical options in order to further improve the accuracy of the EUC Demand Models in representing the NDM population.
- Proposed Success Criteria:
  - [x%] Reduction in Modelling Error between Actual and NDM Allocation
  - [x%] Reduction in UIG volatility and levels
  - Less than [1%] change in the Peak Load Factors
- The above should be proven by simulation of [x] number of historic Gas Years to ensure results are consistent.
- Confirm 'Train' and 'Test' requirements
- Statistical measures to be agreed for representing success criteria

Topics for Discussion (as set out in UNC Request)

- Understanding the objective*
- Review UIG TF outcomes/analysis
- Confirm scope (consultation conclusions)*
- Identify resources / expertise needed
- Agree Timescales
- Determine Data Requirements, Measures and Success Criteria*
- Determine options for analysis
- Impact Assess the options
- Shortlist options before analysis
- Perform analysis
- Assess results against Success Criteria
- Development of Solution (including business rules if appropriate)
- Assessment of potential impacts of the Request
- include any potential Cross Code impacts
- Consider any potential impacts of the Significant Code Review and associated Code Freeze window
- Assessment of implementation costs of any solution identified during the Request
- Assessment of changes to UNC Related Documents and any legal text

* Items covered in presentation material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