Annex N

Detailed IMF&T and Indirects Benchmarking Results

RP6

Final Determination

30 June 2017



About the Utility Regulator

The Utility Regulator is the independent non-ministerial government department responsible for regulating Northern Ireland's electricity, gas, water and sewerage industries, to promote the short and long-term interests of consumers.

We are not a policy-making department of government, but we make sure that the energy and water utility industries in Northern Ireland are regulated and developed within ministerial policy as set out in our statutory duties.

We are governed by a Board of Directors and are accountable to the Northern Ireland Assembly through financial and annual reporting obligations.

We are based at Queens House in the centre of Belfast. The Chief Executive leads a management team of directors representing each of the key functional areas in the organisation: Corporate Affairs; Electricity; Gas; Retail and Social; and Water. The staff team includes economists, engineers, accountants, utility specialists, legal advisors and administration professionals.

Our Mission	Value and sustainability in energy and water.
Our Vision	We will make a difference for consumers by listening, innovating and leading.

Our Values

Be a best practice regulator: transparent, consistent, proportional, accountable, and targeted

Be a united team

Be collaborative and co-operative

Be professional

Listen and explain

Make a difference

Act with integrity

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1 Introduction

1.1 At the draft determination the Utility Regulator conducted benchmarking to assess efficient distribution Inspection, Maintenance, Faults and Tree Cutting (IMF&T) and Indirect expenditure for NIE Networks. As part of this process, we commissioned Cambridge Economic Policy Associates (CEPA) to develop the econometric models used by the UR for the RP6 draft determination. This resulted in a CEPA report titled "RP6 Efficiency Advice", which was included alongside the Utility Regulator's main RP6 draft determination document.[1]

1.2 Since the publication of the draft determination, NIE Networks have resubmitted 2015/16 cost data to the UR after they found a number of cost allocation errors when conducting quality assurance. After consideration, we have decided to take this new information into account for the final determination.

1.3 In addition to accepting NIE Networks' resubmission of 2015/16 data, the UR has also carefully considered and assessed NIE Networks' special factors submission, that was included as part of the company's consultation response to our draft determination.

1.4 As a result of this special factors assessment, we have reconsidered the final benchmarking models used for the final determination. In particular, we have decided to include an additional explanatory variable in our models, "Overhead Line Length as a percentage of Total Line Length", to effectively capture the impact of network topology on company IMF&T and Indirect costs.[2] This decision is discussed in more detail in Annex D: Special Factors and in Chapter 5 of the final determination main document.

1.5 This Annex provides detailed model estimation and efficiency results of the final models the Utility Regulator have chosen to use to assess the relative efficiency of NIE Networks in this final determination. The UR presents tables and figures only, and we refer the reader to Chapter 5 of the final determination main document and the special factors technical Annex for more detailed written analysis of the results. These documents, along with Annexes A and B to the draft determination[3] also provide further details on the model development and refinement process taken by the UR during this RP6 determination process.

[1] Northern Ireland Utility Regulator, 2017. Northern Ireland Electricity Networks Ltd. Transmission & Distribution 6th Price Control (RP6). Draft Determination. Annex B – CEPA Efficiency Modelling.
[2] With the exception of our middle-up business support model, where the inclusion of the overhead line variable does not pass our model selection criteria.
[3] CEPA's Regional Wage Adjustment (Annex A) and CEPAs Efficiency Modelling (Annex B) has been republished in our RP6 final determination for reference and information.

Historical data

1.6 We identified GB Distribution Network Operators (DNOs) as appropriate comparators to NIE Networks, in line with the approach taken by the CC at RP5. We therefore have a total of 15 DNOs included within our analysis (14 GB companies plus NIE Networks).

1.7 A list of DNOs included in our analysis are provided in the table below.

DNO acronym	DNO
ENWL	Electricity North West
NPGN	Northern Powergrid (Northeast)
NPGY	Northern Powergrid (Yorkshire)
WMID	Western Power Distribution (West Midlands)
EMID	Western Power Distribution (East Midlands)
Swales	Western Power Distribution (South Wales)
SWest	Western Power Distribution (South West)
LPN	London Power Networks
SPN	South Eastern Power Networks
EPN	Eastern Power Networks
SPD	SP Distribution
SPMW	SP Manweb
SSEH	Scottish Hydro Electric Power Distribution
SSES	Southern Electric Power Distribution
NIE Networks	Northern Ireland Electricity

Table 1: List of DNOs

1.8 The total available data set available is summarised in the table below.

Company	Companies	Historical Data Available	Observations
NIE Networks	1	4 years	4
GB DNOs	14	6 years	84

Table 2: Historical data set

1.9 However, although we had access to six years of historical GB DNO data, we decided to use only the four most recent years of GB data in our baseline analysis because we preferred to use a balanced panel.

1.10 This gave us 60 observations (15 DNOs over 4 years) in our baseline models. We also tested modelling with all 88 observations, using the full Ofgem ED1 sample.

Cost drivers

1.11 The table below presents the cost drivers used within our final model selection at final determination.

Driver	Rationale
Network length	• Total length of lines, not including dual circuits. • This is a scale variable as it measures total network length.
Network density	• Captures rural vs. urban divide.
Composite scale variables (CSV)	• Used by CC and Ofgem, a CSV weights various cost drivers together. • Our CSV applies 50% weight to network length, a 25% weight to customer numbers, and a 25% weight to units distributed.
OHL Length %	• The proportion of overhead lines in a DNO's network, defined as Total OHL Length divided by Total Network Length. • Captures the impact of network topology on IMF&T and Indirect costs.

Table 3: Cost drivers

UR RP6 Final Determination Model Specifications

1.12 The final model specifications we have chosen to assess the relative efficiency of NIE Networks are presented in the table below.

Model Number	Dependent Variable [4]	Cost Drivers [5]
1	IMF&T and Indirects	• Network Length • Network Density • OHL Length %
2	IMF&T and Indirects	• CSV • Time Dummies • OHL Length %
3	IMF&T and Indirects per customer	• Network Length per Customer • Year Dummies • OHL Length %
4	Network Operating Costs (NOCs)	• Network Length • Network Density • OHL Length %
5	Closely Associated Indirects (CAI)	• CSV • OHL Length %
6	Business Support Costs	• CSV

Table 4: Model specifications

[4] All in natural logarithm.
[5] All in natural logarithm with the exception of the time dummies.

Statistical diagnostic testing

1.13 The results of statistical diagnostic tests played a significant role in our model selection process as they help to assess the validity of each model. The tests we have performed are:

i) **Ramsay RESET:** under this test, the null hypothesis is that there are no omitted non-linearities in the model. If we reject the null hypothesis then this in an indication that the model is mis-specified. CEPA place a relatively high weight on the outcome of this test in their model selection process.

ii) **Normality test:** indicates whether the error term is normally distributed. CEPA placed a low weight on the outcome of this test.

iii) **Pooling test:** indicates whether the data is appropriate for pooling. If this test fails then this would be an indication that using panel data estimation methods is not appropriate.

Sensitivity Analysis

1.14 We have tested our chosen models against a number of sensitivities to see how the models performed against changing inputs. These are listed in the table below. It should be noted that we include Sensitivity 3 results within our final model selection and therefore our final determination triangulation calculation.

Number	Sensitivity
1	Using full historic Ofgem RIIO-ED1 panel
2	Using DPCR5 RIGs for GB DNOs
3	Apply a local labour adjustment to NIE Networks and GB DNOs
4	Only apply a local labour adjustment to GB DNOs
5	RWA using three-digit SOC codes
6	RWA using four-digit SOC codes
7	Excluding NIE Networks from the sample
8	Excluding wayleaves costs

Table 5: Sensitivities tested at final determination

2 Model Estimation Results

Summary

2.1 Presented below are model estimation results for all 6 of our chosen models, used to assess the relative efficiency of NIE Networks at final determination.

2.2 We present results under our baseline assumptions in addition to the eight sensitivities listed above. Results are presented on a pre- and post-allocation basis. Hence, there are two results tables for each model.[6]

2.3 All of the models presented have a log-log model specification. Hence, the estimated parameters can be interpreted as elasticities.

2.4 Our baseline model estimation results show that all estimated elasticities are appropriate in terms of magnitude and all are statistically significant at a 10% significance level for both pre-allocation and post-allocation estimation results.

2.5 When we compare our baseline model results with the sensitivities, overall the parameter estimates stay statistically significant and are similar in magnitude when estimating the models either on a pre-allocation or post-allocation basis. The only exception being that the 'OHL length %' variable is statistically insignificant in a number of Model 3 sensitivities. However; given that the variable is statistically significant in all other IMF&T and Indirect, NOCs and CAI models; and the economic rationale for the inclusion of the variable is clear; we have decided that the 'OHL length %' variable will remain.

2.6 In terms of statistical diagnostic testing, our chosen models perform well.

i) All of our chosen models pass the RESET test with the exception of Model 2. The addition of the 'OHL length %' variable results in Model 2 marginally fails the RESET test. However, the explanatory power of the CC M4 model increases significantly with the inclusion of the 'OHL length %' variable; the estimated coefficient on the 'OHL length %' variable is statistically significant and of a sensible magnitude; and the economic rationale for the inclusion of the 'OHL length %' is clear. For these reasons we deem that this model performs well and is an appropriate model to use to benchmark NIE Networks with GB DNOs.

ii) All of our models pass the normality test with the exception of Model 4. However, this result does not have an effect on important statistical properties such as consistency and unbiasedness.

[6] With the exception of our middle-up NOCs model where there are no differences between pre- and post-allocation results

iii) All of our chosen models pass the pooling test.

2.7 Overall, we consider that all of our models chosen for the final determination either perform well or very well according to our model selection criteria.

Model 1 Estimation Results

Table 6: Model 1 pre-allocation OLS estimation results.[7]

	Baseline	Full Ofgem ED1 Sample	Using DPCR5 RIGs for GB DNOs	Local Labour Adj. - NIE Networks and GB DNOs	Local Labour Adj. - GB DNOs only	RWA using 3-digit SOC codes	RWA using 4-digit SOC codes	Excluding NIEN	Excluding Wayleave Payments
Length	0.746***	0.764***	0.756***	0.777***	0.778***	0.738***	0.633***	0.746***	0.744***
Density	0.600***	0.595***	0.541***	0.595***	0.561***	0.611***	0.589***	0.614***	0.641***
OHL Length %	0.046***	0.042***	0.038***	0.030**	0.027**	0.046***	0.054***	0.047***	0.052***
Constant	-5.298***	-5.490***	-5.235***	-5.642***	-5.534***	-5.244***	-3.982***	-5.344***	-5.397***
RESET	0.291	0.334	0.182	0.283	0.211	0.353	0.167	0.297	0.398
Normality	0.644	0.591	0.325	0.563	0.535	0.664	0.188	0.668	0.714
Pooling	0.972	0.998	0.972	0.949	0.948	0.962	0.961	0.976	0.976
N	60	88	60	60	60	60	60	56	60
R^2	0.877	0.860	0.871	0.895	0.891	0.884	0.865	0.856	0.879

[7] * indicates statistical significance at a 10% level; ** indicates statistical significance at a 5% level; *** indicates statistical significance at a 1% level. Estimated parameters in **bold** are not statistically significant. Statistical diagnostic test results in **bold** indicate that we reject the null hypothesis at a 5% significance level (i.e. the test fails). All explanatory and dependent variables are in natural logarithm.

Table 7: Model 1 post-allocation OLS estimation results.[8]

	Baseline	Full Ofgem ED1 Sample	Using DPCR5 RIGs for GB DNOs	Local Labour Adj. - NIE Networks and GB DNOs	Local Labour Adj. - GB DNOs only	RWA using 3-digit SOC codes	RWA using 4-digit SOC codes	Excluding NIEN	Excluding Wayleave Payments
Length	0.735***	0.747***	0.737***	0.764***	0.765***	0.727***	0.622***	0.736***	0.733***
Density	0.705***	0.656***	0.641***	0.699***	0.668***	0.716***	0.694***	0.670***	0.754***
OHL Length %	0.070***	0.059***	0.067***	0.055***	0.052***	0.070***	0.078***	0.067***	0.077***
Constant	-5.628***	-5.617***	-5.463***	-5.955***	-5.853***	-5.574***	-4.310***	-5.520***	-5.755***
RESET	0.381	0.431	0.239	0.375	0.337	0.452	0.312	0.377	0.447
Normality	0.877	0.648	0.423	0.648	0.771	0.867	0.616	0.764	0.652
Pooling	0.929	0.926	0.971	0.898	0.885	0.913	0.879	0.96	0.953
N	60	88	60	60	60	60	60	56	60
R^2	0.860	0.827	0.849	0.873	0.872	0.867	0.858	0.831	0.858

[8] * indicates statistical significance at a 10% level; ** indicates statistical significance at a 5% level; *** indicates statistical significance at a 1% level. Estimated parameters in **bold** are not statistically significant. Statistical diagnostic test results in **bold** indicate that we reject the null hypothesis at a 5% significance level (i.e. the test fails). All explanatory and dependent variables are in natural logarithm.

Model 2 Estimation Results

Table 8: Model 2 pre-allocation OLS estimation results.[9]

	Baseline	Full Ofgem ED1 Sample	Using DPCR5 RIGs for GB DNOs	Local Labour Adj. - NIE Networks and GB DNOs	Local Labour Adj. - GB DNOs only	RWA using 3-digit SOC codes	RWA using 4-digit SOC codes	Excluding NIEN	Excluding Wayleave Payments
CSV	0.874***	0.880***	0.850***	0.894***	0.876***	0.874***	0.784***	0.857***	0.896***
OHL Length %	0.026***	0.595***	0.026***	0.013**	0.014**	0.025***	0.028***	0.027***	0.027***
2014	0.053***	0.049**	0.051***	0.054***	0.053***	0.053***	0.053***	0.058***	0.051**
2015	0.035**	0.030*	0.043***	0.035**	0.035**	0.035**	0.034**	0.039***	0.034**
2016	**0.030**	**0.025**	0.065**	**0.030**	**0.030**	**0.030**	**0.029**	**0.033**	**0.030**
Constant	-5.162***	-5.234***	-4.925***	-5.415***	-5.200***	-5.163***	-4.094***	-4.967***	-5.393***
RESET	**0.027**	**0.032**	0.057	**0.013**	**0.026**	**0.028**	0.057	**0.028**	**0.017**
Normality	0.474	0.442	0.495	0.439	0.621	0.438	0.422	0.420	0.210
Pooling	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
N	60	88	60	60	60	60	60	56	60
R^2	0.855	0.840	0.863	0.878	0.877	0.860	0.828	0.833	0.852

[9] * indicates statistical significance at a 10% level; ** indicates statistical significance at a 5% level; *** indicates statistical significance at a 1% level. Estimated parameters in **bold** are not statistically significant. Statistical diagnostic test results in **bold** indicate that we reject the null hypothesis at a 5% significance level (i.e. the test fails). All explanatory and dependent variables are in natural logarithm.

Table 9: Model 2 post-allocation OLS estimation results.[10]

	Baseline	Full Ofgem ED1 Sample	Using DPCR5 RIGs for GB DNOs	Local Labour Adj. - NIE Networks and GB DNOs	Local Labour Adj. - GB DNOs only	RWA using 3-digit SOC codes	RWA using 4-digit SOC codes	Excluding NIEN	Excluding Wayleave Payments
CSV	0.924***	0.747***	0.892***	0.943***	0.926***	0.924***	0.834***	0.874***	0.950***
OHL Length %	0.037***	0.033***	0.042***	0.025***	0.026***	0.036***	0.040***	0.041***	0.039***
2014	0.071***	0.088***	0.071***	0.071***	0.071***	0.071***	0.070***	0.077***	0.068***
2015	0.042**	0.059**	0.054***	0.042**	0.042**	0.042**	0.041**	0.050***	0.041**
2016	**0.021**	**0.038**	0.069**	**0.021**	**0.021**	**0.021**	**0.020**	**0.027**	**0.020**
Constant	-5.841***	-5.586***	-5.514***	-6.080***	-5.878***	-5.843***	-4.771***	-5.259***	-6.126***
RESET	**0.022**	0.055	**0.034**	**0.017**	**0.020**	**0.028**	**0.042**	**0.024**	**0.027**
Normality	0.406	0.378	0.416	0.474	0.597	0.323	0.303	0.265	0.292
Pooling	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
N	60	88	60	60	60	60	60	56	60
R^2	0.826	0.803	0.830	0.844	0.848	0.829	0.804	0.804	0.816

[10] * indicates statistical significance at a 10% level; ** indicates statistical significance at a 5% level; *** indicates statistical significance at a 1% level. Estimated parameters in **bold** are not statistically significant. Statistical diagnostic test results in **bold** indicate that we reject the null hypothesis at a 5% significance level (i.e. the test fails). All explanatory and dependent variables are in natural logarithm.

Model 3 Estimation Results

Table 10: Model 3 pre-allocation OLS estimation results.[11]

	Baseline	Full Ofgem ED1 Sample	Using DPCR5 RIGs for GB DNOs	Local Labour Adj. - NIE Networks and GB DNOs	Local Labour Adj. - GB DNOs only	RWA using 3-digit SOC codes	RWA using 4-digit SOC codes	Excluding NIEN	Excluding Wayleave Payments
Network Length per Customer	0.487***	0.484***	0.542***	0.482***	0.515***	0.479***	0.537***	0.476***	0.447***
OHL Length %	0.022*	0.595***	**0.016**	**0.009**	**0.007**	0.022*	**0.020**	0.023*	0.028**
2014	0.048**	0.046**	0.046**	0.048**	0.048**	0.048**	0.048**	0.053***	0.045**
2015	0.024*	**0.022**	0.032**	0.024*	0.024*	0.024*	0.024*	0.028**	0.023*
2016	**0.016**	**0.013**	0.051*	**0.016**	**0.016**	**0.015**	**0.016**	**0.019**	**0.015**
Constant	-7.811***	-7.823***	-7.660***	-7.852***	-7.734***	-7.838***	-7.602***	-7.852***	-7.926***
RESET	0.149	0.095	0.050	0.344	0.174	0.101	**0.002**	0.174	0.172
Normality	0.765	0.301	0.570	0.989	0.966	0.723	0.526	0.751	0.959
Pooling	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
N	60	88	60	60	60	60	60	56	60
R^2	0.705	0.669	0.736	0.702	0.722	0.706	0.696	0.639	0.686

[11] * indicates statistical significance at a 10% level; ** indicates statistical significance at a 5% level; *** indicates statistical significance at a 1% level. Estimated parameters in **bold** are not statistically significant. Statistical diagnostic test results in **bold** indicate that we reject the null hypothesis at a 5% significance level (i.e. the test fails). All explanatory and dependent variables are in natural logarithm.

Table 11: Model 3 post-allocation OLS estimation results.[12]

	Baseline	Full Ofgem ED1 Sample	Using DPCR5 RIGs for GB DNOs	Local Labour Adj. - NIE Networks and GB DNOs	Local Labour Adj. - GB DNOs only	RWA using 3-digit SOC codes	RWA using 4-digit SOC codes	Excluding NIEN	Excluding Wayleave Payments
Network Length per Customer	0.386***	0.747***	0.450***	0.382***	0.413***	0.378***	0.436***	0.424***	0.338***
OHL Length %	0.045***	0.036***	0.043***	0.033**	0.031**	0.045***	0.043***	0.042***	0.052***
2014	0.065***	0.086***	0.065***	0.065***	0.065***	0.065***	0.065***	0.071***	0.062***
2015	0.031*	0.052**	0.043**	0.031*	0.031*	0.031*	0.031*	0.039**	**0.029**
2016	**0.007**	**0.027**	0.054*	**0.007**	**0.007**	**0.006**	**0.006**	**0.013**	**0.006**
Constant	-8.255***	-8.144***	-8.082***	-8.292***	-8.180***	-8.281***	-8.045***	-8.126***	-8.396***
RESET	0.217	0.115	0.111	0.278	0.22	0.191	0.075	0.213	0.277
Normality	0.823	0.533	0.683	0.979	0.935	0.814	0.564	0.908	0.961
Pooling	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
N	60	88	60	60	60	60	60	56	60
R^2	0.654	0.624	0.689	0.636	0.66	0.654	0.661	0.625	0.623

[12] * indicates statistical significance at a 10% level; ** indicates statistical significance at a 5% level; *** indicates statistical significance at a 1% level. Estimated parameters in **bold** are not statistically significant. Statistical diagnostic test results in **bold** indicate that we reject the null hypothesis at a 5% significance level (i.e. the test fails). All explanatory and dependent variables are in natural logarithm.

Model 4 Estimation Results (NOCs)

Table 12: Model 4 pre- and post-allocation OLS estimation results (NOCs).[13]

	Baseline	Full Ofgem ED1 Sample	Using DPCR5 RIGs for GB DNOs	Local Labour Adj. - NIE Networks and GB DNOs	Local Labour Adj. - GB DNOs only	RWA using 3-digit SOC codes	RWA using 4-digit SOC codes	Excluding NIEN
Length	0.808***	0.747***	0.836***	0.816***	0.816***	0.800***	0.692***	0.809***
Density	1.122***	1.095***	0.976***	1.120***	1.113***	1.134***	1.108***	1.077***
OHL Length %	0.118***	0.112***	0.101***	0.114***	0.113***	0.118***	0.126***	0.114***
Constant	-8.779***	-8.564***	-8.656***	-8.865***	-8.840***	-8.722***	-7.408***	-8.632***
RESET	0.758	0.912	0.985	0.750	0.762	0.756	0.791	0.768
Normality	**0.013**	**0.030**	**0.030**	**0.014**	**0.013**	**0.010**	**0.002**	**0.017**
Pooling	0.987	0.996	0.952	0.986	0.986	0.987	0.981	0.992
N	60	88	60	60	60	60	60	56
R^2	0.829	0.825	0.854	0.832	0.831	0.831	0.825	0.785

[13] * indicates statistical significance at a 10% level; ** indicates statistical significance at a 5% level; *** indicates statistical significance at a 1% level. Estimated parameters in **bold** are not statistically significant. Statistical diagnostic test results in **bold** indicate that we reject the null hypothesis at a 5% significance level (i.e. the test fails). All explanatory and dependent variables are in natural logarithm.

Model 5 Estimation Results (CAI)

Table 13: Model 5 pre-allocation OLS estimation results (CAI).[14]

	Baseline	Full Ofgem ED1 Sample	Using DPCR5 RIGs for GB DNOs	Local Labour Adj. - NIE Networks and GB DNOs	Local Labour Adj. - GB DNOs only	RWA using 3-digit SOC codes	RWA using 4-digit SOC codes	Excluding NIEN	Excluding Wayleave Payments
CSV	0.762***	0.803***	0.762***	0.784***	0.765***	0.762***	0.672***	0.791***	0.810***
OHL Length %	0.027***	0.595***	0.027***	0.012*	0.014**	0.026***	0.029***	0.025***	0.031***
Constant	-4.694***	-5.180***	-4.694***	-4.981***	-4.753***	-4.695***	-3.624***	-5.046***	-5.210***
RESET	0.520	0.525	0.501	0.502	0.629	0.542	0.514	0.511	0.252
Normality	0.401	0.057	0.416	0.590	0.369	0.444	0.495	0.377	0.132
Pooling	0.788	0.704	0.795	0.748	0.773	0.765	0.818	0.929	0.812
N	60	88	60	60	60	60	60	56	60
R^2	0.786	0.763	0.783	0.805	0.791	0.792	0.733	0.780	0.803

[14] * indicates statistical significance at a 10% level; ** indicates statistical significance at a 5% level; *** indicates statistical significance at a 1% level. Estimated parameters in **bold** are not statistically significant. Statistical diagnostic test results in **bold** indicate that we reject the null hypothesis at a 5% significance level (i.e. the test fails). All explanatory and dependent variables are in natural logarithm.

Table 14: Model 5 post-allocation OLS estimation results (CAI).[15]

	Baseline	Full Ofgem ED1 Sample	Using DPCR5 RIGs for GB DNOs	Local Labour Adj. - NIE Networks and GB DNOs	Local Labour Adj. - GB DNOs only	RWA using 3-digit SOC codes	RWA using 4-digit SOC codes	Excluding NIEN	Excluding Wayleave Payments
CSV	0.821***	0.747***	0.808***	0.844***	0.824***	0.821***	0.731***	0.817***	0.886***
OHL Length %	0.045***	0.044***	0.053***	0.031***	0.032***	0.044***	0.047***	0.046***	0.049***
Constant	-5.562***	-5.497***	-5.409***	-5.849***	-5.621***	-5.563***	-4.491***	-5.516***	-6.256***
RESET	0.269	0.458	0.232	0.270	0.359	0.302	0.454	0.271	0.172
Normality	0.961	0.801	0.911	0.952	0.999	0.977	0.470	0.963	0.520
Pooling	0.721	0.262	0.738	0.687	0.684	0.706	0.721	0.764	0.818
N	60	88	60	60	60	60	60	56	60
R^2	0.710	0.651	0.704	0.725	0.717	0.714	0.666	0.684	0.721

[15] * indicates statistical significance at a 10% level; ** indicates statistical significance at a 5% level; *** indicates statistical significance at a 1% level. Estimated parameters in **bold** are not statistically significant. Statistical diagnostic test results in **bold** indicate that we reject the null hypothesis at a 5% significance level (i.e. the test fails). All explanatory and dependent variables are in natural logarithm.

Model 6 Estimation Results (Business Support)

Table 15: Model 6 pre-allocation OLS estimation results (Business Support).[16]

	Baseline	Full Ofgem ED1 Sample	Using DPCR5 RIGs for GB DNOs	Local Labour Adj. - NIE Networks and GB DNOs	Local Labour Adj. - GB DNOs only	RWA using 3-digit SOC codes	RWA using 4-digit SOC codes	Excluding NIEN
CSV	0.586***	0.608***	0.586***	0.634***	0.603***	0.587***	0.502***	0.580***
Constant	-3.390***	-3.615***	-3.387***	-3.952***	-3.583***	-3.398***	-2.385**	-3.318**
RESET	0.077	0.116	0.079	**0.043**	0.083	0.063	0.076	0.077
Normality	0.059	0.169	0.058	0.119	0.212	**0.048**	0.089	0.058
Pooling	0.994	0.807	0.993	0.993	0.993	0.992	0.994	0.998
N	60	88	60	60	60	60	60	56
R^2	0.622	0.562	0.625	0.667	0.651	0.642	0.553	0.578

[16] * indicates statistical significance at a 10% level; ** indicates statistical significance at a 5% level; *** indicates statistical significance at a 1% level. Estimated parameters in **bold** are not statistically significant. Statistical diagnostic test results in **bold** indicate that we reject the null hypothesis at a 5% significance level (i.e. the test fails). All explanatory and dependent variables are in natural logarithm.

Table 16: Model 6 post-allocation OLS estimation results (Business Support).[17]

	Baseline	Full Ofgem ED1 Sample	Using DPCR5 RIGs for GB DNOs	Local Labour Adj. - NIE Networks and GB DNOs	Local Labour Adj. - GB DNOs only	RWA using 3-digit SOC codes	RWA using 4-digit SOC codes	Excluding NIEN
CSV	0.604***	0.599***	0.590***	0.652***	0.620***	0.605***	0.519***	0.550***
Constant	-3.734***	-3.664***	-3.580**	-4.296***	-3.928***	-3.742***	-2.730**	-3.103**
RESET	0.225	0.438	0.216	0.191	0.221	0.224	0.267	0.226
Normality	0.135	0.907	0.128	0.293	0.250	0.153	0.165	0.126
Pooling	0.993	0.997	0.997	0.991	0.989	0.991	0.992	1.000
N	60	88	60	60	60	60	60	56
R^2	0.554	0.487	0.537	0.606	0.603	0.569	0.494	0.480

[17] * indicates statistical significance at a 10% level; ** indicates statistical significance at a 5% level; *** indicates statistical significance at a 1% level. Estimated parameters in **bold** are not statistically significant. Statistical diagnostic test results in **bold** indicate that we reject the null hypothesis at a 5% significance level (i.e. the test fails). All explanatory and dependent variables are in natural logarithm.

3 Efficiency Gap Analysis

Summary

3.1 This section shows how NIE Networks performs under our chosen Pooled OLS models for the final determination. The charts and tables presented below shows NIE Networks' efficiency gap compared to the upper quartile company, which we have rounded to the fourth placed company. Hence, the fourth placed company has an efficiency gap of zero.

3.2 Overall, our baseline model efficiency results show that NIE Networks generally appear more efficient on a post-allocation basis than on a pre-allocation basis.

3.3 We also find that NIE Networks are generally more efficient in NOCs (Model 4) than in CAI (Model 5) and Business Support (Model 6).

3.4 When we test the sensitivity of NIE Networks' estimated efficiency to changes in input assumptions, we find that the sensitivities that have the largest impact on NIE Networks' efficiency gap are:

i) Ofgem's Local Labour Adjustment - NIE Networks and GB DNOs.

ii) Granularity of ASHE SOC Codes.

iii) The exclusion of wayleaves.

3.5 As discussed in the Chapter 5 of the final determination main document, we also place weight on Sensitivity 3 when we calculate an overall triangulated efficiency gap for NIE Networks, which could be applied to 2015/16 outturn IMF&T and Indirect expenditure (our chosen baseline).

Model 1 Efficiency Gap Analysis

Model 1 Efficiency Gaps – Pre-Allocation

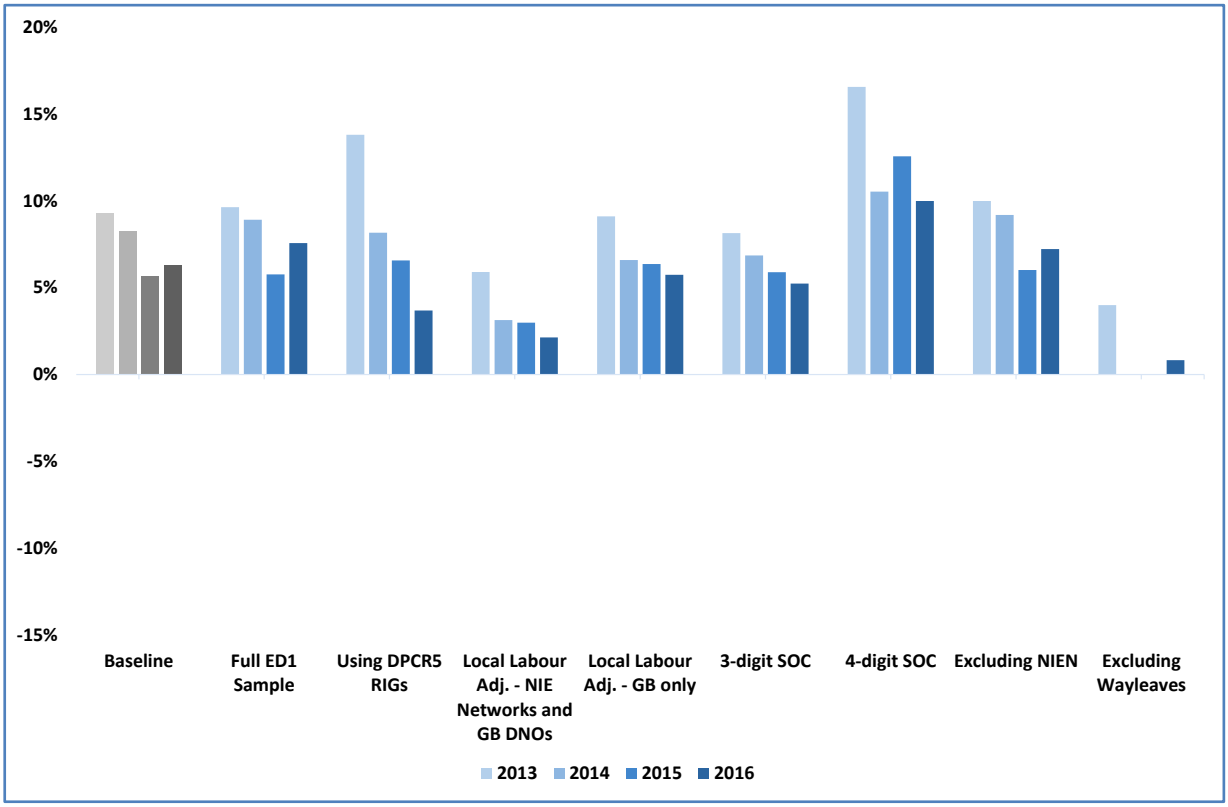

Figure 1: Efficiency gaps from Model 1 (pre-allocation)

	2013	2014	2015	2016
Baseline	9%	8%	6%	6%
Full ED1 Sample	10%	9%	6%	8%
Using DPCR5 RIGs	14%	8%	7%	4%
Local Labour Adj. - NIE Networks and GB DNOs	6%	3%	3%	2%
Local Labour Adj. - GB only	9%	7%	6%	6%
3-digit SOC	8%	7%	6%	5%
4-digit SOC	17%	11%	13%	10%
Excluding NIEN	10%	9%	6%	7%
Excluding Wayleaves	4%	0%	0%	1%

Table 17: Efficiency gaps from Model 1 (pre-allocation)

Model 1 Efficiency Gaps – Post-Allocation

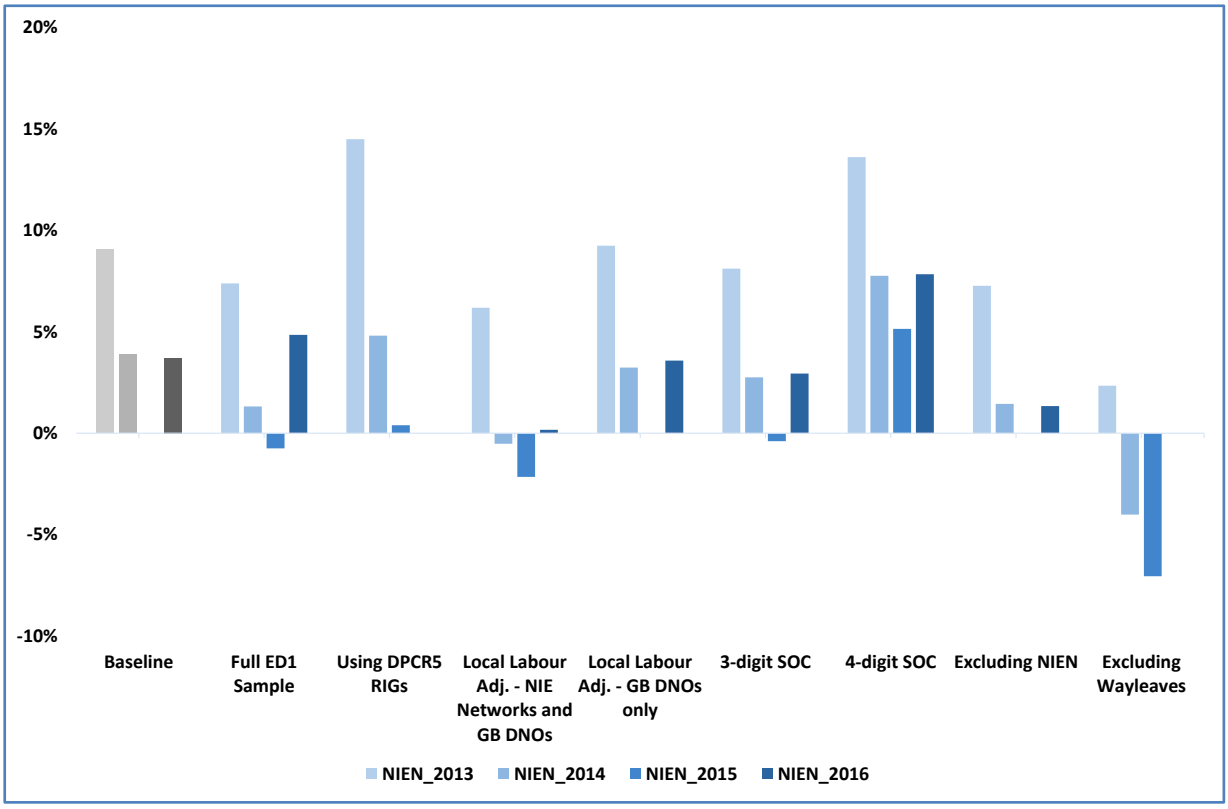

Figure 2: Efficiency gaps from Model 1 (post-allocation)

	2013	2014	2015	2016
Baseline	9%	4%	0%	4%
Full ED1 Sample	7%	1%	-1%	5%
Using DPCR5 RIGs	14%	5%	0%	0%
Local Labour Adj. - NIE Networks and GB DNOs	6%	-1%	-2%	0%
Local Labour Adj. - GB only	9%	3%	0%	4%
3-digit SOC	8%	3%	0%	3%
4-digit SOC	14%	8%	5%	8%
Excluding NIEN	7%	1%	0%	1%
Excluding Wayleaves	2%	-4%	-7%	0%

Table 18: Efficiency gaps from Model 1 (post-allocation)

Model 2 Efficiency Gap Analysis

Model 2 Efficiency Gaps – Pre-Allocation

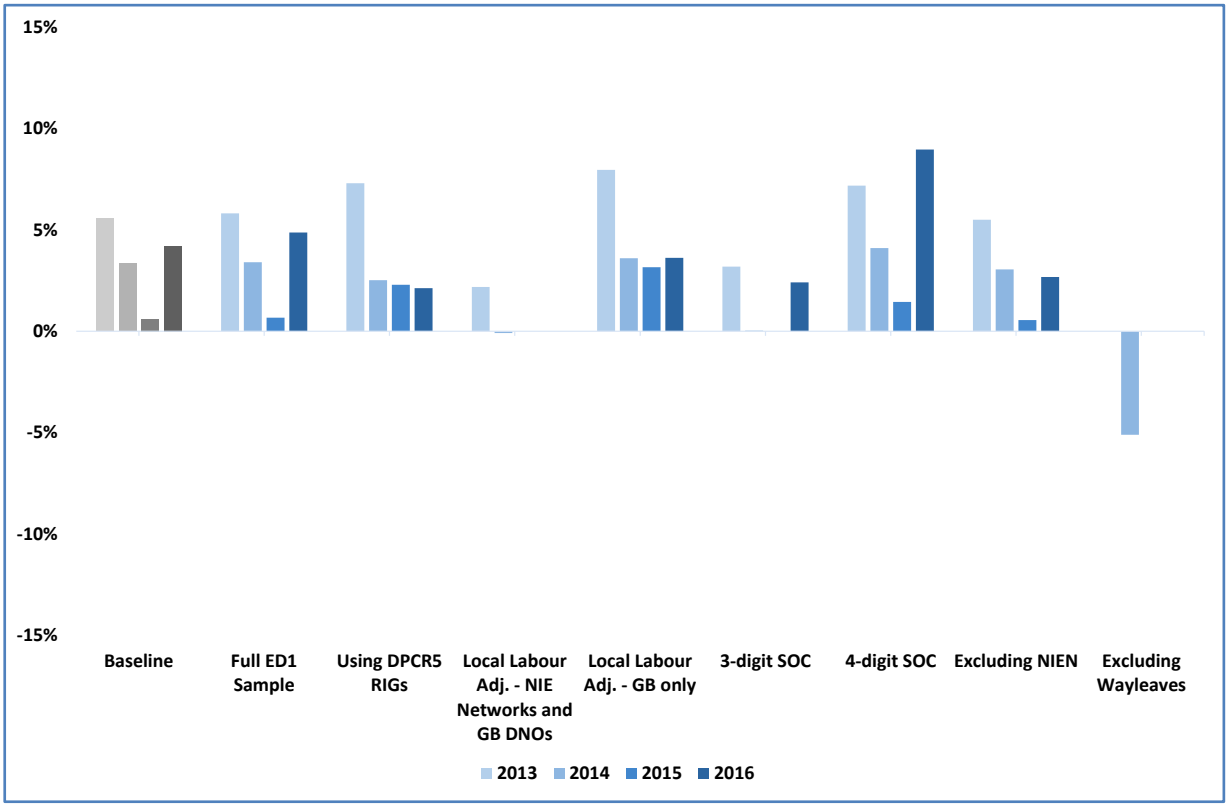

Figure 3: Efficiency gaps from Model 2 (pre-allocation)

	2013	2014	2015	2016
Baseline	6%	3%	1%	4%
Full ED1 Sample	6%	3%	1%	5%
Using DPCR5 RIGs	7%	3%	2%	2%
Local Labour Adj. - NIE Networks and GB DNOs	2%	0%	0%	0%
Local Labour Adj. - GB only	8%	4%	3%	4%
3-digit SOC	3%	0%	0%	2%
4-digit SOC	7%	4%	1%	9%
Excluding NIEN	5%	3%	1%	3%
Excluding Wayleaves	0%	-5%	0%	0%

Table 19: Efficiency gaps from Model 2 (pre-allocation)

Model 2 Efficiency Gaps – Post-Allocation

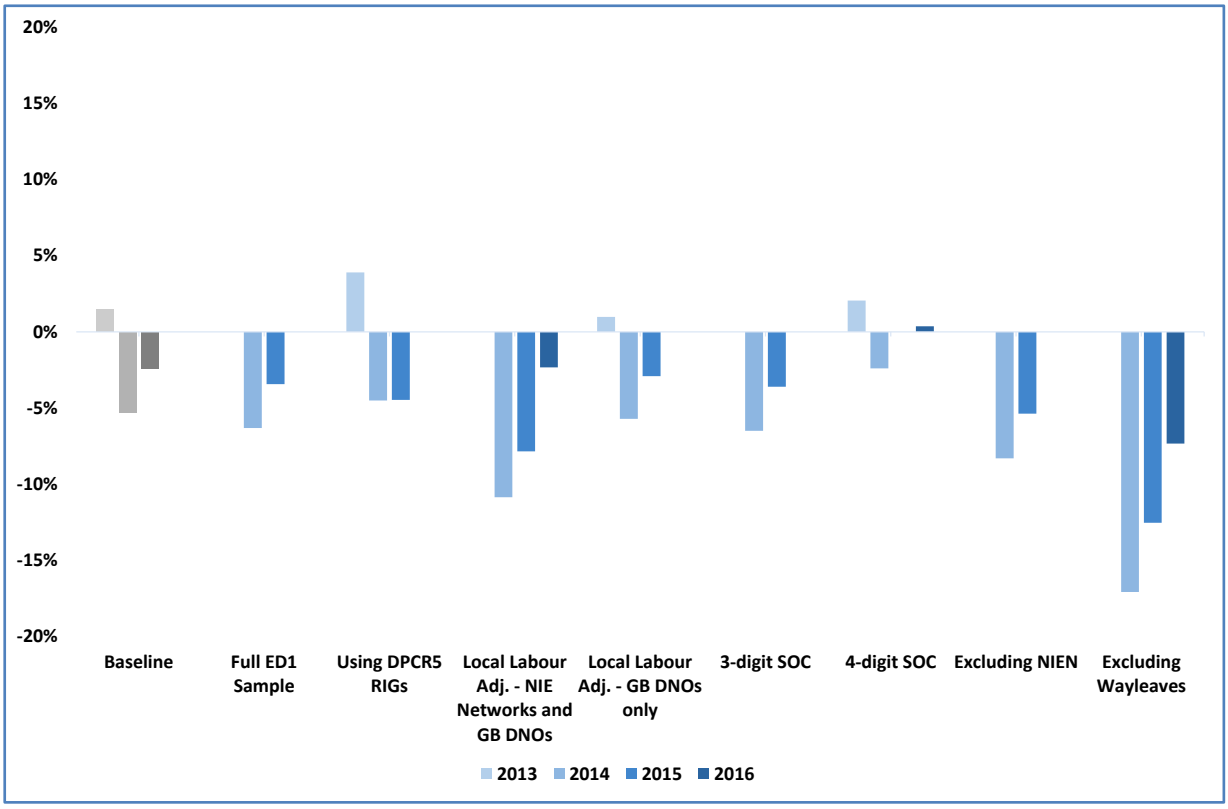

Figure 4: Efficiency gaps from Model 2 (post-allocation)

	2013	2014	2015	2016
Baseline	1%	-5%	-2%	0%
Full ED1 Sample	0%	-6%	-3%	0%
Using DPCR5 RIGs	4%	-5%	-4%	0%
Local Labour Adj. - NIE Networks and GB DNOs	0%	-11%	-8%	-2%
Local Labour Adj. - GB only	1%	-6%	-3%	0%
3-digit SOC	0%	-7%	-4%	0%
4-digit SOC	2%	-2%	0%	0%
Excluding NIEN	0%	-8%	-5%	0%
Excluding Wayleaves	0%	-17%	-13%	-7%

Table 20: Efficiency gaps from Model 2 (post-allocation)

Model 3 Efficiency Gap Analysis

Model 3 Efficiency Gaps – Pre-Allocation

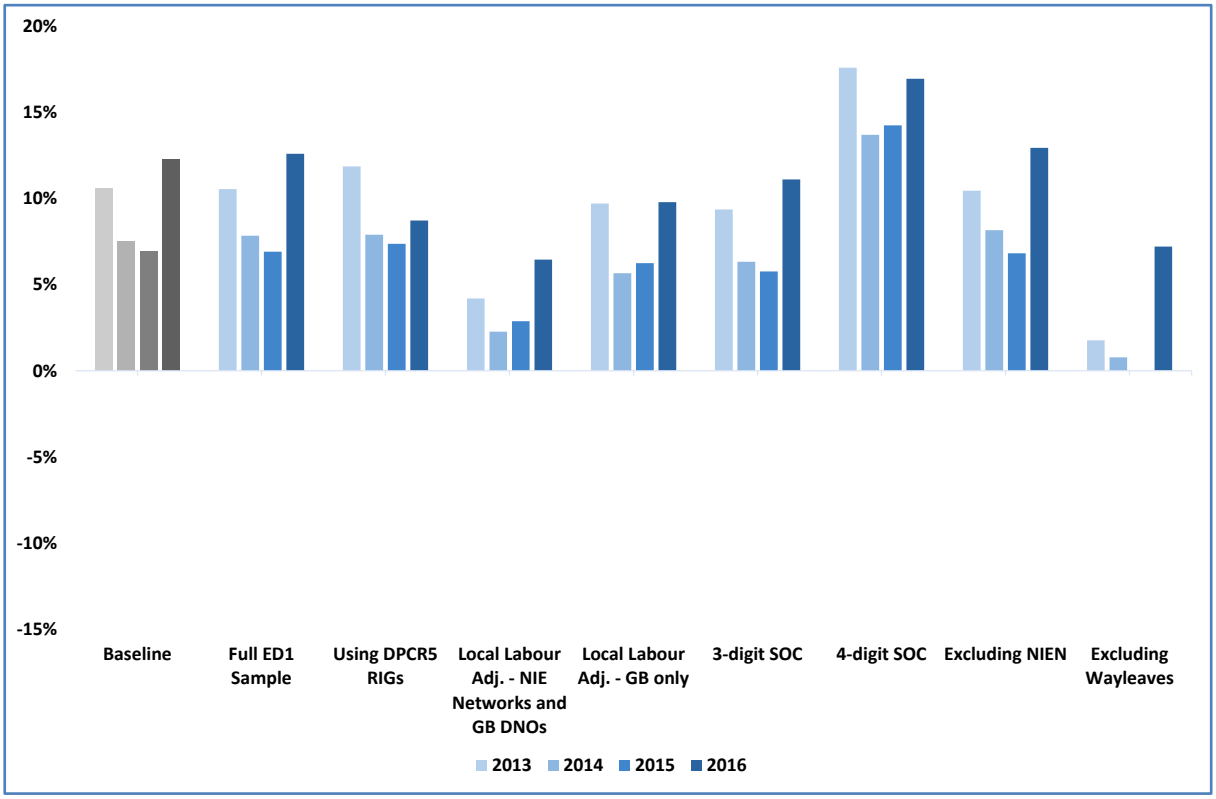

Figure 5: Efficiency gaps from Model 3 (pre-allocation)

	2013	2014	2015	2016
Baseline	11%	8%	7%	12%
Full ED1 Sample	11%	8%	7%	13%
Using DPCR5 RIGs	12%	8%	7%	9%
Local Labour Adj. - NIE Networks and GB DNOs	4%	2%	3%	6%
Local Labour Adj. - GB only	10%	6%	6%	10%
3-digit SOC	9%	6%	6%	11%
4-digit SOC	18%	14%	14%	17%
Excluding NIEN	10%	8%	7%	13%
Excluding Wayleaves	2%	1%	0%	7%

Table 21: Efficiency gaps from Model 3 (pre-allocation)

Model 3 Efficiency Gaps – Post-Allocation

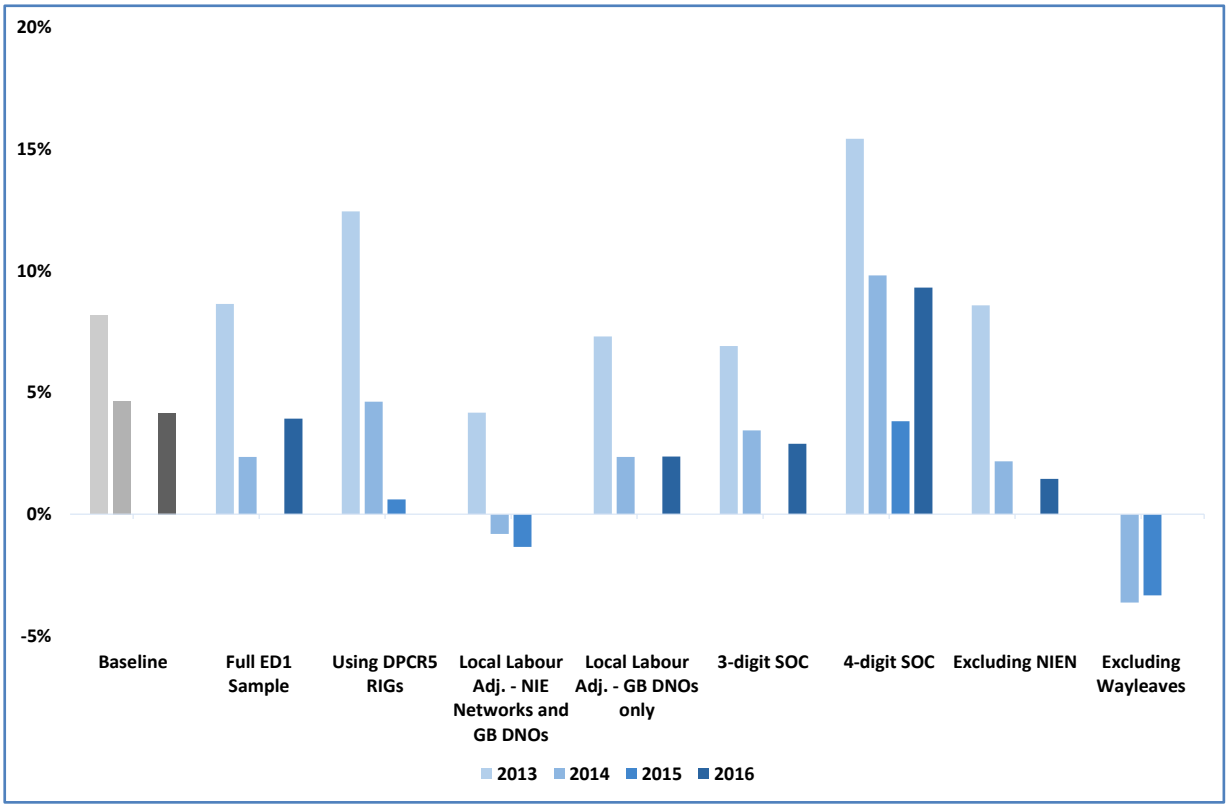

Figure 6: Efficiency gaps from Model 3 (post-allocation)

	2013	2014	2015	2016
Baseline	8%	5%	0%	4%
Full ED1 Sample	9%	2%	0%	4%
Using DPCR5 RIGs	12%	5%	1%	0%
Local Labour Adj. - NIE Networks and GB DNOs	4%	-1%	-1%	0%
Local Labour Adj. - GB only	7%	2%	0%	2%
3-digit SOC	7%	3%	0%	3%
4-digit SOC	15%	10%	4%	9%
Excluding NIEN	9%	2%	0%	1%
Excluding Wayleaves	0%	-4%	-3%	0%

Table 22: Efficiency gaps from Model 3 (post-allocation)

Model 4 Efficiency Gap Analysis (NOCs)

Model 4 Efficiency Gaps – Pre- and Post-Allocation

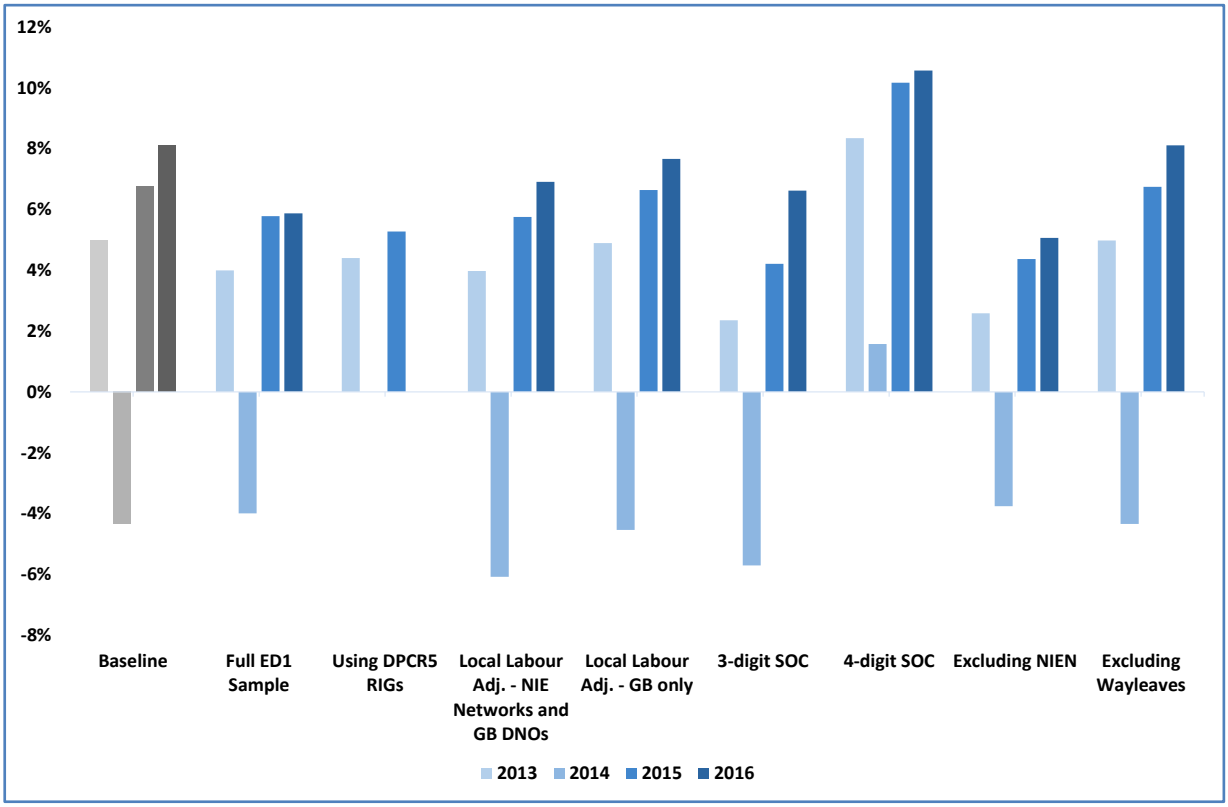

Figure 7: Efficiency gaps from Model 4 (pre- and post-allocation)

	2013	2014	2015	2016
Baseline	5%	-4%	7%	8%
Full ED1 Sample	4%	-4%	6%	6%
Using DPCR5 RIGs	4%	0%	5%	0%
Local Labour Adj. - NIE Networks and GB DNOs	4%	-6%	6%	7%
Local Labour Adj. - GB only	5%	-5%	7%	8%
3-digit SOC	2%	-6%	4%	7%
4-digit SOC	8%	2%	10%	11%
Excluding NIEN	3%	-4%	4%	5%
Excluding Wayleaves	5%	-4%	7%	8%

Table 23: Efficiency gaps from Model 4 (pre- and post-allocation)

Model 5 Efficiency Gap Analysis (CAI)

Model 5 Efficiency Gaps – Pre-Allocation

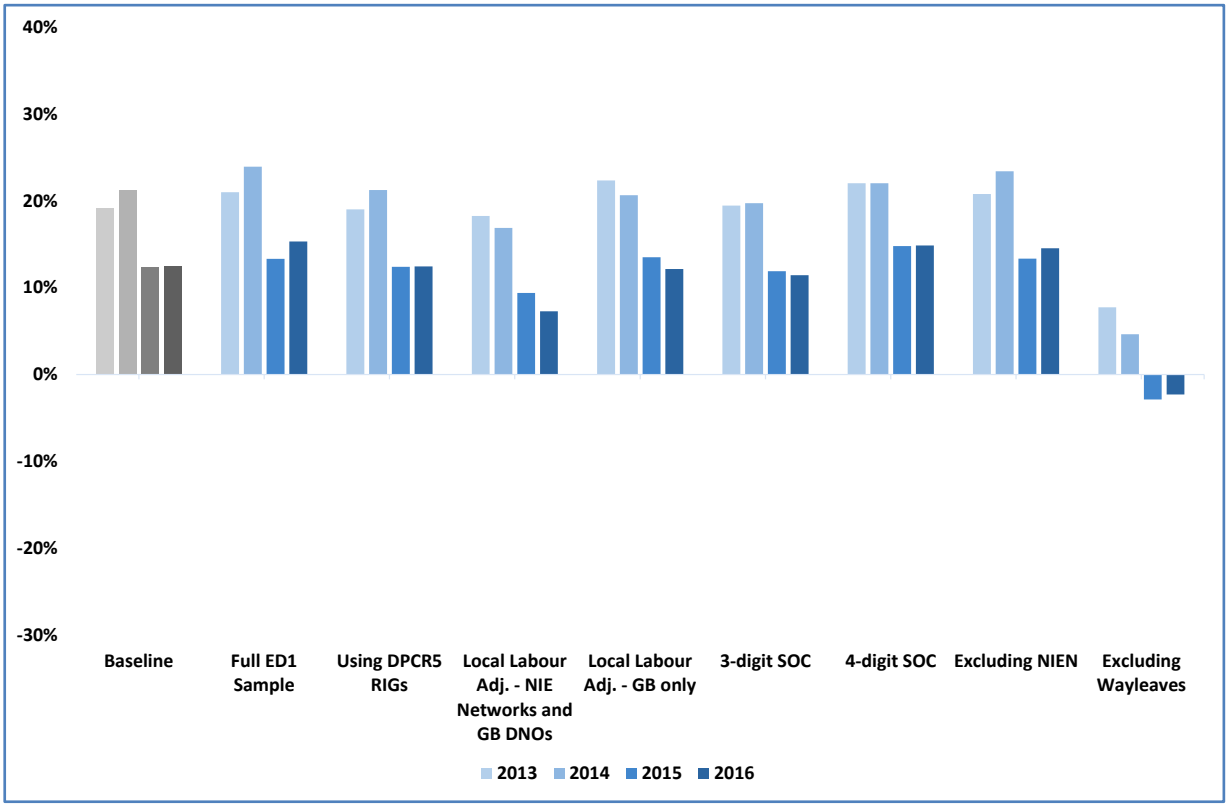

Figure 8: Efficiency gaps from Model 5 (pre-allocation)

	2013	2014	2015	2016
Baseline	19%	21%	12%	12%
Full ED1 Sample	21%	24%	13%	15%
Using DPCR5 RIGs	19%	21%	12%	12%
Local Labour Adj. - NIE Networks and GB DNOs	18%	17%	9%	7%
Local Labour Adj. - GB only	22%	21%	13%	12%
3-digit SOC	19%	20%	12%	11%
4-digit SOC	22%	22%	15%	15%
Excluding NIEN	21%	23%	13%	15%
Excluding Wayleaves	8%	5%	-3%	-2%

Table 24: Efficiency gaps from Model 5 (pre-allocation)

Model 5 Efficiency Gaps – Post-Allocation

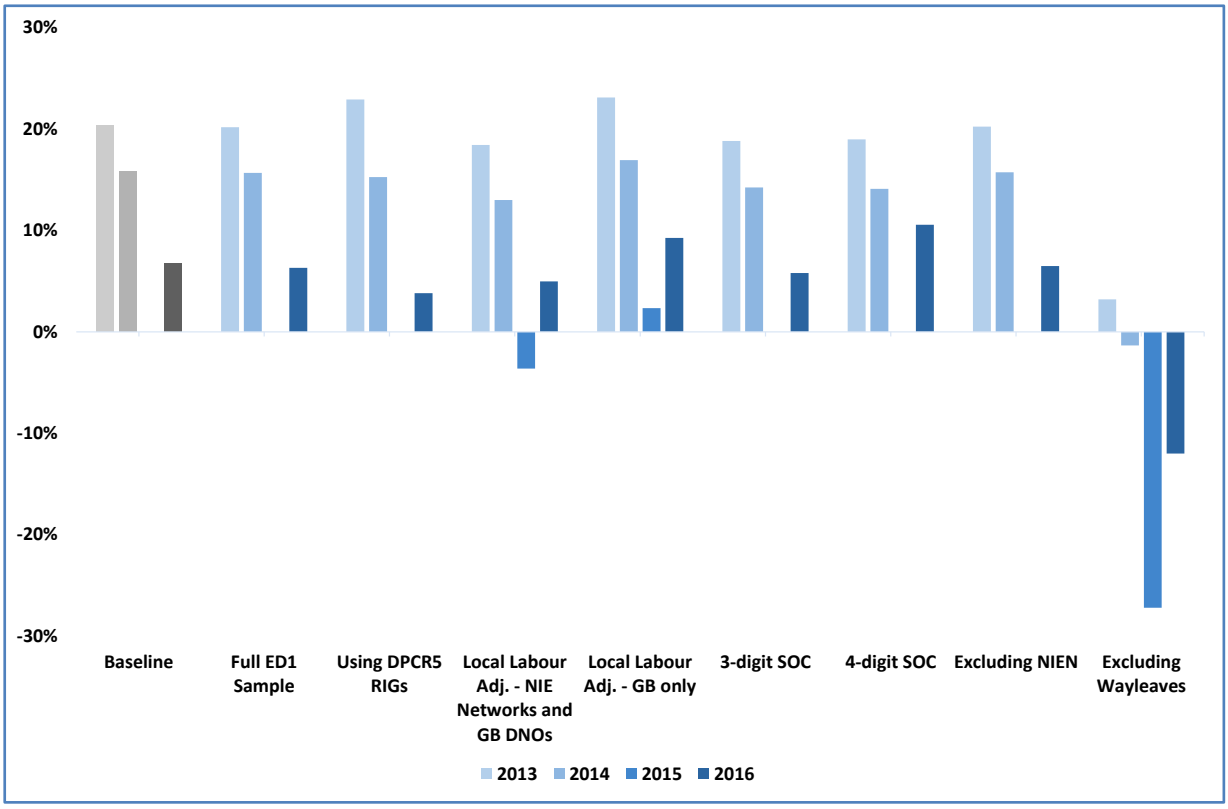

Figure 9: Efficiency gaps from Model 5 (post-allocation)

	2013	2014	2015	2016
Baseline	20%	16%	0%	7%
Full ED1 Sample	20%	16%	0%	6%
Using DPCR5 RIGs	23%	15%	0%	4%
Local Labour Adj. - NIE Networks and GB DNOs	18%	13%	-4%	5%
Local Labour Adj. - GB only	23%	17%	2%	9%
3-digit SOC	19%	14%	0%	6%
4-digit SOC	19%	14%	0%	11%
Excluding NIEN	20%	16%	0%	6%
Excluding Wayleaves	3%	-1%	-27%	-12%

Table 25: Efficiency gaps from Model 5 (post-allocation)

Model 6 Efficiency Gap Analysis (Business Support)

Model 6 Efficiency Gaps – Pre-Allocation

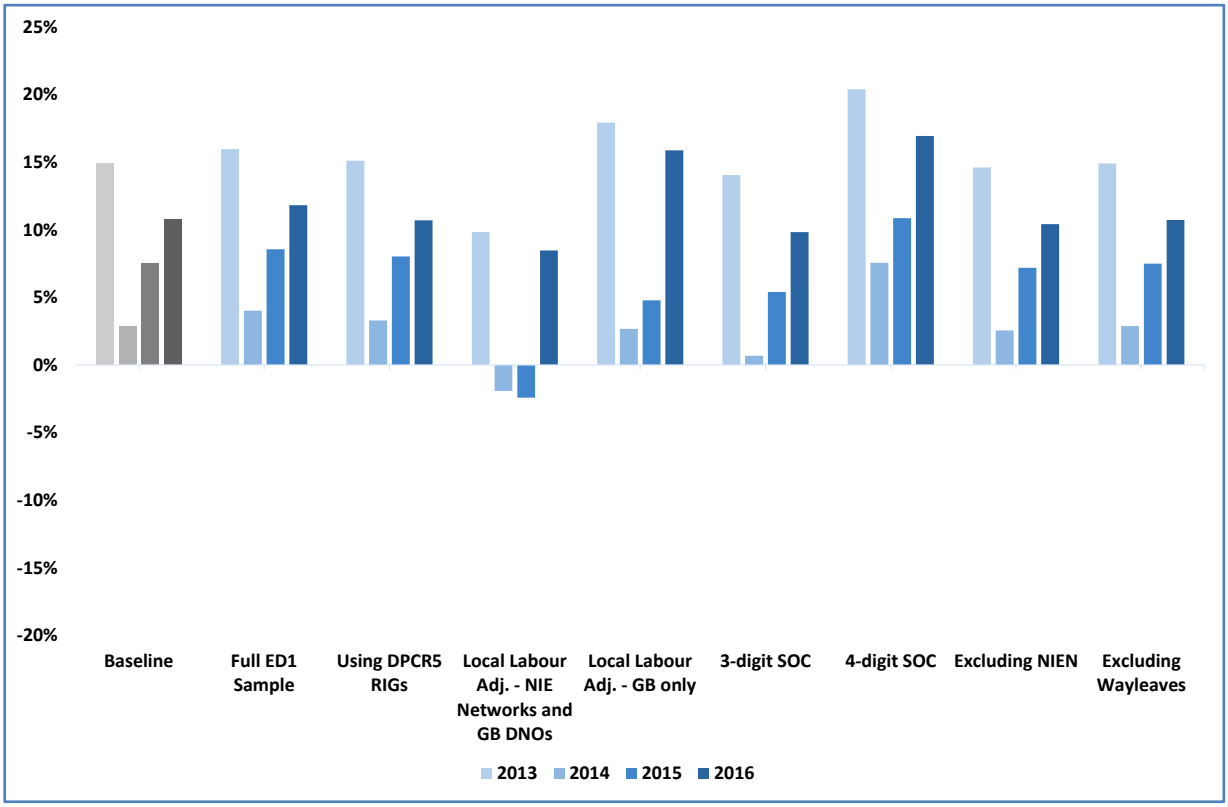

Figure 10: Efficiency gaps from Model 6 (pre-allocation)

	2013	2014	2015	2016
Baseline	15%	3%	7%	11%
Full ED1 Sample	16%	4%	9%	12%
Using DPCR5 RIGs	15%	3%	8%	11%
Local Labour Adj. - NIE Networks and GB DNOs	10%	-2%	-2%	8%
Local Labour Adj. - GB only	18%	3%	5%	16%
3-digit SOC	14%	1%	5%	10%
4-digit SOC	20%	8%	11%	17%
Excluding NIEN	15%	3%	7%	10%
Excluding Wayleaves	15%	3%	7%	11%

Table 26: Efficiency gaps from Model 6 (pre-allocation)

Model 6 Efficiency Gaps – Post-Allocation

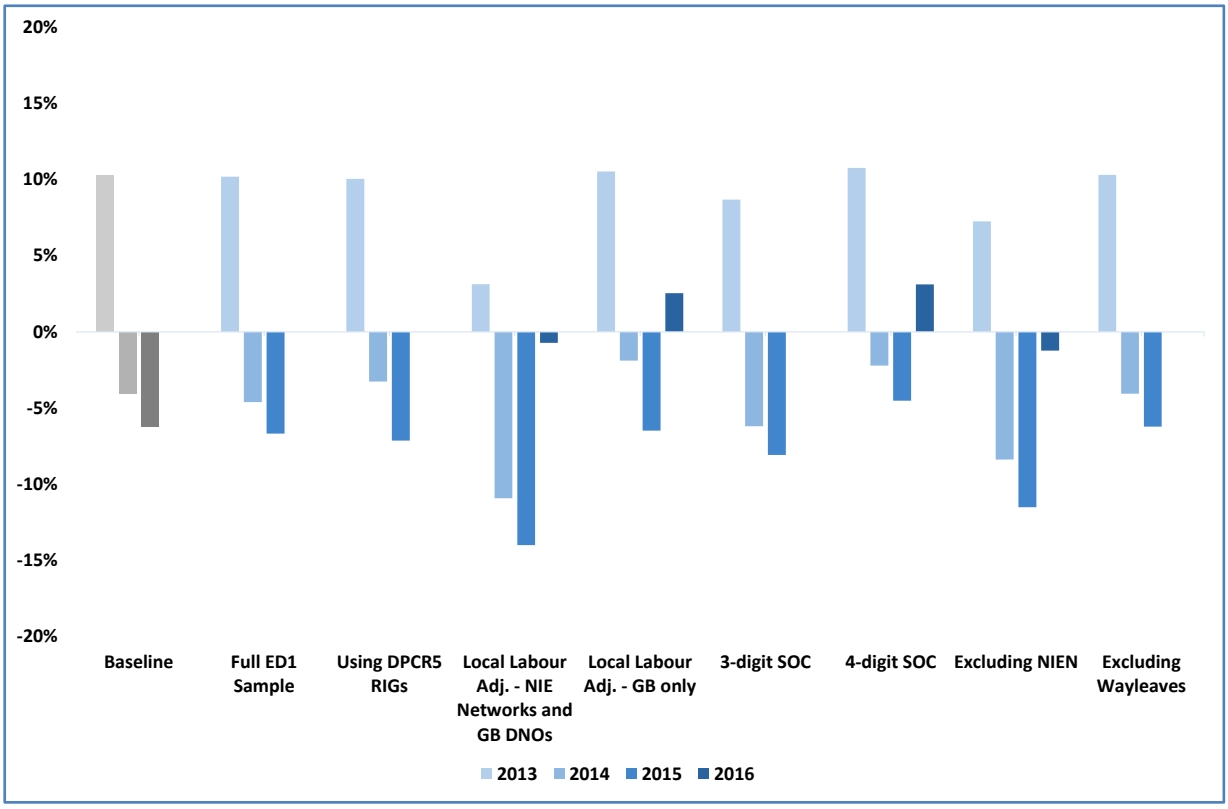

Figure 11: Efficiency gaps from Model 6 (post-allocation)

	2013	2014	2015	2016
Baseline	10%	-4%	-6%	0%
Full ED1 Sample	10%	-5%	-7%	0%
Using DPCR5 RIGs	10%	-3%	-7%	0%
Local Labour Adj. - NIE Networks and GB DNOs	3%	-11%	-14%	-1%
Local Labour Adj. - GB only	11%	-2%	-6%	3%
3-digit SOC	9%	-6%	-8%	0%
4-digit SOC	11%	-2%	-5%	3%
Excluding NIEN	7%	-8%	-12%	-1%
Excluding Wayleaves	10%	-4%	-6%	0%

Table 27: Efficiency gaps from Model 6 (post-allocation)

4 Triangulation

Summary

4.1 The Utility Regulator's approach to triangulation across the different options is presented below. Triangulation allows the UR to make use of multiple methodologies to establish a single value for cost assessment.[18]

4.2 It is important to note that it is not appropriate to simply take the arithmetic average of the different efficiency gaps presented above as this does not take into account:

- The weights the Utility Regulator has chosen to apply to the different options.
- The underlying data differences between the different options that we need to take into account before triangulation to ensure we are comparing like-for-like.

4.3 The Utility Regulator has therefore taken the following approach to obtain an overall catch-up efficiency factor when triangulating across different options:

(i) Run individual models and obtain predicted costs (in natural logarithm) for each year in the sample (2012/13 to 2015/16).

(ii) Take the exponential of predicted costs to reverse the natural logarithm transformation.

(iii) Multiply predicted costs from Model 3 by customer numbers to obtain total predicted IMFT and Indirect costs, for each year in the data sample. [19]

(iv) Sum up predicted costs from the NOCs, CAI and Business Support middle-up models to obtain total predicted IMFT and Indirect costs, for each year in the data sample.

(v) Sum up predicted IMFT and Indirect costs across time (2012/13 to 2015/16) for each model, and divide by the number of years in the sample to obtain the average over the period (i.e. 4 years).

(vi) Multiply the predicted costs from the pre-allocation models by the ratio of "time average normalised adjusted real IMF&T and Indirect costs on a post-allocation basis" and "time average normalised adjusted real IMF&T and Indirect costs on a pre-allocation basis". This ensures that all predicted IMF&T and Indirect costs we are comparing are on a like-for-like post-allocation basis. This ratio can differ depending on the company being examined and the local labour adjustment

[18] As used by CEPA and Ofwat in PR14.
http://www.ofwat.gov.uk/wp-content/uploads/2015/11/rpt_com201301cepacostassess.pdf
[19] Model 3 is a unit cost regression model, and the dependent variable is IMF&T and Indirects per customer.

applied (i.e. no local labour adjustment (CEPA Baseline) or full local labour adjustment (Local Labour Sensitivity 1)).

(vii) Sum up outturn IMF&T and Indirect costs across time (2012/13 to 2015/16) on a post-allocation basis, and divide by the number of years in the sample to obtain the average over the period (i.e. 4 years).[20]

(viii) Multiply the predicted costs from each option by each respective weight chosen by the Utility Regulator, ensuring the weights add up to one. The weights we have chosen for this final determination are presented in the table below.

(ix) Sum up the weighted predicted costs to obtain total predicted IMFT and Indirect costs on a post allocation basis.

(x) Calculate the efficiency score for each company by dividing "average outturn IMF&T and Indirect costs on a post-allocation basis" by "weighted average predicted IMF&T and Indirect costs on a post-allocation basis". We then obtain the triangulated catch-up efficiency factor using the approach described above.

		Weighted time average (2012/13 to 2015/16)			
		No local labour adjustment	**Full local labour adjustment**	**No local labour adjustment**	Full local labour adjustment
Model	**Drivers**	**Pre allocation**		**Post allocation**	
1	Length, Density, OHL Length %	9.38%	3.13%	9.38%	3.13%
2	CSV, Time Dummies, OHL Length %	9.38%	3.13%	9.38%	3.13%
3	Length / Customers, Time Dummies, OHL Length %	9.38%	3.13%	9.38%	3.13%
Middle -up		9.38%	3.13%	9.38%	3.13%
4. NOCs	*Length, Density, OHL Length %*				
5. CAI	*CSV OHL Length %*				
6. Business Support	*CSV*				

Table 28: Utility Regulator chosen final determination model weights

[20] In this instance, when we refer to outturn costs we refer to normalised adjusted real costs that are used as an input into the modelling by CEPA. These are actual DNO costs in real terms once all of the relevant cost adjustments have been made.

Triangulation Results

4.4 The model weights the Utility Regulator has chosen in the table above reflects the decisions we have made throughout this final determination. In particular:

(i) 50% weight on pre-allocation models;

50% weight on post-allocation models.

(ii) 75% weight on models that do not adjust for the local share of labour;

25% weight on models that adjust for the local share of labour.

(iii) 25% weight on Model 1;

25% weight on Model 2;

25% weight on Model 3; and

25% weight on the Middle-Up IMF&T and Indirects model results. [21]

4.5 Using this approach we arrive at a triangulated estimated catch-up efficiency gap of **2.31%** for NIE Networks in this final determination.

4.6 Based on CCNI's and CEPA's recommendations however, the Utility Regulator could have justifiably applied a 100% weight on models that did not apply a local labour adjustment, or applied a 100% weight on models that only applied a local labour adjustment for GB DNOs.

(i) If the UR had made the decision to apply a 100% weight on models that did not apply a local labour adjustment; as was recommended by CCNI and CEPA, and conducted by the CC at RP5; we would have arrived at a triangulated catch-up efficiency gap of 3.99%.

(ii) If the UR had made the decision to apply a 100% weight on models that only applied a local labour adjustment to GB DNOs data; as recommended by CCNI; we would have arrived at a triangulated catch-up efficiency gap of 2.94%.

4.7 Both of these catch-up efficiency factors are greater than the estimated catch-up efficiency gap of 2.31% we have arrived at for this final determination

[21] Models 4, 5 and 6.

Figure 12: Triangulation results at RP6 final determination