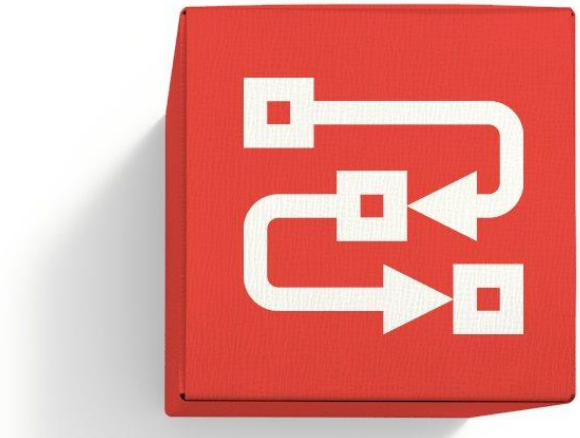
RIIO-GD2: Synthetic Unit Costs Update

Ofgem

27 February 2020



FINAL REPORT FOR PUBLICATION

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EXECUTIVE SUMMARY

Ofgem has commissioned CEPA (under the Economic Strategic Partner contract for RIIO-2) to support it in a review of the synthetic unit costs that feed into the econometric regression models used in gas distribution cost assessment.

In RIIO-GD1, synthetic unit costs were used as a cost driver in the replacement expenditure (repex), connections and reinforcement regressions. For each type of mains replacement activity and services replacement intervention, a fixed synthetic unit cost was assigned for all gas distribution networks (GDNs).

This project has two main aims – an update of the synthetic unit costs, and collation of evidence that Ofgem can use to inform its approach to updating synthetic unit costs.

We start by considering the main areas to consider when updating synthetic unit costs (Section 2): cost drivers; disaggregation of synthetic unit costs; length of time series; and approach to averaging. We then develop an assessment framework (Section 3), which incorporates a range of criteria / tests that are applied to help identify any reasons as to why there may be challenges in using a synthetic unit cost approach for different activities and/or different levels of disaggregation.

We have produced an excel model to calculate the synthetic unit costs using the BPDTs submitted by the gas distribution networks (GDNs) in December 2019. These submissions contain costs and volumes data between 2013/14 (start of RIIO-GD1) and 2025/26 (end of RIIO-GD2). We assess the synthetic unit costs against the assessment framework within the excel model. We have included additional flexibility in the model so that Ofgem can use it for future analysis.

Section 4 presents the outcome of our assessment based on the data available and associated synthetic unit costs. When reviewing our findings, Ofgem should keep in mind the following factors that were either not assessed due to data limitations or were outside the scope of this work:

- It has not been feasible with the data set that is currently available to consider replacement technique and/or surface type explicitly within the synthetic unit cost methodology. Ofgem may want to review how these cost drivers could be reflected in cost allowances using alternative approaches (e.g. post-modelling adjustment to allowances based on engineering judgement).
- Final decisions on whether a synthetic unit cost approach is appropriate for certain activities will require additional consideration of the overall RIIO-GD2 approach to cost assessment, such as the use of non-regression techniques for activities that are excluded from synthetic unit costs.
- It will also be important for Ofgem to consider how the outcome of our synthetic unit cost analysis feeds into the proposed Tier 1 price control deliverable and Tier 2A uncertainty mechanism, which may use the synthetic unit costs within their design.

Repex synthetic unit costs: main findings

- Tier 1 synthetic unit costs perform the best against our assessment framework and are disaggregated by pipe material and pipe diameter. Pipe diameter was reflected in the RIIO-GD1 synthetic unit costs, but pipe material (cast / spun iron, ductile iron or steel) was not. Although the difference in unit costs between pipe material does not appear as significant as the GDNs suggest, it can be used as a disaggregating factor based on performance against the assessment framework.
- Smaller diameter Tier 2 replacement, iron mains more than 30 metres away from a property (Iron>30m) replacement, and other policy mains replacement also perform well against the assessment framework.

Ofgem may want to explore alternative cost assessment approaches for the following mains replacement activity as they do not perform as well against the assessment framework:

- replacement of risers to MOBs;
- replacement of pipes with diameter more than 355mm;

- steel mains more than 2 inches in diameter;
- replacement of mains associated with other policy with diameter more than 180mm;
- diversions non-chargeable; and
- capitalised replacement.

Services synthetic unit costs: main findings

- Domestic services activity performs well against our assessment framework. As expected, there is a significant unit cost difference between transfer and relay domestic services. There are also large unit cost differences between domestic services that are associated with repex and those that are not.
- Ofgem may want to explore alternative cost assessment approaches for non-domestic services activity as it did not perform as well against our assessment framework. Our analysis showed that there is significant variation in non-domestic unit costs both between GDNs and over time.

Reinforcement synthetic unit costs: main findings

- Ofgem may want to explore alternative cost assessment approaches for reinforcement activity as it did not perform well against the assessment framework. Our analysis showed that there is significant unit cost variability /between GDNs as well as many data anomalies that are difficult to explain.

Connections synthetic unit costs: main findings

- Ofgem may want to explore alternative cost assessment approaches for connections activity as it did not perform well against the assessment framework. Our analysis showed that there is significant unit cost variability both between GDNs and over time.

1. INTRODUCTION

1.1. AIM OF THIS REPORT

Ofgem commissioned a partnership of CEPA, AFRY Management Consulting (AFRY) and Economic Consulting Associates (ECA) to provide economic advice for RIIO-2. This independent report has been prepared by CEPA under this Economic Strategic Partner contract for RIIO-2.

Ofgem commissioned CEPA to support it in a review of the synthetic unit costs that feed into the econometric regression models used in gas distribution cost assessment. The work has two main aims – an update of the synthetic unit costs, and collation of evidence that Ofgem can use to inform its approach to updating synthetic unit costs.

1.2. CONTEXT

In RIIO-GD1, synthetic unit costs were used as a cost driver in the replacement expenditure (repex),[2] connections and reinforcement regressions. For each type of mains replacement activity (defined by material and/or diameter, including capitalised replacement), and services replacement intervention (excluding services not associated with mains replacement), a fixed synthetic unit cost was assigned for all gas distribution networks (GDNs).

These synthetic unit costs consisted of average industry costs that were computed based on historical data. These were then multiplied by the company specific workloads volumes being undertaken for each activity and summed to arrive at a single synthetic cost driver (defined in £ millions), which was regressed against submitted costs.

Ofgem has informed us that stakeholder feedback has consistently suggested that they should update these fixed synthetic unit costs for different activities in RIIO-GD2. This could take account of new data that was not available to Ofgem at the time of setting synthetic costs for RIIO-GD1, such as:

- six years of reported actual RIIO-GD1 unit cost data for each of the eight GDNs (2013/14 to 2018/19), and
- seven years of forecast data from the RIIO-GD2 December Business Plan submissions (2019/20 to 2025/26).

1.3. STRUCTURE OF THIS REPORT

This report describes the:

- key areas that need to be considered when updating synthetic unit costs (Section 2);
- assessment framework (Section 3); and
- updated synthetic unit costs (Section 4).

The appendices to this report present:

- our assessment of additional repex data that was requested by Ofgem through the December BPDTs (Appendix A).

[2] Repex or replacement expenditure is expenditure in relation to the replacement or decommissioning of iron gas mains.

2. KEY AREAS OF CONSIDERATION

It is important to define the key issues when updating synthetic unit costs to better inform the overall methodology and assessment framework (Section 3). We have identified four key areas that should be considered when developing a methodology to update the synthetic unit costs based on an information review, and our expert knowledge and experience of working in the gas sector on cost assessment related issues:

- Cost drivers and regional factors.
- Disaggregation of synthetic unit costs.
- Length of time series.
- Approach to averaging.

We discuss each of these four areas in detail in the sub-sections below. We summarise this discussion below, which we reflect in the synthetic unit cost assessment framework and methodology in Section 3.

Final decisions on whether a synthetic unit cost approach is appropriate for certain activities will also require additional consideration of the overall RIIO-GD2 approach to cost assessment, such as the use of non-regression techniques for activities that are excluded from synthetic unit costs.

It will also be important for Ofgem to consider how the outcome of our synthetic unit cost analysis feeds into the proposed Tier 1 price control deliverable and Tier 2A uncertainty mechanism, which may use the synthetic unit costs within their design. This work is outside the scope of this work and will be considered by Ofgem in due course.

Cost driver: main findings

- We have identified four drivers of mains replacement costs: pipe diameter, replacement technique, ground surface and pipe material. Cost and volumes data are only currently broken down by pipe diameter and pipe material, which is reflected in the updated synthetic unit costs in Section 4.
- Ofgem could consider taking into account differences in replacement technique and ground surface between GDNs by making post-modelling adjustments to repex allowances based on engineering judgement.
- The main cost driver of services associated with mains replacement is whether the service pipe is replaced ('relay') with polyethylene pipe (PE) or is only transferred to the new PE main ('transfer').
- Service relays not associated with mains replacement are grouped into six categories within the BPDTs: bulk services; after escape; other (metallic); other (non-metallic); service alterations / meter relocations; and smart metering. Generally, bulk services will be less costly on a unit basis than the other categories as fixed costs can be split across more units. However, bulk services are also less common than service relays after escape, which are expected to make up 65% of service relays not associated with mains replacement in the period 2013/14 to 2025/26.
- If there are exogenous cost drivers that affect GDNs to different extents (i.e. asymmetrical) which are not reflected in the level of disaggregation, adjustments should be made within the synthetic unit cost methodology if sufficient quality data is available. Street works is an example of an asymmetrical cost driver that affects GDNs differently, but data is not currently available to enable an adjustment to be made.

Disaggregation of synthetic unit costs: main findings

- A greater level of cost and volume disaggregation can generally more accurately explain unit cost differences between GDNs.
- However, the use of more disaggregated data can increase the risk of data reporting inconsistencies and reduce the number of comparators. If these risks cannot be mitigated, it may be sensible to use more

aggregated data or representative unit costs where activities are similar in nature. We consider these trade-offs within our assessment framework in Section 3.

Length of time series: main findings

- It may be appropriate to rely on historical data to calculate synthetic unit costs for repex work that is repeatable and undertaken using common techniques, providing that unit costs are not expected to change significantly during RIIO-GD2.
- The use of pain / gain arrangements within the contracts agreed with repex contractors may mean that historical reported costs are not a true reflection of the costs incurred to undertake the repex work. GDNs may also be able to provide more accurate forecast data compared with historical data because data has been requested at a level of disaggregation that was not previously requested at RIIO-GD1. For example, Cadent only disaggregate between cast iron and ductile iron mains replacement for RIIO-GD2, and not for RIIO-GD1. Additionally, synthetic unit costs based on forecast data sometimes reflect differences in unit costs between diameter bands that are more consistent with what would be expected from an engineering perspective. GDNs also forecast a fall in unit costs for a number of activities, which would not be captured using historic data. In these cases, it may be more appropriate to use forecast data to calculate synthetic unit costs, provided there is no forecast step increase in unit costs within the forecast period that cannot be explained.
- The synthetic unit costs are used within the econometric cost models as weights and do not differ between GDNs. As a result, the outcome of the regression analysis may not depend significantly on the synthetic unit costs but more on the volumes of work. However, the decision on what time period to use may be more important in the context of the proposed Tier 1 price control deliverable and Tier 2A uncertainty mechanism, which will likely require unit costs to be defined within the licence and may, therefore, use the synthetic unit costs within their design.
- The choice of using historical or forecast data is also likely to be more important when deciding how to define the dependent variable within the regression analysis (e.g. developing econometric models to explain variations in historical costs, forecast costs or both) because it is could potentially drive significant differences in modelled allowances. These considerations are outside the scope of this work and will be considered by Ofgem in due course.

Approach to averaging: key points

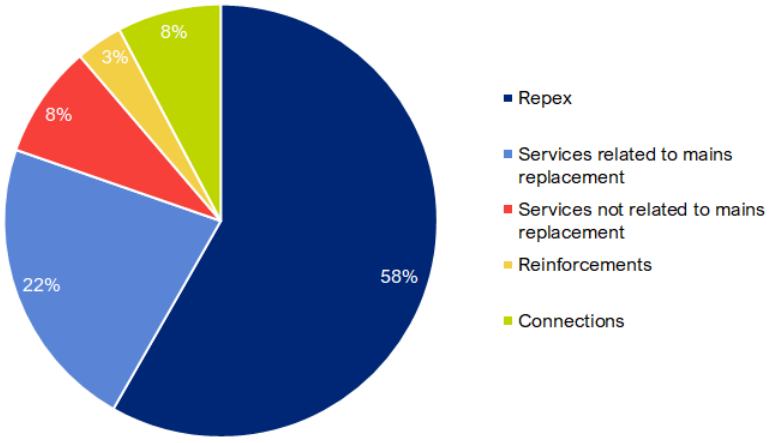
- We consider it appropriate to apply GDN forecast workloads as weights within the synthetic cost calculation. This is because of the protection of the proposed Tier 1 PCD and Tier 2A uncertainty mechanism and to ensure alignment with the cost inputs that are used in the regression analysis.

2.1. COST DRIVERS AND REGIONAL FACTORS

Net expenditure on repex, services, connections and reinforcement in RIIO-GD1 is provided in Figure 2.1 below[3]. The sum of expenditure across these four activities reflects the total expenditure covered in this report. The figure shows that repex and services associated with mains replacement account for 80% of this expenditure in RIIO-GD1. As a result, the focus of this section is on repex and services replacement associated with mains replacement.

[3] Net expenditure is gross expenditure reduced by any contributions received from customers.

Figure 2.1: Breakdown of RIIO-GD1 repex, services, connections and reinforcement expenditure as a percentage of total spending covered in this report[4]



Source: CEPA analysis of Ofgem data

Repex

The Iron Mains Risk Reduction Programme (IMRRP) is based on a three-tier approach set by the Health and Safety Executive (HSE):

- Tier 1 Mains: 8-inch diameter and below (c.80% of all 'at risk' iron pipes);
- Tier 2 Mains: > 8-inch and <18-inch diameter (c.15% of all 'at risk' iron pipes); and
- Tier 3 Mains: 18-inch and above diameter (c.5% of all 'at risk' iron pipes)

HSE's enforcement policy stipulates that all Tier 1 pipes are to be decommissioned (i.e. replaced or abandoned) by the end of 2032 or earlier. Tier 2 pipes scoring above the risk-action threshold identified by the Mains Risk Prioritisation System (MPRS), and defined as Tier 2A, are also mandatory to decommission. Both Tier 1 and Tier 2A pipes were classified by Ofgem as non-discretionary repex at RIIO-GD1.

Tier 2 pipes scoring below the risk-action threshold within MRPS, and defined as Tier 2B, are subject to condition monitoring arrangements along with Tier 3 pipes. Both Tier 2B and Tier 3 pipes were classified by Ofgem at RIIO-GD1 as discretionary repex along with certain other categories of gas distribution pipes including:

- iron mains greater than 30 metres from a property;
- steel mains more than 2 inches in diameter;
- 'other' mains;
- associated services; and
- multiple occupancy buildings (MOBs).

We have identified four possible drivers of costs associated with the replacement of gas mains in order of importance based on engineering rationale and review of company evidence:

- **Pipe diameter**: the larger the diameter, the more costly the polyethylene pipe (PE) being used to replace the metallic main together with, in some cases, the need for specialised pipe handling equipment. From an engineering and technical perspective, unit cost assessments tend to work well for high volume,

[4] Total sums to 99% due to rounding.

standardised, routine activities associated with mains installation and replacement. As a result, unit cost benchmarking can work well for smaller pipe diameters as this replacement tends to be relatively high volume and standardised across companies. Conversely, replacement of larger diameter pipes tends to be relatively low volume and unit cost comparisons between GDNs can be less meaningful because of the variability of inputs.

- **Replacement technique**: the most used technique for the replacement of Tier 1 gas mains is 'dead mains insertion', whereby a section of gas main is temporarily decommissioned, and a PE pipe is inserted through the isolated section of main and then re-commissioned. This technique does involve the need for excavation of 'launch' and 'receive' pits together with gas service connection pits, but, overall, the amount of excavation, backfill and reinstatement is considerably reduced resulting in a lower unit cost of mains replacement. Open-cut mains replacement – i.e. the new pipe is installed in an excavated trench in a different position to the existing gas main - is only carried out where dead mains insertion cannot be undertaken for some technical reason or mains records are inaccurate. Open cut mains replacement is the most costly and disruptive (to traffic and pedestrians) technique for gas mains replacement. The replacement technique may be related to the pipe diameter as larger diameter pipe replacement is more likely to require open-cut mains replacement.

- **Ground surface**: gas mains are typically located in either: (i) grass verges; (ii) flagstone, modular or bitumen footways; and (iii) bituminous or concrete roadways. The category of ground surface can have a significant impact on the unit cost of mains replacement. Where gas mains are located on grass verges, the costs of excavation, backfill and surface reinstatement are relatively low when compared to the activities (and associated costs) of excavation, backfill and surface reinstatement of 'made' footpaths and roadways. Also, for gas mains replacement activity in the roadway, there are often associated costs of traffic management and local highway authority charges. It is likely, however, that there is a relationship between replacement technique and ground surface. For example, open-cut mains replacement will most likely need to take place in footpaths or roadways. Therefore, collecting data on replacement technique may be enough to also capture cost differences caused by ground surface.

- **Pipe material**: companies have argued that there can be significant cost differences between cast iron mains replacement and ductile iron (DI) mains replacement. For example, Wales and West Utilities (WWU) claim they have avoided replacing DI mains during RIIO-GD1 and focused on cast iron and spun iron mains replacement.[5] This was done on the grounds that the former is more risky due to the possible complications and associated cost of cutting DI to connect services to the newly inserted PE main. From our engineering understanding, however, we would not expect that cutting out DI mains is significantly more difficult or expensive than cutting out cast and spun iron mains. The same can also be said for steel mains replacement.

The identification of these four cost drivers means that no category of repex is immediately highlighted as facing challenges in applying a synthetic unit cost approach. This is because consideration of each of the cost drivers is required before deciding whether a synthetic unit cost approach is appropriate, which we reflect in our assessment framework in Section 3.

Services replacement

Services replacement can be divided into two categories:

- **Services associated with mains replacement** – these have relatively low unit costs of replacement (compared to those not associated with mains replacement) as travel, site establishment and set-up costs are spread across a larger project. The main cost driver for these services is whether the service pipe is replaced ('relay') with PE or is only transferred to the new PE main ('transfer'). In this case a transfer is generally less costly than a relay. There may also be unit cost differences for service pipe replacements

[5] Source: Wales & West Utilities (WWU). Appendix 9D – Mains Replacement Performance RIIO-GD1. Link here.

('relay') depending on whether it is replaced using 'dead mains insertion' or 'open-cut' but it is not possible to assess this with the data available.

- **Services not associated with mains replacement –** these activities will lead to the services being replaced and are therefore all relay. Costs will differ depending on whether the service relay is a:
    - **Bulk service relays**: these steel services are replaced on a zonal basis, independent of mains replacement, where 'hot-spots' of service pipe leakage have been identified from data records and the GDN has taken a decision to replace the service pipes in a particular zone.
    - **One-off service relay**: these steel services are replaced as one-off, individual services normally as a result of leakage being reported by the public. These are relatively higher cost services to replace as they involve travel to site, site establishment and set-up costs for the distribution team and, subsequently, the surface reinstatement team. In the BPDTs, these are divided into after escape; other (metallic); other (non-metallic); service alterations / meter relocations; and smart metering.

Reinforcement and connections

Reinforcement and connections are lower volume activities than repex. The work is more bespoke in nature and unit costs can be more distorted by outliers. As such, meaningful comparisons of units between GDNs is more difficult for reinforcement and connections.

Reinforcement typically tends to involve large diameter pipes and is constructed in existing roads via open cut technique, which may make it difficult to make meaningful unit costs comparisons because of the variability of inputs. Ofgem may want to explore alternative cost drivers that better capture differences in reinforcement costs between GDNs and over time (e.g. peak demand) as this was outside the scope of this work.

There are also a number of other factors that are likely to drive differences in connections and make unit cost comparisons difficult. A development with multiple connections can spread the fixed costs across multiple units, leading to a lower unit cost relative to a single connection. Some connections can also be more complex than others. For example, a block of flats that require new gas supply above the first floor have higher risks and costs associated with working at height. Connections that require more than 169 kW peak demand will also be more complex as they may require additional reinforcement. Net unit cost comparisons are further complicated by different levels of contributions to connection costs between GDNs. Hence, Ofgem may want to explore alternative cost drivers that better capture differences in connection costs between GDNs and over time (e.g. number of new connections; complexity of new connections; etc.) as this was outside the scope of this work.

Other factors for consideration

There are other potential cost drivers and regional factors that have not been applied in the synthetic unit cost methodology either because we do not think they should be captured within the methodology or because there is currently insufficient quality data available:

- **If there are exogenous cost drivers that affect GDNs to different extents (i.e. asymmetrical) which are not reflected in the level of disaggregation, adjustments should be made within the synthetic unit cost methodology if sufficient quality data is available.** For example, local highway authority restrictions, charges (e.g. street works), and difficulty with access to congested underground networks in city centre locations, notably London (e.g. network complexity). This could be done through excluding certain costs from the synthetic unit cost calculation if they are not incurred by all GDNs (e.g. street works) and/or through application of company specific adjustment factors.
- Labour cost differentials, which are likely to be caused by two main factors:
    - **Differences in regional labour prices**. For example, labour costs may be more expensive in London than in other parts of GB. All else being equal, this may lead to relatively higher input costs for GDNs operating in London. However, the adjustment applied to bring labour costs onto the GB average would be symmetrical (negative and positive adjustments applied). Therefore, an approach that does not adjust for regional labour cost differentials and one that does should lead to

the same synthetic unit costs (as an average across the companies), as demonstrated in the table below.

Table 2.2: Regional labour cost differential symmetrical adjustment factor

	Reported labour costs	Regional labour cost adjustment factor	Adjusted labour costs
Company A	52	1.04	50
Company B	51	1.02	50
Company C	50	1	50
Company D	49	0.98	50
Company E	48	0.96	50
Average	50	1	50

- **Differences in utilisation of direct and contract labour to carry out mains replacement activity**. Differences in unit costs between the GDNs may result from different proportions of direct labour and contract labour being used to carry out mains replacement activity. This is because there could be cost differentials between the two types of labour. However, the decision on whether to use direct or contract labour is under GDN control, which means it should not be considered within the synthetic unit cost calculation as the GDN should choose the most efficient option.

- **Real price effects (RPEs) do not need to be captured within the synthetic unit cost calculation** given they should approximately affect all GDNs and all activities considered in this report the same. As a result, the application of RPEs would not change the relative weights between different activities.

2.2. DISAGGREGATION OF SYNTHETIC UNIT COSTS

2.2.1. Implications of disaggregation

We would normally expect that using more disaggregated costs and volumes in the synthetic unit cost calculation would more accurately explain cost differences between GDNs. As such, it is preferable to have cost and volume data disaggregated by diameter band, ground surface type and replacement technique.

Mains replacement schemes and projects are typically designed and costed many months, if not years, in advance of site activity commencing. Therefore, the GDNs should have good knowledge of the mix of diameter bands, ground surface categories and replacement technique to be used in such projects, which should enable them to provide data to a relatively high level of disaggregation. For RIIO-GD2, the degree of uncertainty over workloads should be reduced as a result of a shorter price control period, increasingly sophisticated planning tools, and better data recording practices.

However, there are potential disadvantages of using more disaggregated data when calculating synthetic unit costs:

- **A higher risk of data reporting inconsistencies between GDNs and over time**. GDNs are more likely to interpret definitions differently or apply different cost allocation rules if data is requested at a more disaggregated level. As a result, unit cost comparisons between GDNs and over time may not be meaningful and may not reflect true differences in cost efficiency.

- **GDNs may also find it difficult to retrospectively report data at a more detailed disaggregated level** if they were not previously collecting data to that level of detail. This may lead to assumptions being applied to produce historical proxies, which may also limit comparability between GDNs and over time. The GDNs may also need to put enhanced data reporting systems in place, leading to higher costs.

- **Fewer comparators and a higher risk of endogeneity**. A higher level of disaggregation will lead to a lower number of observations for each level of aggregation. In some cases, this may mean it is not

possible to make comparisons between GDNs for certain types of replacement activities (i.e. benchmarking is not feasible). This will lead to a higher risk of endogeneity as the synthetic unit cost for that replacement activity will only be set by one GDN, which would make it difficult to assess cost efficiency. A low number of observations may also reduce comparability with future mains replacement activity.

Allocation methodologies applied by the GDNs could also make unit cost comparisons between GDNs less meaningful. Our review of information provided by the GDNs found that GDNs provided a basic explanation of how direct costs are allocated into reporting categories but generally did not explain how indirect costs have been allocated across different activities. We consider possible implications of inconsistent allocation methodologies between GDNs within the quantitative assessment criteria presented in Section 3.2.

2.2.2. Disaggregation for RIIO-GD2

Replacement technique and surface type

In the December 2019 BPDTs, Ofgem requested repex volumes to be broken down by replacement technique and surface type to test disaggregated approaches to synthetic unit cost calculations.[6] The volume data requested has generally been well populated by the GDNs. However, the data was not requested on an annual basis, which makes it more difficult to incorporate into the synthetic unit cost methodology as we cannot identify and compare values across individual years.

Ofgem requested repex cost data to be broken down by replacement technique and surface type through the supplementary question (SQ) process, as a supplement to the disaggregated workloads provided in the BPDTs. GDN responses varied in terms of granularity of data provided.

In light of the GDN responses, it is not feasible to consider replacement technique and/or surface type within the synthetic unit cost methodology using the data available. Ofgem may want to reassess this for RIIO-GD3 if additional data becomes available. For RIIO-GD2, Ofgem may want to consider how these cost drivers could be reflected in cost allowances using alternative approaches. Alternative approaches such as post-modelling adjustments based on engineering judgement may be preferable based on the limited disaggregated costs data provided by GDNs within the RIIO-GD2 December BPDTs.

Reinstatement and street works

Data was also requested in the December BPDTs on the proportion of repex attributable to reinstatement and street works. However, there is no methodological reason to exclude reinstatement costs from the synthetic cost calculations as these costs are incurred by all GDNs and cost variations are likely to be captured by other cost drivers. For example, reinstatement costs are likely to be higher for open-cut replacement than dead mains insertion replacement.

Conversely, street works are likely to affect companies differently depending on where they are located (i.e. asymmetrical cost driver), which means it may be sensible to exclude these costs from the synthetic unit cost calculation. Unfortunately, the data provided in the BPDTs on street works costs has many gaps and cannot be used to adjust costs. The emphasis should be on the affected GDNs to provide the required data as the overall impact on the synthetic unit cost calculations by excluding street works costs is likely to be relatively small.

2.3. LENGTH OF TIME SERIES

When applying statistical methods, the larger the data set used typically the more robust the statistical analysis will be. For example, in econometric modelling the greater the volume of data and observations the more variables that can in principle be considered within the modelling. Similarly, with unit cost analysis the greater the number of observations, the less likely it is that the calculated unit cost will be significantly influenced by an outlier.

Within the GB gas distribution sector there are eight GDNs, which means there is limited cross-sectional data available for cost assessment. However, Ofgem have collected data over a relatively long time period, covering the

[6] In Appendix A, we assess the quality of new repex data that has been submitted by GDNs in the December BPDTs.

period 2008/09 to 2025/26. This gives the option of using historical and forecast data when calculating the synthetic unit costs.

At RIIO-GD1, the synthetic unit costs consisted of average industry costs that were computed for the previous price control and based only on historical data. While there is agreement among stakeholders that these should be updated for RIIO-GD2 as they are unlikely to be a good reflection of current costs in absolute terms, there is no agreement on either the length of the time series that should be used to update the synthetic unit costs and/or the use of forecast data.

We include a test to decide between the use of forecast or historical data within the assessment framework in Section 3. We apply this on a case-by-case basis.

Use of forecast data

Forecast (i.e. business plan) data may provide useful information if the unit costs of certain repex work are expected to change significantly during the forthcoming regulatory period due to reasons that are outside the control of the company. In this case, historical cost data may not be a good representation of future costs, and as a result GDNs may be significantly overfunded or underfunded for repex work.

In addition, GDNs often have pain / gain contracts in place with repex contractors. Under these contracts, contractors incur a share of the costs associated with any overspend but also keep a share of any underspend associated with efficiency throughout the duration of the contract. This means that reported costs are unlikely to deviate far from expected levels in the short term but may not necessarily be an accurate reflection of actual repex incurred by the contractor. As a result, historical repex reported by the GDN may not be a good reflection of future repex as contractors are likely to renegotiate their contracts ahead of RIIO-GD2 to reflect the most up to date information available. However, the matter is complicated further as the contractors may use the published unit rates as part of RIIO-GD2 to help set their own contractor rates. This leads to the additional risk that Ofgem will never truly understand the efficient cost of undertaking repex work if contractors base their rates on Ofgem's synthetic unit costs.

It may also be the case that the GDNs are able to provide more accurate forecast than historical data given that data has been requested at a level of disaggregation that was not previously requested at RIIO-GD1. This may lead to unit costs that appear more sensible when using forecast data compared with historical data. For example, Cadent disaggregate between cast iron and ductile iron mains replacement only for RIIO-GD2, and not for RIIO-GD1. Additionally, synthetic unit costs based on forecast data sometimes reflect differences in unit costs between diameter bands that are more sensible from an engineering perspective (see Section 4). GDNs also forecast a fall in unit costs for a number of activities (see Section 4), which would not be captured using historic data. In these cases, it may be more appropriate to use forecast data to calculate synthetic unit costs provided there is no step increase in unit costs within the forecast period that cannot be explained.

The synthetic unit costs are used within the econometric cost models as weights and do not differ between GDNs. As a result, the outcome of the regression analysis may not depend significantly on the synthetic unit costs but more on the volumes of work that feed into the synthetic cost drivers as these differ between GDNs. This means that the choice of using historical or forecast data is unlikely to be as important as the choice of unit cost disaggregation in the context of the regression analysis. However, it may be more important in the context of the proposed Tier 1 price control deliverable and Tier 2A uncertainty mechanism, which may use the synthetic unit costs within their design[7].

Use of historical data

It may be appropriate to rely on historical data for repex work that is repeatable and undertaken by the GDNs using common techniques (e.g. Tier 1 mains replacement) conditional on some of the issues discussed above. This approach reduces the risks associated with using forecast data. Most notably, it reduces the independence of the synthetic unit cost analysis from GDN business plans.

[7] Source: https://www.ofgem.gov.uk/system/files/docs/2019/05/riio-2_sector_specific_methodology_decision_-_gd.pdf

This approach would also mitigate for any forecast unit cost increases as a result of GDNs own behaviour. During RIIO-GD1, GDNs have considerable freedom in identifying mains for replacement in that only 20% of the Tier 1 length of pipes to be decommissioned are drawn from the highest risk pipes identified by MPRS. The remaining 80% of the pipes to be decommissioned can be drawn from any part of the remaining Tier 1 population. This flexibility means that GDNs are likely to 'cherry-pick' low unit cost replacement mains and subsequently over-recover costs under the regulatory framework. The consequence of this is that RIIO-GD1 expenditure is being incurred on replacing mains that have very low risk scores whilst mains with relatively higher risk scores continue to deteriorate. The unit costs associated with replacing mains with relatively higher risk scores may be forecast to be higher during RIIO-GD2 as a result of this. The use of historical data should mitigate for this risk and protect consumers whilst doing so.

If we rely only on historical data, it may still be necessary to assess the length of the historical time series as it may be appropriate to place more weight on more recent historical data that better reflects the current efficient cost of undertaking the work rather than using the longest historical time series available. This assessment is conditional on the decision to use historical rather than forecast data and would only consider RIIO-GD1 data given that the December BPDTs only requested historical data going back to the start of RIIO-GD1 (2013/14).

2.4. APPROACH TO AVERAGING

In RIIO-GD1, all repex was assessed using regression analysis. Synthetic unit costs for different categories of mains and services were multiplied by the GDN submitted workload (e.g. km of mains) to derive a synthetic cost of workload[8]. This workload driver was regressed against repex to assess the efficient level of repex for each company based on their forecast mix of work. Ofgem also adjusted GDNs' forecast workloads in cases where they did not consider the GDNs' forecast was appropriate.

There is one key question to consider when reviewing the approach to averaging adopted at RIIO-GD1:

Should Ofgem apply GDN forecast workloads as weights rather than notional workloads?

Forecast workloads for each GDN would be taken directly from the BPDT submitted by each GDN. Whereas notional workloads would be based on workloads for the average / typical GDN and would be the same for all GDNs.

Ofgem applied GDN forecast workloads as weights in RIIO-GD1, with some adjustments where appropriate. The main advantage of this approach is that the derived synthetic cost of workload for each GDN is more likely to be a true reflection of the efficient cost of repex work that will be undertaken by the GDN than if notional workloads were applied.

The statement above, however, is presented under the assumption that GDNs deliver the forecast mix of work. However, as mentioned above, GDNs have considerable freedom during RIIO-GD1 in identifying mains for replacement and do not need to deliver their forecast mix of work. This has given GDNs the opportunity to 'cherry pick' low unit cost replacement mains and subsequently over-recover costs under the regulatory framework as there is no mechanism in place to adjust allowances for a different mix of work to what was forecast. However, this risk may also have been realised if notional weights had been used because the risk is driven by the GDNs' behaviour during the price control rather than ex-ante assumptions on workload weights.

The risk of this unintended consequence occurring again during RIIO-GD2 is somewhat mitigated through the introduction of a price control deliverable (PCD) for Tier 1 and the Tier 2A uncertainty mechanism, which means that cost allowances will be adjusted for any undelivered Tier 1 and Tier 2A workloads relative to the RIIO-GD2 targets. Therefore, we consider it appropriate to apply GDN forecast workloads as weights under the protection of the Tier 1 PCD and Tier 2A uncertainty mechanism. It also adds necessary variation in synthetic cost of workloads, which is vital for regression analysis, and aligns with the cost inputs that are used in the regression analysis.

[8] This calculation is conducted separately by Ofgem. This report only provides the updated synthetic unit costs for different activities.

3. ASSESSMENT FRAMEWORK

This section presents our framework for assessing the suitability of a synthetic unit cost approach for different activities and/or different levels of disaggregation. For example, the framework can be used to assess whether a synthetic unit cost approach is appropriate for Tier 1 low pressure cast iron & spun mains replacement in the 180mm to 250mm diameter band.

Through the framework we attempt to answer the following questions:

- Are there enough observations to enable a robust synthetic unit cost to be calculated?
- Should any outliers be excluded from the synthetic unit cost calculation to avoid the weighted synthetic unit cost from being distorted?
- Is there high unit cost variability between RIIO-GD1 and RIIO-GD2 that is not explained?
- Is there high unit cost variability between GDNs that may mean a synthetic unit cost approach is not appropriate?
- Is there high and unexpected unit cost variability over time that means a synthetic unit cost approach may not accurately reflect the evolution of costs over time?
- Are there any reasons from a qualitative perspective (e.g. data quality) that means a synthetic unit cost approach may not be appropriate?

The assessment framework is divided into quantitative and qualitative criteria. We have attached a level of importance to each aspect that reflects the potential implications of failing the criterion / test and what action could be taken.

- **Very high:** failure would mean that a synthetic unit cost approach should not be applied, and it would be advisable to (i) test again with a greater level of aggregation; (ii) use representative unit costs where activities are considered to be comparable from an engineering perspective; or (iii) remove activity from the synthetic unit cost approach.
- **High**: failure would raise serious concerns that a synthetic unit cost approach is not appropriate. Trade-offs with other test / criterion results should be considered, but all else being equal, it would be advisable to (i) test again with a greater level of aggregation; (ii) use representative unit costs where activities are considered to be comparable from an engineering perspective; or (iii) remove activity from the synthetic unit cost approach.
- **Medium**: failure would raise some concerns that a synthetic unit cost approach is not appropriate. But a synthetic unit cost approach could be used with caution if it passes other more important tests / criterion.
- **Low**: failure would raise very limited concerns about using a synthetic unit cost approach.

Trade-offs between individual criterion should be considered carefully. Therefore, we do not envisage the assessment framework being applied mechanically and it will be necessary to apply a degree of regulatory judgement when deciding whether to apply the synthetic unit cost approach. In addition, Ofgem should keep in mind the following factors that were either not assessed due to data limitations or were outside the scope of this work:

- It has not been feasible with the data set that is currently available to consider replacement technique and/or surface type explicitly within the synthetic unit cost methodology. Ofgem may want to review how these cost drivers could be reflected in cost allowances using alternative approaches (e.g. post-modelling adjustment to allowances based on engineering judgement).
- Final decisions on whether a synthetic unit cost approach is appropriate for certain activities will require additional consideration of the overall RIIO-GD2 approach to cost assessment, such as the use of non-regression techniques for activities that are excluded from synthetic unit costs.

- It will also be important for Ofgem to consider how the outcome of our synthetic unit cost analysis feeds into the proposed Tier 1 price control deliverable and Tier 2A uncertainty mechanism, which may use the synthetic unit costs within their design.

3.1. QUANTITATIVE CRITERIA

The table below presents the quantitative criteria broken down into different tests that are applied within the assessment framework. These tests should be assessed iteratively to ensure that the final selection of synthetic unit costs passes all pass / fail criteria, i.e. the first two criteria.[9]

Table 3.1: quantitative assessment criteria

Criteria	Level of importance	Description
(1) Minimum number of observations	Very high	**Test** • Data must be provided for a minimum of two historical reporting years and two forecast reporting years, and for a minimum of two GDNs. **Rationale** • As a minimum threshold, we require two observations per data category (historical/forecast, GDN) since a minimum of two observations are required to benchmark costs. This criterion also aims to mitigate the risk that a synthetic unit cost is driven by an outlier or one GDN, which in turn reduces concerns about endogeneity. • Consideration of whether observations come from the same company (e.g. Cadent) are considered in the qualitative assessment criteria. For example, there may be a greater chance that allocation methodologies influence the outcome if observations are only available from one management group (e.g. capitalised replacement). • Dependent on the choice of reporting period, it is important to assess how unit costs are forecast to change between the historical and forecast period (see quantitative criterion 3), which is why we require a minimum of two historical and two forecast years of data.
(2) Outlier test	Very high	**Test** • Unit costs calculated using RIIO-GD1 (RIIO-GD2) data must be within 100% of the industry average unit cost over the same period. **Rationale** • This criterion ensures that very high or very low values do not affect the average industry unit cost. • For example, a major project with a high unit cost is unlikely to be representative of the average unit cost for that activity.
(3) Maximum unit cost variability between RIIO-GD1 and RIIO-GD2	High	**Test** We assess whether the RIIO-GD2 industry average unit cost is within 40% of the RIIO-GD1 industry average unit cost. **Rationale** • If this test fails, it is unlikely to be appropriate to calculate the synthetic unit costs based on the complete data series as

[9] Negative net costs are removed from the analysis to ensure that the industry average unit costs are not skewed by negative values. Negative values may be caused by imprecise allocation of cost contributions across different activities.

Criteria	Level of importance	Description
		the result would indicate there is a step change between historical and forecast unit costs. • When this test fails, one should assess whether it is appropriate to use historical or forecast data based on qualitative criteria.
(4) Maximum unit cost variability between GDNs	High	**Test** • We assess whether individual GDN unit costs calculated using RIIO-GD1 (RIIO-GD2) data are within 40% of the industry average unit cost over the same period, once outliers have been removed. • We apply a pragmatic approach to determine whether this criterion passes for each activity. A pass is assigned if less than 10% of GDNs unit costs are beyond the threshold. A partial pass is assigned if between 10% and 25% of GDNs unit costs beyond the threshold. A fail is assigned if more than 25% of GDN unit costs are beyond the threshold. **Rationale** • Unit costs that are more than 40% away from the industry average may not fully reflect differences in cost efficiency. • If this test fails, one may want to assess the reasons why the test fails. For example, are there any adjustments that could be applied that would mean the test would not fail?
(5) Maximum unit cost variability over time	Medium	**Test** • We assess whether unit costs calculated in each year of RIIO-GD1 (RIIO-GD2) are within 40% of the average unit cost over the same period. • We apply a pragmatic approach to determine whether this criterion passes for each activity. A pass is assigned if less than 10% of GDNs unit costs are beyond the threshold. A partial pass is assigned if between 10% and 25% of GDNs unit costs beyond the threshold. A fail is assigned if more than 25% of GDN unit costs are beyond the threshold. **Rationale** • This criterion aims to mitigate for the likelihood that large variability in unit costs over time is unlikely to fully reflect differences in cost efficiency. • However, variability over time may be the result of costs and volumes not being aligned, which may be mitigated using an average over time.

Source: CEPA analysis

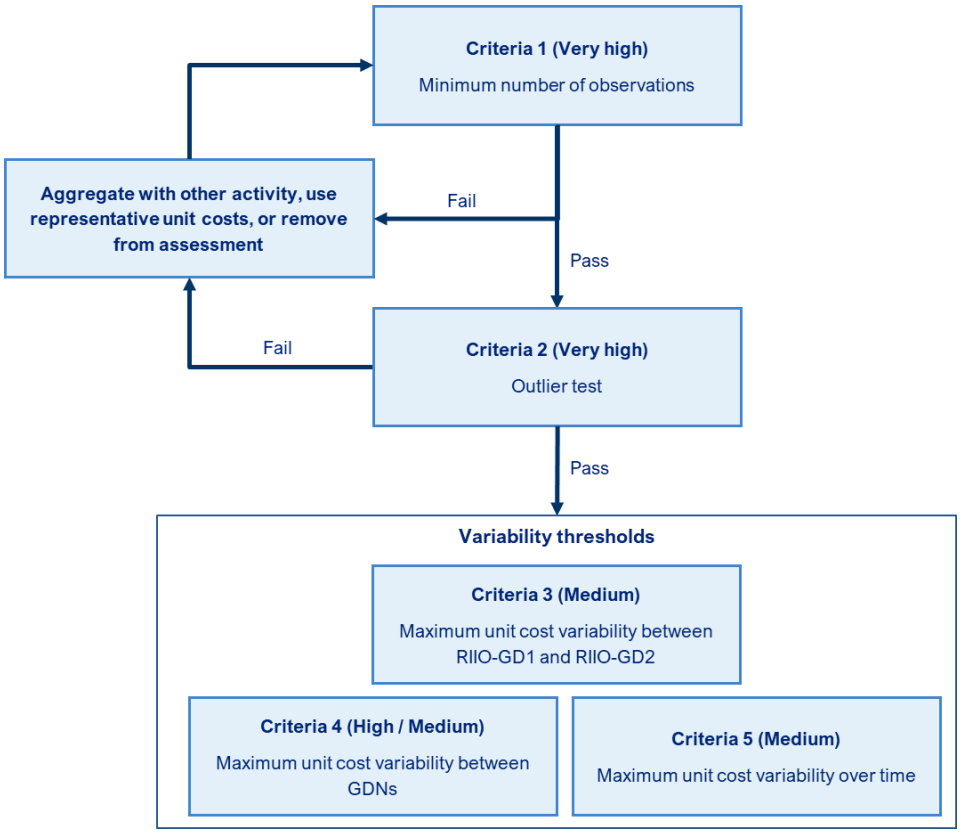
Figure 3.1 outlines how the quantitative criteria should be applied. The very high criteria are applied iteratively until the selected unit costs pass both pass / fail criterion. If a unit cost fails one of these criteria, a decision is made on whether it is aggregated with another activity or excluded from the synthetic unit cost methodology all together.

This decision is informed by our assessment against other criteria. For example, it may be sensible to exclude costs and volumes associated with the replacement of pipe with diameter more than 355mm from the synthetic unit cost methodology if this activity does not meet the minimum number of observations, has unit costs that are significantly higher than the unit cost of smaller diameter pipe replacement, and unit cost comparisons are unlikely to be meaningful from an engineering perspective because of the bespoke nature of the work.

The remaining quantitative test results should be considered in the round before deciding whether a synthetic unit cost approach is appropriate. This means that Ofgem must apply a degree of regulatory judgement when deciding

whether it is appropriate to adopt the synthetic unit cost methodology for certain workloads. For tests 3, 4 and 5, we have selected a maximum threshold of 40%, which was set at a level that would clearly identify observations that are far away from the industry average. The 40% threshold also aligns with Ofgem's approach to developing econometric costs where it has set a minimum model explanatory power (as indicated by the R-squared) of 60%.

Figure 3.1: Quantitative criteria decision tree



Source: CEPA analysis

3.2. QUALITATIVE CRITERIA

Table 3.2 presents the qualitative criteria broken down into different tests to be applied within the assessment framework. The qualitative criteria are applied at different stages in the framework process. Criteria 6, 7 and 8 are applied to inform the appropriate level of disaggregation before performing quantitative analysis. For example, there may be some cases where data quality and comparability (Criteria 6) are considered very poor, meaning that the calculation of unit costs would not be sensible (e.g. replacement of MOB risers). Criteria 9 and 10 are then applied following the application of the quantitative criteria.

The process of applying the assessment framework is summarised in Figure 3.2.

Table 3.2: qualitative assessment criteria

Criteria	Level of importance	Description
(6) Data quality and comparability	High	**Test** • Is the data of sufficient quality and comparability to enable meaningful comparison of unit costs between GDNs and over time? For example, ○ Are GDNs reporting data based on well-defined and unambiguous definitions?

Criteria	Level of importance	Description
		○ Are GDNs allocating costs and volumes using similar methodologies? ○ Have data tables been populated based on data taken directly from their reporting systems (i.e. not assumption driven)? **Rationale** • Data may not be suitable for unit cost analysis if GDNs identify and report works based on significantly different cost allocation methodologies.
(7) Routineness of work	Medium	**Test** • Determine if work is routine, high volume and standardised. **Rationale** • From an engineering perspective, unit cost assessments are more appropriate for routine, high volume and standardised activities. For example, replacement of pipes with diameters below 355mm.
(8) Materiality	Low	**Test** • Establish whether it is proportionate to exclude certain costs / volumes from the synthetic unit cost based on their materiality. **Rationale** • Excluding costs / volumes increases the amount of works requiring evaluation outside of the unit cost assessment process.
(9) Importance of cost drivers in causing differences in unit costs between GDNs	High	**Test** • Cost drivers should be considered in relative order of importance based on engineering rationale as greater disaggregation of unit costs may lead to greater allocation issues. **Rationale** • Factors that only affect a small number of GDNs should be captured through other means (e.g. exclusion of certain costs / volumes and/or post modelling adjustments to allowances).
(10) Importance of cost drivers in causing changes in unit costs over time	Medium	**Test** • Have exogenous cost drivers led to significant changes in unit costs over time and should they be captured in the synthetic unit cost methodology? • Have the GDNs presented convincing evidence that the change in unit costs was caused by factors that were / are outside of their control? **Rationale** • Including cost drivers caused by endogenous factors may bias the synthetic unit cost analysis.

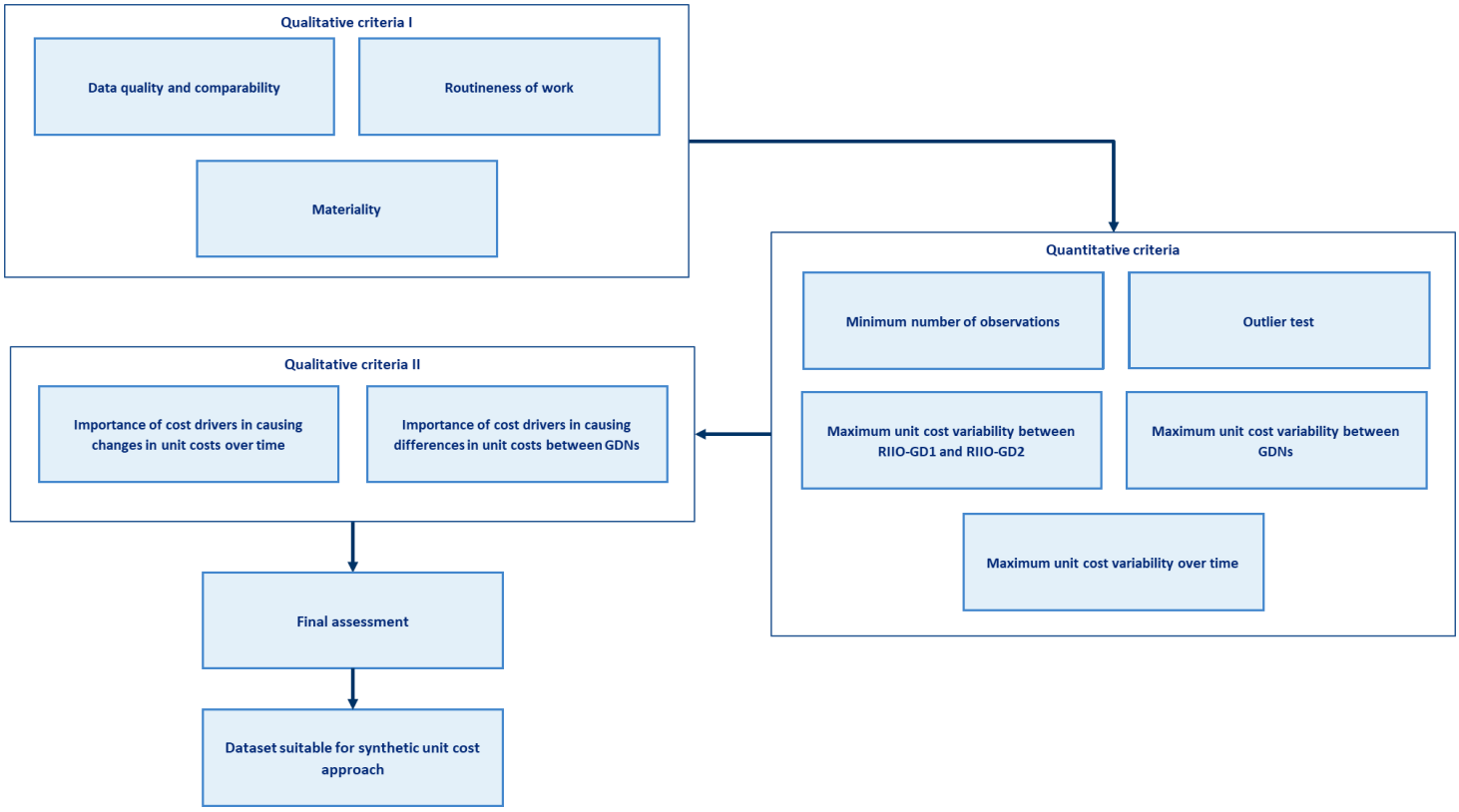
Source: CEPA analysis

3.3. ASSESSMENT FRAMEWORK PROCESS

The assessment framework should be applied as a concurrent process, where quantitative and qualitative criteria are considered and applied sequentially. Figure 3.2 outlines the process of applying the assessment framework. The quantitative criteria act as filters to select data based on fixed thresholds. The qualitative criteria require a greater degree of regulatory and/or engineering judgement and may adjust the selection beyond the mechanical, quantitative criteria.

The last step of the framework is a final assessment of the resulting set of unit costs. This consists of sense-checking the aggregations, exclusions and proxy substitutions made under the quantitative and qualitative criteria to ensure the final set of unit costs is appropriate for unit cost assessment.

Figure 3.2: Assessment framework diagram



Source: CEPA analysis

4. UPDATED SYNTHETIC UNIT COSTS

This section of the report presents the updated synthetic unit costs, which we assess against the assessment framework developed in Section 3.

We have developed an Excel model to accompany this report, which calculates synthetic unit costs using repex, services, reinforcement and connections cost and volumes data that was submitted by GDNs within their December 2019 BPDTs submissions. The model also applies the quantitative criteria discussed in Section 3.1. Within the model, unit costs have been calculated on a net cost basis (i.e. after subtraction of contributions from gross costs) for each activity in 2018/19 prices and are based on the weighted average industry average. For most activities, the use of net costs does not have a significant impact on the outcome of our analysis given that contributions are close to zero. However, Ofgem may want to analyse synthetic unit costs on a gross cost basis for activities where there is a more substantial difference between gross and net costs (e.g. connections).

Based on the data available in the December 2019 BPDTs we have assessed the following levels of synthetic unit cost disaggregation against the assessment framework:

- Repex
    - Mains replacement categorisation (e.g. tier 1, tier 2, tier 3, other policy, etc.).
    - Pipe diameter bands (e.g. less than 75 millimetres in diameter).
    - Pipe material (e.g. cast iron, ductile iron and steel).
- Services
    - Associated or not associated with the mains replacement programme.
    - Relay or transfer.
    - Domestic or non-domestic.
- Reinforcement
    - General or specific reinforcement.
    - Asset type (e.g. mains or district governors).
    - Mains by diameter (e.g. less than and equal to 180 millimetres and more than 180 millimetres).
    - District governors by inlet pressure (e.g. intermediate pressure (IP) or medium pressure).
- Connections
    - Housing type (e.g. new housing, existing housing, non-domestic, fuel poverty network extension scheme (FPNES)).
    - Asset type (e.g. mains, district governors or services).
    - Mains by diameter (e.g. less than and equal to 180 millimetres and more than 180 millimetres).
    - District governors by inlet pressure (e.g. intermediate pressure (IP), medium pressure or service).

It has not been feasible with the current data to consider replacement technique and/or surface type explicitly within the synthetic unit cost methodology (see Section 2.2). While these factors may be captured by the different diameter bands (e.g. larger diameter pipe replacement in more likely to require open-cut replacement), Ofgem may want to reconsider if additional data becomes available following completion of this project and/or may want to consider how these cost drivers could be reflected in cost allowances using alternative approaches based on engineering judgement (e.g. post-modelling adjustment to allowances based on engineering judgement).

The subsections below present the updated synthetic unit costs for repex, services, reinforcement and connections. We assess the synthetic unit costs against the assessment framework and exclude synthetic unit costs from the main report that did not perform well against the assessment framework. We have removed negative

net costs from the analysis to ensure that the industry average unit costs are not skewed by negative values. Negative values may be caused by imprecise allocation of cost contributions across different activities. We also provide separate synthetic unit cost estimates depending on whether they are calculated using RIIO-GD1 or RIIO-GD2 data.

Further details of our assessment are provided in Appendix A. Within this appendix we provide an overall assessment for each activity after considering performance against the different assessment criteria. Synthetic unit costs that pass or partially pass against the assessment framework are presented in this section of the report:

- **Pass**: we conclude that a synthetic unit cost approach can be applied for this activity.
- **Partial pass**: we conclude that a synthetic unit cost approach can be applied for this activity but with some reservations given its performance against certain criteria.
- **Fail:** we conclude that Ofgem should consider alternative cost assessment approaches for this activity as a synthetic unit cost approach may not sufficiently explain cost differences between GDNs and over time.

We have not considered whether there are significant changes in synthetic unit costs between GDPCR and RIIO-GD1 as the December BPDTs only requested data going back to the start of RIIO-GD1. We also summarise the flexibility we have introduced into the excel model that Ofgem could use in future analysis.

4.1. REPEX

Table 4.1 below presents the repex synthetic unit costs that we consider pass or partially pass the assessment framework. As expected, diameter band appears to be a key driver of unit cost differences. We also present normalised synthetic unit cost weights to better highlight the relative differences between different activities[10].

Tier 1 mains replacement performs the best against our assessment framework, which is not surprising given that Tier 1 mains replacement accounts for almost 80 percent of repex and is generally high-volume work that is undertaken using common techniques.

We disaggregate Tier 1 synthetic unit costs by pipe material, which was a cost driver identified by some of the GDNs. However, the difference in the unit cost between cast iron and ductile mains tier 1 mains replacement does not appear as significant as the GDNs suggest.

Relatively smaller diameter Tier 2 replacement, iron mains more than 30 metres away from a property (Iron>30m) replacement, and other policy mains replacement also perform well against the assessment framework. This finding is in line with our engineering and technical understanding that unit cost comparisons are generally more meaningful for routine, high volume and standardised activities.

We identify separate synthetic unit costs for irons mains replacement more than 30 metres away from the property (Iron>30m) rather than aggregating with other iron mains replacement. This is because we have greater cost allocation concerns between mains and service replacement for this activity due to the relatively higher costs associated with service replacement (e.g. longer than average service pipe will be required). There would also need to be a degree of discretion around where the costs and volumes are allocated to due to diameter band overlaps between tiers (e.g. tier 1 or tier 2), which may distort synthetic unit costs for other iron mains replacement.

If our selected Tier 1 breakdown is adopted by Ofgem, it may be advisable to rely on RIIO-GD2 forecast data as unit costs are generally forecast to decrease between RIIO-GD1 and RIIO-GD2 and unit cost differences between diameter bands appear somewhat more sensible from an engineering perspective. In addition, one company has not disaggregated between cast iron and ductile iron mains replacement for RIIO-GD1, which may explain why ductile tier 1 mains replacement does not always seem more expensive than cast iron tier 1 mains replacement based on RIIO-GD1 cost data. This may further support the reliance on RIIO-GD2 forecast data when calculating Tier 1 synthetic unit costs.

[10] Normalised based on the average synthetic unit cost across the activities presented in the table.

More details of our assessment are presented in Appendix A.

Table 4.1: Repex synthetic unit costs that pass or partially pass the assessment framework

Repex activity (in diameter)	RIIO-1 Average (per km)	RIIO-1 Normalised Weight	RIIO-2 Average (per km)	RIIO-2 Normalised Weight
Tier 1 – Cast Iron – up to 75mm	£110,472	0.57	£108,459	0.60
Tier 1 – Cast Iron – 75mm to 125mm	£130,610	0.68	£153,995	0.85
Tier 1 – Cast Iron – 125mm to 180mm	£197,337	1.02	£167,798	0.92
Tier 1 – Cast Iron – 180mm to 250mm	£369,492	1.92	£281,560	1.55
Tier 1 – Ductile Iron – up to 75mm	£101,726	0.53	£114,543	0.63
Tier 1 – Ductile Iron – 75mm to 125mm	£113,841	0.59	£158,858	0.87
Tier 1 – Ductile Iron – 125mm to 180mm	£188,926	0.98	£182,365	1.00
Tier 1 – Ductile Iron – 180mm to 250mm	£391,954	2.03	£293,006	1.61
Tier 1 – Steel less than 2 inches	£121,968	0.63	£137,669	0.76
Tier 2 – All pipe material - up to 355mm	£385,186	2.00	£368,237	2.03
Iron >30m - All pipe material – up to 125mm	£125,977	0.65	£113,838	0.63
Iron >30m - All pipe material – 125mm to 180mm	£179,883	0.93	£145,448	0.80
Other policy – All pipe material – up to 75mm	£126,976	0.66	£139,780	0.77
Other policy – All pipe material – 75mm to 125mm	£155,894	0.81	£179,791	0.99

Source: CEPA analysis

Table 4.2 presents the list of repex activities that do not perform well against the assessment framework. For these activities, Ofgem may want to consider alternative cost assessment approaches as a synthetic unit cost approach may not be appropriate. The table also outlines the main reasons why these activities did not perform well against the assessment framework.

Table 4.2: Repex synthetic unit costs that require further consideration

Repex activity	Reasoning
Replacement of risers to MOBs	• This activity was excluded from synthetic unit costs at RIIO-GD1 because costs can vary significantly depending on the number of storeys, the

Repex activity	Reasoning
	arrangements for access via scaffolding systems and the location of the gas meter within each property. • There can also be access problems in terms of gaining access to the apartments during the replacement, which can lead to increases in costs and delays in replacing the riser.
Replacement of pipes with diameter more than 355mm	• Either fails to meet the very high quantitative criteria or unit costs vary significantly between GDNs / over time. • This work is also not routine in nature, which means there is also an engineering and technical rationale to justify why a synthetic unit cost approach may not be appropriate.
Steel mains more than 2 inches in diameter	• Some diameter bands fail to pass the very high quantitative criteria. • Other diameter bands also perform poorly on the other quantitative tests. The industry average unit cost is forecast to increase significantly between RIIO-GD1 and RIIO-GD2 for a number of diameter bands (failing criterion 3); and there is significant variability between GDNs (failing criterion 4) and over time (partial pass for criterion 5). • We considered combining this activity with Tier 1 iron mains replacement on the basis that these activities are similar at the diameter band level, but the unit costs are significantly different between the two activities. This may reflect the increased difficulty in cutting steel mains relative to iron mains. • Ofgem could consider applying a cost adjustment factor to Tier 1 iron mains replacement synthetic unit costs to reflect the increased difficulty and cost in cutting steel mains relative to iron mains based on engineering rationale.
Replacement of mains with diameter more than 180mm associated with other policy	• This activity failed to pass the very high quantitative criteria when medium pressure ductile iron policy replacement and other policy replacement were considered separately. These workloads were combined and reassessed at the total 'other policy' level but still failed the very high quantitative criteria for a number of diameter bands. • GDNs are also forecasting significant increases in unit costs for some diameter bands that could not be explained (failing criterion 3) and unit cost comparisons are difficult from a qualitative perspective as this is not standard mains replacement.
Replacement of iron mains more than 30 metres away from the property with diameter more than 180mm	• There is significant variability between GDNs (failing criterion 4), which is most likely driven by the low volume nature of the activity.
Diversions non-chargeable	• There is significant variability between GDNs (failing criterion 4) and over time (partial pass for criterion 5), which is most likely driven by the low volume and bespoke nature of the activity.
Capitalised replacement	• Only SGN report costs and volumes against capitalised replacement. • In addition, variability of unit costs over time is significant (failing criterion 3 and 5) and do not increase in line with the diameter band of the pipe being replaced.

Source: CEPA analysis

4.2. SERVICES

Table 4.3 below presents the services synthetic unit costs that we consider pass or partially pass the assessment framework.

As expected, there is a significant difference between transfer and relay domestic synthetic unit costs. This is reflected in our final selection, which breaks down the synthetic unit costs for domestic services associated into relay and transfer services. There is also a significant step-change in the unit cost for domestic services not associated with repex, which is expected given that the fixed costs associated with this work cannot be allocated between mains and services.

Table 4.3: Services synthetic unit costs that pass or partially pass the assessment framework

Services activity	RIIO-1 Average (per service)	RIIO-1 Normalised Weight	RIIO-2 Average (per service)	RIIO-2 Normalised Weight
Services associated with repex – relay – domestic	£742	0.84	£707	0.79
Services associated with repex – transfer – domestic	£475	0.54	£445	0.50
Services not associated with repex – relay – domestic	£1,434	1.62	£1,527	1.71

Source: CEPA analysis

Non-domestic services did not perform well against our assessment framework. Our analysis showed that there was significant variation in non-domestic unit costs between GDNs (failing criterion 4) and over time (failing criterion 5). We considered it was not appropriate to calculate the synthetic unit costs at a total customer level because it distorted the domestic unit costs.

From an engineering perspective there is limited reasoning why costs would differ significantly between domestic and non-domestic services after controlling for transfer / relay. Differences in capacity requirements between domestic and non-domestic services may drive unit cost differences but it is not possible based on the data available to assess the significance of this possible cost driver.

With this in mind, it may be proportionate for Ofgem to use an approach of applying domestic services unit costs to all services because non-domestic service volumes are relatively low across all GDNs.

4.3. REINFORCEMENT

We recommend that Ofgem considers alternative cost assessment approaches for reinforcement as there are significant challenges in applying a synthetic unit cost approach.

Engineering rationale recommends against using a unit cost approach for reinforcement because it is generally low volume work that requires reinforcement pipes that are large diameter and constructed in roads via open-cut replacement. The large variability of inputs that can be used to deliver this work alongside the low work volumes means that meaningful unit cost comparisons are unlikely.

This is reflected in our quantitative assessment, which showed significant unit cost variability between GDNs (failing criterion 4) and many data anomalies that are difficult to explain. One GDN in particular appears to be a complete outlier relative to the other GDNs.

Ofgem may want to explore alternative cost drivers to explain variations in reinforcement costs between GDNs and over time (e.g. peak demand).

4.4. CONNECTIONS

We recommend that Ofgem considers alternative cost assessment approaches for connections as a synthetic unit cost approach is unlikely to be appropriate.

From an ex-ante qualitative perspective, unit cost comparisons may be difficult because the complexity of connections can differ significantly between GDNs. For example, connections that require more than 169 kW peak demand may require additional reinforcement. In addition, a development with multiple connections can spread the fixed costs across multiple units, leading to a lower unit cost relative to a single connection.

These concerns are realised through our assessment, which shows that unit costs vary significantly between GDNs (failing criterion 4) and over time (failing criterion 5 for some connection activities). The large variability between GDNs may be due to unit costs being calculated on a net cost basis, which takes into account differences in cost contributions between GDNs.

Ofgem may want to explore alternative cost drivers to explain variations in connections costs between GDNs and over time (e.g. number of new connections and/or complexity of new connections).

4.5. MODEL FLEXIBILITY FOR FUTURE OFGEM ANALYSIS

As discussed in Section 2.1, exogenous cost drivers that affect GDNs to different extents (i.e. asymmetrical) and are not reflected in the level of disaggregation could be captured through regional cost adjustments or through post-modelling adjustments to allowances based on engineering judgement. At the time of developing this report Ofgem had not finalised its position on regional cost adjustments for RIIO-GD2 so we have not applied any regional cost adjustments to costs before calculating unit costs. However, the excel model has the flexibility to apply regional cost adjustments if Ofgem want to revisit this at a later date.

The excel model also has the flexibility to exclude street works from the unit cost calculations. As discussed in Section 2.2, street works are likely to affect companies differently depending on where they are located. At the time of writing this report, street works cost data was not complete enough to make an adjustment. But Ofgem may want to exclude street works costs from the synthetic unit cost calculation if better quality data becomes available.

The application of the quantitative criteria within the excel model does require manual intervention given the iterative nature of the process. Therefore, if Ofgem want to update the results, it will not be a simple mechanical process and careful checking will be required.

Appendix A PERFORMANCE OF SYNTHETIC UNIT COSTS AGAINST ASSESSMENT FRAMEWORK

This appendix provides a more detailed assessment of the synthetic unit costs against the assessment framework presented in Section 3. The criteria that made up the assessment framework are listed in the table below.

Table A.1: Summary of assessment framework criteria

Criteria	Quantitative / Qualitative	Level of importance
(1) Minimum number of observations	Quantitative	Very high
(2) Outlier test	Quantitative	Very high
(3) Maximum unit cost variability between RIIO-GD1 and RIIO-GD2	Quantitative	High
(4) Maximum unit cost variability between GDNs	Quantitative	High
(5) Maximum unit cost variability over time	Quantitative	Medium
(6) Data quality and comparability	Qualitative	High
(7) Routineness of work	Qualitative	Medium
(8) Materiality	Qualitative	Low
(9) Importance of cost drivers in causing differences in unit costs between GDNs	Qualitative	High
(10) Importance of cost drivers in causing changes in unit costs over time	Qualitative	Medium

Source: CEPA analysis

From a quantitative perspective, the focus of this assessment on Criteria 3 to 5 as synthetic used costs that failed Criteria 1 and 2 are excluded. We also provide a qualitative assessment for each activity, which considers performance against Criteria 6 to 10 in the round.

We provide an overall assessment for each activity after considering performance against the different assessment criteria:

- Pass: we conclude that a synthetic unit cost approach can be applied for this activity.
- Partial pass: we conclude that a synthetic unit cost approach can be applied for this activity but with some minor reservations given its performance against some criteria.
- Fail: we conclude that Ofgem should consider alternative cost assessment approaches for this activity as a synthetic unit cost approach may not sufficiently explain cost differences between GDNs and over time.

A.1. REPEX

Table A.2: Repex synthetic unit costs assessed against framework

Repex Activity	Criterion 3: Unit cost variability between RIIO-GD1 and RIIO-GD2	Criterion 4: Unit cost variability between GDNs	Criterion 5: Unit cost variability over time	Qualitative Assessment	Overall assessment
Tier 1 – Cast Iron – up to 75mm in diameter	Pass	Pass	Pass	Pass	Pass

Repex Activity	Criterion 3: Unit cost variability between RIIO-GD1 and RIIO-GD2	Criterion 4: Unit cost variability between GDNs	Criterion 5: Unit cost variability over time	Qualitative Assessment	**Overall assessment**
Tier 1 – Cast Iron – 75mm to 125mm in diameter	Pass	Pass	Pass	Pass	Pass
Tier 1 – Cast Iron – 125mm to 180mm in diameter	Pass	Partial Pass	Pass	Pass	Pass
Tier 1 – Cast Iron – 180mm to 250mm in diameter	Pass	Partial Pass	Pass	Pass	Pass
Tier 1 – Ductile Iron – up to 75mm in diameter	Pass	Pass	Pass	Pass	Pass
Tier 1 – Ductile Iron – 75mm to 125mm in diameter	Pass	Pass	Pass	Pass	Pass
Tier 1 – Ductile Iron – 125mm to 180mm in diameter	Pass	Pass	Pass	Pass	Pass
Tier 1 – Ductile Iron – 180mm to 250mm in diameter	Pass	Partial Pass	Pass	Pass	Pass
Tier 1 – Steel less than 2 inches in diameter	Pass	Partial Pass	Pass	Pass	Pass
Tier 2 – All pipe material - up to 355mm in diameter	Pass	Partial Pass	Pass	Pass	Pass
Tier 2 – All pipe material – 355mm to 500mm	Pass	Fail	Partial Pass	Fail	Fail
Tier 3 – All pipe material – 355mm to 500mm	Pass	Fail	Partial Pass	Fail	Fail
Iron >30m - All pipe material – up to 125mm in diameter	Pass	Pass	Pass	Pass	Pass
Iron >30m - All pipe material – 125mm to 180mm in diameter	Pass	Partial Pass	Partial Pass	Pass	Partial Pass
Iron >30m - All pipe material – 180mm to 250mm in diameter	Pass	Fail	Pass	Pass	Fail
Iron >30m - All pipe material – 250mm to 355mm in diameter	Pass	Fail	Partial Pass	Pass	Fail
Iron >30m - All pipe material – 355mm to 500mm in diameter	Pass	Fail	Pass	Fail	Fail
Steel mains more than 2 inches in diameter – less than 75mm	Fail	Fail	Pass	Fail	Fail

Repex Activity	Criterion 3: Unit cost variability between RIIO-GD1 and RIIO-GD2	Criterion 4: Unit cost variability between GDNs	Criterion 5: Unit cost variability over time	Qualitative Assessment	**Overall assessment**
Steel mains more than 2 inches in diameter – 125mm to 180mm	Fail	Fail	Partial Pass	Fail	Fail
Steel mains more than 2 inches in diameter – 180mm to 250mm	Fail	Partial Pass	Partial Pass	Fail	Fail
Steel mains more than 2 inches in diameter – 250mm to 355mm	Fail	Partial Pass	Partial Pass	Fail	Fail
Steel mains more than 2 inches in diameter – 355mm to 500mm	Pass	Fail	Partial Pass	Fail	Fail
Other policy – All pipe material – up to 75mm in diameter	Pass	Partial Pass	Partial Pass	Partial Pass	Partial Pass
Other policy – All pipe material – 75mm to 125mm in diameter	Pass	Pass	Pass	Partial Pass	Pass
Other policy – All pipe material – 180mm to 250mm in diameter	Fail	Fail	Pass	Partial Pass	Fail
Other policy – All pipe material – 250mm to 355mm in diameter	Pass	Fail	Partial Pass	Partial Pass	Fail
Diversions (non-charge) – All pipe material – less than 75mm in diameter	Pass	Fail	Partial Pass	Fail	Fail
Diversions (non-charge) – All pipe material – between 75mm and 125mm in diameter	Pass	Fail	Partial Pass	Fail	Fail
Diversions (non-charge) – All pipe material – between 125mm and 180mm in diameter	Pass	Fail	Partial Pass	Fail	Fail
Diversions (non-charge) – All pipe material – between 250mm and 355mm in diameter	Pass	Fail	Partial Pass	Fail	Fail
Diversions (non-charge) – All pipe material – between 355mm and 500mm in diameter	Fail	Partial Pass	Pass	Fail	Fail
Capitalised replacement – All pipe material – between	Fail	Pass	Fail	Fail	Fail

Repex Activity	Criterion 3: Unit cost variability between RIIO-GD1 and RIIO-GD2	Criterion 4: Unit cost variability between GDNs	Criterion 5: Unit cost variability over time	Qualitative Assessment	Overall assessment
125mm and 180mm in diameter					
Capitalised replacement – All pipe material – between 180mm and 250mm in diameter	Fail	Pass	Fail	Fail	Fail
Capitalised replacement – All pipe material – between 250mm and 355mm in diameter	Pass	Partial Pass	Partial Pass	Fail	Fail

Source: CEPA analysis

A.2. SERVICES

Table A.3: Services synthetic unit costs assessed against framework

Services Activity	Criterion 3: Unit cost variability between RIIO-GD1 and RIIO-GD2	Criterion 4: Unit cost variability between GDNs	Criterion 5: Unit cost variability over time	Qualitative Assessment	Overall assessment
Associated with repex – relay - domestic	Pass	Partial Pass	Pass	Pass	Pass
Associated with repex – relay – non-domestic	Fail	Fail	Fail	Fail	Fail
Associated with repex – transfer – domestic	Pass	Partial Pass	Partial Pass	Pass	Partial Pass
Associated with repex – transfer – non-domestic	Pass	Fail	Fail	Fail	Fail
Not associated with repex – relay - domestic	Pass	Partial Pass	Partial Pass	Partial Pass	Partial Pass
Not associated with repex – relay – non-domestic	Pass	Fail	Fail	Fail	Fail

Source: CEPA analysis

A.3. REINFORCEMENT

Table A.4: Reinforcement synthetic unit costs assessed against framework

Reinforcement Activity	Criterion 3: Unit cost variability between RIIO-GD1 and RIIO-GD2	Criterion 4: Unit cost variability between GDNs	Criterion 5: Unit cost variability over time	Qualitative Assessment	Overall assessment
All mains less than or equal to 180mm in diameter	Pass	Fail	Partial Pass	Fail	Fail

Reinforcement Activity	Criterion 3: Unit cost variability between RIIO-GD1 and RIIO-GD2	Criterion 4: Unit cost variability between GDNs	Criterion 5: Unit cost variability over time	Qualitative Assessment	Overall assessment
All mains more than 180mm in diameter	Pass	Partial Pass	Partial Pass	Fail	Fail

Source: CEPA analysis

A.4. CONNECTIONS

Table A.5: Connections synthetic unit costs assessed against framework

Connections Activity	Criterion 3: Unit cost variability between RIIO-GD1 and RIIO-GD2	Criterion 4: Unit cost variability between GDNs	Criterion 5: Unit cost variability over time	Qualitative Assessment	Overall assessment
All mains less than or equal to 180mm in diameter	Pass	Fail	Partial Pass	Fail	Fail
All services	Pass	Fail	Pass	Fail	Fail

Source: CEPA analysis

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