October 2002

Information and incentives programme

Comparing quality of supply performance

Summary

Distribution Network Operators (DNOs) provide a service that has little scope for the introduction of competition. Effective regulation of quality of supply therefore requires effective use of comparisons between companies.

The introduction of standard definitions, guidance and minimum levels of accuracy for reporting the number and duration of interruptions were important first steps towards making more robust comparisons of quality of supply performance across DNOs. However, it is also necessary to take account of other factors such as inherited network design and customer density, which impact on DNOs' performance and currently limit the ability to make performance comparisons. In particular it seems appropriate to make adjustments for those factors that are outside the direct control of management, at least in the short-term.

This document discusses the issues associated with establishing a framework for making more robust comparisons of quality of supply performance and sets out an initial version of a model for making adjustments to DNOs' reported performance. It also invites views on how the model should be developed, including whether any additional factors should be incorporated or whether alternative approaches would be more appropriate.

Table of contents

1. Rationale

Issue

1.1 Ofgem's primary objective is to protect the interests of customers, wherever appropriate by promoting effective competition. Many areas of the energy industry are subject to, or are in the process of being opened up to, competition – including the generation of electricity and supply of electricity and gas to customers and the provision of metering and connection services. Where competition has been introduced Ofgem will continue to monitor markets to make sure that they work effectively, which will help ensure that customers' interests are protected.

1.2 Distribution network operators (DNOs) provide a service – the distribution of electricity from the transmission network to customers' premises – that has little scope for the introduction of effective competition. In this case the promotion of effective competition means making effective use of comparisons between these companies in setting and monitoring RPI-X price controls.

1.3 Extensive use has been made of performance comparisons in the past, for example in setting quality of supply targets for 2004/05 as part of the last distribution price control review. However, there were a number of areas for potential improvement in those comparisons including improvements in the quality of data and the consistency of quality of supply information.

1.4 The introduction of standard definitions, guidance and minimum levels of accuracy for reporting during the first two years of the Information and Incentives Project (IIP) were important first steps towards being able to make more robust comparisons of quality of supply performance across DNOs. However, it is also necessary to take account of other factors that impact on DNO's performance and currently limit the ability to make comparisons across companies.

Objective

1.5 It is important that those with an interest in quality of supply are able to make robust comparisons of performance across the DNOs. This includes:

- Ofgem - to help it protect customers by setting more robust targets for quality of supply across all DNOs and providing appropriate incentives for the delivery of these targets;

- the customers of DNOs - supply businesses, end-customers and other connected customers, such as distributed generators. This will help them better understand the network performance of given DNOs; and

- the DNOs - to gain a better understanding of their performance compared to other DNOs, which may bring benefits in terms of more efficient investment and identifying best practice.

1.6 Better performance comparisons should also facilitate analysis of the relationship between quality of supply, costs and distribution losses.

Policy

1.7 There are number of possible approaches for improving comparisons of quality of supply performance. These include:

- adjusting performance for certain factors which are outside the direct control of management, at least in the short-term. These include factors such as customer density and high-level aspects of network design. This approach builds on work that has already been carried out by the industry and data that is currently collected by the DNOs. It should therefore impose relatively little cost on the industry; and

- comparing performance of the DNO's actual networks with the performance that could be delivered by reference or optimal networks for its distribution services area.[1] The reference network would be derived by optimising a range of factors such as the failure rates of various network components, levels of protection, automation and fault

[1] UMIST have been developing the reference network approach. Its latest paper on this topic, "Regulation of Distribution Systems using Reference Networks" was published in the IEE Power Engineering Journal in December 2001.

management, taking into account the costs of additional operating and capital expenditure and the benefits in terms of improved service delivery.

1.8 The development of benchmark networks may be a desirable long-term objective but it will not be practical to derive these in detail before the next distribution price control period. Ofgem considers that the most pragmatic approach in the short-term is to develop a model that adjusts DNOs' performance for a small number of factors outside their control. The results of this work can be used to inform analysis of the relationship between costs and quality of service as part of the distribution price control review.

1.9 The direct costs that Ofgem will incur from undertaking this work are small in relation to its importance and the charges customers pay for distribution services. Most of the work will be carried out in-house with an allowance of £25,000 in this financial year for consultancy support. The work will provide substantial benefits by helping customers to make more informed performance comparisons and allowing Ofgem to set more robust performance targets.

2. Timetable and responses

2.1 This document sets out Ofgem's initial thoughts on the development of a framework for making more robust comparisons of quality of service performance across DNOs. The indicative timetable for ongoing work on in this area is set out in table 2.1 below.

Table 5.1 Indicative timetable

Date	Deliverable
2002	
October	1st working group meeting
November	Industry workshop Closing date for responses
Late November	Information request
2003	
January	Deadline for completed information submissions
February	Second consultation paper (including initial results of model)

2.2 Ofgem intends to hold an initial workshop on comparing DNOs' quality of supply performance in early November. This will provide interested parties with an opportunity to discuss these issues in an open forum. The nature of the workshop may vary depending on the level of interest.

2.3 Ofgem will also hold regular working group meetings with representatives of several of the DNOs and Transco as a means of stimulating ideas and discussion on how comparisons of quality of supply performance should be developed. The first of these meetings will be held in October.

2.4 Ofgem will consider how the model should be revised in the light of industry discussions and the consultation responses. Ofgem will then send out an information request later in November to populate the revised version of the model. By that time most companies should be able to provide several months' data on the number and duration of interruptions, which will have been measured using their new connectivity models. Ofgem will allow DNOs six weeks to complete the information submission.

2.5 Ofgem will run the performance comparison model and undertake further analysis prior to publishing the results as part of a second consultation paper in February 2003.

Responding to this document

2.6 Ofgem would like to hear from all those with an interest in the development of the work on comparing network performance, including the DNOs, supply businesses, customers, their representatives and any other interested parties. Any comments should be received by 14 November. They should be sent to:

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2.7 All responses will normally be published on the Ofgem website and held electronically in the Research and Information Centre unless there are good reasons why they must remain confidential. Consultees should try to put any confidential material in the appendices of their responses. Ofgem prefers to receive responses in an electronic form so that they can easily be placed on the Ofgem website. Any questions on this document should, in the first instance, be directed to Chris Watts on 020-7901-7333.

3. Background

Introduction

3.1 This chapter sets out the background to the work on developing a framework for comparing quality of performance across DNOs. It explains the work that has been completed to date in setting targets for quality of supply as part of the last distribution price control review and improving the consistency and accuracy of performance information as part of the Information and Incentives Project (IIP). It also considers the key areas of work on quality of supply that will be undertaken as part of the next distribution price control review. This highlights the need for further work to be done on improving performance comparisons to enable more robust quality of supply targets to be set for the next price control period. This will also facilitate analysis of the relationship between quality, cost and other factors such as distribution losses.

Setting targets for quality of supply

3.2 The quality of supply provided by DNOs is important for industrial, commercial and domestic customers alike. Given this, the DNOs were set targets for the quality of supply that they deliver to customers as part of the existing price control.[2] These targets focus on two important areas:

- the number of interruptions to supply; and
- the duration of interruptions to supply.

3.3 The targets for each DNO were derived from a comparison of their historic performance, excluding years where performance was more than two standard deviations above the average. This was calculated by requiring a percentage improvement in performance based on a ranking of:

- (the better of) absolute performance in 1997/98 and 1998/99; and

[2] In the previous price control period the DNOs set their own quality of supply targets, which were monitored and reported by Offer in the Distribution and Transmission System Reports.

- the improvement in own performance over time, measured as the (better of) performance in 1997/98 and 1998/99 compared to average performance over the period 1990/91 to 1994/95.

3.4 Companies were ranked separately on the basis of each of these criteria and these rankings were then combined to derive the final overall ranking. Based on the final overall ranking, companies were required to make a percentage improvement (of between 5 and 10 per cent) on the forecast performance figure for 1999/00, by the end of the price control period. This produced a figure for the final target for 2004/05.

Information and Incentives Project (IIP)

3.5 The IIP began in December 1999, following the distribution price control review, and has focused on putting in place:

- *arrangements to help ensure that the information that DNOs provide on quality of supply is accurate and as consistent as possible across all companies.* It was clear from the work undertaken during the first year of the IIP that DNOs were using different definitions and different approaches to measuring their quality of service performance. These differences meant that DNOs did not report quality of supply performance to the same level of accuracy. Ofgem has now put in place standard definitions, guidance and minimum levels of accuracy that DNOs must meet for reporting quality of service performance. These are set out in the Regulatory Instructions and Guidance (RIGs).[3] DNOs were required to make, and have made, improvements to their measurement systems to meet the required levels of accuracy and are implementing the standard definitions and guidance;

- *rebased targets to reflect changes in definitions and measurement systems.* One-off adjustments were made on 1 April 2002 to the existing 2004/05 quality of supply targets to ensure that they are consistent with the definitions set out in the RIGs and new measurement systems for recording the number and duration of interruptions. However, for a number of companies there was still considerable uncertainty regarding the impact of changes that were being made to their measurement systems. For these companies there is the option of a further review of targets this year[4]; and

- *an incentive scheme to strengthen the incentives on all DNOs to deliver the appropriate level of service to customers.* The DNOs have agreed to a new quality of service incentive scheme that allows for financial rewards or penalties depending on their quality of service performance in three key areas

  - the number and duration of interruptions to supply - DNOs that fail to meet their quality of supply targets can be penalised annually, by up to 1.75 per cent of revenue. There is also a mechanism for rewarding companies that exceed their quality of supply targets for 2004/05 based on their rate of improvement up to that date; and

  - the quality of telephone response – DNOs can be rewarded or penalised annually by up to 0.125 per cent of revenue depending on the quality of telephone response they provide to customers.[5]

Developing the framework of price controls

3.6 Ofgem is currently undertaking work on the development of the framework of price controls. This has two workstreams that are closely related:

- *developing the price control framework for monopolies.* This workstream is looking at how Ofgem sets price controls for *all* network monopoly companies and in particular how the framework could be improved and whether there are any principles that should be consistently applied across all the sectors;

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[3] Version 2 of the RIGs was published in March 2002. This applies for the 2002/3 reporting year.
[4] Seven of the DNOs have re-openers of their final targets in their incentive scheme licence conditions. Paragraph 7A of of Special Condition G (J in Scotland) of the distribution licence requires Ofgem or the licensee to notify the other party by the 30 September 2002 if it believes there should be a change to the licensee's 2004/5 targets for the number and duration of interruptions.
[5] For details see "Information and incentives project – Incentive schemes final proposals" December 2001, 78/01. The introduction of incentives for the speed of telephone response was postponed until April 2003. A further 0.125% of revenue is proposed to be exposed to this measure.

- *reviewing the incentive framework and price control principles applying to the fourteen electricity distribution companies, ahead of the next price control review in 2003/04.* Areas of work related to quality of supply include:

  - identifying the most appropriate ways of setting targets for quality of supply, including whether targets should be set over a longer period than the price control;

  - the balance between overall quality of supply performance and the quality of supply received by particular customer groups (e.g. worst-served customers); and

  - whether the scope of output measures adequately covers the requirements of all customer groups, particularly those who may have special requirements such as larger business customers.

  These workstreams are discussed in more detail in Ofgem's August 2002 paper on developing network monopoly price controls.[6]

Structure of the document

3.7 The rest of this document sets out Ofgem's initial thoughts on improving comparisons of quality of service performance across DNOs. Chapter 4 sets out a framework for making more robust comparisons of performance. Chapter 5 outlines an initial version of a model that has been developed to make adjustments to companies' data to take account of differences in their networks and the areas that they serve. Chapter 6 sets out the key issues that will need to be considered going forwards.[7] Appendix 1 provides a detailed worked example of the model.

[6] "Developing network monopoly price controls" August 2002, Ofgem 51/02.
[7] Ofgem has been assisted by EA Technology in developing the first version of the model, although this work will now be taken forward by Ofgem in consultation with interested parties.

4. Factors affecting quality of supply performance

Introduction

4.1 This chapter sets out a framework for comparing quality of supply across DNOs. It highlights the main factors which impact on DNOs' quality of supply performance, and examines whether it is appropriate to take these into account when comparing performance.

Factors affecting performance

4.2 If all DNOs had very similar networks and similar distribution service areas in terms of customer numbers, location, densities and exposure to environmental influences then it would be possible to make robust comparisons of headline performance figures. Differences in performance would primarily be explained by differences in managerial decisions relating to the development, maintenance and operation of the network.

4.3 In practice there are significant differences between the DNOs and therefore a range of factors, which may explain variations in performance. Broadly these factors can be thought of as falling into three main categories. Those which are:

- *inherited* – these are differences that the DNOs inherited at privatisation and include differences in the design and configuration of the network that they operate, such as the length of overhead line and the extent of any interconnection. For example, long overhead lines are likely to have a larger number of faults than shorter lines, particularly where the former are exposed to bad weather. Interconnected networks offer greater options for reconfiguration and restoration of customers' supplies following interruptions;

- *inherent* – these are differences which relate to the area which a DNO is licensed to serve and include topographic and demographic factors, such as the level of customer density. For example, in urban areas there will typically be a greater number of customers associated with faults than in rural areas. In rural areas there will be fewer customers affected by a fault, but there were will be less options for restoration of supplies because of limited interconnection; and

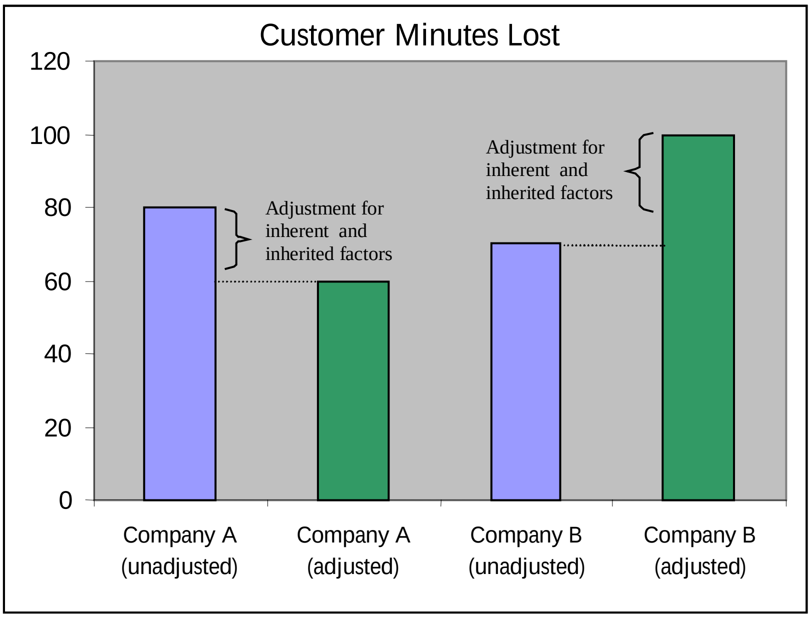
♦ *incurred* – these are differences which are the direct result of management action since privatisation and include the strategy a DNO has taken to operating and maintaining the network. For example investment in investment in additional protection equipment will reduce the number of customers affected by a fault on a particular circuit. Better co-ordination of field staff may significantly reduce the duration of interruptions.

4.4 These factors also have a varying time horizon. Inherent factors such as the topography of a company's distribution service area or the spread of its customers will typically be permanent. It may take a long period to significantly alter inherited certain aspects of network design. However, incurred factors such as the deployment of field staff may change very quickly.

4.5 It is important to consider the extent to which these factors affect the ability to make performance comparisons across DNOs, and whether it is appropriate to take account of them. This is not about adjusting performance for everything but rather making it easier to identify genuine differences in DNOs' quality of supply performance in a given price control period by making an adjustment for some of the factors outside their control. Whilst DNOs may have little influence over inherent or inherited factors, there are still steps that can be taken to mitigate their impact on customers.

4.6 In figure 4.1 below, a simple comparison of the headline performance figures would suggest that company B is outperforming company A by 10 minutes lost per connected customer (CMLs).

Figure 4.1 Performance comparison



4.7 However, the performance of each company is in practice based on a mixture of inherent, inherited and incurred factors. If the impact of inherent and inherited factors were adjusted for, then company A would be outperforming company B by 40 CMLs.

4.8 Ofgem considers that three criteria are relevant in considering what factors should be taken into account when comparing quality of supply performance:

- whether they have a significant effects on the number of faults, or the number and duration of interruptions caused by those faults;
- whether the company has limited influence over that effect; and
- whether the impact is asymmetric across companies either individually or in aggregate.

4.9 Where factors meet these criteria it is necessary to determine whether it is possible to measure them consistently across all companies (or whether there are suitable proxies).

Impact on performance

4.10 It is only appropriate to take account of factors that have a material impact on the number of faults or the number and duration of interruptions caused by those faults. For example, the length of overhead line can be expected to have a significant impact on the number of faults. Both the mix of customer densities in a DNO's distribution services area and the level of protection can be expected to have a material impact on the number and duration of interruptions, whereas factors such as soil conditions may be less significant.

Extent of company influence

4.11 It is clear that the ability of a DNO to influence a particular factor varies. For example, most DNOs mitigate the effect of tree growth on the network through extensive programmes of tree-cutting. By contrast there is little that DNOs can do to mitigate the effect of high or low customer densities on the number of faults or the potential number of customers affected by those faults. However, DNOs can take steps to limit the impact of the faults on its customers.

4.12 It would seem that those factors over which a DNO has least influence are mainly those which are inherent or inherited. Over time the influence of inherited differences on performance should be reduced as companies invest in the network. The influence of inherent differences may be expected to persist longer (or indefinitely).

4.13 This suggests that if robust comparisons of performance are to be made across DNOs, it is important that the influence of factors which are outside the direct control of DNOs (i.e. where their influence is weak), should be taken into account in some way.

Symmetry

4.14 It is only necessary to take account of factors that have varying effects across companies. For example, differences in network design between DNOs will cause significant variations in performance. Some DNOs have extensive urban networks with varying degrees of interconnection, while others have largely rural networks, with long overhead lines and limited options for interconnection. By contrast, factors that have a similar effect either individually or in aggregate across all companies do not affect relative performance and the ability to make comparisons. For example, travel times in urban/rural areas may have the same order of effect on quality of supply performance.

Measurement

4.15 It is only practical to take account of factors that can be measured economically and consistently across companies or for which there is a suitable proxy. For example, it is possible to use meteorological information to compare weather across service areas. Customer density can be measured directly or by proxy using the number of customers per HV circuit. Other factors such as travel times are more difficult and costly to measure across DNOs.

Factors for adjusting performance

4.16 A number of DNOs have put forward factors which they consider should be taken into account as part of a performance comparison model. These include:

- demography;
- topography;
- network design;
- travel times;
- tree growth; and
- weather.

Ofgem has applied the three criteria set out in paragraph 4.8 above to each of the factors to determine whether they should be taken into account in comparing performance. Where appropriate, Ofgem has then considered whether it is possible to measure the factors consistently across companies or use suitable proxies. The results are set out in table 4.1 and discussed in more detail below.

Table 4.1 Assessment of possible factors adjusting performance

Factors	Whether it has a significant impact on performance?	Extent of company influence?	Is the impact asymmetric across companies?	Should an adjustment be made?	Is the factor measurable (or is there a suitable proxy)?
Demographic factors (Customer density)	YES (both CIs[8] and CMLs[9])	WEAK	YES	YES	YES (using a proxy at present. In future should be directly measurable)
Topographic factors/Network Design	YES (both CIs and CMLs)	MEDIUM	YES	YES	YES (key information on lengths of O/H and U/G circuits at different voltages is available.)
Travel times	YES (CMLs only)	STRONG	POSSIBLY	NO	NOT APPLICABLE
Tree Growth	YES (both CIs and CMLs)	STRONG	POSSIBLY	NO	NOT APPLICABLE
Severe Weather	YES (both CIs and CMLs)	MEDIUM	YES	YES	YES (IIP licence condition – exceptional events mechanism)
Average Weather	NO	MEDIUM	NO	NO	NOT APPLICABLE

[8] CIs are the number of customer interruptions per 100 connected customers.
[9] CMLs are the number of customer minutes lost per connected customer.

Demography

4.17 Demographic factors such as the number of customers, their spread, and level of electricity demand are inherent factors, which have a significant effect on DNOs' performance and which they can do relatively little to influence. The effects will vary across DNOs as they have different demographics.

4.18 Ofgem believes that it is reasonable to capture demographic factors using customer density as this is closely related with levels of electricity demand. As will be discussed in chapters 5 and 6 customer density can either be measured directly using measures such as the number of customers per square kilometre or through proxies such as the number of customers per kilometre of HV circuit. On these grounds Ofgem considers that it is appropriate to include customer density as part of a model that adjusts performance for factors outside management control.

4.19 Some companies have suggested that some low-density areas such as city centre parks are surrounded by urban high-density areas. Despite their topographic and demographic characteristics these areas would have networks that are typical for high-density areas. However, such areas and the number of customers associated with them will be relatively small in the context of the DNO's whole service area so they should not have a significant impact on the robustness of the performance comparisons.

Topography

4.20 The geographic characteristics of DNOs' service areas, such as the size of their areas, the type of terrain and extent of urban and rural habitats have a significant effect on performance, which they can do relatively little to influence. However, as topography and network design are closely related, Ofgem believes that it is reasonable to capture topographic factors by adjusting performance for high-level features of network design such as the length of overhead and underground circuits at different voltage levels.

Network design

4.21 Differences in the design of DNOs' networks have a significant and asymmetric effect on their performance. Companies inherited different networks at privatisation including differences in the proportion of overhead line and underground cable, the length of their networks, the degree of interconnection and poorly performing circuits. For example, LPN inherited a predominantly underground network with high levels of interconnection, giving greater options for restoration when there is a fault. Scottish Hydro has a network with long stretches of overhead line in rural areas and a limited degree of interconnection.

4.22 In the short-term DNOs only have a limited ability to alter the high-level design of their networks as investment in additional circuits is costly and there is a time lag before such projects are completed and have an impact on performance.

4.23 There is data readily available on many of the key aspects of network design such as the voltage and length of overhead and underground circuits. Ofgem therefore considers that these factors should be taken into account in a performance comparison model. Other aspects of network design may also need to be taken into account by adjusting the data before it is put into the model or, in the way the results of the model are interpreted.

4.24 Over time the influence of inherited network design on performance should be reduced as companies' investment changes the nature of their network and assets they had at privatisation reach the end of their operational lives. Companies have taken significant steps since privatisation to mitigate the impact of these inherited factors on quality of supply performance. This has included the installation of additional manual and automated protection equipment on the network and the replacement of poorly performing assets. This suggests that in the longer-term it should not be necessary to include inherited aspects of network design as part of a performance comparison model.

4.25 It will also be important to understand the impact of distributed generation on the design and operation of the distribution networks, including whether the effects are different across companies. It may be necessary in future to make an adjustment to reported performance to take this into account. This would help encourage innovation in distributed generation.

Travel times

4.26 The time taken for engineers and jointers to travel to carry out switching operations and/or make repairs to the network has a significant effect on the duration of an interruption once a fault occurs. However, problems of traffic congestion at peak times in dense urban areas will typically be offset by the need to cover much larger areas and travel longer distances in sparse rural areas. Ofgem considers that in aggregate the effect of travel times should be broadly similar across DNOs with different mixes of urban and rural areas. The time taken to attend repairs will also depend on operational decisions such as the efficient dispatch of repair teams and the forms of transport provided. Some companies use detailed tracking of their staff so that they can dispatch the nearest teams to a fault. Some DNOs have also equipped their field staff with motorbikes in order to attend to faults more rapidly.

4.27 On these grounds Ofgem considers that it is inappropriate to take travel times into account in a performance comparison model.

Tree Growth

4.28 Several DNOs have suggested that the extent of tree growth and consequent tree damage to overhead lines could have a significant asymmetric impact on their performance. Ofgem recognises that tree damage does have significant effects on performance, however most companies undertake extensive programmes of tree-cutting along the relevant overhead lines to mitigate these effects. Ofgem therefore does not consider that it is appropriate to adjust performance for tree growth as it is under the control of management.

Severe Weather

4.29 Distribution networks are designed to meet the minimum standards for security of supply set out in Engineering Recommendation P2/5[10]. They therefore offer significant resilience to bad weather. However, there will be severe weather incidents which cause damage beyond that envisaged by P2/5. These will be asymmetrically distributed across DNOs with those in Scotland, Wales and the North of England typically being worst affected. There will generally be a greater impact on overhead lines (through wind, lightning, snow etc) than on underground circuits where flooding may affect performance. As there is already a mechanism for adjusting for exceptional events under the IIP incentive scheme

[10] The governance processes relating to the production and revision of electricity standards is currently under review. Engineering Recommendation P2/5 is also being reviewed.

(paragraph 10 of Special Condition G in England and Wales and Special Condition J in Scotland), it is not appropriate to make separate adjustments for severe weather. Any adjustment to reported performance figures for severe weather events under the IIP incentive scheme should be made before the data is inputted in the performance comparison model.

Average weather

4.30 While severe weather events will typically have significant and asymmetric effects on performance across DNOs, underlying or average weather is less material. The EA design and construction specifications for electrical plant and equipment cater for the impact of average weather conditions. For example the design standards will vary with altitude above sea level. There are also significant steps that a company could take to mitigate the effects of average weather conditions. For example, putting in place additional protection equipment. Ofgem, therefore, does not consider that it is appropriate to include average weather conditions as a factor in the performance comparison model.

Summary

4.31 Ofgem currently considers that customer density and high-level network design are the key factors that should be used to adjust reported performance. They have significant and asymmetric effects across DNOs, who only have a limited ability to influence their impact (at least in the short-term). Severe weather should be taken into account using the mechanism for exceptional events set out in the IIP incentive scheme.

5. Outline of the model

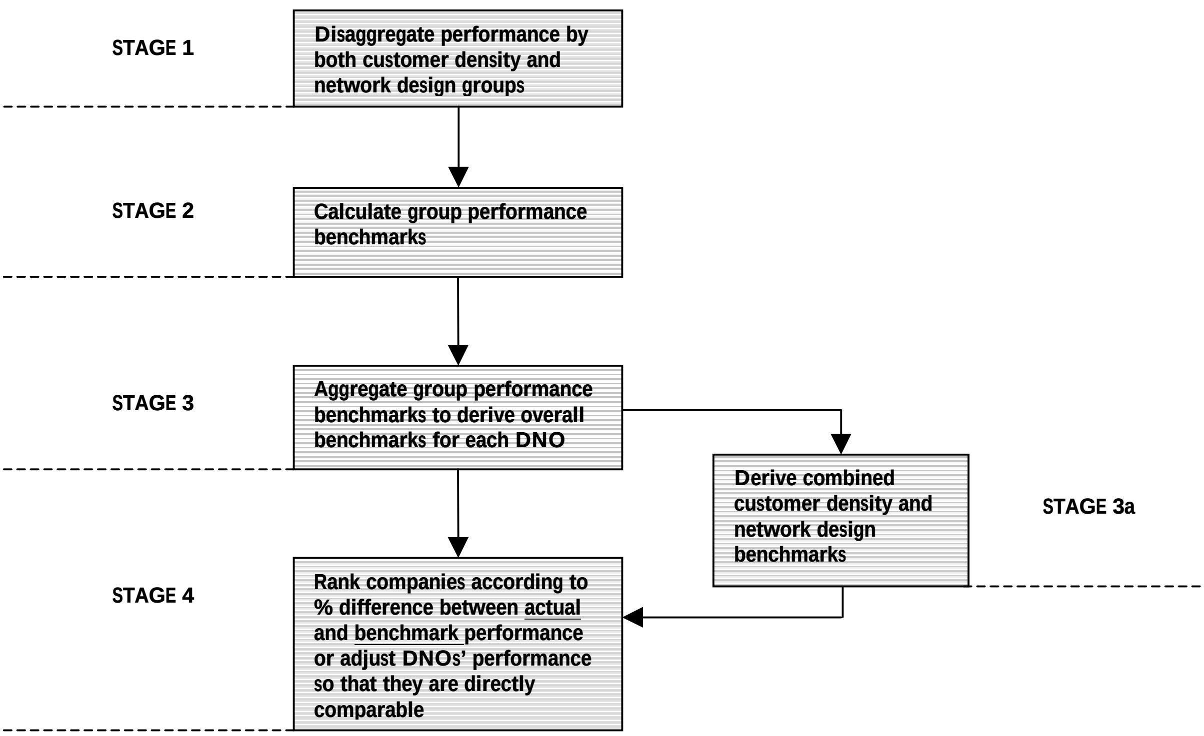
Introduction

5.1 This chapter outlines the model that has been developed by Ofgem's consultants[11] to make better performance comparisons across DNOs. It has built on a range of useful work that has been carried out by the industry in relation to adjusting performance for customer density and network design characteristics. The model is one possible approach to adjusting DNOs' performance data and there may be other approaches that are equally valid. Ofgem anticipates that the model will evolve over time through consultation and discussion with the industry. It may be appropriate to include additional factors that are outside companies' control and refine the way in which the factors are taken into account.

Outline of the model

5.2 The performance comparison model is a four-stage process. This is illustrated in figure 5.1 and discussed in more detail below.

Figure 5.1 Flowchart for performance comparison model



[11] EATL carried out the initial work on the development of the performance comparison (normalisation) model on behalf of Ofgem.

Stage 1 – Disaggregating performance

5.3 The first step in making more robust performance comparisons is to disaggregate performance into a number of groups for both:

- customer density; and
- network design.

Customer density

5.4 Ideally customer density should be measured directly using geographical data on customers' addresses and the associated network performance information measured using companies' connectivity models. However, given limitations in the data that is available, the number of customers per kilometre of high voltage (HV) circuit has been used as a proxy.

5.5 An example of possible customer density groups is set out in table 5.1 below.

Table 5.1 Possible customer density groups

Customer Density Groups	Customers per km of HV circuit
A	< 1
B	$1 - < 5$
C	$5 - < 10$
D	$10 - < 50$
E	$50 - < 100$
F	$100 - < 500$
G	≥ 500

Network design

5.6 Performance should be disaggregated into several bands based on the voltage levels set out in the RIGs, the percentage of overhead line and network length.

5.7 An example of possible network design groups is set out in table 5.2 below. Where circuits contain a mixture of overhead lines and underground cable, the number of interruptions should be allocated to the relevant categories according to the section on which the fault actually occurred.

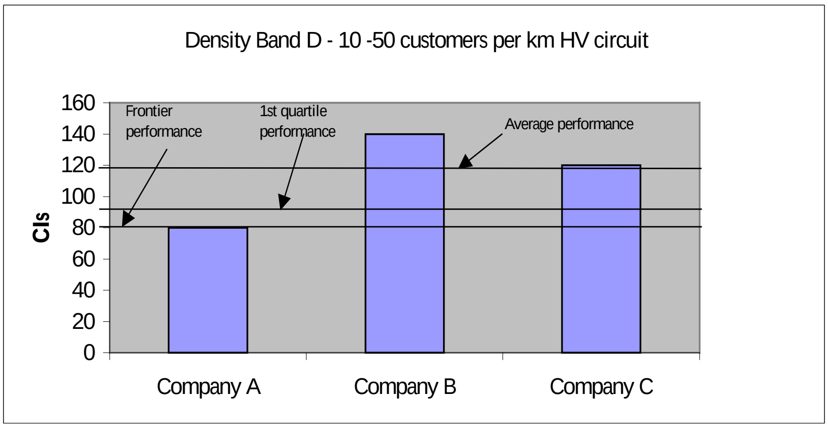
Table 5.2 Possible network design groups[12]

Network design groups	
A	LV U/G
B	LV O/H
C	HV U/G
D	HV O/H
E	EHV U/G
F	EHV O/H
G	Sub-transmission U/G
H	Sub-transmission O/H

Stage 2 – Deriving group benchmarks

5.8 The performance within each group is then directly compared across DNOs to derive performance benchmarks. These may be based on the frontier performance, average performance or alternative measures such as first quartile performance. For example, consider figure 5.2 below. The average number of interruptions in density band D is 119. The first quartile performance is 90 and the frontier performance is 80.

Figure 5.2 Possible group performance benchmarks



Stage 3 – Deriving overall company benchmarks for each DNO

5.9 The group benchmarks are then aggregated to obtain overall performance benchmarks for each DNO, taking into account the proportion of its customers

[12] The voltages are as defined in "Information and Incentives Project Regulatory Instructions and Guidance", Version 2, Ofgem March 2002.

that are in each customer density group band or the length of circuit in each network design group.

Stage 3a – Deriving combined benchmarks for customer density and network design

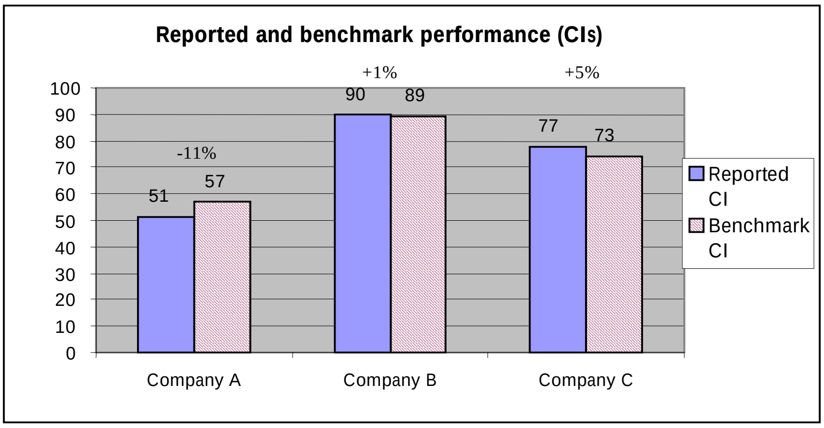
5.10 The network design and customer density benchmarks can either be used separately to assess performance or combined using a weighted average. The initial version of the performance comparison model developed by Ofgem's consultants gives equal weight to both benchmarks, but the weighting needs to be given further consideration. Companies will typically have greater influence over inherited factors such as network design than inherent factors such as customer density, at least in the longer-term, so it may be appropriate to give them a lower weighting.

Stage 4 – Performance rankings

5.11 The DNOs should then be ranked according to the difference between their actual and benchmark performance. This effectively adjusts their performance for the impact of different mixes of customer densities and/or differences in high-level network design.

5.12 For example, consider figure 5.3. Company A should be ranked first as it is outperforming its performance benchmark by 11 per cent, followed by company B, whose performance is only 1 per cent over its benchmark, and Company C whose performance is 5 per cent over than its benchmark.

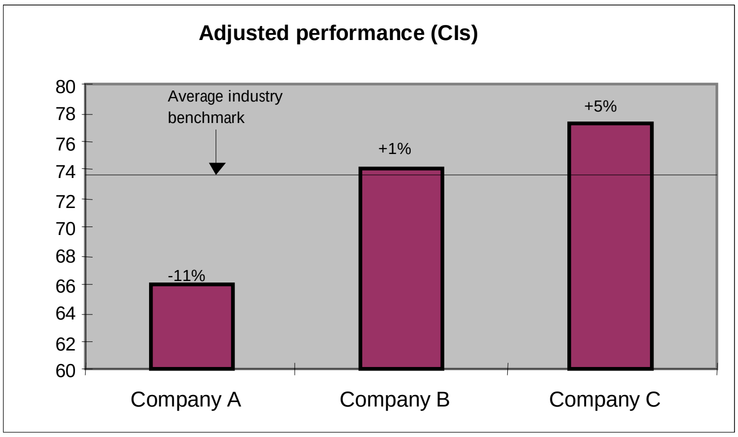
Figure 5.3 Performance comparison



5.13 Alternatively the reported performance figures for each DNO can be adjusted so that they become directly comparable. Each DNO's reported performance is adjusted by an adjustment factor, which is the ratio of the industry average performance benchmark to its own performance benchmark. This takes into account its mix of customer densities and/or network design relative to those of an average network.

5.14 Consider figure 5.4 below. Again company A is the best performer followed by company B and company C.[13]

Figure 5.4 Adjusted performance



13 Note that the percentage difference between the DNOs' adjusted performance figures and the average industry benchmark is the same as the percentage difference between the DNOs' reported performance figures and their individual benchmarks.

6. Key issues and areas of work

Introduction

6.1 This paper is the first step in the process of developing a performance comparison model. It sets out one possible approach to comparing companies' quality of supply performance and an initial version of a model to support such comparisons. Ofgem considers that it is important to develop and refine the model in discussion with the industry and other interested parties. It is also important to consider alternative approaches such as the use of reference networks.

Issues for consideration

6.2 There are a number of key issues for consideration as part of the ongoing work on developing the performance comparison model including:

- the method of adjusting performance for customer density;
- the method of adjusting performance for network design;
- whether other factors should be included in the model;
- what weighting should be given to each of the factors;
- how the model will be used; and
- the benefits of alternative approaches such as the use of reference networks.

Approach to adjusting performance for customer density

6.3 There are a number of possible approaches to adjusting performance for customer density. Ideally, customer density should be measured directly using geographic or postcode data on individual customers' locations. For example, each DNO's service area could be divided into 1 km square tiles or postcode areas and the areas then aggregated into customer density groups based on the number of customers per square km. The number and duration of interruptions for each DNO in each customer density band would be identified using their connectivity models.

6.4 At the time the model was initially developed, many of the DNOs were still in the process of populating their LV connectivity models. The number of customers per HV circuit was, therefore, used as a proxy for customer density. While most of the DNOs now have more accurate performance data down to the LV feeder level, most companies do not have detailed performance information on the number and duration of interruptions for individual customers. Therefore it is still unlikely to be possible to measure customer density and associated performance information directly.

6.5 An alternative approach suggested by some of the DNOs is to use the grid reference or postcode of distribution transformers to disaggregate information on customer numbers and associated performance into geographic or postcode areas. For incidents at HV and higher voltage levels companies have information on the relevant HV circuits and therefore distribution transformers affected. For interruptions at LV it would be necessary to associate the number and duration of interruptions with the relevant upstream transformer.

6.6 Ofgem would welcome views on the most suitable approach to adjusting performance for customer density and in particular on:

- whether it is appropriate to retain the existing approach to adjusting performance based on the number of customers per km of HV circuit or whether performance should be disaggregated into geographic or postcode areas; and
- the appropriate customer density groups for both the HV circuit and the geographic/postcode approaches to adjusting performance.

6.7 There is clearly a trade-off between increasing the number of density groups to enable more robust performance comparisons within each group across DNOs and maintaining simplicity and limiting the amount of data that is required.

Network design

6.8 There is data readily available for all DNOs for many of the key aspects of network design such as the voltage, length of circuits and whether circuits are overhead or underground and it is therefore possible to account for these in the way the model is structured. The approach outlined in the previous chapter disaggregates performance by circuit category based on voltage and the percentage of overhead line. Within each category performance is normalised by circuit length.

6.9 A similar approach, considered by the industry, is to disaggregate the number and duration of HV interruptions into 10 circuit categories based on circuit length and the percentage of overhead line. Within each category performance is normalised by the number of connected customers.[14]

6.10 A combination of these approaches could also be used. For example, as the majority of customer interruptions relate to HV faults, HV circuits could be disaggregated into several categories based on the percentage of overhead line. Simpler disaggregation could be used for other voltage levels, separating performance into two categories for overhead lines and underground cables. Where circuits are mixed, the number and duration of interruptions can be allocated to the relevant categories according to the section of the circuit on which the fault actually occurred. Possible network design groups are set out in table 6.1 below.

[14] The industry has also considered disaggregating these categories further by customer density thereby combining the customer density and network design approaches to adjusting performance.

Table 6.1 Possible network design groups

Network design groups	
A	LV U/G
B	LV O/H
C	HV 0% O/H
D	HV 1-19% O/H
E	HV 20-50% O/H
F	HV 51-80% O/H
G	HV 81-100% O/H
I	EHV U/G
J	EHV O/H
K	132 kV U/G
L	132 kV O/H

6.11 There is clearly a trade-off between increasing the number of network design groups and therefore making more robust comparisons between DNOs and limiting information requirements.

6.12 Certain specific network designs or components may only be common within a small number of DNOs. It would be difficult to take account of such factors as part of the model itself. However, if such factors have a significant effect on performance which cannot be mitigated, it may be appropriate to take them into account by adjusting the data that is inputted into the performance comparison model or in the way the results of the model are interpreted.

6.13 Ofgem would welcome views on the most appropriate means of adjusting performance for network design, including the appropriate network design groups.

Other factors

6.14 Ofgem would welcome views on whether other factors should be included in the model, subject to satisfying the three criteria set out in paragraph 4.8 and it being possible to measure them consistently across companies or take them into account using proxies. Ofgem would also welcome views on how such factors should be taken into account.

Weighting

6.15 The initial version of the performance comparison model developed by Ofgem's consultants gives equal weight to customer density and network design benchmarks, but the weighting needs to be given further consideration. Companies will typically have greater influence over inherited factors such as network design than inherent factors, at least in the longer-term, so it may be appropriate to give them a lower weighting.

6.16 Ofgem would welcome views on the appropriate weightings in the performance comparison model.

Use of the model

6.17 In the short-term the model will be used to make better performance comparisons across DNOs both at an overall and disaggregated level. This should help reveal underlying differences in DNOs' performance. Ofgem intends to publish the initial results of the model in February 2003 and include updated results using a full year's data as part of the quality of supply report in Autumn 2003. This will ensure that the DNOs, customers and other interested parties have more detailed information both on headline and adjusted performance.

6.18 The results of this work will also feed into the work on setting targets as part of the distribution price control review. This should help ensure that all DNOs face equally challenging targets for the next price control period.

6.19 In assessing efficiency, appropriate account should be taken of the outputs that a company delivers – this would provide a balanced assessment of companies' overall performance. The work on comparing quality of supply performance should facilitate analysis of the trade-offs between costs and quality of supply.

6.20 Ofgem would welcome views on the use of the performance comparison model.

Alternative approaches

6.21 One alternative approach for improving quality of supply comparisons is to compare the performance of the DNO's actual networks with the performance that could be delivered by reference or optimal networks for their distribution services area. The reference network would be derived by optimising a range of factors such as the failure rates of various network components, levels of protection, automation and fault management, taking into account the costs of increased operating and capital expenditure and the benefits in terms of improved service delivery.

6.22 Such an approach could give a much better understanding of the performance a network could potentially deliver taking into account its individual circumstances. It could therefore have benefits for both the regulator in setting quality of supply targets and the trade-off between cost and quality as part of the price control and for the DNOs in responding efficiently to these incentives.

6.23 There are however, a number of potential concerns with this approach. It may require taking a view on the appropriate configuration of the network. It is not clear that the regulator should set targets in this way as it may constrain innovation. Further, such an approach would be both data and resource intensive.

6.24 The development of benchmark networks may be a desirable long-term objective but it will not be practical to derive these in detail before the next distribution price control. Ofgem considers that the most pragmatic approach in the short-term is to develop a model that adjusts performance for a small number of factors outside of DNOs' managerial control.

6.25 Ofgem would welcome views on whether the development of such a performance comparison model is the most appropriate approach in the short-term. Ofgem would also welcome views on the benefits of alternative approaches to comparing quality of supply performance, including the development of a reference network approach.

Appendix 1 Worked example of the performance comparison model

Introduction

1.1 This Appendix sets out a worked example of the performance comparison model. For simplicity it considers the number of interruptions for three hypothetical DNOs and uses a limited degree of disaggregation. However, the same steps apply using actual performance data for all 14 DNOs to a greater level of disaggregation.

Stage 1 (Customer Density) – Disaggregating performance

1.2 Table A.1 sets out data for the total number of customer interruptions and the number of connected customers for three density groups.

Table A.1 Data for the total number of interruptions by customer density band

	Company A		Company B		Company C	
Customer density bands (no. of customers per km of HV circuit)	**Total no. of customer interruptions**	**No. of customers**	**Total no. of customer interruptions**	**No. of customers**	**Total no. of customer interruptions**	**No. of customers**
0-10	58,351	21,530	464,990	128,986	29,712	11,824
10-100	397,954	308,860	578,272	288,403	1,202,610	871,260
> 100	608,097	1,735,454	191,357	953,707	915,042	1,881,886
Overall	1,064,401	2,065,844	1,234,620	1,371,095	2,147,363	2,764,970

Stage 2 (Customer density) – Deriving group benchmarks

1.3 The second stage is to establish a performance benchmark for each customer density group, based on the average performance of all companies in that group. For example, for the first customer density group (0-10 customers per km of HV circuit) the performance benchmark $= \frac{(58,351 + 464,990 + 29,712) x 100}{(21,530 + 128,986 + 11,824)}$ = 341 interruptions per 100 connected customers.

1.4 The results for each density group are set out in table A.2 below.

Table A.2 Group performance benchmarks

Customer density groups (No. of customers per km of HV circuit)	Group performance benchmarks (CI)
0-10	340.68
10-100	148.37
> 100	37.51

Stage 3 (Customer Density) – Deriving overall company benchmarks for each DNO

1.5 The third stage is to establish an overall performance benchmark for each DNO. This calculation is shown in table A.3 below for DNO A.

1.6 Firstly, each group performance benchmark (A) is multiplied by the proportion of the company's customers that are in that group (B). The result (C) is then summed across all groups to give the overall company performance benchmark (D). This takes into account the company's mix of customer densities.

Table A.3 Calculation of the overall performance for company A

	A	B	C = AxB
Customer density groups (number of customers per km of HV circuit)	**Group performance benchmark (CI)**	**Percentage of company's customer base**	**Contribution to overall company performance benchmark (CI)**
0-10	340.68	1.04%	3.55
10-100	148.37	14.95%	22.18
> 100	37.51	84.01%	31.51
Total		100%	**(D) = 3.55 + 22.18 + 31.51 = 57.24**

1.7 The results for each DNO are set out in table A.4 below.

Table A.4 Company benchmarks

Company	Benchmark (CI)
Company A	57.24
Company B	89.35
Company C	73.74
Average	73.44

Stage 1 (Network Design) – Disaggregating performance

1.8 Table A.1 sets out data for the total number of customer interruptions and the number of kilometres of circuit for three network design groups.

Table A.5 Data for the total number of interruptions by network group

	Company A		Company B		Company C	
Network groups	**Total no. of customer interruptions**	**Length km**	**Total no. of customer interruptions**	**Length km**	**Total no. of customer interruptions**	**Length km**
LV	163,015	29,608	67,552	19,397	229,919	41,083
HV	809,770	16,738	876,952	37,946	1,627,251	29,722
EHV and sub-transmission	91,617	3,957	290,116	8,828	290,194	8,283
Total	1,064,401	50,302	1,234,620	66,1701	2,147,363	79,087

Stage 2 (Network design) – Deriving group benchmarks

1.9 A performance benchmark is calculated for each network design group, based on the average performance across all DNOs. For example, for LV circuits the group performance benchmark

$$= \frac{(163{,}015 + 67{,}552 + 229{,}919)}{(29{,}608 + 19{,}397 + 41{,}083)} = 5.11 \text{ interruptions/km.}$$

1.10 The performance benchmark for each network design group is set out in table A.6.

Table A.6 Performance benchmarks for each network design group

Network design	Performance benchmarks (No. of interruptions per km)
LV	5.11
HV	39.26
EHV and sub-transmission	31.89

Stage 3 (Network Design) – Deriving overall company benchmarks for each DNO

1.11 An overall performance benchmark is then calculated for each DNO. Firstly, the performance benchmark for each network design group (A) is multiplied by the length of that type of circuit on the company's network (B) times 100 and divided by the total number of customers connected to the company's network.

The results (C) are then summed across all the groups to give an overall company benchmark (D).

Table A.7 Calculation of the overall performance for company A

	A	B	C = AxBx100 / Total customers
Network group	**Group performance benchmark (No. of interruptions per km)**	**Length (km)**	**Total performance benchmark (Total no. interruptions)**
LV	5.11	29,608	7.33
HV	39.26	16,738	31.81
EHV and sub-transmission	31.89	3,957	6.11
Total		50,302.5	**(D) = 7.33 + 31.81 + 6.11 = 45.25**

1.12 The results for each DNO are set out in table A.8 below.

Table A.8 Company benchmarks

Companies	Benchmark (CI)
Company A	45.25
Company B	136.43
Company C	59.35
Average	80.34

Stage 3a – Deriving combined benchmarks for customer density and network design

1.13 A combined benchmark is calculated taking a weighted average of the customer density and network design benchmarks. Equal weights have been assigned in this case. For example, for company A, the combined benchmark is (57.24 + 45.25)/2 = 51.24.

Table A.9 Combined benchmarks

	A	B	C	D	E = (A*B + C*D) / (B + D)
Companies	**Customer density benchmark (CI)**	**Weighting**	**Network design benchmark (CI)**	**Weighting**	**Combined benchmark (CI)**
Company A	57.24	1	45.25	1	51.24
Company B	89.35	1	136.43	1	112.89
Company C	73.74	1	59.35	1	66.55
Average	73.44		80.34		76.89

Stage 4 – Performance rankings

1.14 The DNOs are ranked according to the percentage difference between their actual performance and their benchmark. A negative percentage indicates that they are outperforming their benchmark whereas a positive percentage indicates that they are performing worse than their benchmark. This effectively takes into account the impact of different mixes of customer densities and/or differences in high-level network design. In this case company B should be ranked first as it is outperforming its performance benchmark by 20 per cent, followed by company A, whose performance is only 1 per cent higher than its benchmark, and Company C whose performance is 17 per cent higher than its benchmark.

Table A.10 Company benchmarks, reported and adjusted performance

		A		B	C = AxB
Companies	**Benchmark (CIs)**	**Reported performance (CIs)**	**Difference between reported and actual performance**	**Adjustment Factor (average benchmark/ company benchmark)**	**Adjusted performance (CIs)**
Company A	51.24	51.52 (1)	+1% (2)	1.50	77.31 (2)
Company B	112.89	90.05 (3)	-20% (1)	0.68	61.33 (1)
Company C	66.55	77.66 (2)	17% (3)	1.16	89.74 (3)
Average	76.89	73.08			

1.15 Alternatively an adjustment factor (B) can be derived for each company. This takes into account both the effects of the company's profile of customer densities and its network design relative to those of an average company. Reported performance (A) is multiplied by the adjustment factor (B) to obtain adjusted performance (C). The adjusted performance figures can then be directly compared across DNOs.