



International cost efficiency benchmarking of Network Rail

September 2010

Contents

1. Executive summary	1
Econometric analysis.....	1
Gap analysis.....	2
2. Introduction.....	5
Context.....	5
Purpose of this document.....	6
Contact.....	6
3. Background.....	7
Introduction.....	7
Assessing efficiency	7
Network Rail's efficiency improvement in CP3	7
Our efficiency assessment in PR08.....	8
Our judgements for CP4.....	9
Network Rail's performance in 2009-10 – efficiency update.....	9
4. Econometric analysis.....	11
Introduction.....	11
Background	11
The LICB dataset.....	12
Developing our econometric model	14
Results of our updated analysis.....	17
Comparison to PR08 econometric analysis	18
Time trend of Network Rail's relative efficiency	18
Robustness and validation	19
Review of our econometric analysis	19
5. Understanding the efficiency gap	21
Introduction.....	21
Understanding the cost efficiency gap.....	21
Gap analysis work in PR08	21
Our further work to understand the cost efficiency gap	22
Annex A: Our efficiency calculations for CP4	27

1. Executive summary

- 1.1 Assessment of the scope for Network Rail to improve its cost efficiency is central to our work, in particular so that we can establish levels of access charges at a periodic review of Network Rail's outputs and access charges that reflect challenging and achievable levels of efficiency. Assessing the scope for efficiency improvement is also important for Network Rail itself, so that it can identify technologies and working methods that allow it to deliver, or outperform, our periodic review determination; and also for it to plan for the longer term and prepare its submissions to a periodic review.
- 1.2 This report is our first annual update of our work on Network Rail's cost efficiency compared to its international peers since we completed our 2008 periodic review (PR08) of its outputs and funding for control period 4 (CP4). The report covers maintenance and renewals costs only, and does not compare operating or enhancements costs.
- 1.3 The use of international benchmarking is necessary as Network Rail is a single national monopoly, and hence there are no direct domestic comparators. The international peer group we use is predominantly made up of west European rail infrastructure managers but we are also considering with Network Rail the scope for benchmarking other countries and industries (since west European rail infrastructure managers may not represent the best benchmarks in all cases).
- 1.4 Comparing Network Rail's efficiency directly with other rail infrastructure managers shows how the company is progressing in improving its relative efficiency. Providing a regular update provides important information for us and other interested parties. It also provides a further spur on Network Rail to achieve efficiency and for it to understand the reasons for differences in costs in different countries.
- 1.5 We have undertaken two complementary types of efficiency analysis: "top-down" econometric (statistical) analysis and "bottom-up" engineering based analysis. The engineering based work is important as it helps to validate and better understand the "efficiency gap" calculated using econometric analysis.

Econometric analysis

- 1.6 Our econometric analysis is undertaken using the "lasting infrastructure cost benchmarking" (LICB) dataset developed and maintained by the International

Union of Railways (UIC) for 14 European rail infrastructure managers, including Network Rail, covering the 13 years from 1996 to 2008 (the most recent year available). We are very grateful to the UIC, its members, and Network Rail for making the dataset available and for the discussions and ongoing close working.

- 1.7 Undertaking international benchmarking using econometric analysis is complex and there are uncertainties associated with it. We have undertaken extensive econometric model development and sensitivity testing to make sure our analysis is as robust as possible.
- 1.8 Our results show that, in 2008, Network Rail was between 34 to 40% less efficient than the estimated frontier (leading) European infrastructure managers in the peer group in our analysis (using the full 13 year sample). This result is broadly consistent with the econometric analysis we undertook in PR08 which showed that, compared to the top European infrastructure managers, Network Rail was 40% less efficient.
- 1.9 By comparison, against the upper quartile, the difference is 29 to 37% (using the full 13 year sample)¹. In PR08 we estimated that there was a difference from the upper quartile of 37%.
- 1.10 These results indicate an improvement against our PR08 econometric modelling analysis.
- 1.11 The results are dependent upon a number of assumptions, including the specific econometric modelling approach used and the quality and comparability of the underlying cost information.
- 1.12 Ahead of, and as part of, our 2013 periodic review (PR13) we will continue to develop and expand the scope of our benchmarking work and econometric analysis.
- 1.13 Network Rail is undertaking detailed further work to support the econometric analysis. In particular, it is working to develop a more detailed understanding of the cost data used in this analysis and the relevant cost drivers.

Gap analysis

- 1.14 We have conducted further work to understand the drivers of the differences in maintenance and renewals efficiency between Network Rail and its peers,

¹ The upper quartile is the 25th percentile, which corresponds to either the third or fourth best company in our peer group.

to confirm whether it represents a real difference in efficiency that is controllable by Network Rail. The study, undertaken by our consultants, RailKonsult, shows that there are significant differences between Network Rail's efficiency and four international comparators, which is due to a number of factors including, in particular, differences in contracting and possessions strategies. The differences in the "harmonised" costs between Network Rail and the four comparators lie between 25 and 50%. The study confirms that Network Rail still has the opportunity to learn from other railways to deliver cost savings, and work to identify and learn from best practice needs to continue.

- 1.15 The work to understand the efficiency gap is important, and we will continue to develop it with Network Rail. Network Rail will be undertaking detailed bottom up comparisons with other infrastructure managers, relating for example to unit costs and productivity so that this can be reconciled with, and inform, the development of the econometric analysis.

2. Introduction

Context

- 2.1 Assessment of the scope for Network Rail to improve its cost efficiency is central to our work, in particular so that we can establish levels of access charges at a periodic review of Network Rail's outputs and access charges that reflect challenging and achievable levels of efficiency.
- 2.2 Assessing the scope for efficiency improvement is also important for Network Rail itself, so that it can identify technologies and working methods that allow it to deliver, or outperform, our periodic review determination; and also for it to prepare its submissions to a periodic review. Understanding the scope for improvement will also help Network Rail in debates with its customers, funders, and other interested parties.
- 2.3 Because Network Rail is a single national monopoly, the use of international benchmarking is necessary. This makes the benchmarking work more challenging, in particular to ensure that the comparisons are conducted on a like-for-like basis, but it is essential to make international comparisons when there are no direct domestic comparators.
- 2.4 We used international benchmarking extensively in our 2008 periodic review (PR08), in particular in relation to the benchmarking of Network Rail's relative efficiency in maintenance and renewals. We used the International Union of Railways' (UIC) 'lasting infrastructure cost benchmarking' (LICB) dataset as input to econometric (statistical) analysis we undertook, working with the Institute for Transport Studies at the University of Leeds and, to a degree, Network Rail. We are very grateful to both the UIC and Network Rail for making this dataset available for our use and for the ongoing debate and engagement on the econometric analysis.
- 2.5 The results for other infrastructure managers in the LICB dataset (except for Network Rail) are treated in full confidence. We only report on Network Rail's cost efficiency and do not disclose the relative efficiency of other infrastructure managers.
- 2.6 We intend to update and publish the results of top down efficiency econometric analysis for Network Rail every year. This will provide regular information on Network Rail's relative efficiency and, we believe, an important

spur on the company to keep a close focus on its efficiency improvement programme and plans.

Purpose of this document

- 2.7 At the end of PR08, we said that we would continue to widen and deepen our international benchmarking analysis during control period 4 (CP4) – continuing with our econometric analysis of maintenance and renewals, and undertaking further work to understand and validate the gap between Network Rail and its international peers.
- 2.8 Undertaking international benchmarking using econometric analysis is complex and there are uncertainties associated with it. We have undertaken extensive econometric model development and sensitivity testing.
- 2.9 We have committed to publishing an annual statement about Network Rail's relative efficiency compared to its international peers. This report provides the first annual update since PR08 on Network Rail's comparative cost efficiency performance. Building on the econometric analysis we undertook in PR08, we have performed new econometric analysis using the updated LICB dataset with data for two additional years in order to provide an updated picture of Network Rail's relative maintenance and renewals efficiency. The report also summarises engineering-based work we have undertaken to understand the cost efficiency gap between Network Rail and its peers calculated using the econometric analysis. This gap analysis is an essential part of our work to understand the scope for efficiency improvement, in particular to help validate the results of the econometric analysis given the uncertainties with it.

Contact

- 2.10 For further information or to discuss any of the analysis described in this document, please contact: Gian Carlo Scarsi, Head of Regulatory Economics, Tel. 020 7282 2078, E-mail: GianCarlo.Scarsi@orr.gsi.gov.uk.

3. Background

Introduction

3.1 This chapter provides background to our efficiency benchmarking.

Assessing efficiency

3.2 At a periodic review, we assess efficiency across all of Network Rail's activity and expenditure: support functions, operations, maintenance, renewals, and enhancements. In doing this we use a wide range of approaches, including the assessment of Network Rail's own submissions and detailed "bottom-up" engineering or process based studies. We also use "top-down" econometric, or statistical, approaches.

3.3 External cost benchmarking (i.e. comparing a company's costs to a reference level that cannot be influenced by the company concerned) is widely used by regulators to inform their judgement on the extent to which companies can improve on cost efficiency. Comparing Network Rail to its direct peers, i.e. other rail infrastructure managers, can provide insights into industry best practice and the relative efficiency of Network Rail. The international peer group for Network Rail consists predominantly of west European comparators in which the infrastructure and operating conditions are most similar to Network Rail's. We recognise that west European rail infrastructure managers may not always represent the best organisations to benchmark against. Rail infrastructure managers in other countries, such as North American infrastructure managers, may provide a useful benchmark, as can infrastructure managers in other sectors.

Network Rail's efficiency improvement in CP3

3.4 Network Rail took over a railway in 2002 where costs were out of control. Following the Hatfield accident, operating, maintenance and renewals (OM&R) cost increased from a pre-Hatfield level of £3.7bn per annum to a peak of £6.9bn in 2003-04 (in 2009-10 prices). Much of this increase was to do with the additional costs of dealing with the renewals backlog, but efficiency worsened dramatically over the period that Railtrack was in administration and during the early period of Network Rail's ownership.

3.5 In the 2003 access charges review, we assumed that Network Rail could achieve 31% efficiency improvement over CP3. This assumption was based

on extensive analysis, including in particular internal, procurement, and process/activity (including operating expenditure) benchmarking. No serious international benchmarking was undertaken in the 2003 review.

- 3.6 Network Rail achieved a 27% efficiency improvement in OM&R during CP3. In terms of efficiency in operating and maintenance expenditure, the company performed well, but on renewals Network Rail significantly underperformed our 30% assumption, achieving 24% savings during the control period. This was due in particular to track renewals, where Network Rail struggled to implement necessary changes in its working methods in order to make the necessary improvements in efficiency.

Our efficiency assessment in PR08

- 3.7 We undertook an extensive range of analysis on efficiency in PR08, including both top-down (econometric) and bottom-up (engineering) benchmarking, and we reviewed Network Rail's own plans. One of the key areas of work we undertook to assess the scope for improvement in maintenance and renewals (M&R) efficiency was to conduct econometric efficiency analysis using the UIC's LICB dataset.
- 3.8 At the time of PR08, the LICB dataset contained cost and other information for Network Rail and 12 other European rail infrastructure managers, with data covering 11 years (1996 to 2006).
- 3.9 Our most robust econometric modelling results in PR08 showed that Network Rail was 37% less efficient than the upper quartile of the peer group in 2006, and 40% to the frontier². Rolled forward to the end of CP3 on the basis of the projected efficiency improvement in the final year of CP3, this gap to the upper quartile was estimated at 35%, and 38% to the frontier. However, we had a range of results, and the majority of these gave higher levels of inefficiency for Network Rail, up to 50%, mostly driven by inefficiency in renewals, although the robustness of some of these results needed to be confirmed.
- 3.10 For operating expenditure, we looked at the long run trends in real unit operating expenditure (RUOE) across the range of UK regulated companies, which highlighted an operating expenditure gap at the end of CP3 of around

² The upper quartile is the 25th percentile, which corresponds to either the third or fourth best company in our peer group. The frontier is the leading company (which may change over time).

35% (similar to the gap in M&R). We also benchmarked employment costs and other parts of operating expenditure.

- 3.11 For enhancements, we made a specific assessment of the company's proposals. Of the £1.4bn reduction in Network Rail's proposed expenditure of £9.7bn that we made, around £850m was for efficiency savings (in 2009-10 prices).

Our judgements for CP4

- 3.12 Given the very high gap between Network Rail and its peers based on our econometric analysis, we considered it essential to undertake a wide range of work to understand the gap in more detail. Our engineering team undertook a range of international visits to other rail infrastructure managers to understand how they worked. Our consultants RailKonsult (part of Balfour Beatty Rail) did detailed engineering work on technologies and working methods used in mainland Europe (in particular, the Netherlands and Switzerland) that could be used by Network Rail to improve on its efficiency.
- 3.13 For the purposes of making our decisions in PR08 on maintenance and renewals efficiency improvement, we adopted a conservative approach and used the results benchmarked to the upper quartile, as part of our consideration of all the evidence available, and we assumed that Network Rail would be able to catch up by two-thirds of this gap over CP4.
- 3.14 As part of our determination for CP4, we assumed that Network Rail would be able to achieve 21% improvement in its OM&R cost efficiency (22% in M&R), compared to the 13% proposed by Network Rail. The breakdown of our efficiency assumptions is set out in annex A.
- 3.15 Ultimately, the discussion on efficiency in PR08 revolved principally around the pace of change achievable in CP4 rather than the size of the gap. We considered the pace of change as part of our considerations for the whole package of judgements and decisions we took. A key factor was that we recognised that Network Rail has much to do in CP4 as part of the overall package (all the improvements in outputs, enhancements, etc.). We decided that Network Rail should be able to close two-thirds of the PR08 efficiency gap in CP4.

Network Rail's performance in 2009-10 – efficiency update

- 3.16 During 2009-10, Network Rail improved its OM&R efficiency by 3.6% compared to our determination assumption of 3.8%. Our analysis of Network

Rail's efficiency improvement in 2009-10 is explained in more detail in our annual efficiency and finance assessment³.

³ *Annual assessment of Network Rail's efficiency and finance*, Office of Rail Regulation, September 2010.

4. Econometric analysis

Introduction

- 4.1 This chapter provides the updated econometric analysis of Network Rail's maintenance and renewals efficiency compared to its west European peers.
- 4.2 For our update, we have continued to use the 'lasting infrastructure cost benchmarking' (LICB) dataset compiled by the International Union of Railways (*Union Internationale des Chemins de Fer*, UIC). This dataset comprises maintenance and renewals expenditure and other data for a total of 14 European rail infrastructure managers (of which we used 12), including Network Rail, for the period from 1996 to 2008.
- 4.3 We are grateful to the UIC for providing us with access to their dataset, and to Network Rail, the UIC and its members, for working with us. We have shared and discussed our results with Network Rail, the UIC, and participating infrastructure managers.
- 4.4 The outputs of this work, while demonstrating the power of international benchmarking, are specific to our assessment of Network Rail and we do not comment on the relative efficiency of other infrastructure managers. All the information for other infrastructure managers, except for Network Rail, is treated in full confidence.

Background

- 4.5 Efficiency analysis can be performed using econometric (statistical) techniques to understand the relationship between cost and other factors (drivers of cost), and hence to estimate the levels of relative cost efficiency between different companies.
- 4.6 Econometric analysis allows a comparison of efficiency from a "top-down" perspective and provides the basis to establish a company's relative efficiency to its peers or benchmarks. Using just "bottom-up" engineering or operational based analysis is useful, but does not typically identify the total scope for potential efficiency savings. We use both approaches, seeing them as complementary in order to establish a full picture of the scope for efficiency improvement. Econometric analysis also enables the quantification of the interaction between costs and cost drivers.

- 4.7 The shortcomings of econometric analysis are that it does not allow for a qualitative understanding of the reasons for differences between companies. This requires separate work. There is also the possibility that there are data limitations or quality issues, and that the analysis does not include all the variables which drive cost. It is never possible to identify all cost drivers but it is important that the material cost drivers are included in the modelling, or taken account of in some other way in using results.
- 4.8 Doing good quality benchmarking is challenging, and this is particularly relevant for international benchmarking. In our work in PR08, we recognised that the available data for the econometric analysis did not enable us to explain fully in confidence, and in detail, all of the difference between Network Rail's cost base and that of its peers. We undertook considerable effort to understand from a qualitative and quantitative perspective the factors driving the results, including engineering and statistical issues. The results of this work confirmed to us that the results of our international econometric benchmarking work were robust.
- 4.9 Despite the difficulties surrounding international benchmarking, there were several factors that led to success in our international benchmarking during PR08. These included access to the existing, good quality, LICB dataset, the use of other evidence in support of our analysis, starting early, and the clear recognition of uncertainty in doing international benchmarking, which led us to adopt a conservative interpretation of the results.
- 4.10 During PR08, there were two strands to our work. The first involved working with the LICB dataset, employing econometric techniques to estimate the relative efficiency of Network Rail compared to other railways in the dataset. The second used sub-national level data from five railway infrastructure managers in Europe and North America (including Network Rail) that we collected directly from the infrastructure managers. This regional analysis is currently being updated and is not covered in this report. The preliminary analysis we undertook in PR08 gave results that were in line with the analysis of the LICB dataset.

The LICB dataset

- 4.11 The LICB dataset comprises maintenance and renewals expenditure and cost driver data for 14 European rail infrastructure managers, including Network

Rail, for the thirteen years from 1996 to 2008⁴. For our update, we have used a sub-sample of 12 infrastructure managers, including Network Rail. We have excluded REFER (Portugal) and Chemins de Fer Luxembourgeois (Luxembourg) due to data incompatibilities (Luxembourg being a clear outlier due to the very small size of its network, and Portugal failing to provide the LICB with renewal cost data in recent years.)

- 4.12 Besides data for Network Rail, the dataset we have used covers: ÖBB (Austria), Infrabel (Belgium), BDK (Denmark), RHK (Finland), Deutsche Bahn (Germany), Irish Railways, RFI (Italy), ProRail (the Netherlands), Jernbaneverket (Norway), Banverket (Sweden), and SBB (Switzerland).
- 4.13 The variables for which there was sufficient coverage for benchmarking purposes are summarised in table 1.

Table 1: UIC/LICB variables usable for econometric cost benchmarking

Cost data	Output data	Network features data
Total maintenance and renewal costs (the original dataset provides them separately)	Passenger train km Passenger tonne km Freight train km Freight tonne km Total tonne km Total train km	Main track or route km Ratio of single track to track km Proportion of track electrified Number of switches per track km Stations per route km

- 4.14 The updated dataset we received from UIC through Network Rail in early 2010 included the data for the years 2007 and 2008, which were not in the version of the dataset we used in PR08. The updated dataset has been validated by UIC. We have performed our own checks and corrections by filling gaps in the data (mainly by interpolation) and omitting non-credible observations.

⁴ Further information on the LICB dataset and UIC is available at http://www.uic.asso.fr/uic/spip.php?page=imprimer&id_article=582 and a summary report is available at http://www.uic.asso.fr/reunion.php/20123/li06c_sum_en.pdf.

Developing our econometric model

- 4.15 The econometric methodologies that we have adopted are widely used. These methodologies construct an “efficiency frontier”, based on the performance of those companies in the peer group deemed to be most efficient. Any company located on the frontier is considered to be efficient. The relative efficiency of other companies is then determined by their “distance” from this frontier. The further they are from the frontier, the greater is their potential scope for efficiency catch-up. More detail on the econometric analysis is provided in our supporting technical paper⁵.
- 4.16 As in PR08, we used three techniques: stochastic frontier analysis (SFA), corrected ordinary least squares (COLS), and data envelopment analysis (DEA). SFA tackles the issue of data noise (measurement error etc.) when estimating the inefficiency gap in a mathematical way. COLS measures the full gap from the frontier ignoring the separation between data noise and inefficiency, and for this reason has a tendency to over-estimate the efficiency gap. DEA is a mathematical technique that calculates the inefficiency gap without testing for the significance of cost drivers.
- 4.17 In keeping with our PR08 approach and best practice in the academic literature, we have retained SFA as our default technique. We have performed cross-checks using COLS and we tentatively tried DEA, obtaining a cost inefficiency gap for Network Rail of 50% or more. Similar cross-checking results had been obtained in PR08.
- 4.18 The fact that the dataset contains data for a number of infrastructure managers over a period of time provides a number of advantages over a dataset with only a single year’s worth of data. In particular:
- (a) the estimate of Network Rail’s cost efficiency gap is made more robust as the greater number of data points increases the available information and enables more advanced modelling techniques to be used; and
 - (b) it allows us to study the time path (trend) of efficiency.

⁵ 2010 LICB International Econometric M&R Cost Benchmarking of Network Rail (2008 UIC dataset update): Technical Support Paper, Office of Rail Regulation and Institute for Transport Studies, University of Leeds, September 2010. This may be accessed at http://www.rail-reg.gov.uk/upload/pdf/econometric_update_2010_its_paper.pdf.

- 4.19 We have tested a variety of cost function models combining different cost drivers (listed in table 1) to explain total maintenance and renewal cost. Our preferred explanatory model considers total maintenance and renewal expenditure (cash cost) to be explained by route km (network size), passenger train density (measured as passenger train km on the main line network), freight train density (measured as freight tonnage on the main line network), the proportion of single track on total track km, and a time variable to capture technological progress. The single track variable provides an indication of the complexity of the network, and the nature of the assets being maintained or renewed. The model is robust to reasonable changes in methodology and underlying data. Other LICB cost drivers are not included in the final model as they did not prove to be statistically significant in explaining maintenance and renewal cost.
- 4.20 Although we have also modelled maintenance and renewals costs separately, our preferred model is based on total M&R cost. This is appropriate as it means that both the trade-offs between maintenance and renewals, and any accounting differences between countries in the way in which they record maintenance and renewal costs, are taken into account.
- 4.21 Our approach and preferred model is similar to our PR08 model with several improvements. We have kept our core model specification but have expanded our sensitivity analysis. As a result of this, we have achieved more robust results statistically.
- 4.22 The cost drivers used in our model are consistent with the key drivers identified in the gap analysis work (described in the following chapter).
- 4.23 During model development we eliminated insignificant variables from the model. There were several changes compared to the PR08 approach. For instance, we dropped the Portuguese infrastructure manager because of lack of renewal cost data in recent years. During PR08, we had the latest Portuguese data which allowed us to have observations for all years across all railways in the sample, which at the time covered 1996-2006. We are also working to further understand the level of renewals REFER has been undertaking over the last two years, which might affect the results of the analysis. The other key difference to PR08 is that the electrification control variable, which was statistically insignificant, has now been dropped from our core model.

- 4.24 We also removed Luxembourg from the sample, as we had done in PR08, because network size in Luxembourg is considerably smaller than in all other countries covered by LICB.
- 4.25 In order to make the cost data comparable, we adjusted it to a common currency using purchasing power parity (PPP) exchange rates and converted them into constant prices, deflated back to German currency at the base year (1996). The data therefore take into account differences in price (including wage) levels at the economy-wide level, although they do not take into account any relative differences between rail-specific and whole-economy (or other sectors') price levels.
- 4.26 PPP exchange rates mitigate (but do not eliminate) the effects of nominal exchange rate volatility between countries. They are extensively used in international economic analysis and comparisons, as they take account of relative differences in the cost of living and in the different purchasing powers of currencies not just in their own domestic markets, but also internationally (For the same basket of goods and services; many services are not tradable by definition or in practice, so the PPP adjustment is naturally skewed in favour of tradable goods.)

Steady-state adjustment

- 4.27 We adjusted Railtrack/Network Rail's renewal cost figures, before and after the Hatfield derailment, for "steady state", which is consistent with our approach during PR08.
- 4.28 During PR08, we recognised that at least part of the difference between Network Rail's expenditure levels and those of its peers in mainland Europe is due to it renewing assets at a rate greater than the "steady state" (that is, the long-run equilibrium in the investment cycle) as the company continued to address the backlog built up in the years before the Hatfield derailment. The issue of "steady state" is important, as the impact on relative expenditure levels has a follow-through impact on relative efficiency estimates.
- 4.29 To ensure that the econometric benchmarking does not penalise Network Rail unfairly for this, we have made an adjustment to Network Rail's renewal cost data for the whole time period, which assumes its track and signalling renewal volumes were at steady state. This has the effect of increasing Railtrack's and decreasing Network Rail's expenditure used in the econometric analysis.

- 4.30 We consider that a “steady state” level of renewals corresponds to renewing roughly 2.5% of the network, on average, on an annual basis.
- 4.31 We have not adjusted the data for the other companies in this way. We are therefore assuming that, on average, the leading (frontier, upper quartile) companies are in steady state.
- 4.32 In its “ten year” report on the LICB study published in 2007, UIC included information on rail, sleeper, and ballast renewal rates for some of the member countries for 2004 – 2006. We have analysed this, and taking into account relative traffic levels (which have a significant bearing on track renewals rates), there does not necessarily appear to be a significant difference between Network Rail and the peer group. However, there is further work required to develop our knowledge of relative renewals levels and steady-state adjustments made in the econometric analysis. This will be a key area of future work.

Results of our updated analysis

- 4.33 The econometric model we have used as the basis of our best estimate of the top down cost efficiency gap is in the middle of a range of sensitivities (as explained in more detail in the supporting technical paper).
- 4.34 Our results show that in 2008-09, corresponding to the last year of CP3, Network Rail was between 34 to 40% less cost-efficient than the top European infrastructure managers in the peer group, using our preferred model. The range is due to the specific econometric model used and we have not chosen a single preferred model at this time.
- 4.35 A key difference we have adopted compared to PR08 is that we now benchmark to the frontier rather than the upper quartile. This is because stochastic frontier analysis is a technique that already takes into account “noise” in the data, and hence there is no specific need to “aim off” further for this reason, as we did in PR08 because we chose to adopt a very cautious approach⁶.
- 4.36 Our updated models show in their totality that the cost inefficiency range for Network Rail in 2008 could be as high as 70% and as low as 20%⁷. However,

⁶ Dr Michael Pollitt of the Judge Institute of Management Studies at Cambridge University (UK) noted in his review of our PR08 work that there is no need to make an adjustment from the full frontier to the upper quartile on theoretical (efficiency analysis) grounds.

⁷ If we include some of the translog models, we get a gap of zero – this is shown in the technical support paper.

from a methodological standpoint, this would be a very simplistic way of looking at our results, because the models showing very high values for efficiency or inefficiency had to be immediately discarded due to statistical inconsistencies. Therefore, we consider the credible range for the efficiency gap is 34 to 40%.

Comparison to PR08 econometric analysis

4.37 Table 2 shows our econometric results from our PR08 calculations and the results of our update.

Table 2: Updated and PR08 efficiency gaps estimated for Network Rail for 2008

Study	Efficiency gap (best estimate / range)	Comments
PR08 results	38 / 28 – 44%	To frontier of peer group
	35 / 22 – 41%	To upper quartile of peer group
2010 international benchmarking update	34 – 40%	To frontier of peer group
	29 – 37%	To upper quartile of peer group

Note: The PR08 econometric analysis was for the LICB dataset up to 2006. We rolled forward the results (Network Rail's efficiency gap) to 2008 (the end of CP3) using Network Rail's efficiency improvement.

Time trend of Network Rail's relative efficiency

4.38 Figure 1 shows the evolution of Network Rail's gap against the best practice frontier over the period 1996-2008 (the figure shows the lower gap from our current range (34%)).

4.39 As can be seen, Network Rail's relative efficiency declined markedly between 2000 and 2004-05, even taking into account the steady state adjustment. However, it started recovering since 2005-06, which is to be expected given the significant efficiency improvements the company achieved in the first years of CP3. The chart also suggests that renewals were running well below the steady state level prior to 2000, but slightly above steady state thereafter, on the basis of the adjustment we have made. The figure shows efficiency performance (score) from 0 to 1, and the gap is simply the distance to 1 (the frontier). So, for example, a score of 0.6 corresponds to an efficiency gap of 40%.

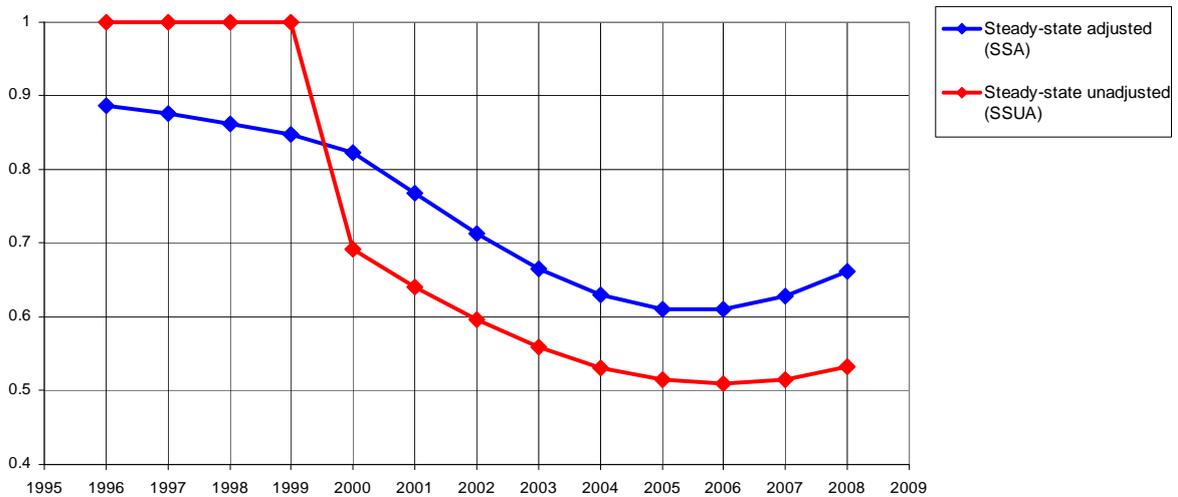


Figure 1: Trajectory of Network Rail’s efficiency gap (34%) versus the frontier for our preferred updated model (2008-09 data)

Robustness and validation

4.40 We believe that the econometric analysis we performed is robust, as it was cross checked against other efficiency analysis techniques; it was subject to extensive cross-model testing (as reported in our supporting technical paper), and is consistent with our modelling work from PR08 and other work (e.g. bottom-up gap analysis). The technical/statistical details of the modelling process are given in the supporting technical paper.

Review of our econometric analysis

4.41 In 2009 we commissioned a report from Oxera⁸, working with Professor Subal Kumbhakar of Binghamton University, USA, to evaluate our PR08 econometric benchmarking work and to provide us with suggestions on how it could be improved. We have taken on board some of their suggestions for the analysis underlying this report. We will consider further, more suggestions contained in their report as we progress with our econometric analysis.

⁸ *Recommendations on how to model efficiency for future price reviews*, Oxera and Professor Subal Kumbhakar, November 2009. This may be accessed at http://www.rail-reg.gov.uk/upload/pdf/econometric_update_2010_oxera_paper.pdf.

5. Understanding the efficiency gap

Introduction

5.1 This chapter summarises the “bottom-up” based engineering analysis we have undertaken alongside our updated econometric analysis in order to understand the cost efficiency gap (for maintenance and renewals) between Network Rail and its international peers.

Understanding the cost efficiency gap

5.2 Developing an understanding of the cost efficiency gap between Network Rail and its peers is important work for us. It complements the econometric analysis, especially given the size of the efficiency gap estimated by the econometric analysis. Because econometric analysis does not explain the reasons for the efficiency gap, and since there are uncertainties with the econometric analysis, it is essential to undertake work to understand the gap and validate whether it is due entirely to inefficiency or whether there are other factors outside the control of Network Rail which cause it, e.g. government policies, macroeconomic factors or geographical factors.

Gap analysis work in PR08

5.3 In PR08, we examined the cost efficiency gap from different perspectives. The work included studies we commissioned from RailKonsult to look at individual technologies and working methods used by infrastructure managers in other countries, and Network Rail study commissioned work from BSL to help it understand better the nature of the cost gap between itself and its peers^{9,10}. In addition, our engineers visited infrastructure managers in a number of countries to understand the approaches to asset management used.

5.4 This broad set of studies highlighted a range of reasons for the efficiency gap between Network Rail and its international peers and helped confirm to us the

⁹ Rail Infrastructure Cost Benchmarking: Brief LICB-gap analysis and cost driver assessment, BSL, April 2008. This may be accessed on Network Rail’s website at [http://www.networkrail.co.uk/browse%20documents/StrategicBusinessPlan/Update/Cost%20benchmarking%20assessment%20\(BSL\).pdf](http://www.networkrail.co.uk/browse%20documents/StrategicBusinessPlan/Update/Cost%20benchmarking%20assessment%20(BSL).pdf).

¹⁰ Review of European renewal and maintenance methodologies – overview, RailKonsult, May 2008. The overview may be accessed at <http://www.rail-reg.gov.uk/upload/pdf/pr08-konsov-290508.pdf>. Detailed appendices may be accessed at <http://www.rail-reg.gov.uk/server/show/nav.2001>.

robustness of the econometric analysis we had undertaken. Chapter 7 of our PR08 determination explains this work in more detail¹¹.

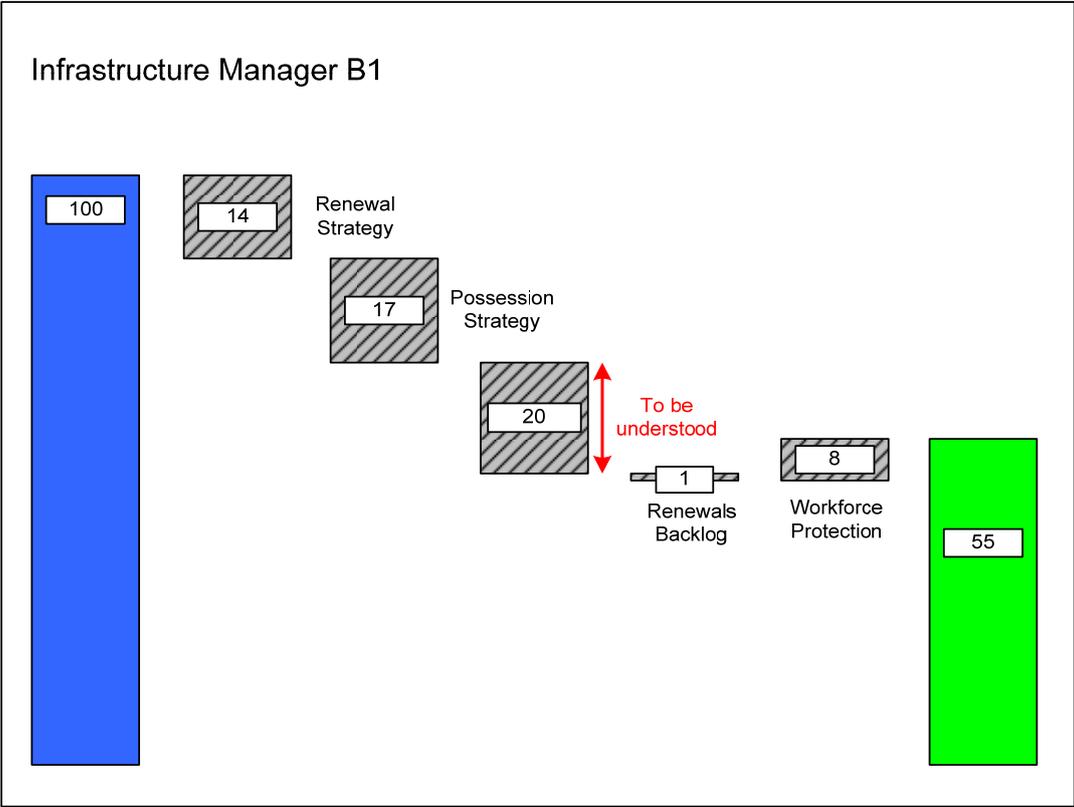
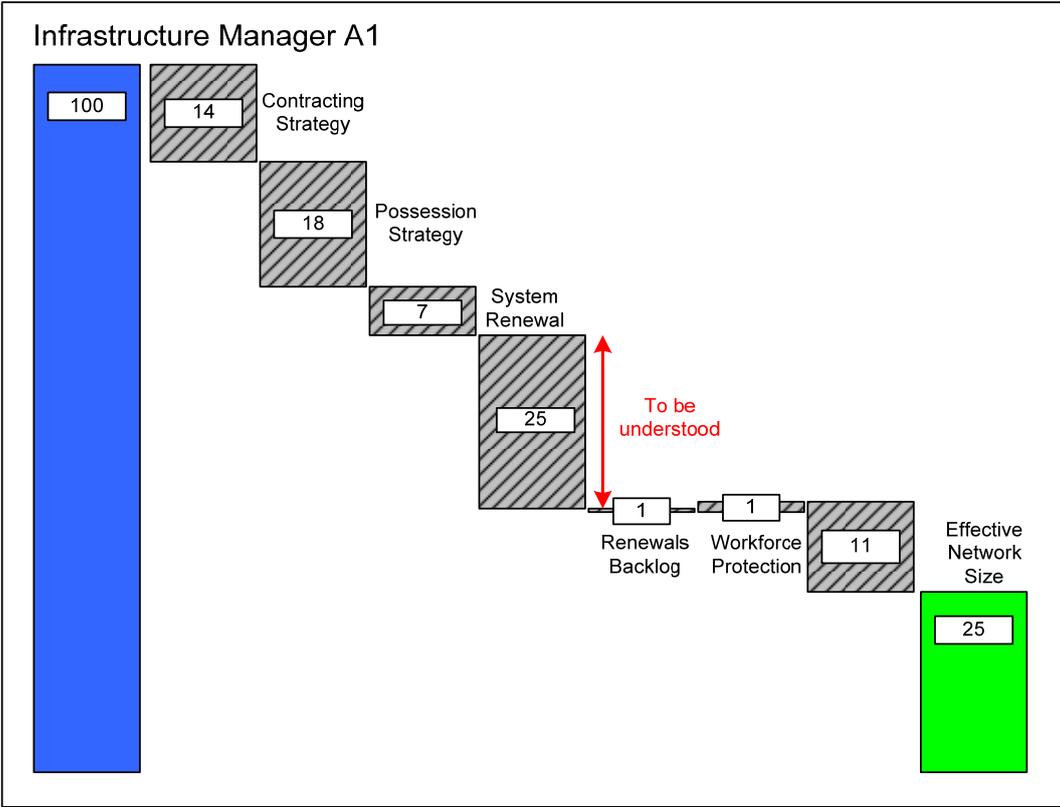
Our further work to understand the cost efficiency gap

- 5.5 Given the significant cost efficiency gap between Network Rail and its peers calculated by our updated econometric analysis, and the need to improve the understanding and extent of this, we have undertaken further work to help develop our understanding.
- 5.6 We commissioned a study from RailKonsult, part of Balfour Beatty Rail, to understand the existing gap in more detail¹². This study is part of the ongoing work to build on the work undertaken in PR08.
- 5.7 Following PR08, we agreed with Network Rail that we would work together to conduct further work to explain the drivers behind the maintenance and renewals cost efficiency gap. This type of analysis potentially encompasses a wide range of factors. They include technologies and working methods, network/infrastructure configuration, wage rate differentials, differences in geography, macroeconomic factors and differences in government policy. The ability of Network Rail to control for these different factors will vary, as may the timeframe over which change can be made.
- 5.8 RailKonsult's work encompassed:
- (a) a review of the harmonisation factors used by the UIC when it makes comparisons between infrastructure managers using the LICB dataset;
 - (b) development of two "green field" (ideal network) models to test the impact and scale of different maintenance and renewal practices;
 - (c) four international study visits to identify good engineering and asset management practice; and
 - (d) assessment of the cost efficiency gap between Network Rail and the other infrastructure managers.

¹¹ *Periodic review 2008: Determination of Network Rail's outputs and funding for 2009-14*, Office of Rail Regulation, October 2008. This may be accessed at <http://www.rail-reg.gov.uk/upload/pdf/383.pdf>.

¹² *Relative Infrastructure Managers' Efficiency: Evaluation of UIC LICB Approach*, RailKonsult, August 2010. This may be accessed at http://www.rail-reg.gov.uk/upload/pdf/econometric_update_2010_railkonsult_paper.pdf.

- 5.9 RailKonsult reviewed the way UIC harmonises its cost data for differences between countries. It is helpful for our econometric work as it analyses some of the cost drivers which are tested for in the econometric benchmarking exercise. As a cross-check on the econometrics, and in its own right, it provides a better understanding of how to harmonise infrastructure cost data, and it gives a deeper understanding of the contribution of individual factors to the cost efficiency gap.
- 5.10 RailKonsult developed an engineering model to assess the impact of different factors on infrastructure maintenance and renewal costs, based on a set of standard network characteristics. The results found that the highest cost impacts came from switches and crossings, assets operated beyond design life, level crossings, traction power systems, the level of passenger utilisation, and multiple track. Some these factors are included in the LICB dataset and used in our econometric modelling.
- 5.11 RailKonsult made study visits to railway infrastructure managers, which enabled the consultants to witness a range of different approaches to asset management. These visits have helped highlight opportunities for Network Rail to improve its efficiency.
- 5.12 RailKonsult undertook some analysis of the maintenance and renewals cost gaps between the four countries. Figure 2 highlights large cost efficiency gaps between Network Rail and the four international peers analysed by RailKonsult (presented on an anonymous basis).
- 5.13 The assessment is based on 2007 data (taken from the UIC and annual reports for each company), which has been indexed (with Network Rail set at 100). The “raw” Network Rail and comparator costs are harmonised by RailKonsult based on the UIC’s approach.
- 5.14 The differences in the harmonised costs lie between 25 and 50% (excluding the unexplained differences). The majority of the differences between Network Rail and the comparators (excluding the part of the gap that could not be explained) are due to contracting strategy and possessions strategy.
- 5.15 Figure 2 shows that, whilst there are significant efficiency gaps, there is an important residual gap “to be understood”. The residual gap may or may not be due to inefficiency, as opposed to, say, non-controllable environmental factors.



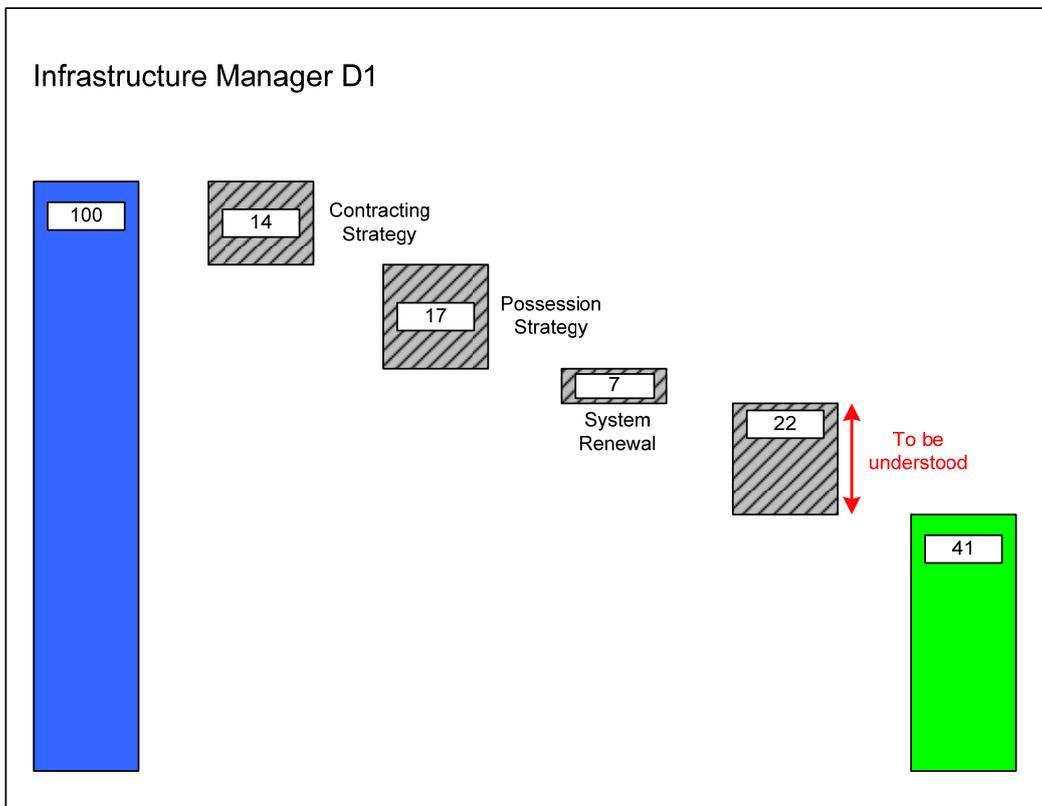
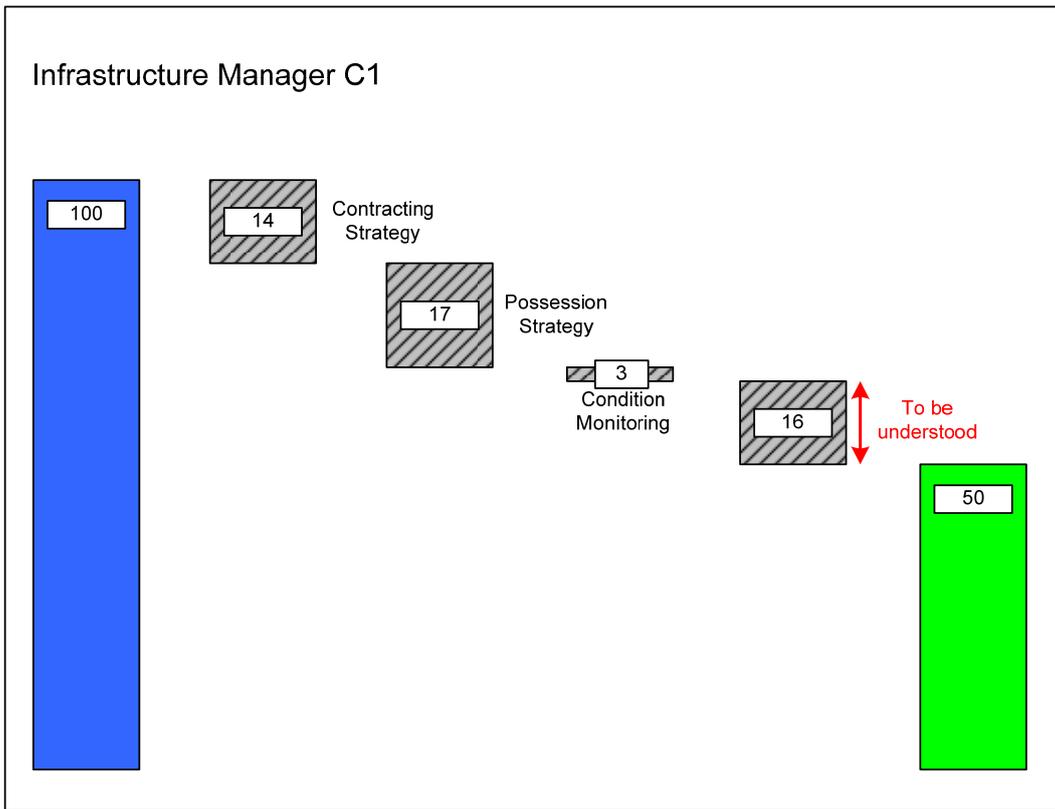


Figure 2: Cost gap analysis of Network Rail against four comparators

Annex A: Our efficiency calculations for CP4

1. Broadly, in considering the scope for CP4 efficiency improvement, we adopted the approach commonly used by economic regulators, that is to consider three aspects of efficiency in order to inform our judgements:
 - (a) **catch-up efficiency:** the efficiency improvement that Network Rail should make in order to close the gap between itself and the best (or better) performing companies against which we have benchmarked the company;
 - (b) **frontier-shift efficiency:** the continual improvement in efficiency (above that reflected in RPI) that would be expected from even the best (or better) performing companies¹³; and
 - (c) **input prices:** the impact of expected input price inflation on Network Rail's cost base (above that reflected in RPI) which reduces the effective level of efficiency improvement possible.
2. Table A.1 shows the breakdown of our assumptions for OM&R for CP4.

¹³ We use the all-items retail price index (RPI) to annually rebase Network Rail's access charges. RPI already reflects general, average economy-wide growth and input price inflation.

Table A.1: Our OM&R efficiency assumptions for CP4

	2009-10	2010-11	2011-12	2012-13	2013-14
<i>Controllable opex</i>					
Catch-up efficiency	4.9%	4.9%	4.9%	4.9%	4.9%
Frontier-shift efficiency	0.2%	0.2%	0.2%	0.2%	0.2%
Gross efficiency	5.1%	5.1%	5.1%	5.1%	5.1%
Input price adjustment	-2.3%	-2.3%	-1.1%	-1.1%	-1.1%
Net efficiency	2.8%	2.8%	4.0%	4.0%	4.0%
Cumulative net efficiency	2.8%	5.5%	9.3%	12.9%	16.4%
<i>Maintenance</i>					
Catch-up efficiency	4.5%	4.6%	4.6%	4.3%	4.3%
Frontier-shift efficiency	0.7%	0.7%	0.7%	0.7%	0.7%
Gross efficiency	5.2%	5.3%	5.3%	5.0%	5.0%
Input price adjustment	-2.0%	-2.1%	-1.3%	-0.5%	-0.5%
Net efficiency	3.2%	3.2%	4.0%	4.5%	4.5%
Cumulative net efficiency	3.2%	6.3%	10.1%	14.1%	18.0%
<i>Renewals</i>					
Catch-up efficiency	5.2%	5.7%	5.6%	4.9%	5.0%
Frontier-shift efficiency	0.7%	0.7%	0.7%	0.7%	0.7%
Gross efficiency	5.9%	6.4%	6.3%	5.6%	5.7%
Input price adjustment	-0.9%	-1.4%	-0.8%	-0.1%	-0.2%
Net efficiency	5.0%	5.0%	5.5%	5.5%	5.5%
Cumulative net efficiency	5.0%	9.8%	14.7%	19.4%	23.8%