Appendix

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First Economics Report on Productivity

The Scope for Future Productivity Growth

A report prepared for Northern Gas Networks

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Executive Summary

Introduction

This report considers the scope for Northern Gas Networks (NGN) to make improvements in productivity in the period 2013/14 to 2020/21. We break down productivity growth into three component parts:

- catch up – the efficiencies that a specific gas distribution network (GDN) might need to achieve in order to close the gap between its own costs and the costs currently incurred by the most efficient GDN in the sector;
- demerger dividend – the additional savings that the GDNs collectively should be able to deliver to customers following the break-up of Transco in 2005; and
- frontier shift – the ongoing productivity improvements that a GDN should be capable of delivering year-on-year even when all catch-up opportunities and demerger-related savings have been exhausted.

Catch up

The scope for a GDN to make catch-up efficiencies is being assessed separately via a range of different benchmarking analyses. We note that NGN appears currently to be the most efficient network in the sector and we therefore assume for the purposes of this report that NGN will not need a catch-up target for the period covered by the RIIO-GD1 review. This hypothesis will be validated (or refuted) by Ofgem separately from this study.

Demerger dividend

When it approved the sale of four GDNs in 2005 Ofgem identified that the injection of new owners into the sector and the consequent emergence of comparative competition could be expected to bring about significant cost savings. It estimated that the benefit to customers would eventually be equivalent to a 15% reduction in industry controllable opex.

GDPCR1 price controls were set in such a way as to hand customers approximately one third of this demerger dividend by 2012/13. This leaves the remaining two thirds, or around 10% of the GDNs' starting opex, to be paid to customers after April 2013. In NGN's case the amount still owed increases to just over £8m by 2022/23.

How far NGN needs to factor associated productivity improvements in to its post-2013 cost forecasts depends on how much of the required savings have already been made in the current price control period. Out-turn figures for 2010/11 show opex out-performance of £17.6m – i.e. actual controllable expenditure of £70.9m versus Ofgem's allowance of £88.5m. Prima facie this indicates that NGN has already identified and delivered sufficient cost reductions to put it in a position to pay out the remaining demerger dividend from the start of the next price control and should not necessarily expect further demerger-related savings to emerge in future.

A more detailed look at year-on-year changes in opex since 2005 reveals a number of factors that individually suggest that actual efficiency savings have been higher or lower than the fairly simple calculation that we have just described might suggest. They include the manner in which Ofgem's GDPCR1 methodology created an expectation of around £5m of current period out-performance, variations in expected input price inflation and the effect that atypical weather-related costs have had on 2010/11 out-turn opex. Taken together, these things reduce slightly perceptions of actual productivity improvement in GDPCR1 but do not lead us to alter the conclusion that NGN's efficiencies since 2005 at least match the 15% reduction in opex that Ofgem foresaw during the sale process.

We therefore conclude that it is not necessary for NGN to factor any further demerger-driven productivity savings into its post-2013 business plan.

Frontier shift

This leaves frontier shift as the principal driver of NGN's productivity growth in the 2013/14 to 2020/21 control period. Consistent with Ofgem's guidance in its RIIO strategy documents, we have benchmarked the rate of frontier shift in the gas distribution sector against historical productivity growth in a range of comparator sectors. Each of these benchmark industries carry out activities which exhibit similarities to specific activities that the GDNs carry out in their day-to-day work.

Our usual approach in this sort of benchmarking is to look at the productivity improvements achieved by the comparator industries since 1990. However, recognising Ofgem's preference for a longer horizon we have also examined productivity growth in our chosen industries since 1970. The source of the data for this analysis is the EU KLEMS project.

Table 1: Value-added productivity growth in comparator sectors

Comparators	Benchmark annual productivity growth rate
Opex	
Finance, insurance, real estate, business services	-0.9% to 0.3%
Electricity, gas and water supply	0.9% to 2.2%
Sale, maintenance, repair of motor vehicles	2.0% to 2.6%
Transport and storage	1.7% to 2.1%
Construction	0.6% to 0.7%
Repex and capex	
Construction	0.6% to 0.7%

The benchmarking shows that the scope for NGN to make productivity improvement differs across the different activities it undertakes. We have weighted the opex comparator evidence according to the composition of NGN's cost base. The aggregate calculations are set out in table 2 below.

Table 2: Value-added productivity benchmarks by expenditure type

Opex	Repex	Capex
1.0% to 1.2%	0.6% to 0.7%	0.6% to 0.7%

The above productivity benchmarks are for value added productivity growth; this means that they relate to the scope for a business to rationalise its on-site labour and capital inputs. NGN has asked us to calculate the equivalent reductions in unit costs, which requires us to identify the proportion of NGN's expenditures which are adding value to the materials and other inputs that it buys in from outside suppliers. We estimate the percentages to be 80%, 85% and 90% for opex, repex and capex respectively.

In the cases of repex and capex the adjusted productivity growth forecasts translate into reductions in projected unit costs. In the case of opex, and by implication, totex, it is necessary to make an adjustment for capital substitution or the scope for companies to reduce labour costs by investing in new assets and technologies. Consistent with regulatory precedent in a wide range of sectors, we add 0% to 0.5% for this effect.

The table below combines the figures in table 2 with the above adjustments to give an overall point estimate of the scope for year-on-year cost reductions.

Table 3: Estimated scope for reductions in unit costs (mid-points)

Opex	Repex	Capex
1.05%	0.5%	0.6%

We take comfort from the comparability of the above numbers to the frontier shift assumptions appearing in other periodic reviews. The table below shows that the opex estimate sits squarely in line with Ofgem's DPCR5 assessment of the scope for cost reduction in the electricity distribution networks and the Competition Commission's 2010 estimate of frontier shift in the water sector. The repex/capex numbers are also consistent with the comparatively fewer regulatory decisions that have included assumptions about capex frontier shift.

Table 4: Our estimates compared to recent regulatory decisions

Opex		**Repex/capex**	
Ofgem – GDPCR, 2007	1.3%	ORR – Network Rail, capex, 2008	0.7%
Ofgem – electricity distribution, 2009	1.0%	PPP Arbiter – Tube Lines, capex, 2010	0.9%
ORR – Network Rail, opex, 2008	0.2%	First Economics – gas distribution, 2011	0.5% to 0.6%
ORR – Network Rail, maintenance, 2008	0.7%		
PPP Arbiter – Tube Lines, central costs, 2010	0.7%		
PPP Arbiter – Tube Lines, opex, 2010	0.9%		
Competition Commission – water, 2010	0.9%		
First Economics – gas distribution, 2011	1.05%		

We take from this comparison that the estimates we are putting forward are a valid and useful input into the sort of well-justified business plan that Ofgem is seeking from companies in the RIIO-GD1 review.

Contents

1. Introduction

A key area for analysis in Ofgem's RIIO-GD1 review is the projected trend in GDN expenditures. This report looks at one of the inputs into Northern Gas Networks' (NGN's) calculations: the rate of productivity growth that the business might reasonably be expected to achieve over the period 2013/14 to 2020/21.

The paper is structured into five main parts:

- section 2 gives an overview of the concept of efficiency and the different ways by which the scope for NGN to make efficiency improvements might be assessed;

- section 3 revisits the efficiencies that NGN was asked to make following the break-up of Transco in 2005 and asks how much of the expected 'demerger dividend' NGN has already captured for customers and how much still needs to factored into future cost projections;

- section 4 focuses on frontier shift – i.e. the extent to which technical progress in the gas industry permits all GDNs, no matter how efficient or inefficient, to introduce new cost saving measures on an annual basis; and

- section 5 concludes.

In addition, a technical annex to this report reconciles the results that we put forward with the work carried out by Ofgem in its previous periodic reviews.

2. Methodology

2.1 Principles

The business plans that the GDNs are currently preparing contain forecasts of opex, repex and capex for the period to 1 April 2011 to 31 March 2021. When populating these plans companies will be thinking about three main influences on costs:

- variations in outputs: will the service offered to customers change, necessitating changes in the level or mix of activities that a company undertakes;
- input price inflation: how much more will companies have to pay in future for the labour, materials and equipment that they require in order to run their businesses; and
- productivity improvement: what opportunities are there to make savings in manpower or other inputs so as to improve the overall efficiency with which activities are carried out?

These three factors can be combined as follows:

$$\text{Annual change in costs} \approx \text{cost associated with variations in outputs } \textit{plus} \text{ input price inflation } \textit{minus} \text{ productivity improvement} \quad (1)$$

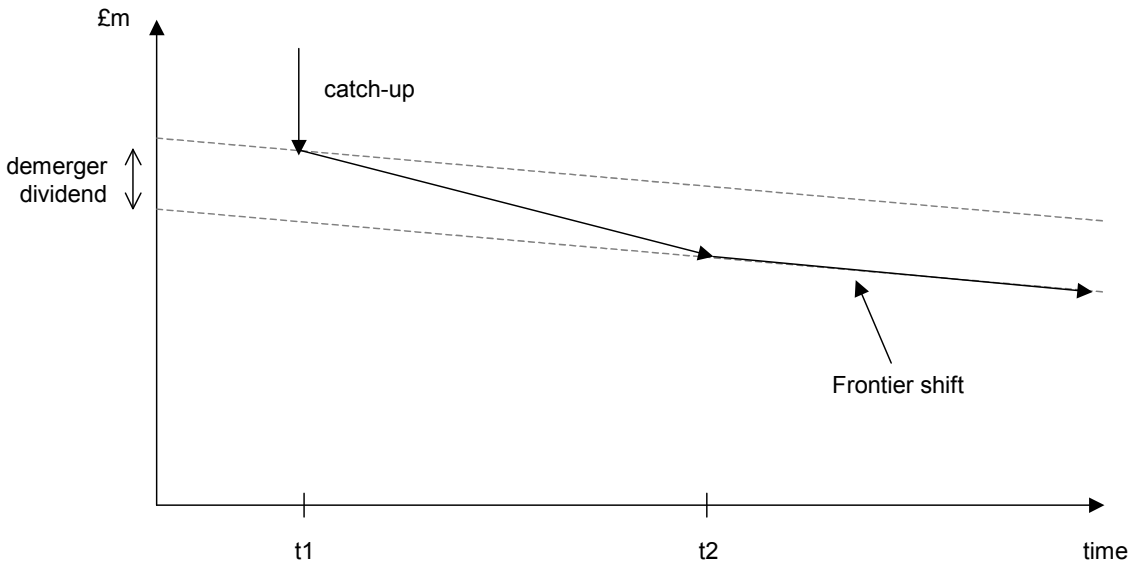
In this report we ignore output changes and input price inflation and focus only on the efficiency/productivity component of equation 1. Holding all other things equal, we want to know how quickly NGN can reasonably be expected to reduce the ratio of inputs to outputs and we want to know by how much this reduces opex and capital unit costs.

In carrying out this analysis it is useful to distinguish three quite distinct categories of efficiency improvement:

- catch up – the efficiencies that a specific GDN might need to achieve in order to close the gap between its own costs and the costs currently incurred by the most efficient GDN in the sector;
- demerger dividend – the additional savings that the GDNs collectively should be able to deliver to customers following the break-up of Transco in 2005; and
- frontier shift – the ongoing productivity improvements that a GDN should be capable of delivering year-on-year even when all catch-up opportunities and demerger-related savings have been exhausted.

For the sake of further clarity, figure 2.1 depicts the concepts graphically in a hypothetical world of zero input price inflation. Initially, at date t1, a GDN may sit some way behind the best performing GDN and will need to close the efficiency gap depicted by the vertical line. It may also still owe customers some of the demerger dividend depicted by the gap between the dotted lines. However, by some date t2, all of the catch-up and demerger savings will be exhausted and the rate of cost reduction will revert to the sector's natural rate of frontier shift.

Figure 2.1: Factors influencing trends in costs



Using the above logic, NGN's task in projecting future productivity improvement has three parts to it:

- first, NGN needs to determine what catch-up target, if any, it should set itself;
- second, it needs to establish how much of a demerger dividend still needs to be extracted for customers; and
- third, it needs to estimate the underlying rate of frontier shift in the gas distribution sector.

These three elements correspond to calculating the size of the solid vertical catch-up line, sizing the gap between the dotted lines and estimating the slope of the dotted lines. Once NGN has this information, it will be able to calculate the efficiency savings it might be expected to achieve over the 2011 to 2021.

2.2 Approach

We explain below how we have set out to help NGN in these tasks.

Catch up

The relative efficiency of the eight GDNs is being examined separately by Ofgem and the industry in a range of different benchmarking studies. We not sought either to replicate or rival this work but have instead recommended to NGN that it takes the results of this comparative analysis directly into its cost forecasts.

We note that the provisional findings published in March 2011 suggest that NGN is the most efficient GDN in the sector. We have therefore assumed provisionally for the purposes of this April 2011 report that NGN will not require a catch-up target.

Demerger dividend

The scale of the cost savings that the break-up of Transco could be expected to release was studied in some detail between 2003 and 2005. Ofgem's conclusion at that time was that the GDN sales and the resulting reinforcement of comparative competition in the sector would

bring about a reduction in industry controllable opex of around 15% within 15 years of the demerger.

We do not seek to reopen this calculation in this report. The key issue we consider is how much of this dividend NGN has already captured and how much is still to come out of costs. In particular, we consider the possibility that NGN as the apparently most efficient GDN in the sector may have proceeded to capture demerger-related cost savings much more quickly than Ofgem envisaged when it originally identified a 15-year horizon and may therefore find itself in a position where little or no further savings remain available in the 2013-21 control period.

We do this by looking at NGN's out-turn opex in the period 2006 to 2011 and particularly at the scale of the out-performance that NGN has achieved in the current price control period. If the accumulated out-performance falls short on a like-for-like basis of the 15% saving identified by Ofgem, we take this as evidence that the business still needs to make further efficiencies if it is to be able to pay customers their demerger dividend in full. If, however, accumulated out-performance matches or even exceeds Ofgem's target, we assume that NGN has captured the full benefit of the demerger and that it is unnecessary to write further savings into future cost forecasts.

Frontier shift

There is now a well-established methodology for estimating the long-term, underlying rate of frontier shift in any given industry as a result of studies carried out in periodic reviews of the energy, rail and water sectors.

The starting point in the analysis is a database compiled by academic researchers containing information on the annual rates of productivity improvement in 38 UK industries between 1970 and 2007 (the EU KLEMS database). Within this database it is possible to identify industries from outside the gas sector in which firms are undertaking activities which are broadly comparable to the sorts of activities carried out by the GDNs. By tracking the trend rate of productivity growth in these industries over time we can obtain a good idea of the underlying rate of efficiency improvement that should be apparent in NGN's long-term cost forecasts.

To harness this data we have to:

- identify the best comparators from within the database;
- calculate the trend rate of productivity growth across those industries; and
- apply the calculated productivity growth to NGN's cost base on a like-for-like basis.

We explain in section 4 how we have approached these tasks.

3. Demerger Dividend

3.1 Ofgem's 2005 Analysis

The starting point in our analysis of the cost reductions that are owed to customers following the break-up of Transco is Ofgem's November 2004 regulatory impact assessment.[1]

This document contains the cost-benefit analysis that Ofgem relied upon when it determined that the sale of four GDNs would benefit customers and should proceed as planned. It is relevant to the analysis that we are undertaking because the analysis includes clear and authoritative conclusions about the opex cost reductions that the break-up was expected to produce. The key passages are reproduced below.

> The sale of DNs would create a number of similar, but independently owned DN businesses. Relative to the current situation in which NGT owns all of the networks, this should allow Ofgem to compare the performance of independently owned distribution networks. In turn, this would give Ofgem the opportunity to set the revenues that distribution networks are allowed to recover from customers through charges on the basis of the costs of the most efficient network, should it believe this was the most appropriate approach.
>
> Ofgem has estimated the level of potential benefits that might accrue to customers were DN sales to proceed. This assumes that the sale proceeds on the basis of NGT's recently announced plans of selling four networks to three purchasers.
>
> A relatively simple approach has been applied whereby:
>
> - under the no sale option, all DNs are assumed to face improvements in allowed controllable operating costs, as specified in the preceding section i.e. at 3 percent under the base case; and
> - under the sale option, all DNs are assumed to face improvements in allowed controllable operating costs, as specified in the preceding section i.e. at 4.13 percent under the base case agreed sale scenario i.e. with three additional comparators (in addition to NGT's RDN business).
>
> In calculating present values (PVs) for the benefits case, the reduction in allowed controllable operating expenditure, assuming DN sales proceed, over and above the status quo are quantified. This additional reduction in allowed operating expenditure is assumed to pass directly through into customer charges and therefore represents a benefit to customers. These benefits are assumed to occur during the period 2008/9 – 2022/23.

We take from this that all eight GDNs were expected to reduce opex by 1.13% per annum or by 15% in total over 15 years. As confirmation of this conclusion, we note that Ofgem included exactly this amount of 'additional' cost reduction in its GDPCR1 decision when adding 1.1% per annum to its revised estimate of frontier shift efficiencies of 1.4% per annum.

3.2 NGN's performance to date

The key number in the above analysis is the 15% figure. While the 2004 impact assessment contains assumptions about the profile of cost savings, there is no reason why the GDNs should be expected to make their cost reductions with the same precise timing that Ofgem factored into its impact assessment. In saying this, we note, in particular, that customers will be better off if an efficient GDN like NGN proves able to capture efficiencies more quickly than Ofgem originally envisaged.

[1] Ofgem (2004), National Grid Transco – potential sale of gas distribution network businesses: final impact assessment.

NGN's out-turn controllable opex since its creation are recorded in table 3.1 below.

Table 3.1: NGN's controllable opex

Year	£m, 2009/10 prices
2005/06	81.3
2006/07	79.1
2007/08	74.4
2008/09	75.5
2009/10	71.5
2010/11	70.9

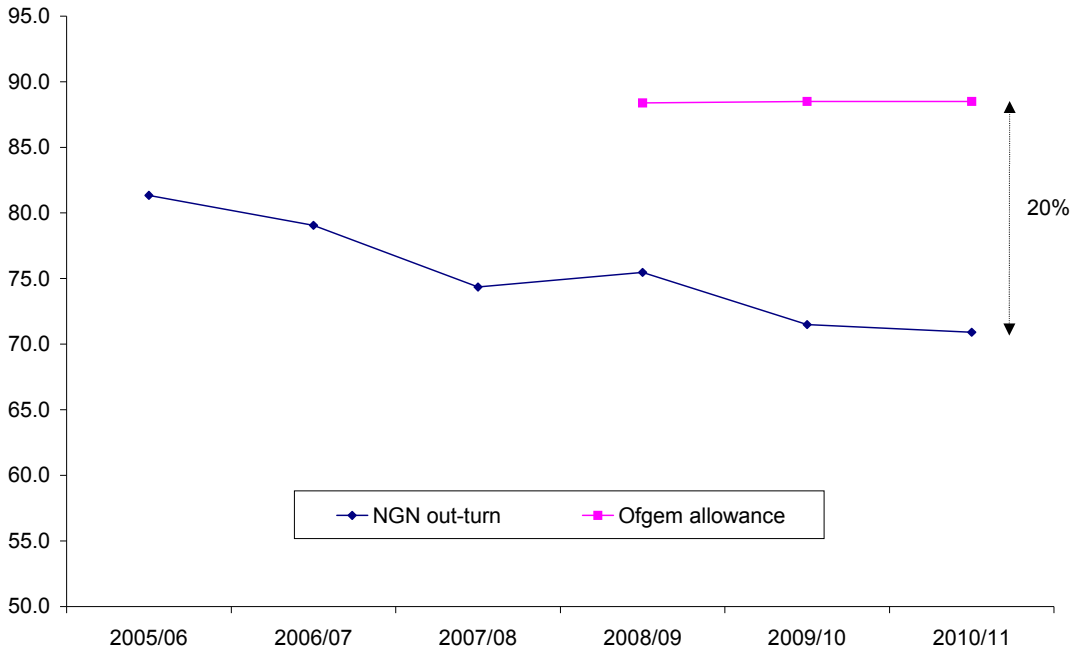
Source: Northern Gas Networks.

The table shows that NGN has reduced controllable opex by £10.4m in real terms since 2005/06. The percentage cost reduction is not, however, directly comparable to the 15% target for a number of reasons, notably:

- NGN was expected to deliver a certain amount of efficiency improvement in this period irrespective of its change in ownership; and
- NGN has also taken on additional activity and additional cost in these years, especially as a result of Ofgem's GDPCR1 decisions in respect of additional funding for quality of service improvements, environmental remediation and training/apprenticeships.

A better measure of the 'true' efficiency improvement that NGN has delivered in recent years comes from comparing NGN's out-turn costs with the GDPCR1 cost allowances. Because the regulatory allowances have baked in to them both the efficiencies and the additional costs that NGN was always expected to incur during the 2008-13 control period, any unexpected out-performance against Ofgem's assumptions can be considered genuine efficiency. The comparison is shown in figure 3.2.

Figure 3.2: NGN's controllable opex vs Ofgem's GDPCR1 allowances



The gap of 20% in figure 3.1 should be compared to the 15% target less the first three instalments of 1.13% that Ofgem factored into its year 1-3 GDPCR1 allowances, or a revised target of 12.7%. Prima facie this comparison indicates that NGN has captured significant additional efficiencies in the current control period and is currently capable of paying customers' their demerger dividend in full without needing to make further opex savings.

3.3 Possible adjustments

Before making this a firm conclusion, we first consider whether there are other factors which might explain or otherwise alter perceptions of NGN's out-performance and associated productivity improvement.

Expected out-performance

One such factor is the way in which Ofgem's GDPCR1 calculations created an expectation of at least some out-performance during the control period.

When Ofgem set the GDNs' controllable opex allowances it chose not to roll forward their actual costs but instead set allowances in line with the cost control it expected of an upper quartile company. For most GDNs this meant that they came away from GDPCR1 with a cost allowance that sat some way below their actual costs, but in NGN's case Ofgem's approach had the opposite impact. Specifically, as the leading GDN in the sector, NGN's actual costs were at that time below the upper quartile benchmark and Ofgem's policy had the effect of giving NGN an allowance that sat a little way above actual costs.

The published documentation from GDPCR1 does not enable us to quantify precisely how much this uplift was worth, but we can put an upper bound on its value at £5.0m. This is the amount (in 2009/10 prices) that Ofgem calculates to be the difference between the controllable opex of an idealised frontier company and the upper quartile benchmark. Since NGN's costs were not at that time as low as the idealised frontier company, it must be that the value of gap between NGN's actual costs and the upper quartile is no more than £5.0m.

If we deduct this £5.0m from NGN's out-performance, the percentage efficiency improvement in 2010/11 falls from 20% to 12%.

Atypical costs

The 2010/11 expenditure reports that NGN has provided to us identify £2.5m of the £70.9m of controllable opex that NGN incurred in 2010/11 as atypical weather-related costs. We understand that this is additional expenditure that NGN had to incur due to the snow and cold temperatures in December 2010.

This is relevant to our analysis because the £2.5m of expenditure masks efficiencies that NGN has introduced to the business. By this we mean that going forward the business's underlying cost base for 2011/12 and beyond is approximately £68.4m and not £70.9m. We should take account of the underlying cost reduction in our analysis of the extent to which NGN has or has not captured the demerger dividend that it owes to customers. This means adding around 3 percentage points to the reported out-performance.

Input price inflation

In making simple comparisons between out-turn and expected opex we are implicitly assuming that all other factors which were known in advance to be pushing costs up or down in the current control period have cystallised in exactly the way that Ofgem envisaged. This is unlikely to be the case. In particular, we know that input price inflation – one of the key drivers of changes in cost that we identified in equation 1 – has turned out to be different from Ofgem's GDPCR forecast.

Input price inflation is being considered separately for NGN by EC Harris in a parallel study to this report. Using EC Harris's labour, materials and other price indices, so as to be consistent with their work, we estimate that annual real input price inflation has averaged -0.1% between 2008/09 and 2010/11 and not the 1.3% per annum that Ofgem factored into its GDPCR decision. This is mainly because average earnings growth has been depressed at a time when RPI-measured inflation has been quite elevated.

If we ignore this in our analysis we will mistakenly equate out-performance to efficiency improvement when in fact it is the result of an over-forecast of input price inflation. Accordingly, we need to reduce our estimate of NGN's efficiency improvement by just over 4 percentage points.

Loss of metering business

NGN has also brought to our attention the increase in cost it experienced as a result of losing contracts for the supply of metering services to National Grid. We understand that the treatment of these cost increases is being discussed separately with Ofgem and note only for the purposes of this paper that the unavoidable absorption of £2m of labour cost into NGN's regulated opex has the effect of masking efficiencies of the same amount that would otherwise have translated into approximately 2 percentage points of additional out-performance.

3.4 Conclusions

Table 3.3 brings together the possible overlays identified above.

Table 3.3: A calculation of NGN's out-performance

	£m	%
Difference between actual costs and Ofgem's allowance	17.6	19.9
Expected out-performance (max)	–5.0	–5.7
Correction for atypical costs in 2010/11	+2.5	+2.8
Correction for over-forecast of input price inflation	–3.7	–4.1
Correction for loss of metering contracts	+2.0	+2.3
Net	13.4	15.1

The table shows that NGN's adjusted out-performance – or what we consider to be a better measure of true productivity growth – in the current control period is no lower than 15.1%. This compares to the outstanding demerger dividend of 12.7% of total opex.

The conclusion we draw from the analysis is that NGN has made sufficient savings to pay customers in full the price reductions that they are owed. It does not appear that it is necessary for NGN to factor further cost reductions into its business plan forecasts, save for the reversal of the £2.5m of exceptional weather-related costs that NGN incurred in 2010/11.

4. Frontier Shift

4.1 Value-added productivity growth

The rate of frontier shift in the gas distribution industry depends on a number of factors, including:

- the pace of technical progress affecting the sector;
- the availability of opportunities to reduce overheads; and
- companies' ability to bring better working practices to bear on their operational activities.

Insights into the scale of the likely efficiency improvement in these areas may initially be obtained by looking at data on historical total factor productivity (TFP) improvements. As noted in section 2, the most up-to-date source of data is the EU KLEMS project which looked at economic growth, productivity and technological change for all European Union member states during the period 1970 to 2007. A database released to 2007 and updated in 2009 allows researchers to analyse TFP growth on an industry-by-industry basis and to compare/benchmark the historical performance of UK companies against firms from other countries.

For the purposes of analysing trends in the gas distribution industry, data for three types of sector are especially interesting:[2]

- sectors where firms are repairing/maintaining existing assets or operating some sort of established asset/network;
- sectors where the core activity is the provision of a business service; and
- sectors in which equipment is being installed.

In each case, the industries in this list can be said to be carrying out activities which bear similarities to the activities contained within a GDN's direct opex, indirect opex and repex/capex. Knowing what productivity trends in these industries have been may therefore help to reveal the underlying potential for all GDNs to deliver productivity improvements of their own during the 2013-21 period.

Table 4.1 shows average annual TFP growth rates in these sorts of industries for the 1970 to 2007 period as a whole and for the more recent 1990 to 2007 business cycle. The definition of TFP growth that has been used is value added TFP growth, consistent with the measure used in other periodic reviews.

[2] A full list of the industries in the EU KLEMS data set can be found at www.euklems.net.

Table 4.1: Annual total factor productivity growth (%) by sector

	UK Sector	1970 to 2007	1990 to 2007
A	Electricity, gas and water supply	2.2	0.9
B	Sale, maintenance and repair of motor vehicles; retail sale of fuel	2.0	2.6
C	Transport and storage	2.1	1.7
D	Finance, insurance, real estate and business services	(0.9)	0.3
E	Construction	0.7	0.6

It is apparent from table 4.1 that perceptions of the GDNs' productivity improvement potential depends in part on which of the periods is seen as providing the best guide to future performance and in part on which of the industries are considered to be the best comparators. On the first of these points, we have a strong preference for using up-to-date information. Although there are difficulties with any approach that seeks to extrapolate from the past to predict the future, much more confidence can be taken from using data from the most recent business cycle (i.e. 1990 to 2007) in such an exercise. We recognise, however, that Ofgem's previous work in this area tends to make use of data from a longer period and we therefore use data from both periods in the calculations that follow.

On the second point, previous studies in this field have sought to weight the different components of table 4.1 in line with the 'nature of work' involved in running a network. Although by no means completely precise, an overall comparator constructed in this way ought to show how the different rates of productivity growth affecting different parts of a company's business come together at the overall company level.

Our nature of work comparators are shown in table 4.2.

Table 4.2: Nature of work TFP benchmarks

Activity	% of opex	Comparators	Annual productivity growth (1970 to 2005 benchmark)	Annual productivity growth (1990 to 2005 benchmark)
Opex				
Work management	25%	ABCD	1.3%	1.4%
Work execution	50%	ABCE	1.7%	1.5%
Indirect support costs	25%	D	(0.9%)	0.3%
Weighted average			1.0%	1.2%
Repex				
All	100%	E	0.7%	0.6%
Capex				
All	100%	E	0.7%	0.6%

The figures in the fourth and fifth columns are simple averages of the chosen comparators. Combined together, they point to total factor productivity growth of just over 1% for opex and between 0.6% and 0.7% for repex and capex.

To put these figures in to some sort of perspective, the rate of value-added productivity improvement for the UK as a whole between 1970 and 2007 was around 0.7% per annum. - As such, the figures in table 4.2 imply that the underlying rate of productivity improvement in the gas distribution sector matches or outstrips the productivity growth potential of the UK economy as whole.

4.2 Efficiency Improvement

It is necessary for NGN to make two further adjustments prior to inputting the numbers we have just calculated into its business plan forecasts.

4.2.1 Capital substitution effect

In previous studies of this type it has been recognised that opex productivity typically increases more quickly than TFP as companies over time replace people with capital. In applying our analysis of TFP trends to opex[3] we need to make an adjustment for any capital substitution affecting the GDNs otherwise we will be understating the reductions in opex that electricity GDNs will make in matching the achievements of our nature of work comparator.

The scale that this adjustment should take is not something that can be easily measured. The EU KLEMS data shows that labour productivity growth tends to outstrip TFP growth in most industries, but a large part of this differential will be as a result of the sorts of quality-improving and volume-growing investments that NGN is costing separately.

In the absence of any reliable information from comparators, estimation of the capital substitution effect really ought to be something for companies and Ofgem to take a view on having observed what sorts of people costs companies save when they carry out only like-for-like investment.

In our discussions with the GDNs and other energy networks, we have been told that we should not expect a significant capital substitution effect in the next five-year period. The view among the companies is that company investment plans are sized so as to maintain a constant fault rate, and that the new assets and technologies involved can be both opex increasing opex reducing. As we are not in a position to make such judgements, we present the capital substitution effect as a range:

- the bottom end of which allows for a zero effect on opex from companies' capex; and
- the top end of which draws from the most recent regulatory precedent in this area, which is ORR's June 2008 draft determination for Network Rail. In its forecasts of opex ORR allows for a 0.5% per annum productivity improvement over and above TFP growth as a result of capital substitution. This calculation is anchored in the assumption that the marginal rate of capital substitution in the comparator analysis matches the marginal rate of capital substitution in the UK economy as a whole – an assumption which seems to provide an equally valid point of reference in our analysis.

4.2.2 Application to labour and capital

The figures in table 4.2 do not translate directly into the efficiency component of our earlier equation 2. As measures of value-added productivity growth they show only the extent to which firms have been able to use labour and capital more productively. It follows that the figures in table 4.2 should be applied only to the labour and capital components of a GDN's costs (note: this point is explored more fully in annex 1 to this paper).

[3] Note that no such adjustment is required in respect of repex and capex because productivity in this area relates to the all-in costs of building physical assets. Any substitution between labour and capital during the building will still impact directly on the cost of the finished asset.

Table 4.3 gives a preliminary allocation provided to us by Northern Gas Networks.

Table 4.3: Cost breakdown

	Opex	Repex	Capex
Labour	75	85	65
Equipment	5		25
Materials	5	7.5	5
Other	15	7.5	5

Source: Northern Gas Networks.

The table shows that our productivity growth estimates have to be scaled to 80%, 85% and 90% of opex, repex and capex costs.

4.3 Conclusions

The raw TFP benchmarks, our estimate of the capital substitution effect and the scaling for labour/capital input combine as follows.

Opex

1.0% to 1.2% *plus* 0% to 0.5% *multiplied by* 0.8 = 0.8% to 1.3%

Repex

0.6% to 0.7% *multiplied by* 0.85 = 0.5%

Capex

0.6% to 0.7% *multiplied by* 0.9 = 0.6%

This produces the indicative calculations of efficiency improvement in table 4.4.

Table 4.4: Final calculation of unit cost efficiency improvement

	Expected annual efficiency improvement (%)
Opex	0.8% to 1.3% (midpoint 1.05%)
Repex	0.5%
Capex	0.6%

5. Summary and Conclusions

The forecast productivity savings that emerge from the preceding analysis are summarised below.

Table 5.1: Summary of analysis

	Opex	Repex	Capex
Catch up	nil	nil	nil
Demerger dividend	nil	n/a	n/a
Frontier shift	1.05%	0.5%	0.6%

We consider these findings to be broadly consistent with the conclusions that Ofgem has reached in previous price controls, having regard to NGN's good performance in the latest comparative efficiency analysis. We also note that the efficiency targets sit well with wider regulatory precedent as summarised in the tables below.

Table 5.2: Recent regulatory efficiency targets for frontier companies: opex

Decision	% cost reduction per annum
Ofgem – GDPCR, 2007	1.3
Ofgem – electricity distribution, 2009	1.0
ORR – Network Rail, opex, 2008	0.2
ORR – Network Rail, maintenance, 2008	0.7
PPP Arbiter – Tube Lines, central costs, 2010	0.7
PPP Arbiter – Tube Lines, opex, 2010	0.9
Competition Commission – water, 2010	0.9
First Economics – gas distribution, 2011	1.05

Table 5.3: Recent regulatory efficiency targets for frontier companies: capex

Decision	% cost reduction per annum
ORR – Network Rail, capex, 2008	0.7
PPP Arbiter – Tube Lines, capex, 2010	0.5 to 0.6
First Economics – repex/capex, 2011	0.6 to 0.7

As ever in this type of analysis there are ways and means of cherry picking from the analysis to obtain either higher or lower targets. We think that tables 5.2 and 5.3 show that we have, on balance, produced balanced and sensible forecasts. Accordingly, we think the estimates we are putting forward are a valid and useful input into the sort of well-justified business plan that Ofgem is seeking from companies in the RIIO-GD1 review.

Annex 1: Methodological Issues

The frontier shift analysis that we put forward in this report is deliberately intended to sit consistently with the analysis that Ofgem carried out in the 2009 electricity distribution price control review. There are, however, a few places in which we depart from Ofgem's previous methodology. These are noted below along with an explanation of the reasons for the departure.

Choice of comparators

In our work on repex and capex frontier shift we benchmark expected productivity growth against historical productivity growth in a single sector from the EU KLEMS database, i.e. construction. Ofgem has previously considered other comparators including manufacture of chemicals, manufacture of electrical equipment and manufacture of transport equipment.

We do not think this is a logical way of benchmarking repex/capex productivity. In most asset areas NGN is engaged primarily in the installation and commissioning of already manufactured equipment like pipes and pumps. It is not responsible for manufacturing anything itself. As evidence of this, most of the activities under consideration – laying mains, building storage, making connections, etc. – can themselves be found in the 'construction' section of the EU KLEMS database, suggesting prima facie that the construction sector alone is the natural benchmark.[4] They are not automated, fixed-location production activities and it is not therefore sensible to think that manufacturing industries give a reliable indication of the scope for productivity improvement in such work.

(NB: The manufacturing sector would provide relevant comparators if interest lay in the annual rate of change in unit cost of the actual materials and equipment that NGN is installing – e.g. the 'manufacture of transport equipment' sector would be the obvious benchmark for a van manufacturer. However, efficiencies in these parts of the supply chain are being picked up separately in the work on input price inflation.)

We were picked up on precisely this point by one of the economic regulators after making a similar mistake in work that we undertook on capex efficiencies in another periodic review. We subsequently reconsidered the way that we look at capex efficiencies and no longer use comparators from the manufacturing sector in our benchmarking. We would suggest that it is appropriate for Ofgem to do likewise in relation to the capital expenditure it is considering.

Choice of time period

Ofgem in its previous work has generally preferred to use the full EU KLEMS data set and to benchmark expected productivity growth using measured productivity improvements from 1970 onwards. By contrast, we prefer to focus on the data from the last business cycle (i.e. 1990 to 2007) and have argued repeatedly that experience from the 1970s and 1980s is of little relevance going forward.

In this report we seek a compromise between these two positions by giving equal weight to both time periods. Irrespective of the theoretical differences that we have with Ofgem, we think that this is appropriate and necessary in this study given concerns that we have about some of the estimated growth rates from each period. In particular:

- it is noticeable that measured productivity growth in the finance/insurance/real estate/business services sector (and, indeed, all of its sub-sectors) is negative over the

[4] The EU KLEMS project makes use of the EC's NACE classification. Gas network construction, replacement and associated installation activities are classified under the 'construction' division. See Eurostat (2008), NACE Rev. 2: Statistical Classification of Economic Activities in the European Community, e.g. class 42.21, class 42.9 and class 43.2.

1970 to 2007 period but positive over the 1990 to 2007 period. We think it is intuitively more sensible to think that the later period gives the more reliable benchmark given the way in which IT has revolutionised business services in the last 20 years; but

- the three sectors – electricity/gas/water, sale/maintenance/repair of motor vehicles and transport storage – that we rely on heavily as comparators for GDNs' direct opex show very similar rates of productivity growth in the 1970 to 2007 period but quite different rates over the shorter 1990 to 2007 period. Some of the changes are quite difficult to rationalise, especially the finding that electricity/gas/water productivity growth was lower after 1990 than before. In this case, we think it makes sense to make use of the 1970 to 2007 data rather than discard sectors from the analysis.

We note that our approach of giving equal weight to both time periods is relevant mainly to the opex frontier shift analysis and has no real impact on the repex and capex calculations.

Gross output versus value-added productivity estimates

Ofgem's previous work has included two different calculations of productivity growth: gross output productivity growth and value-added productivity growth. In this study we make use of only the latter estimates for a very pragmatic reason: the latest release of EU KLEMS data includes only value-added productivity growth data.

In principle, one could ignore the latest release and go back to the old data set which included both types of data. We are uncomfortable about doing this because the latest release includes significant revisions to the previous numbers and therefore seems to us to say that the earlier figures are no longer valid.

We also note that Ofgem is the only regulator to have used the gross output data in the past, with others considering it less reliable and less useful than the value-added data. This is partly due to concerns about basic error in the measured data – as evidenced by the scale of the revisions to the data set after previous releases – and partly due to concerns about the consistency of a gross output productivity growth series over periods in which industries undergo vertical separation and/or vertical integration. We would suggest to Ofgem that these issues carry sufficient weight that Ofgem should not make use of gross output productivity measures even if the up-to-date EU KLEMS data becomes available during the timescales of the RIIO-GD1 review.

Application of productivity improvements to labour and capital costs only

In our analysis of frontier shift we make an important distinction between (a) labour and equipment costs and (b) materials and other costs. The reason we do this is that cost-reducing efficiency improvement means something fundamentally different when one is looking at the impact of a GDN's own labour and capital on cost compared to the opportunities that a GDN has to spend less on bought-in materials.

As far as labour and equipment are concerned, a reduction in the number of workers that a GDN employs to install 100m of pipe and/or the number of vehicles or generators that are used while the work is carried out are unambiguously an improvement in productivity. For the same output – i.e. 100m of installed pipe – a GDN has been able to reduce the quantity of inputs it uses and will have reduced its unit cost in proportion to the labour and equipment saved.

The story when it comes to materials costs is different because installing 100m of pipe, by definition, requires 100m of pipe. The same is true of most of the other 'units' that NGN is costing up in its business plan projections: e.g. installing a pump, a storage tank or a new PC requires the purchase of one pump, one storage tank and one PC. Because the units of activity are defined by the quantities of materials involved, the materials component of the

final unit costs varies only with input prices and cannot be said to change as a result of 'productivity improvement'.

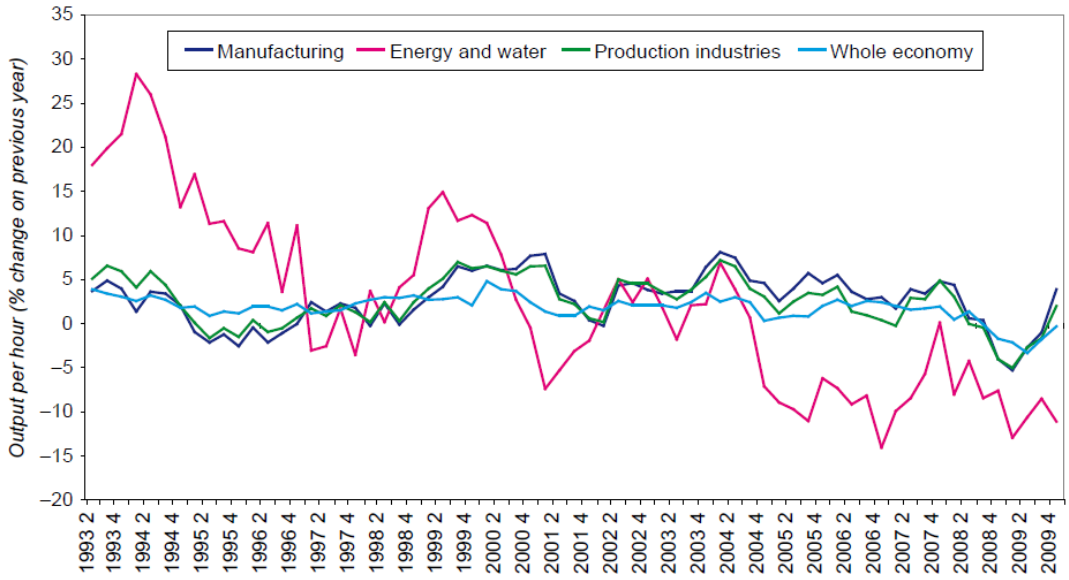
That is not to say that the concept of productivity improvement is completely irrelevant. It may well be that the manufacturers of pipes, pumps and IT equipment are able over time produce their goods more cheaply. For example, a supplier of pipes might invent new technologies that enable it to increase the amount of pipe that its workforce produces or it may find ways of reducing its management overheads. Importantly, however, such savings manifest themselves in the price that a GDN pays for its materials and not in the quantity of materials that the GDN purchases. If we were to impose a productivity assumption on materials we would essentially be double counting efficiencies that are already reflected elsewhere in the (changing) price that the GDN is paying for its purchases.

These ideas are consistent with the focus on 'value added' or the extent to which a firm's own labour and equipment add value to materials that it purchases from third parties. By definition a change in the quantity of material inputs has no impact on either value added or value added productivity growth. It follows that we should apply the numbers on a like-for-like basis – i.e. to value added – and recognise that the productivity growth being measured relates only to the potential to reduce the labour and capital inputs that are required in order to produce any given unit of output.

ONS data

Ofgem's March 2011 RIIO-GD1 consultation document indicates that GDNs should consider ONS productivity data in addition to the EU KLEMS data that we probe in our paper. The relevant ONS series as identified by the Competition Commission (CC) in its 2010 Bristol Water inquiry are set out in figure A1 below.

Figure A1: Productivity growth by sector



Source: CC calculations, based on ONS data.

The CC in its report noted that the ONS data shows a decline in energy and water sector productivity growth, probably due to higher levels of capex and improvements in quality over time. It concluded that the data recorded above provided no additional information over and above the EU KLEMS data set – a conclusion which we accept.