ASSESSMENT OF THE METHOD TO DETERMINE THE VALUE OF THE REGULATORY ASSET BASE (GAS CONNECTIONS) MANAGED BY DUTCH GAS DISTRIBUTION NETWORK OPERATORS

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Disclaimer

1 Introduction and Summary

In September 2008 the Netherlands Competition Authority (NMa) decided that the tariffs relating to gas connections – that is, the pipe from the distribution network to the customer's site – will be subject to a price control. The price control for connection charges will start on 1 January 2011, to coincide with the start of the fourth regulation period that runs from 2011 to 2013 inclusive. The regulation will be in line with the existing regulation method for the gas transportation network.

A key element of the method of regulating gas distribution charges, including connection charges, is the determination of the costs that Distribution Network Operators (DNOs) incur with respect to connections. The Dutch Office of Energy Regulation (*Energiekamer* or EK) must determine the Regulated Asset Base (RAB) relating to gas connections for each DNO. In Dutch the RAB of the gas connections is called the *gestandaardiseerde activawaarde van de gasaansluitingen* or GAW-GA, and we use this abbreviation throughout this report. EK published a concept method decision that describes the method for determining the GAW-GA (hereafter 'the method' or 'the proposed method'),[1] and has received financial data from the DNO's to enable it to determine the GAW-GAs.

EK has commissioned *The Brattle Group* to assess the method proposed by NMa against three key criteria:

- Objectivity – the method as far as possible should avoid making subjective decisions or judgements;
- Comparability – the calculations are done on the same basis for all DNOs, and the method ensures a like-for-like comparison, and;
- Fairness/balance or reasonableness – DNOs have the opportunity to earn a reasonable return on efficiently incurred costs, but at the same time customers do not end up 'paying twice' for the connection.

Conclusions and recommendations

The method proposes the use of the investment amounts – that is, the original investment less any revenues received at the time of investment – to determine the GAW-GA. Using net investments is reasonable because it prevents the customer paying twice for the connection. In a world with perfect information we would recommend a further step, deducting as well any historical connection charges that exceeded operating costs, depreciation and a reasonable return on capital after considering corporate taxes. The GAW-GA calculated in this way would represent the remaining amount the DNO should recover while earning no more than a reasonable return. Unfortunately the DNOs do not have sufficient historical data available to perform this calculation. However, we note that the DNOs have had an unregulated monopoly with respect to connection charges. Economic theory suggests that a monopolist would charge more than depreciation and a

[1] NMa 5 February 2010 Document number 103222_1/99.

reasonable return on capital. Accordingly, the GAW-GA estimated by the proposed method is likely to *overestimate* a 'reasonable' GAW-GA, because it does not subtract any 'excess charges' made between the date of each investment in connections and 2008. Nevertheless, we agree that in the absence of better information, using net investment costs is the best way to reach a reasonable 2008 GAW-GA.

The method inflates the historical net investment costs using the Dutch CPI. The reasonableness of inflating the net investment costs depends on the methodology the DNOs used to set the unregulated connection tariffs before 2010. If the DNOs based unregulated tariffs on a nominal rate of return, which includes inflation, then inflating the asset base would now result in over recovery of costs for the DNOs. We find it likely that the DNOs based tariffs on a nominal rate of return for an extended time period, because it was standard practice until the second half of the 1990s. Accordingly inflating the historic asset costs could result in over-recovery of costs for the DNOs, and consumers could in effect pay twice for their connections.

Perhaps the DNOs switched to a "real" rate of return methodology at some point in the 1990s. A real rate of return excludes inflation, but compensates the asset-holder for the effects of inflation by increasing the asset base over time. If this were the case, then inflating the assets would be appropriate, and declining to inflate them could lead to under recovery. In the absence of sufficient data, a reasonable decision must rely on an assessment of likely DNO policy in the past. It seems more likely that DNOs charged nominal returns, and may have exceeded the rates consistent with accepted regulatory principles. It seems less likely that DNOs switched from nominal to real returns without informing consumers, postponing capital recovery. Declining to inflate the net investment costs seems more reasonable, protecting consumers from paying twice. We estimate that not applying any inflation would reduce the 2008 GAW-GA by 22%.

We see tension between the criteria of comparability and fairness/reasonableness when it comes to calculating depreciation prior to 2009. Use of a single common depreciation period facilitates comparability. However, the averaging technique used by the proposed method would underestimate the depreciation collected by the DNOs prior to 2009. While using the same average depreciation period contributes to comparability, it appears to shift the balance between consumers and DNOs excessively in favour of DNOs.

The use of an average depreciation method will overestimate the 2008 GAW-GA for DNOs that applied a shorter-than-average depreciation period. These DNOs will have collected more depreciation prior to 2009 than the method assumes. Conversely the method will underestimate the 2008 GAW-GAs for DNOs with a longer than average depreciation period. While the return on capital earned will partially offset differences in depreciation collected, it will not completely erase any differences.

On balance we think that the method could better meet the overall criteria by calculating the pre-2009 depreciation based on the actual depreciation periods that each DNO applied in the past. To avoid biases in benchmarking and to improve comparability, EK could calculate two rate bases: one for assessing the appropriate revenues for connections, and the second (GAW-GA) for the purposes of comparing DNOs to assess their relative efficiency. The second "bench-marking" rate base could use the same depreciation period for all DNOs, or just the un-depreciated (but inflated) asset bases. This would avoid the potential problem that some DNOs may over or under recover as a result of their actual depreciation period differing from the average, while facilitating the benchmarking of DNO efficiency.

In determining the pattern of depreciation after 2008, the method depreciates the 2008 GAW-GA as if all the investments were made in a single past year. The alternative would be to depreciate investments from the year in which they were made. In our view the choice of depreciating from a single year suffers from a number of drawbacks. The use of a single year T from which to start depreciation is not 'incorrect', but neither is it standard. Therefore one could view this part of the method as a subjective decision that alters both the Present Value of DNOs' revenues and the way that costs are allocated between current and future users of the connections. Depreciating the investments from the year in which they were made would seem to be a more objective and standard assumption. Each DNO has a different year from which its 2008 GAW-GA is depreciated, so this part of the method does not make the DNOs more comparable.

We have also examined the data provided by the DNOs regarding the connection point percentage – that is, the percentage of costs for heavy connections that can be included in the GAW-GA. While we have not carried out any detailed statistical analysis, the connection point percentage for renewed connections seems to be consistently higher than the connection point percentage for first-time connections or installations. Given the difference, it may be better to calculate separate connection point percentages for installations and renewals. Calculating separate connection point percentages for installations and renewals we arrive at 32.0% for installations and 38.5% for renewals. Using separate connection point percentages might better meet the criteria of objectivity and reasonableness. This approach is of course subject to the DNOs having data available on which investments were installations and which were renewals.

A further possible improvement would be to calculate an average of the connection point percentages reported by each DNO and then take an average of these averages. This would avoid giving too much weight to any one connection point percentage reported by a DNO, and would make the estimate of the connection point percentage more robust.

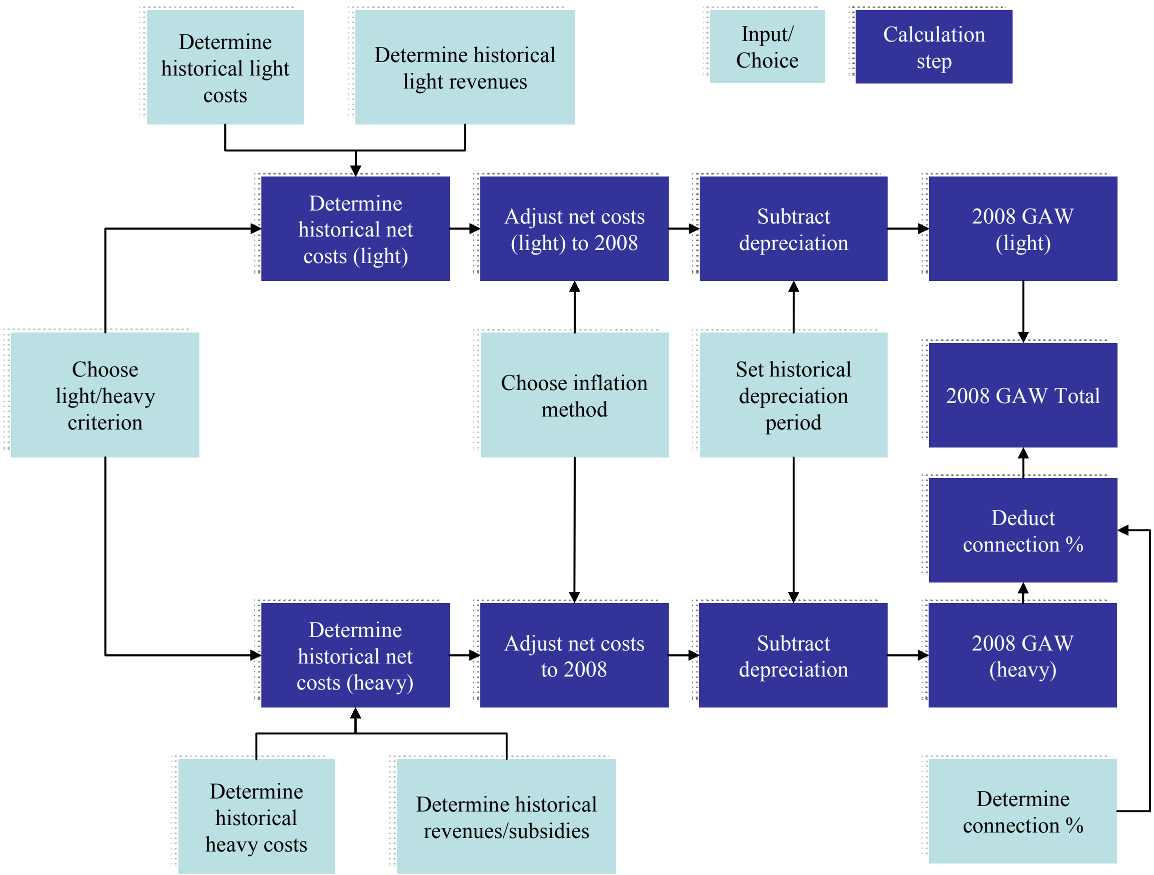
2 Overview of the proposed method

Figure 1 below gives a schematic overview of the method for determining the 2008 GAW-GA, and the main assumptions involved. EK determines separate GAWs for connections with a capacity of less than 40 m^3/hour – so-called 'light' connections – and connections with a capacity of greater than 40 m^3/hour – 'heavy' connections. However, the method for both light and heavy connections is essentially the same, with the exception that the GAW-GA includes only a percentage of the costs of the heavy connections.

The method determines the net historical investment costs, which is the historical cost of the connection less any revenue received from the customer or any subsidies paid. The method inflates the historical costs to 2008 money using the Dutch Consumer Price Index (CPI), before subtracting depreciation that occurred between the year the investment was made and 2008. The length of the depreciation period is the same for all DNOs, but the actual depreciation is calculated for each DNO based on their actual historical investments. The inflated, depreciated net investment costs form the basis of the 2008 GAW-GA.

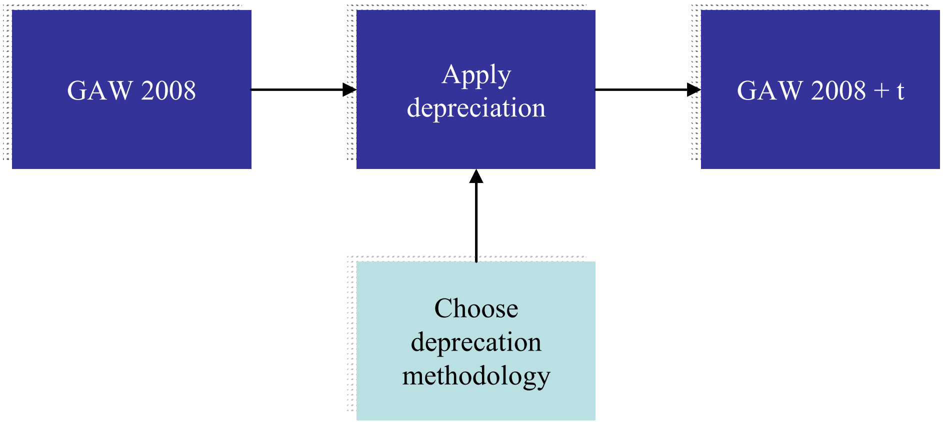
Regarding the GAW-GA, heavy connections are defined as the pipework up to the first valve between the customer and the network. Since the DNOs have recorded the costs of the entire connection, including the cost of the downstream pipework, EK must make an adjustment to exclude costs that are not part of the heavy connection that is included in the rate base. EK has surveyed the DNOs for estimates of the proportion of heavy connection costs associated for pipework up to the first valve. On the basis of this survey EK has concluded that 38.5% of the total net costs associated with heavy connections should be included in the GAW-GA. We understand that as per the new regulation period new heavy investments will be added to the GAW-GA using their actual costs, as DNOs will be aware of the need to record separately costs incurred up to the first valve and other costs.

Figure 1: Key steps in determining the 2008 GAW-GA



Once EK has determined the rate base as of 2008, it must then adjust the rate base for 2009 and future years. The method again inflates the 2008 GAW-GA using CPI, and deducts depreciation. However, there are two differences in the post-2008 depreciation methodology. First, the duration of the depreciation period is shorter. Second, the 2008 GAW-GA is depreciated from a single year in the past. In other words, while in reality the DNOs invested in connections over many years (typically from the 1960s onward) the method treats all connections as a single investment made in one past year, and depreciations the GAW-GA from this point. The method calculates the 'single year of investment' referred to as year T, for each DNO, based on their profile of connection investments between 1973 and 2008. The net costs of connections made in 2009 and later years will be added to the GAW-GA, and depreciated over a period of D years. For a more detailed description of the method, see Appendix 3 of the proposed method.

Figure 2: Determining the GAW-GA from 2008



2.1 Existing charges for connections

Before assessing the proposed methodology, we briefly describe how DNOs have charged for gas connections to date, when charges were not regulated. This description is based on information supplied to us by EK.

At present, for a new gas connection DNOs charge a one-off connection fee or EAV, and an annual fee or PAV. We understand that a typical connection to a household in today's money costs is about €800, and that the one-off connection charge is about €650, leaving net costs of €150. However, these numbers are only representative, and actual numbers vary. The GAW-GA method measures net investment cost as the costs incurred in making the connection less the EAV and any other contributions the DNO received.

In reality there are few if any OPEX costs for maintaining a connection. Connections may need replacing – perhaps due to corrosion or soil subsidence. In this case the DNO will not charge the customer again for replacing the connection. Rather the DNO funds the costs from the PAV annual payments, either by adjusting the PAV yearly to the expected cost of renewing that year, by using the PAV to 'save up' money for future renewals, or by including the depreciation costs and a return on the investment for the renewal in the annual PAV payments. We understand that PAV payments vary widely, from around €9/year to about €50/year. The average payment is around €25/year. If the DNOs are indeed funding replacement connections by saving PAV payments, then, it would be appropriate to ensure that the DNOs contribute any interest earned on the savings to the funding of the replacement connections.

The DNOs do not have records of the historical EAV and PAV revenues from the date at which they made their connection investments. Accordingly, it is not possible to look back in time to see if the DNOs have historically recovered more than the cost of their connection costs. Given that connection charges were not regulated, and that the DNOs had a monopoly on providing connections, it would be surprising if the DNOs had not opted to recover fully the costs of the connections.

3 Assessment of the method decision

3.1 Use of 'net' costs

The method only allows the net costs to contribute to the GAW-GA – that is the actual costs incurred less the payment received by the customer at the time the connection was made. Using net costs is reasonable. The DNOs should only receive ongoing compensation via the connection charge for the connection costs that were incurred but not reimbursed at the time the investment was made. Not to account for the payment already received would in effect result in the customer paying twice for the connection.

During the period between the time the investment was made and the end of 2008, ideally the DNOs should have earned the depreciation on the net costs, operating costs (including taxes) plus a 'fair return' on the net cost less cumulative depreciation. If the DNOs earned this amount, they would pass what we call the 'NPV test'. That is, at the time of the investment, the present value of the stream of capital charges (depreciation plus a return on capital employed) would equal the net cost of the investment. We advocated this test in our 2000 report for the European Commission, and noted that charges in excess of those given by the NPV test contain an element of monopoly profit and are therefore inconsistent with the Gas Directive and with EU competition law.[2]

Table 1 illustrates a simple example of the NPV test, where the pipeline's revenues are calculated using a 10% nominal rate of return. The present value of the revenues, discounted at the 10% rate of return, equals the value of the initial investment.

Table 1: Example of the NPV test

Cost of Capital	[1]	Example	10%									
Year			1	2	3	4	5	6	7	8	9	10
BOY Asset Value	[2]	See note	100	90	80	70	60	50	40	30	20	10
Depreciation	[3]	See note	10	10	10	10	10	10	10	10	10	10
EOY Asset Value	[4]	[2]-[3]	90	80	70	60	50	40	30	20	10	0
Rate of Return	[5]	[1]	10%	10%	10%	10%	10%	10%	10%	10%	10%	10%
Return on Capital	[6]	[2]x[5]	10	9	8	7	6	5	4	3	2	1
Total Capital Charges	[7]	[3]+[6]	20	19	18	17	16	15	14	13	12	11
Discount Factor to Year 1	[8]	$1/(1+[1])^y$	90.9%	82.6%	75.1%	68.3%	62.1%	56.4%	51.3%	46.7%	42.4%	38.6%
PV Year 1	[9]	[7]x[8]	18.2	15.7	13.5	11.6	9.9	8.5	7.2	6.1	5.1	4.2
Present Value	[10]	See note	100									

[2]: Initial investment of 100; thereafter $[4]_{y-1}$
[3]: Ten year straight line depreciation assumed
[10]: Sum of [9] for all years

To be consistent with the NPV test, the 2008 GAW-GA should equal the net investment costs, *less any charges between the investment date and 2008 that were in excess of taxes, operating costs depreciation and a fair return on capital*. The GAW-GA calculated in this way would represent the

[2] The Brattle Group, Methodologies for Establishing national and Cross-Border Systems of Pricing of Access to the gas System in Europe, 17 February 2000, p.52. Available on the European Commission's website.

remaining amount the DNO should recover so that its charges pass the NPV test. In a world with perfect information, we would analyse the DNOs' historical revenues from connection charges, estimate the value of any charges in excess of those given by the NPV test, and subtract these 'excess' charges from the 2008 GAW-GA. Unfortunately the DNOs do not have such historical revenue information available, and so such an exercise is not possible. However, as noted above it seems highly unlikely that the DNOs' charges would recover less than the NPV test.

We also note that the use of net investment costs introduces a tax issue, which means that the DNOs may have collected slightly less revenue after tax than a simple without-tax model might suggest. To understand why, consider a standard tariff regime without an up-front payment by the customer, with charges based on depreciation and a return on capital, as illustrated in Table 1. In this case the DNO would be able to reduce its taxable income by offsetting a steady stream of revenue from the customer against depreciation.

But what actually happened in the Netherlands was that the DNO received a high proportion of the investment cost from the customer in the year the connection was built. Under standard depreciation practices, the amount of depreciation that the DNO could offset against this up-front payment is relatively small.[3] For example, suppose the connection cost €800, the DNO depreciated the connection over 20 years and the customer paid €650 immediately. The DNO would only be able to set €40 of depreciation against the €650 of income. This would result in a large tax bill in the first year. In Appendix I we illustrate an example with a depreciation period of 10 years. We show that the 'simple' method without tax the DNO earns revenues with a PV of €800, but after considering tax the DNO only earns revenues with a PV of €754 – about 6% less than assumed. These numbers are of course only illustrative – to ascertain the actual numbers EK would need to look at actual depreciation periods, tax rates and costs of capital.

The possible complication introduced by taxes does not mean that EK should now raise the GAW-GA in response. In the absence of detailed data it may be difficult to estimate the size of any tax effects. EK also lacks any information confirming that the DNOs followed the methodology assumed in our example in the Appendix. Any DNO who appreciated the impact of corporate taxes could have have raised charges beyond the levels shown in our example to compensate. EK should consider the risk that DNOs received 'excess' revenues prior to 2008 – that is revenues in excess of depreciation and a return on capital, even after tax effects are considered.

3.2 Choice of inflation method

As noted above, the method inflates the 2008 historical costs using the Dutch CPI. The choice of inflation methodology depends on the rationale for inflation. Below we discuss two possible reasons for inflating the historical assets.

3.2.1. Use of a real rate of return in the past (first reason)

The first reason for inflating the historical costs would be an assumption that the DNOs based unregulated charges on a real rate of return (also known as a 'trended costs' tariff methodology),

[3] Our comment is based on general accounting practices. It is possible that accounting practices in the Netherlands in the 1960s and later allowed DNOs to depreciate more of the cost of the connection in the first year, but this would not be common practice.

combined with a desire to continue this practice in future. By real rate of return, we mean that the allowed revenues are calculated in real terms at the year of the price control, excluding inflation, and then translated into nominal or money-of-the-day charges using the expected inflation.[4] At the start of the next price control the asset base is inflated to the first year of the new price control. Table 2 illustrates a simple example of using a real rate of return to estimate allowed revenues. All the calculations are done in real terms – that is, in the money of the first year. In row [8] of Table 2 the real year 1 revenues are translated into nominal money-of-the-day revenues.

Table 2: Example of tariffs based on trended costs – all numbers are real unless noted otherwise

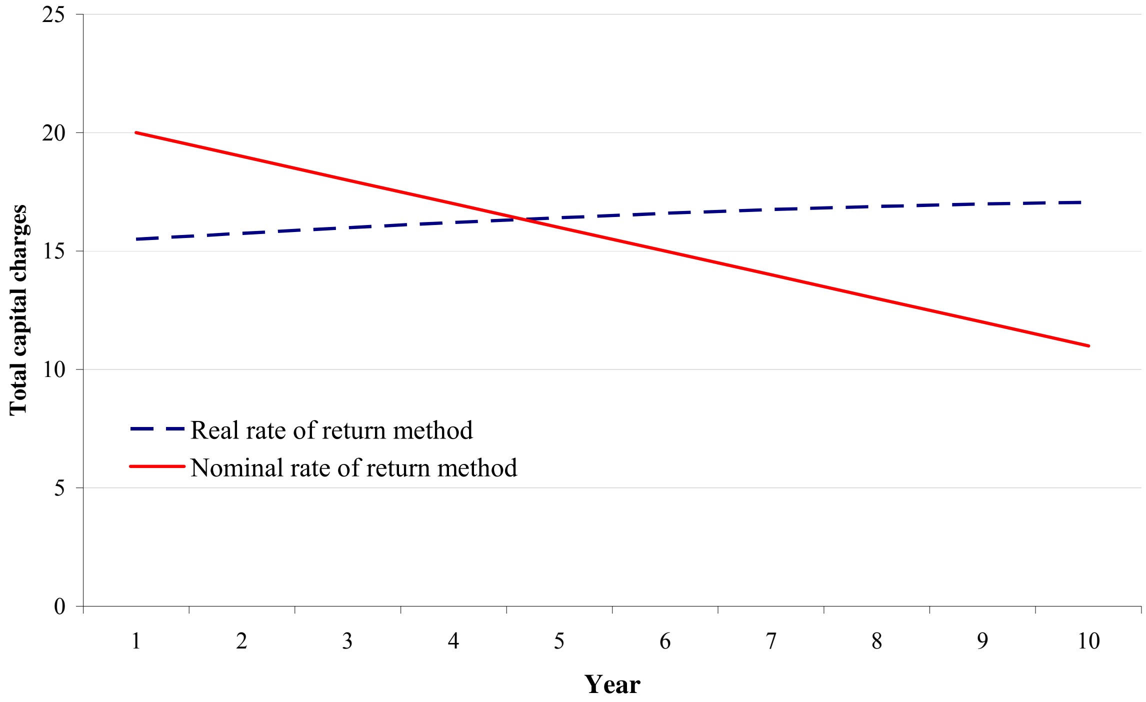
Cost of Capital (Nominal)	[1]	Example	10%									
Inflation	[2]	Example	5%									
Cost of Capital (Real)	[3]	See note	4.8%									
Year			1	2	3	4	5	6	7	8	9	10
BOY Asset Value	[4]	See note	100	90	80	70	60	50	40	30	20	10
Depreciation	[5]	See note	10	10	10	10	10	10	10	10	10	10
EOY Asset Value	[6]	[2]-[3]	90	80	70	60	50	40	30	20	10	0
Rate of Return	[7]	[3]	4.8%	4.8%	4.8%	4.8%	4.8%	4.8%	4.8%	4.8%	4.8%	4.8%
Return on Capital	[8]	[4]x[7]	4.8	4.3	3.8	3.3	2.9	2.4	1.9	1.4	1.0	0.5
Total Capital Charges	[9]	[5]+[8]	15	14	14	13	13	12	12	11	11	10
Total Capital Charges (Nominal)	[10]	See note	15.5	15.8	16.0	16.2	16.4	16.6	16.8	16.9	17.0	17.1
Discount Factor to Year 1	[11]	$1/(1+[1])^y$	90.9%	82.6%	75.1%	68.3%	62.1%	56.4%	51.3%	46.7%	42.4%	38.6%
PV Year 1 (Nominal)	[12]	[10]x[11]	14.1	13.0	12.0	11.1	10.2	9.4	8.6	7.9	7.2	6.6
PV Total (Nominal)	[13]	See note	100.0									

[3]: {(1+[1])/(1+[2])}-1
[4]: Initial investment of 100; thereafter $[4]_{y-1}$
[5]: Ten year straight line depreciation assumed
[10]: $[9]x(1+[2])^y$
[13]: Sum of [12] for all years

Looking at Table 1 and Table 2 we see that, compared to using a nominal rate of return, applying a real rate of return results in lower charges at the beginning of the life of the asset and higher charges at the end. Figure 3 illustrates the capital charges of the two rate methodologies. Figure 3 also shows that, in this example, switching from a nominal rate of return method to a real rate of return method after year 4 will result in an *increase* in capital charges.

[4] One of the effects of using a real rate of return is that it reduces the risk of inflation for the pipeline company. In contrast, if the regulator set nominal charges, and inflation turned out very different from expected at the time of the price control, the pipeline could be left with a revenue shortfall or a wind fall.

Figure 3: Capital charges under nominal and real rate of return methodologies



If the DNOs have applied a nominal rate of return methodology prior to 2009, then switching to a real rate of return post-2008 and inflating the historical value of the assets will give the DNOs a 'windfall' (an unexpected bonus). The DNOs would get 'the best of both worlds'. They obtain relatively high charges prior to 2008 then move from the solid red line to the broken blue line in Figure 3, giving them higher charges than they would have received, had they continued to base charges on a nominal rate of return. Table 3 illustrates that the connections of most DNOs are almost two thirds of the way through their useful life, the equivalent of being at year 6 in Figure 3. Inflating the historical value of the assets and moving from a nominal to a real rate of return methodology in year 6 results in charges with a PV of €109, higher than the €100 investment. In contrast, switching to a real rate of return methodology without inflating the assets would produce a PV of €100.

Table 3: Average remaining life of assets

DNO	T	Remaining life in 2008
	[A] EK	[B] See note
DNO1	1985	36%
DNO2	1986	39%
DNO3	1989	47%
DNO4	1985	36%
DNO5	1990	50%
DNO6	1983	31%
DNO7	1985	36%
DNO8	1984	33%
DNO9	1988	44%
DNO10	1991	53%
DNO11	1978	17%
Average		38%

[B]: 1-({2008-[A]}/36)

The tables below illustrate how to switch in practice from using a nominal rate of return to a real rate of return. Table 4 illustrates the first five years of charges based on an investment in year 1 of €100. Connection charges are not regulated, and we assume that the DNOs apply the nominal rate of return methodology. Table 4 illustrates that the Present value (PV) of charges in the first five years amounts to €69.

Table 4: Years 1-5 of investment – nominal rate of return

Cost of Capital	[1]	Example	10%				
Year			1	2	3	4	5
BOY Asset Value	[2]	See note	100	90	80	70	60
Depreciation	[3]	See note	10	10	10	10	10
EOY Asset Value	[4]	[2]-[3]	90	80	70	60	50
Rate of Return	[5]	[1]	10%	10%	10%	10%	10%
Return on Capital	[6]	[2]x[5]	10	9	8	7	6
Total Capital Charges	[7]	[3]+[6]	20	19	18	17	16
Discount Factor to Year 1	[8]	$1/(1+[1])^y$	90.9%	82.6%	75.1%	68.3%	62.1%
PV Year 1	[9]	[7]x[8]	18.2	15.7	13.5	11.6	9.9
Present Value Total	[10]	See note	69.0				

[2]: Initial investment of 100; thereafter $[4]_{y-1}$
[3]: Ten year straight line depreciation assumed
[10]: Sum of [9] for all years

In our example we assume that in year 6 the methodology changes to using the trended cost or real rate of return. In Table 5 we begin in year 6 with the depreciated nominal asset base from the end of year 5 in Table 4 above. In other words, *we do not inflate the historical costs of the assets*. Working through Table 5 we see that the PV of the revenues for years 6-10 inclusive is €31. Adding this to the PV of the revenues in years 1-5 we get a total PV of €100 – the original sum invested. The example illustrates that switching to a real rate of return without inflating the assets gives the correct revenue stream to the DNOs.

Table 5: Years 6-10 of investment – real rate of return

Cost of Capital (Nominal)	[1]	Example	10%				
Inflation	[2]	Example	5%				
Cost of Capital (Real)	[3]	See note	4.8%				
Year			6	7	8	9	10
BOY Asset Value	[4]	See note	50	40	30	20	10
Depreciation	[5]	See note	10	10	10	10	10
EOY Asset Value	[6]	[4]-[5]	40	30	20	10	0
Rate of Return	[7]	[3]	4.8%	4.8%	4.8%	4.8%	4.8%
Return on Capital	[8]	[4]x[7]	2.4	1.9	1.4	1.0	0.5
Total Capital Charges	[9]	[5]+[8]	12	12	11	11	10
Total Capital Charges (Nominal)	[10]	See note	13.0	13.1	13.2	13.3	13.4
Discount factor to year 1	[11]	$1/(1+[1])^y$	56%	51%	47%	42%	39%
PV in Year 1	[12]	[10]x[11]	7.3	6.7	6.2	5.6	5.2
Total PV in years 6-10	[13]	See note	31.0				
Total PV in years 1-5	[14]	Table 4	69.0				
PV all years	[15]	[13]+[14]	100.0				

[3]: {(1+[1])/(1+[2])}-1
[4]: Initial investment of 100; thereafter $[6]_{y-1}$
[5]: Ten year straight line depreciation assumed
[10]: $[9]x(1+[2])^{y-5}$
[13]: Sum of [12] for years 6-10

If we apply the proposed method, we would begin in year 6 with an asset base of €64 – Table 6 illustrates the calculation. If we then repeat the calculation in Table 5 starting with the inflated asset base of €64, Table 7 shows that we then end up with a PV in year 1 of €109. Inflating the historic asset values has created a windfall for the DNOs of €9 for every €100 invested.

Table 6: Inflating the historic costs as per the proposed method

Original investment	[1]	Example	100
Annual Inflation	[2]	Example	5%
Inflation factor years 1-5	[3]	$(1+[2])^5$	1.28
Inflated investment	[4]	[1]x[3]	128
Remaining asset life, %	[5]	See note	50%
Depreciated inflated investment	[6]	[4]x[5]	64

[5]: Straight line depreciation over 10 years assumed.

Table 7: Years 6-10 of investment – real rate of return starting with inflated historic costs

Cost of Capital (Nominal)	[1]	Example	10%				
Inflation	[2]	Example	5%				
Cost of Capital (Real)	[3]	See note	4.8%				
Year			6	7	8	9	10
BOY Asset Value	[4]	See note	64	51	38	26	13
Depreciation	[5]	See note	13	13	13	13	13
EOY Asset Value	[6]	[4]-[5]	51	38	26	13	0
Rate of Return	[7]	[3]	4.8%	4.8%	4.8%	4.8%	4.8%
Return on Capital	[8]	[4]x[7]	3.0	2.4	1.8	1.2	0.6
Total Capital Charges	[9]	[5]+[8]	16	15	15	14	13
Total Capital Charges (Nominal)	[10]	See note	21.2	21.4	21.6	21.7	21.8
Discount factor to year 1	[11]	$1/(1+[1])^y$	56%	51%	47%	42%	39%
PV in Year 1	[12]	[10]x[11]	12.0	11.0	10.1	9.2	8.4
Total PV in year 1 of earnings in years 6-10	[13]	See note	50.6				
Total PV in year 1 of earnings in years 1-5	[14]	Table 4	69.0				
Total PV in year 1 of all earnings	[15]	[13]+[14]	119.5				

[3]: {(1+[1])/(1+[2])}-1
[4]: Year 6 BOY inflated asset value from table 6; thereafter $[6]_{y-1}$
[5]: Ten year straight line depreciation assumed
[10]: $[9]x(1+[2])^y$
[13]: Sum of [12] for years 6-10

If the DNOs have previously applied a nominal rate of return, then there is no need to inflate the historical rate base. Doing so would create a windfall for the DNOs. We can simply use the depreciated historical costs to determine the 2008 GAW-GA. From 2009 we switch to using a real rate of return. We only inflate the 2008 GAW-GA from 2009 onward.

While it is unclear exactly what method the DNOs used to set the unregulated connection charges, we find it highly unlikely that they have been applying the real rate of return methodology since their first investment in connections. The real rate of return methodology is associated with the RPI-X method of price control, which was first proposed by Professor Stephen Littlechild in 1983 for application to the prices of the GB Telecoms incumbent, BT.[5] Under RPI-X, rather than

[5] Stephen Littlechild, 'Regulation of British Telecommunications' Profitability', 1983, HMSO.

increasing the nominal tariff at the rate of inflation as in Table 2, the regulator increases the tariff at the Retail Price Index (RPI, equivalent to CPI in most cases) less a percentage X. This means that tariffs decline in real terms. The regulated firm is supposed to respond to its declining real revenues by becoming more efficient, thereby reducing costs. Application of the RPI-X and the real rate of return naturally go together, because the real rate of return methodology uses inflation explicitly to arrive at the nominal tariffs, and so the application of the X factor is a straightforward addition to the calculation.

While the RPI-X methodology was proposed in 1983, it was not applied to British Gas for several years. In the Netherlands the RPI-X methodology is also used for electricity distribution price-controls, but only since 2001.[6] Given that connection charges have been levied since the 1960s and the real rate of return was only used for price controls in the 1990s, we find it extremely unlikely that the DNOs applied a real rate of return methodology for any significant portion of the assets' life. Therefore we see no need to inflate the historical asset values to 2008 money.

3.2.2. Depreciated Replacement Costs (second reason)

Second, the DNOs may have based their un-regulated connection tariffs on the Depreciated Replacement Costs (DRC) methodology. The depreciation used under the DRC methodology is essentially the same as that used under the real rate of return methodology, except that instead of increasing the value of the assets with inflation so as to keep the value constant in real terms, the replacement value of the asset is estimated every year. In this case it would be appropriate to inflate the historical costs using an index that tracks the cost of replacing the connections. We understand that the majority of the connection costs involve labour, essentially for digging up and re-laying the roads and pavements under which the connections are installed. Accordingly, 80% of a suitable index might reflect the cost of labour in the Netherlands and 20% could reflect the costs of steel or plastic.

The DRC method raises similar issues to the use of a real rate of return. If the DNOs have not applied the DRC method, but the method inflates the historical cost of the assets using an index linked to the cost of building connections, then the DNOs will over recover their costs.

3.2.3. Conclusions on choice of inflation

As we explain above, whether or not to inflate the historical assets depends on the methodology that the DNOs previously used to set the unregulated connection tariffs. We find it likely that, if the DNOs were using a rate of return methodology at all to set connection tariffs, then the DNOs would have based tariffs on a nominal rate of return for at least much of the life of the assets. Using a nominal rate of return was standard practice before the 1990s. Switching to a real rate of return while inflating the historical asset costs would create a windfall for the DNOs, compromising the objective of reasonableness.

Perhaps the DNOs switched to using a real rate of return methodology at some point in the 1990s without making official announcements or keeping records that have been saved. If this were the case, not inflating the assets at all could lead to under recovery. However, in the absence of sufficient data regarding pre-2008 charging methodologies and based on the DNO's previously

[6] This was the intended data of introduction – in practice the X factors were agreed in 2003.

unregulated monopoly situation, we see little risk of DNO under-recovery if EK declines to inflate the historical costs. We see a greater risk that consumers might over-pay for connections if EK applies inflation to historical costs.

Table 8 illustrates the effect that only inflating the costs from a later year – 1990 and 2000 – or not inflating the costs at all would have on the 2008 GAW-GA. Not applying any inflation reduces the 2008 GAW-GA by 22%.

Table 8: Effect of different inflation policies on the 2008 GAW-GA

	GAW-GA, € mln				Change from original, %		
	Original (inflate all years)	Inflate from 1990	Inflate from 2000	No inflation	Inflate from 1990	Inflate from 2000	No inflation
DNO1	17.5	15.2	13.4	13.2	-13%	-23%	-25%
DNO2	27.1	23.0	20.7	20.2	-15%	-24%	-26%
DNO3	193.2	174.0	157.9	155.1	-10%	-18%	-20%
DNO4	6.0	5.0	4.5	4.4	-17%	-26%	-27%
DNO5	20.9	19.4	17.9	17.2	-7%	-14%	-18%
DNO6	202.9	154.1	138.8	139.4	-24%	-32%	-31%
DNO7	19.3	16.1	14.6	14.4	-17%	-24%	-25%
DNO8	18.6	15.2	13.5	13.3	-18%	-28%	-28%
DNO9	16.1	14.1	12.7	12.5	-13%	-21%	-22%
DNO10	464.5	427.6	393.4	380.5	-8%	-15%	-18%
DNO11	5.2	3.8	3.8	3.7	-26%	-26%	-28%
Total	991.5	867.6	791.1	774.0	-12%	-20%	-22%

3.3 Choice of depreciation methodology pre-2009

As described above, the method depreciates the inflated rate base using the same depreciation period for all DNOs. Different DNOs have applied different depreciation periods, and most DNOs lengthened their depreciation periods before 2009 as they realised that the connections were going to be used for a longer time than envisaged at the installation date.

To arrive at a single depreciation period for all DNOs, the method first determines the weighted average depreciation period used for each DNO pre-2009, using the net investments made in the years prior to 2009 as the basis for the weighting. For example, if a DNO switched from a 25-year depreciation period to a 40-year depreciation period in 1999, then the method calculates the average depreciation period weighted by the investments made in each year. Note that assets that are fully depreciated in 2009 do not count toward this average – so in the example all investments made before 1983 would be fully depreciated by 2009 using a 25-year depreciation period, and so would not contribute. In other words, the method is only interested in the un-depreciated assets as of 2009.

Having established the average depreciation period for each DNO, the method then calculates the standardised depreciation period for all DNOs – an average of the average – by weighting the depreciation period for each DNO by the number of connections operated by a network operator at year-end 2008. To avoid giving undue weight to relatively inefficient or expensive network operators the method weights according to the number of connections and not by investment amounts.

3.3.1. Consequences of the method

The averaging calculations applied by the method have two main effects. First because the method ignores assets that were fully depreciated as of 2009, it gives too much weight to more recent years with a longer depreciation period. This will result in an average depreciation period that is too long relative to that which the DNOs actually applied historically. If the period is longer than actually applied, then the implied depreciation amounts will understate the actual depreciation collected, and in turn will tend to overestimate the value of the 'unrecovered' connection assets and hence the 2008 GAW-GA. Put another way, the method applies the pre-2009 depreciation period to all historical investments. Therefore the calculation of the average depreciation period should also weight all historical investments, including those that were fully depreciated as of 2009.

In Table 9 we have quantified the effect for the light connections, by re-calculating the 2008 GAW-GAs but using all of the years to calculate the average depreciation period. Table 9 shows that the effect of leaving out earlier years is to increase the GAW-GA by about €37 million, or 4%.

Table 9: 2008 GAW-GAs for light connections calculated according to the method and calculating including all years in the depreciation calculation

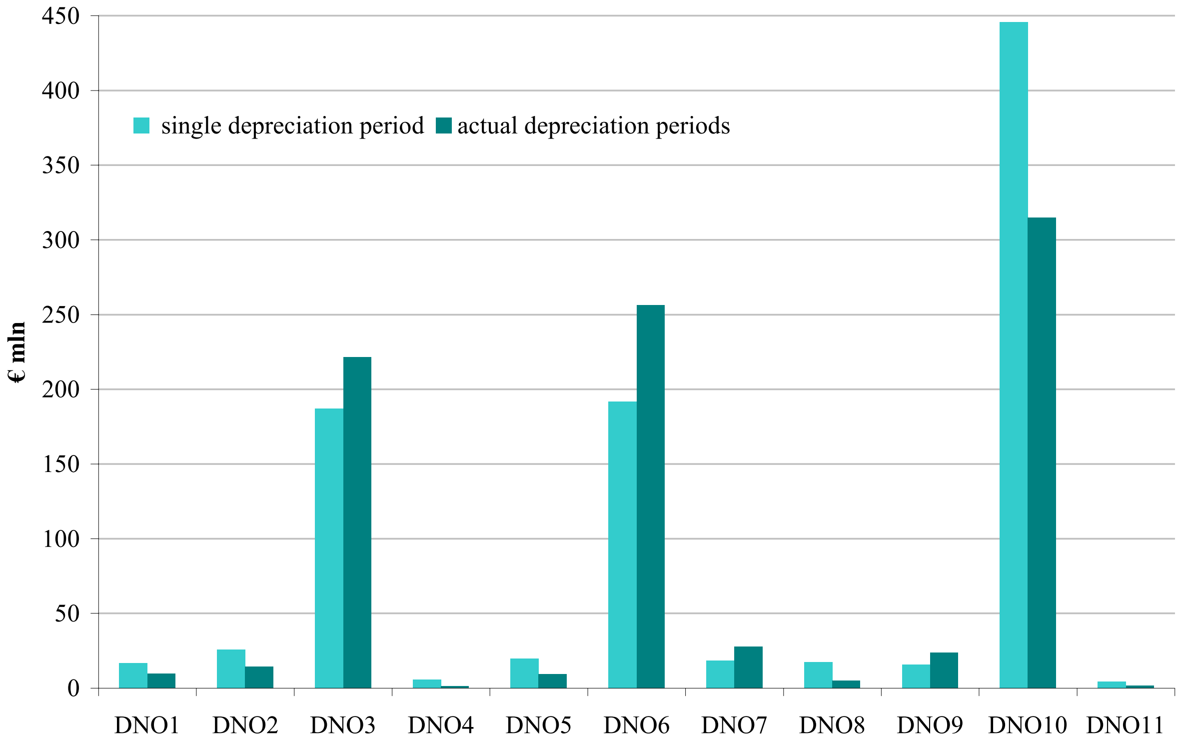
DNO	GAW-GA folowing the method €, million	GAW-GA using all years €, million	Difference €, million	Difference %
DNO1	16.8	15.9	0.9	5.1%
DNO2	25.8	24.6	1.2	4.6%
DNO3	187.3	181.0	6.3	3.3%
DNO4	5.6	5.4	0.3	5.0%
DNO5	19.9	19.3	0.6	2.9%
DNO6	191.7	178.9	12.8	6.7%
DNO7	18.6	17.6	0.9	5.0%
DNO8	17.6	16.6	1.0	5.6%
DNO9	15.9	15.3	0.6	3.5%
DNO10	445.9	434.2	11.6	2.6%
DNO11	4.4	3.7	0.7	15.4%
Total	949.4	912.6	36.8	4.03%

In our view the goal of the averaging process should be to derive a single depreciation period which, when applied to the asset base of the DNO, arrives at the same total amount of depreciation as applying the two separate depreciation periods. However, in Appendix I we show that while including all years to calculate the weighted average depreciation period reduces the over estimate of the GAW-GA, it still does not result in the same amount of depreciation as of 2008 as would be the case by applying the two separate depreciation periods. We could find a single depreciation period that gave the same total depreciation as using the two separate depreciation periods, but only by trial and error. In other words, it is difficult to find a single depreciation period that will result in the same total amount of depreciation as applying the two separate depreciation periods.

The second issue is that DNOs that applied a shorter than average depreciation period will have recovered more depreciation than the method assumes. This creates the possibility that the method could over estimate the GAW-GA for these DNOs. Conversely, the method could underestimate the GAW-GA for DNOs with a longer than average depreciation period.

To test the objectivity and reasonableness of the methodology, a natural step is to compare the GAW-GAs produced by the method to the GAW-GAs that result from using the actual depreciation periods the DNOs applied before 2009. Figure 4 illustrates this comparison using illustrative numbers –the final 2008 GAW-GA numbers will differ from those presented in Figure 4. For some DNOs there is a significant difference between the 2008 GAW-GA that results from using their actual depreciation periods rather than using the average period. For example, the 2008 GAW-GA of DNO10 decreases by €130 million as a result of using actual depreciation periods, while the 2008 GAW-GA of DNO6 increases by €65 million.

Figure 4: Comparison of 2008 GAW-GAs for light connections using EK's depreciation method and the actual historical DNO depreciation periods



In practice we note that this issue is not likely to be as stark as might be suggested just from looking at the depreciation recovered and the resulting GAW-GAs. DNOs that have applied a lower depreciation rate than average will have received a higher return on capital – to a degree these two effects cancel out. Table 10 and Table 11 illustrate the capital charges over the first 10 years for a connection using a 40-year and 20-year depreciation schedule respectively. The connection with the longer depreciation schedule has a remaining asset base of €75 after 10 years, compared to the €50 asset base of the connection with a 20-year depreciation period. However, the differences in the PV of the total capital charges are much smaller – the PV of charges for the connection with the 40-

year depreciation period is €71 compared to €81 for the 20-year schedule. The return on capital has partially cancelled out the difference in depreciation recovered.

Table 10: Example of capital charges after 10 years with a 40 year depreciation period

Cost of Capital	[1]	Example	10%									
Year			1	2	3	4	5	6	7	8	9	10
BOY Asset Value	[2]	See note	100	98	95	93	90	88	85	83	80	78
Depreciation	[3]	See note	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5
EOY Asset Value	[4]	[2]-[3]	98	95	93	90	88	85	83	80	78	75
Rate of Return	[5]	[1]	10%	10%	10%	10%	10%	10%	10%	10%	10%	10%
Return on Capital	[6]	[2]x[5]	10	10	10	9	9	9	9	8	8	8
Total Capital Charges	[7]	[3]+[6]	13	12	12	12	12	11	11	11	11	10
Discount Factor to Year 1	[8]	$1/(1+[1])^y$	90.9%	82.6%	75.1%	68.3%	62.1%	56.4%	51.3%	46.7%	42.4%	38.6%
PV Year 1	[9]	[7]x[8]	11.4	10.1	9.0	8.0	7.1	6.4	5.6	5.0	4.5	4.0
Present Value	[10]	See note	71.1									

[2]: Initial investment of 100; thereafter $[4]_{y-1}$
[3]: 40 year straight line depreciation assumed
[10]: Sum of [9] for all years

Table 11: Example of capital charges after 10 years with a 20 year depreciation period

Cost of Capital	[1]	Example	10%									
Year			1	2	3	4	5	6	7	8	9	10
BOY Asset Value	[2]	See note	100	95	90	85	80	75	70	65	60	55
Depreciation	[3]	See note	5	5	5	5	5	5	5	5	5	5
EOY Asset Value	[4]	[2]-[3]	95	90	85	80	75	70	65	60	55	50
Rate of Return	[5]	[1]	10%	10%	10%	10%	10%	10%	10%	10%	10%	10%
Return on Capital	[6]	[2]x[5]	10	10	9	9	8	8	7	7	6	6
Total Capital Charges	[7]	[3]+[6]	15	15	14	14	13	13	12	12	11	11
Discount Factor to Year 1	[8]	$1/(1+[1])^y$	90.9%	82.6%	75.1%	68.3%	62.1%	56.4%	51.3%	46.7%	42.4%	38.6%
PV Year 1	[9]	[7]x[8]	13.6	12.0	10.5	9.2	8.1	7.1	6.2	5.4	4.7	4.0
Present Value	[10]	See note	80.7									

[2]: Initial investment of 100; thereafter $[4]_{y-1}$
[3]: 20 year straight line depreciation assumed
[10]: Sum of [9] for all years

3.3.2. Conclusions on pre-2009 depreciation methodolMogy

Using a single depreciation period for all DNOs helps achieve the objective of comparability. For example, we understand that DNOs are benchmarked on the basis of their depreciated asset base. Using the same depreciation period for all DNOs avoids the situation where a DNO appears to have a high and possibly inefficient asset base because it has a longer depreciation schedule.

However, we find that the method for estimating the single depreciation period comes at the expense of reasonableness, in the sense that the method overestimates the 2008 GAW-GA relative to the depreciation the DNOs have actually collected.

Under the method, DNOs will have a higher or lower GAW-GA than would be the case using their actual historical depreciation periods, depending on whether they have a longer or shorter depreciation period than average. Arguably, the decision to use an average depreciation period is somewhat subjective, and gives rise to subjective differences between the DNOs' 2008 GAW-GAs.

There seems to be no analytically simple way of estimating a single depreciation period for each DNO that does not bias the 2008 GAW-GA. Given this, an alternative method would be simply to apply each DNO's actual historical depreciation period. We understand that EK does not always have all the historical investment data for the DNOs, and has had to make estimates of investment costs for some DNOs. However, using actual depreciation periods does not make this problem any worse. The proposed method requires EK to estimate the 2008 GAW-GA's based on actual historical investments, and EK must estimate these investments regardless of whether it uses a single depreciation period or both. Where EK does not have information on actual historical depreciation periods it could use estimates based on the average of the other DNOs. It must do this under the proposed method in any case.

To avoid biases in benchmarking and improve comparability, EK could calculate a *separate* rate base using the same depreciation period for all DNOs, or just use the un-depreciated (but inflated) asset bases. In other words, EK could simply compare the historical investments in connections for the DNOs in its benchmarking exercises. This would avoid the issues in underestimating the 2008 GAW-GA, while ensuring that DNOs were comparable for the purposes of benchmarking.

Using the actual historical depreciation periods would on balance meet the criteria of objectiveness and reasonableness better, even if it complicates the issue of comparability.

3.4 **Choice of depreciation methodology after 2008**

As described in section 2, for depreciating the GAW-GA from 2009 onward, the method calculates a 'single year of investment' referred to as year T, for each DNO, based on the profile of connection investments between 1973 and 2008. For example, if T was the year 1985 for a DNO, then the method would depreciate GAW-GA until the year 1985 + D, where D is the total length of the depreciation period.

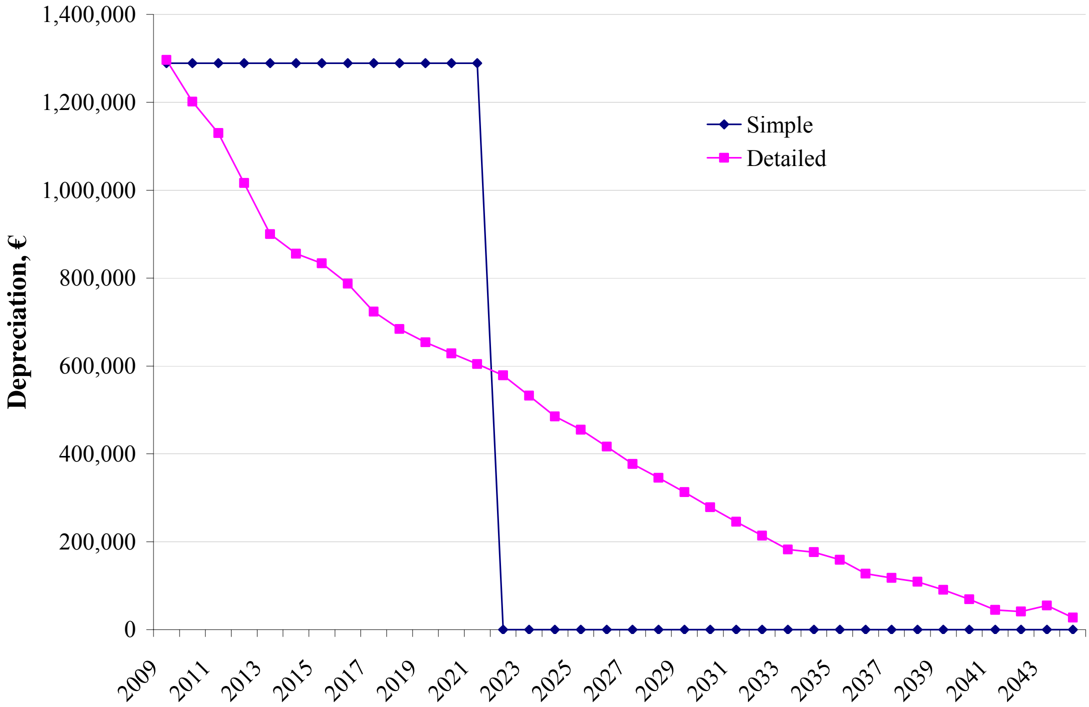
An alternative to the use of a single year T would be simply to depreciate each investment from the year in which it was made. For ease of reference we will refer to the method where all investments prior to 2009 are assumed to have taken place in year T as the 'simplified depreciation method', and the method where each investment is depreciated from the year it was made as the 'detailed depreciation method'.

Figure 5 below illustrates the alternative depreciation profiles under the simplified and detailed depreciation methodologies, for the light connections of a DNO picked at random. Note that the sum of the depreciation charges is exactly the same under both profiles, but the simplified method results in a shorter period of higher depreciation charges relative to the detailed method. The detailed method includes the depreciation of investments made up to 2008, and so the depreciation schedule continues for longer.

Use of the simplified method has a number of effects. First, it allocates more costs to the 'earlier' generation of customers, and less costs to the 'later' generation of customers that will use the connections after 2023 (in the example below).

Second, the simplified method will alter the PV of charges the DNOs receive by bringing forward depreciation in time relative to the detailed method. As we discussed above, lower revenues from a return on assets will partially offset the higher and earlier depreciation charges – but these two factors will not offset one another exactly. There will be a change in the PV of the total capital charges by using the simplified depreciation method.

Figure 5: Future Depreciation schedules for a DNO picked at random (light connections), using the detailed and simplified depreciation methods, assuming depreciation ends at year T +36 years



In our view the simplified depreciation method suffers from a number of drawbacks. First, it does not seem to best meet the goal of being objective. The use of a single year T from which to start depreciation is not 'incorrect', but neither is it standard. Therefore one could view this part of the method as a subjective decision which alters both the PV of DNOs' revenues and the way that costs are allocated between current and future users of the connections. Each DNO has a different T, so this part of the method does not make the DNOs more comparable.

One justification for using the simplified method might be that it is simpler than depreciating assets from the year in which they were built. However, in our view the 'simplified' method is in some ways more complicated, because several extra calculations are required to estimate the T for each DNO. We note that to calculate the 2008 GAW-GA the method already depreciates the investments from the year in which they were made up to 2008. It would be a simple matter to extend the depreciation calculations from 2008 to future years.

We also note that, while not one of the criteria, the detailed method will give customers greater tariff stability. In the example in Figure 5, under the simplified depreciation method the connection charges based on depreciation and return on capital would fall to zero in 2023, whereas the detailed method gives a much more gradual decline in depreciation and therefore tariffs.[7] Customers tend to prefer smoother changes in tariffs, and the detailed methodology would deliver this. In sum, the detailed depreciation methodology seems to better meet the criteria of objectivity, and is arguably simpler since it involves less calculation steps.

For the depreciation period for the period for 2009 onward, the method uses the depreciation period that each DNO applied in 2008. We agree that this is the most objective and reasonable method to use.

3.5 Connection point percentage

As explained in section 2, for heavy connections only the pipework up to the first valve between the distribution network and the customer counts as a gas connection for the purposes of calculating the GAW-GA. However, in most cases the DNOs only recorded the costs of the entire connection, including pipework and valves downstream. Therefore the method has to estimate how much of the recorded heavy connection costs should be allowed to contribute to the GAW-GA.

To determine this, EK asked the DNOs for their estimated ‘connection point percentage’ or the costs of pipework up to the first valve as a percentage of the total costs. Of the 12 DNOs, seven submitted their estimates of the level of the connection point percentage in their individual networks. The answers varied substantially between the DNOs.

Based on the responses from the DNOs, the method uses a connection point percentage of 38.5%. EK arrived at this figure by calculating the mid-point between the highest and lowest connection point percentages reported by the DNOs (which were 67% and 10% respectively).

We show in Figure 6 the connection point percentages reported by the seven DNOs who responded to EK’s request. The figure shows the connection point percentages for different types of connection. The percentages in the left half of the figure relate to installations while the percentages in the right half of the figure relate to renewals. A number of companies only reported a single connection point percentage figure. In these cases, we use this single connection point percentage for all the connections types shown in Figure 6.

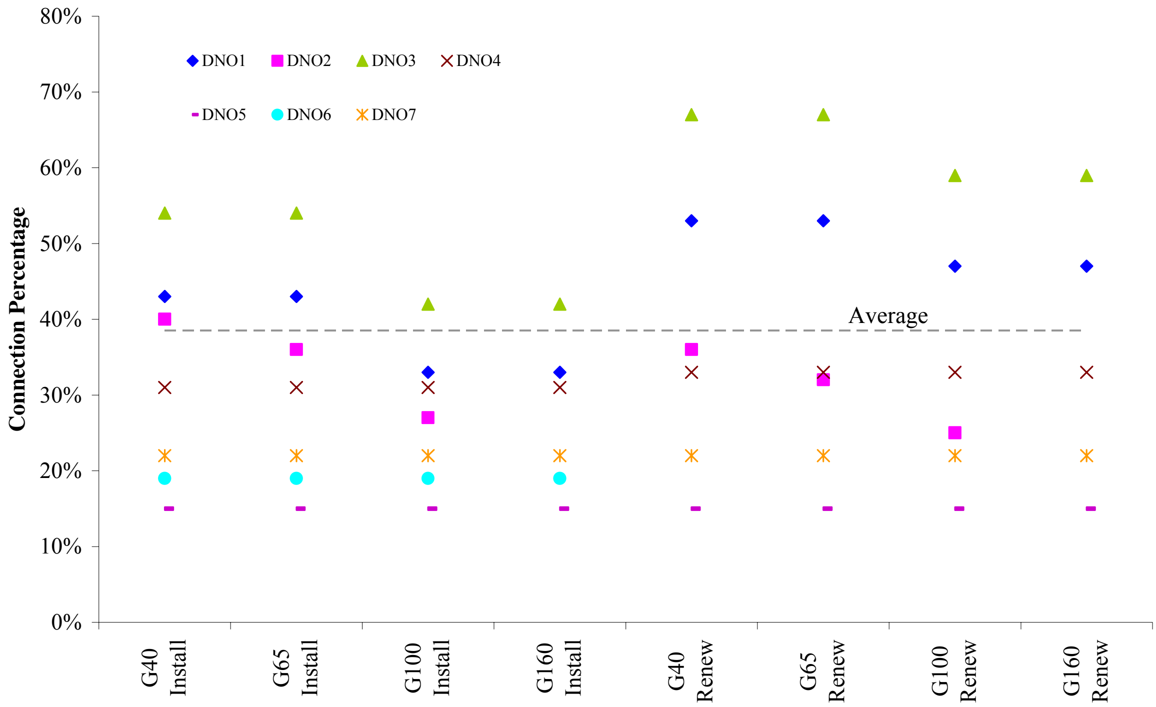
While we have not carried out any statistical tests, Figure 6 indicates that the connection point percentage for renewals is consistently higher than the connection point percentage for installations. The method’s connection point percentage of 38.5% is based on the highest percentage reported (67%) which is for a renewal. The highest figure reported for installations is 54% which is 20% lower than 67%.

Given the clear difference between connection point percentages for installations and renewals, it may be better to calculate separate connection point percentages for installations and renewals. If we use EK’s method but calculate separate connection point percentages for installations and

[7] In reality connection charges would not fall to zero because new investments would have been added to the GAW-GA since 2008.

renewals we arrive at 32.0% for installations and 38.5% for renewals. Using separate connection point percentages might better meet the criteria of objectivity and reasonableness. This approach is of course subject to the DNOs having data available on which investments were installations and which were renewals.

Figure 6: Connection Point Percentages Reported by DNOs[8]



The 67% used in the method was reported by a DNO for a renewal for a G40/G65 connection. This DNO also reports 59% for a renewal for G100/G160 connection. EK used 67% in its calculation but a figure closer to 59% might be more representative of all renewals if G40/G65 connections are more prevalent. In the absence of information on the number of each type of connection, a more objective approach might be to use a simple average of the percentages for all types of connection. This calculation could be performed for each DNO and the highest and lowest of the averages used in the EK's calculation. This approach would generate 31.5% for installations and 39.0% for renewals

EK calculates its connection point percentage as the mid-point of highest and lowest values reported by the DNOs. One potential problem with this approach is the mid-point may not be representative of the whole dataset if either the highest value or the lowest value is very different to the rest of the dataset. However, as Figure 6 shows, this problem does not occur with the connection point percentages reported by the DNOs. An alternative reasonable approach that does not have this potential problem is to calculate an average of the connection point percentages

[8] One of the DNOs reported that the connection point percentage would typically be less than 22% if the whole connection was installed by the same contractor otherwise the percentage would be more than 22%. As we do not know the split between connections that are built by the same contractor and those built by different contractors nor how much lower or higher than 22% the percentage typically is, we use 22% in the Figure.

reported by each DNO and then take an average of these averages. Separate percentages could still be calculated for installations and for renewals. Using this approach we arrive at a figure of 29.6% for installations and 35.7% for renewals. This approach could be refined by weighting by the number of connections.

Appendix I : Example of tax issues created by use of net investment

Table 12 illustrates a calculation with the charges and present value of a connection costing €800, where the DNO receives €650 as an up-front payment from the customer. Ignoring taxes, it looks as if the DNO earns payments with a PV of €800 – the same as the original investment.

Table 12: Receipt of up-front Payment, Ignoring Taxes

		Remaining Asset Balance							
	Up-front Payment	Beginning of Year	Depreciation	End of Year	Rate of Return	Return on Capital	Charge to Customer	Discount Factor	Present Value
	A	B	C	D	E	F	G	H	I
		150, then D_{t-1}	B_1 / 10	B-C		B x E	A+C+F	1, then $H_{t-1}/(1+E)$	G x H
0	650						650	100.0%	650
1		150	15	135	10.0%	15	30	90.9%	27
2		135	15	120	10.0%	14	29	82.6%	24
3		120	15	105	10.0%	12	27	75.1%	20
4		105	15	90	10.0%	11	26	68.3%	17
5		90	15	75	10.0%	9	24	62.1%	15
6		75	15	60	10.0%	8	23	56.4%	13
7		60	15	45	10.0%	6	21	51.3%	11
8		45	15	30	10.0%	5	20	46.7%	9
9		30	15	15	10.0%	3	18	42.4%	8
10		15	15	0	10.0%	2	17	38.6%	6
								Total PV	**800**

Table 13 shows the same situation but this time considering the effect of taxes. The PV is now only €754, €46 less than the investment. Note that it is not the effect of taxes that result in this short fall, but rather the tax effect of the up-front payment. If we did the same calculations as in Table 12 and Table 13 without an up-front payment then we would see that the PV of the cash flows to the DNO both with and without taxes was €800.

Table 13: Receipt of up-front Payment, Considering Taxes

		Tax Rate (τ)	25%											
		Asset Balance			*After-Tax*			Taxes						
	Up-front Payment	Beginning of Year	Deprec	End of Year	Rate of Return	Return on Capital	Charge to Customer	Deductible Costs	Net Income	Taxes	After-Tax Cash Flow	Discount Factor	Present Value
	A	B	C	D	E	F	G*	H	I	J	K	L	M
		150, then D_{t-1}	B_1 / 10	A-B		$A \times D \times \tau / (1-\tau)$	A + C + F	800 / 10	G-H	$I \times \tau$	G-J	1, then $L_{t-1}/(1+E)$	K x L
0	650						650	40	610	153	498	100.0%	498
1		150	15	135	7.5%	15	30	80	-50	-13	43	93.0%	40
2		135	15	120	7.5%	14	29	80	-52	-13	41	86.5%	36
3		120	15	105	7.5%	12	27	80	-53	-13	40	80.5%	32
4		105	15	90	7.5%	11	26	80	-55	-14	39	74.9%	29
5		90	15	75	7.5%	9	24	80	-56	-14	38	69.7%	26
6		75	15	60	7.5%	8	23	80	-58	-14	37	64.8%	24
7		60	15	45	7.5%	6	21	80	-59	-15	36	60.3%	22
8		45	15	30	7.5%	5	20	80	-61	-15	35	56.1%	19
9		30	15	15	7.5%	3	18	80	-62	-16	34	52.2%	17
10		15	15	0	7.5%	2	17	40	-24	-6	22	48.5%	11
												Total PV	**754**

* Matches Charge to Customer in Table 3.
† In year 1, F the up-front payment in A is also taxed.

Appendix II : Example of pre-2009 depreciation methodology

As mentioned in Section 3.3, the method uses a single depreciation period to depreciate the inflated rate base. This in turn changes the amount of total depreciation and leads to different GAW-GAs than the case where the actual depreciation periods are used.

Consider, as an example, the depreciation plan in Table 14, with equal investments each year over a period of 8 years. The depreciation period changes in year 6 and, by year 9, the total amount of depreciation is €590.

Table 14: Depreciation table using the two distinct depreciation periods

Depreciation		Investment /	Depreciation								
Period	Year	year	1	2	3	4	5	6	7	8	9
5	1	100	20.0	20.0	20.0	20.0	20.0				
5	2	100		20.0	20.0	20.0	20.0	20.0			
5	3	100			20.0	20.0	20.0	20.0	20.0		
5	4	100				20.0	20.0	20.0	20.0	20.0	
5	5	100					20.0	20.0	20.0	20.0	20.0
10	6	100						10.0	10.0	10.0	10.0
10	7	100							10.0	10.0	10.0
10	8	100								10.0	10.0
		Total									590.0

The method[9] would compute the single depreciation period by taking the weighted average of the depreciation periods, using the investments as weights. The weights are zero for those investments that have already been depreciated by year 9. This means that the weighted average relies entirely on investments made in year 5 onwards. However, as seen in Table 15, the resulting depreciation period of 8.75 years leads to a total amount of depreciation (€500) inferior to the one in the initial example (see Table 14). This was to be expected, since the method gives higher weight to more recent years, with longer depreciation periods.

[9] Our calculation differs slightly from the method, in that we allocate a full year of depreciation in the first year – in other words we assume that the investment is made at the start of the year. The method uses a mid-year investment. However this difference does not affect the argument above.

Table 15: Depreciation table using a unique depreciation period (proposed method)

Depreciation Period	Year	Investment / year	Depreciation 1	2	3	4	5	6	7	8	9
8.75	1	100	11.4	11.4	11.4	11.4	11.4	11.4	11.4	11.4	8.6
8.75	2	100		11.4	11.4	11.4	11.4	11.4	11.4	11.4	11.4
8.75	3	100			11.4	11.4	11.4	11.4	11.4	11.4	11.4
8.75	4	100				11.4	11.4	11.4	11.4	11.4	11.4
8.75	5	100					11.4	11.4	11.4	11.4	11.4
8.75	6	100						11.4	11.4	11.4	11.4
8.75	7	100							11.4	11.4	11.4
8.75	8	100								11.4	11.4
		Total									500.0

The alternative is to include all the investments with their respective depreciation periods when computing the weighted average. This leads, in this example, to a single depreciation period of 6.88 years as seen in Table 16. The total amount of depreciation resulting is almost equal to the one obtained using two distinct depreciation periods.

Table 16: Depreciation table using a unique depreciation period (Brattle method)

Depreciation Period	Year	Investment each year	Depreciation 1	2	3	4	5	6	7	8	9
6.88	1	100	14.5	14.5	14.5	14.5	14.5	14.5	12.7		
6.88	2	100		14.5	14.5	14.5	14.5	14.5	14.5	12.7	
6.88	3	100			14.5	14.5	14.5	14.5	14.5	14.5	12.7
6.88	4	100				14.5	14.5	14.5	14.5	14.5	14.5
6.88	5	100					14.5	14.5	14.5	14.5	14.5
6.88	6	100						14.5	14.5	14.5	14.5
6.88	7	100							14.5	14.5	14.5
6.88	8	100								14.5	14.5
		Total									590.9

However, when considering variable investments, we no longer get a total amount of depreciation equal to the one computed using two distinct depreciation periods. A depreciation period that will insure this condition is fulfilled can, most likely, only be obtained by several iterations, using a tool such as the Excel Solver.