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The costs & benefits of moving to full water metering

Science Report – SC070016/SR1 (WP2)

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Steve Killeen

Head of Science

Executive summary

INTRODUCTION

The Environment Agency's position statement on household water metering[1] calls for metering to be accelerated where it is most needed, i.e. in water stressed areas, with a target for the majority of homes in such areas to be metered by 2015. Over the longer term it expects metering to form the basis for charging for water across England and Wales.

The recently published Strategic Direction Statements for each water company show that they are seeking to accelerate metering, though only four have indicated that they will pursue compulsory metering in the short term. The Environment Agency is keen to ensure water company plans reflect a balanced assessment of metering that is consistent across all companies. Experience of compulsory metering is currently limited and this project sets out to consolidate and examine the available evidence in four key areas:

- Meter penetration;
- Rate of metering;
- Costs and benefits of metering;
- Implications of alternative tariffs.

METER PENETRATION

Overall household meter penetration is currently just over 30%. This section of the project assessed what level of meter penetration is reasonable to assume as "full" and the major influences on achieving that. Regulatory, technical and customer-related issues were explored.

Current funding arrangements, under optant (customer request for meter) and change of occupancy policies, allow companies to put customers on assessed charges where properties are deemed to expensive to meter. Very few households cannot be metered, though some will require more complex installations than are currently carried out. Two particular groups of properties were identified where metering can be more challenging (or expensive). These are those on shared supplies (estimated to be approximately 20% of properties overall) and flats. In order to achieve high meter penetration, more such properties would need to have meters installed, hence having implications for funding levels.

If meters are installed in all but the most complex situations, it was estimated that an overall household meter penetration of 92.7% would be achievable. This will vary in different environments depending on the property type distribution, with lower penetration rates feasible in inner city areas which have high proportions of flats and shared supplies compared with other urban and rural areas.

While the majority of customers think that metering is the fairest way to pay for water, they realise that metering will have to be paid for and they are concerned about the impact on bills. There is wider concern that water will become less affordable to those

[1] Household water metering: Position Statement. Environment Agency 2007. http://www.environment-agency.gov.uk/aboutus/512398/289428/1927662/?version=1&lang=_e

on low incomes or with specific water needs (for example large families and those with medical needs). There is evidence that good communication with customers is important in facilitating the efficient deployment of meters and for the benefits to be fully realised.

RATE OF METERING

To achieve 90% household metering by 2015 in the serious water stress areas would require a five fold increase in the rate of meter installation compared with that currently being achieved. This would present a major challenge to parts of the supply chain. The principal constraint identified was the lack of suitably trained personnel to carry out the installation programme. A co-ordinated and planned strategy across water companies could ensure that demand was even and could be planned for, and met, with maximum efficiency. Water companies were, on the whole, confident about their ability to deal with the demands of an increased metering programme, provided that adequate funding was allocated.

COSTS AND BENEFITS OF FULL METERING

There is no reported data on the costs of compulsory metering. However, data has been collected on the costs of metering under optant and change of occupancy (COM) metering polices upon which estimates for compulsory metering might be based.

Under a full metering programme, there are likely to be efficiencies in meter installation and discounts on procurement but there is uncertainty on how much this will be. Estimates are typically 10-20%. One practical example of potential efficiency savings is the fitting of appropriate meter boundary boxes during other works, for example stopcock replacement or mains rehabilitation. The marginal cost of a boundary box capable of taking a meter over one that does not is low and the potential savings when meters come to be installed are high. A rapid expansion of metering will put pressure on resources, particularly skilled installers, and there is uncertainty over the impact of the Traffic Management Act (TMA) as parts of the TMA directly affect utilities, eg. carrying out street works.

A full metering programme will impact on the operational costs of the industry. The meters will need to be maintained and replaced, and supporting services may also need to expand, for example dealing with increased customer enquiries. This could be viewed as an opportunity to build better relationships with customers, reinforce messages on water conservation and offer additional services.

The evidence for a reduction in consumption with metering of the order of 10% is quite strong. However, most of this comes from studies of optants, many of whom are water conscious before they switch to a meter. Recent information on the effect of compulsory metering is limited.

A cost benefit model for metering, based on typical data from across the industry and looking over 25 years, was used to explore the impact of different scenarios for full metering. The measure of cost benefit used was the average incremental cost (AISC). In water resource planning, an option with a low AISC is preferable to one with a high AISC. The modelling showed that in order to achieve meter penetration above 90%, the average cost of a meter installation will need to rise from its current level because of the need to meter some of the properties that are currently deemed too expensive to meter. However, the AISC would fall. Metering all properties would lead to a significantly higher increase in cost to deal with the most complex installations and, as the benefits in water savings would not rise in proportion to the additional costs, the AISC would also rise. Any efficiency savings in installation and equipment will reduce the average installation cost and the AISC. Stretching the installation programme over a longer period increases the AISC as benefits are accrued more slowly which outweighs the slowdown in spending on installation.

The impact of intelligent metering is difficult to assess. To realise the full benefits of intelligent metering, e.g. in overall leakage management, requires close to full metering over an area. The modelling suggests that if the additional costs of installing and reading intelligent meters are not excessive, the additional benefits would only need to be modest to make the use of intelligent meters worthwhile.

IMPACT OF ALTERNATIVE TARIFFS

The implementation of alternative tariffs is likely to require some form of intelligent metering in order to be able to capture an increased number of readings. There is considerable uncertainty in the costs associated with this and predictions vary depending on the degree of meter penetration and the actual systems considered. Evidence on the effect of alternative tariffs on water demand will emerge from trials that are commencing in a number of water companies. The efficacy of tariffs to achieve their aims in changing behaviour will depend on getting information back to the customer effectively and in a timely manner. This can be done retrospectively through bills or live, via multiple meter registers or a home display unit. Such units are currently being developed and trialled for energy and many of those currently on trial include the facility to also display water use. This is an area which will require further investigation such that equipment suppliers can develop appropriate solutions.

KEY CONCLUSIONS AND RECOMMENDATIONS

- An overall household meter penetration of slightly over 90% should be feasible though this will require some of the cases that are more difficult to meter to be tackled.
- To achieve over 90% household meter penetration, the funding for meters allowed by Ofwat will need to rise and therefore should be reviewed. Companies should build up a profile of the housing stock in their areas to identify the likely distribution of installations, and hence cost, to strengthen their case for funding.
- Customer support is essential to ensure that any compulsory metering programme can be implemented efficiently and enable the full benefits to be realised. Hence, a co-ordinated programme of engagement with customers should be developed supported by water companies, regulators and government.
- Changes to the planning process should be sought to ensure that water companies are automatically informed of the conversion of individual properties into flats or apartments.
- It is likely that more internal meters will need to be installed, particularly to help meter flats and properties on shared supplies. Hence the DG8 (OFWAT Guidance on standards of service including bills for metered customers) requirement for meter reading should be reviewed.
- In water stressed areas, the rate at which meters are being installed will need to increase by a factor of 5 to achieve over 90% household meters by 2015. This will be a major challenge to the supply chain, particularly in the availability of suitably skilled labour with competing needs from the Olympics and general development in the South East. A co-ordinated

strategy for increasing metering across all companies should be developed to mitigate these problems.

- Water companies are confident that there are no internal barriers to expanding metering, though initial experience suggests that changes to billing systems will be required.
- There may be scope for efficiencies in meter installation costs if compulsory metering is carried out in an area by area programme, though they may require changes in current working practices.
- Further data should be gathered regarding the full level of benefits likely to arise from a compulsory metering programme. This should include water savings through demand reduction and better leakage management.
- With full metering, automatic meter reading systems are likely to be needed for efficient and frequent reading of meters and to enable the benefits of metering to be realised. However, their higher cost will need to be recognised and funded.
- The implementation of alternative tariffs is likely to require some form of intelligent metering. The effect of alternative tariffs on water demand is not yet known, but evidence will emerge from trials that are commencing in a number of water companies and should be reviewed and disseminated as it becomes available.
- A consistent approach to cost benefit analysis for metering should be developed that would facilitate comparisons and exploration of different metering scenarios in the context of individual companies. This would include agreement on what cost items were included and how benefits should be calculated.

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Severn Trent Water	Groundbreaker Systems
Sutton and East Surrey Water	I&P Services Ltd.
Thames Water	Sensus Metering Systems
Three Valleys Water	Severn Trent Services
United Utilities	Waterfit Ltd.

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1.1 Background

Following a government consultation in early 2007, the Water Industry (Prescribed Condition) Regulations 1999 were changed in October 2007 to allow water companies to undertake compulsory metering in areas defined by the Environment Agency as being under serious water stress. Those companies who operate in areas defined as under serious water stress, are required to assess compulsory metering alongside other supply/demand options considered in their Water Resource Management Plans. This important change to the Regulations does not mean that these companies are obliged to meter on compulsory basis, just that they have the option if they believe it is appropriate.

The Environment Agency has called[2] for household water metering to be accelerated in water stressed areas, with a target for the majority of homes in such areas to be metered by 2015, though recognising that this may not be achievable for some companies until 2020. Over the longer term it expects metering to form the basis for charging for water across England and Wales.

The Environment Agency is keen to ensure water company plans reflect a balanced assessment of metering as an option and that this assessment is consistent across all companies. Experience of compulsory metering is currently limited and this project sets out to consolidate and examine the available evidence.

1.2 Project Objectives

The overall objective is to undertake an assessment of compulsory metering as an option to manage demand, with particular focus on:

- **Meter penetration** - When companies discuss "full metering" they talk about a range between 60% to 90% meter penetration. This wide range is of concern to the Agency and reflects the scarcity of information on the ease of metering particular groups of properties, such as flats. The objective of this area of work will be to assess what level of metering penetration is reasonable to assume as “full” and whether differences between different property types, water supply configuration and socio-geographic areas are fully justifiable. This assessment will need to be closely linked to the work on metering costs;

- **Rate of metering** - Companies express an inconsistent view on how fast it is reasonable for metering under compulsory powers to progress. The objective of this area of work is to develop an evidence-based position on what rate of metering constitutes a reasonable progress to full metering;

- **Costs and benefits of metering** - At the last periodic review a very broad range of costs for metering was presented. Recent work by WRc under its

[2] Household water metering: Position Statement. Environment Agency 2007. http://www.environment-agency.gov.uk/aboutus/512398/289428/1927662/?version=1&lang=_e

CP222A collaborative project[3] produced costs of optant and change of occupancy metering in terms of average incremental costs and showed a very wide range of values. There is no reported data on the costs of compulsory metering and an assessment is required of the base cost for the efficient purchase and installation of meters under a large scale compulsory metering programme. The objective of this area of work is to examine the validity of reasons for the current wide range of costs and to form an evidence-based view of what is a reasonable range of costs and benefits under different regimes, including intelligent metering scenarios.

1.3 Report structure

This report is divided up into a number of sections. Within each Section, short case studies are presented to illustrate significant points and at the end of each section a short summary of key points is included.

Section 2 describes the methodology and data sources used in the preparation of the report.

Section 3 examines meter penetration. It looks at current levels of meter penetration and identifies the factors that constrain metering, such as shared supplies, flats and the regulatory framework. The practical constraints are examined in three different environments – inner city, urban and rural areas. A summary table shows the relative proportions of meters in 6 different installation examples ranging from straightforward external to complex internal installations.

Section 4 examines the rate of metering. Current rates of meter installation are presented and compared with the rates that would be needed to reach full metering over periods of 5 to 20 years. The constraints to the achievable rate of metering are reviewed for both the water companies and the supply chain.

Section 5 examines the costs and benefits of metering. Data on metering costs are collated and the evidence for the benefits is summarised. A cost benefit model is used to explore the impact of different metering scenarios on the average cost per meter and the cost benefit in terms of an average incremental cost (AISC).

Section 6 examines what additional requirements the adoption of alternative water charging tariffs will impose on the technical requirements for metering. The meter technology requirements for different types of tariff, including rising block, seasonal and time of day are explored and their impact on costs is estimated.

Section 7 contains the conclusions and recommendations from the project.

[3] Godley A, Mobbs P, Davey A Cost-benefit Analysis of Metering Policies. WRc Report UC7381 June 2007

2 Methodology

2.1 Task 1 – Meter penetration

The factors that constrain installation of meters are identified. To do this the following sources have been used:

- The reports from the Isle of Wight metering trials;
- Data published by Ofwat as part of the June returns;
- Published data and papers from water companies and other sources;
- The cost benefit work carried out previously by WRc under CP222A to identify the limitations for change of occupancy metering (COM) and free meter option (FMO) policies;
- Discussions with a range of water companies via a workshop held at WRc in December 2007. The workshop was attended by representatives from 3 of the large water and wastewater companies and also representatives from 3 water only companies. Amongst the companies attending were those with experience in inner city, urban and rural areas;
- Water companies' Strategic Direction Statements;
- Direct contact with individuals, including extensive discussion with Folkestone and Dover Water – the only company to have started to install compulsory meters as a result of their water scarcity status;
- Discussions with meter installation contractors.

For each of the factors identified, the reason why the factor constrains meter installation is explored. Once the limiting factors have been defined, the potential meter penetration levels are assessed for 3 different types of area:

- Inner city - Typically inner city areas will contain a large percentage of flats – both purpose built and newer conversions, dense housing with a high proportion of shared supplies, high rates of movement, busy roads and a high proportion of rental property);
- Urban - The urban areas, small towns and city suburbs, typically contain a mix of property types (flats, terraced, semi-detached and detached) but at a lower overall density than the inner cities. There are more owner occupiers and customers are generally more affluent than those in the inner cities;
- Rural - The rural areas contain more scattered communities, with a large proportion of single family dwellings. There are fewer flats than in the preceding categories and there is a wide spread of customer incomes.

The proportions of different dwelling types in each area have been assessed from the 2001 Census data.

2.2 Task 2 – Rate of metering

There is little hard data on the rate of metering that can be achieved for compulsory metering policies, though numbers of meters installed under current optant and COM policies are taken from the June returns.

The number of unmeasured households is also given in the June returns for each water company, thus the number of properties in each water company that require meters installed in order to achieve a given meter penetration can be calculated. An estimate of the rate of metering necessary to achieve that penetration can be obtained by dividing that total by a timescale. The rates of metering to achieve 80%, 90% and 100% of household meter penetration over timescales from 5 to 20 years are calculated and compared with the rates of metering being achieved under existing COM and optant policies.

The data sources used were as for Task 1 but there was wider consultation with the supply chain via the Society of British Water and Wastewater Industries (SBWWI) whose membership includes a wide range of meter technology suppliers and metering contractors (a full list of the SBWWI members can be found on their website www.sbwwi.co.uk). SBWWI members with an interest in metering were contacted and sent a questionnaire, see Appendix 1. This was followed up by further targeted discussions.

2.3 Task 3 – Review of costs and benefits

The previous WRc project CP222A on cost benefit analysis for optant and COM metering collected a significant amount of data on metering costs from the 8 water companies that participated and reviewed the literature available in this area. This was used to provide a starting point for assessing costs and benefits of full metering for this project. Input was sought from the water companies and the supply chain about the efficiencies that might be obtained in moving to a systematic full metering programme.

The cost benefit analysis in this project was carried out using a modified version of the model developed for WRc Project CP222A. In this model, to allow the costs and benefits to be compared with other water management options, the long run marginal cost (LRMC) is estimated using the average incremental cost (AISC) approach including social and environmental costs, as according to the method in the UKWIR EBSD report[4]. The AISC for each policy is calculated in pence per cubic metre (p/m^3) as:

$$\text{AISC (p/m}^3\text{)} = \frac{\text{NPV (costs, over and above the “as if unmeasured” position)}}{\text{NPV (water saved, over and above the “as if unmeasured” position)}}$$

The AISC is calculated over a 25 year time horizon to ensure consistency with the water resources plan forecast period. As meters typically have a lifetime of 15 years, meter replacement needs to be included when examining the costs over this time period.

For the purposes of this project, a fixed discount rate of 5.5% was used.

The key changes that were made to the model were:

- Incorporating the 6 categories of meter installation developed in Task 1;

[4] The Economics of Balancing Supply & Demand (EBSD) Guidelines Report Ref. 02/WR/27/4. UKWIR

- Building the profile of meter installation from the mix of dwelling types in the 3 different environments (inner city, urban and rural);
- Incorporating a cost efficiency by which base costs may be reduced;
- Setting a timescale over which meters would be installed.

To provide consistency with the previous work, it assumes a fictitious water company with 1 million households that are distributed between inner city, urban and rural areas according to the analysis carried out in Task 1 from the Census data. The base costs have been taken from the central data set for COM metering derived during CP222A.

A number of metering scenarios are explored using the model to determine what the key factors are that drive the cost benefit.

2.4 Task 4 – Potential types of tariff and implications for meter costs

In this task the technology implications of various alternative metered tariff options are explored. This is largely drawn from previous work carried out for the industry by WRc. An overview of the tariff trials that are commencing in the UK is included.

3 Meter penetration

3.1 Definition of meter penetration

Meter penetration can be measured in two ways:

- the percentage of properties where consumption is metered; or
- the percentage of customers receiving a bill based on a meter reading.

This is an important distinction when considering what approach should be adopted for multi-occupancy buildings or areas such as caravan or mobile home parks which will typically have a bulk supply meter in the inlet to the site, with site managers being responsible for the bill and recovering water charges from the tenants. So whilst the overall consumption of those properties is being metered, individual householders are not receiving individual metered bills from the water company. In some cases, the site manager may have installed sub-meters to each property to allow the disaggregation of bills.

There is also the distinction of household and non-household properties. This report focuses on the metering of domestic customers. However, under Ofwat's definitions for "households" and "non-households", multi-occupancy buildings can be classed as household or non-household depending on how the standing charges are allocated. A block of flats where a single aggregate bill is issued to cover separate dwellings having individual standing charges (even if that standing charge is zero), is classed as household and the number of individual dwellings is counted in the reporting figures for total households. However, blocks of flats, multi-use properties (e.g. flats over a shop) or caravan parks are counted as non-household if they are covered by a single standing charge. In the reporting figures, these are counted as one non-household property, despite the fact that they may include a number of individual domestic dwellings. For flats, this situation can occur with buildings that have been converted to individual dwelling units and the water supplier is unaware of the conversions (see also 3.3.5).

The definitions of households and non-households make it difficult to accurately assess domestic meter penetration as the total number of individual domestic dwellings is not known precisely. Clearly a household meter penetration calculated on the number of connections will be higher than one based on individual customers, the difference depending on the number of connections covering more than one dwelling.

To send out signals to individual customers regarding water use, a metered bill per household would be preferable.

3.2 Current household meter penetration

The current rates of household meter penetration for each water company, as taken from the 2006/07 June Returns[5] are given in Appendix 2. They range from 7.9% households (Portsmouth) to 65.9% (Tendring Hundred). Overall household meter penetration is 30.3%, though there is a difference between the companies in water stressed areas (34.3% overall) and the rest (27.3% overall).

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[5] Security of Supply 2006-07 report. Ofwat 2007

3.3 Non-household meter penetration

Metering of commercial premises has been the norm for many years and, whilst this report is primarily concerned with domestic properties, it useful to note that the proportion of non-households metered in England and Wales was reported as 88.2% for 2006/07 and has only risen from 86.4% since 2002/03. There is some variation from company to company, from 80.5% for Southern Water to 97.6% for Tendring Hundred (2006/07 figures). The unmetered non-households are typically those with very low usage (where the cost of a meter cannot be justified from the revenue received), infrequently used properties or those where a meter cannot be fitted without significant alteration to the plumbing or other major work. On this basis, it would not be unreasonable to assume that, as a first estimate, a similar figure (around 90%) could be considered as full metering for households.

Appendix 2 also shows the proportions of non-households billed on the basis of a metered reading by company as taken from the 2006/07 June Return data published by Ofwat.

3.4 Current forecasts

3.4.1 Ofwat

Ofwat has issued a consultation on the future strategy for customer charges for water and sewerage services[6]. Section 3.2 of the Ofwat consultation document deals specifically with metering. Ofwat state that they see increased metering as crucial to the development of volume based charging schemes and the development of tariffs to support demand control and competition, though recognise that there will be an associated cost. Ofwat strategy will be to support more rapid progress towards high levels of meter penetration where this is shown to be appropriate in companies' water resource plans and their Strategic Direction Statements.

3.4.2 Environment Agency

The Environment Agency have issued a position statement on household water metering[7] calling for metering to be accelerated where it is most needed, i.e. in water stressed areas, with a target for the majority of homes in such areas to be metered by 2015, though recognising that this may not be achievable for some companies until 2020. Over the longer term it expects metering to form the basis for charging for water across England and Wales.

3.4.3 Defra

Defra, in its recent Future Water document[8], remains cautious about any increase in domestic metering, though believes that universal metering in water stressed areas will

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[6] Ofwat's future strategy for customer charges for water and sewerage services: a consultation. Ofwat January 2008

[7] Household water metering: Position Statement. Environment Agency 2007. http://www.environment-agency.gov.uk/aboutus/512398/289428/1927662/?version=1&lang=_e

[8] Future Water. The Government's Water Strategy for England. Defra. January 2008

be required by 2030. Whilst it acknowledges the potential benefits, it recognises that these come at a cost. It does welcome the commitment to metering that companies have made in their Strategic Direction Statements. Defra have also announced a consultation on water charging that will be carried out later in 2008.

3.4.4 Water companies

Water companies provided Ofwat with their projections for household meter penetration for PR04 and beyond as part of their PR04 submissions. These are shown graphically in Figure 3.1. The most optimistic of those projections at the time was that from Folkestone and Dover who were predicting a growth to 94% household meter penetration by 2020. Folkestone and Dover are the only company to date to have applied for and been granted water scarcity status enabling them to introduce compulsory metering. The next highest projected figure was that for South West Water who were predicting a household penetration of 92% by 2030. South West has a high rate of optants due to their relatively high bills. The remaining companies were predicting <90% household meter penetration by 2030, with 5 companies predicting less than 50%. Only Folkestone and Dover were predicting to have over 80% of households metered by 2015. It can be seen from the figures in Appendix 2 that, for 2006/07, all the water companies were at or slightly ahead of those projections. However, for most companies full metering, even over the next 25 years, would represent a significant advance on these plans.

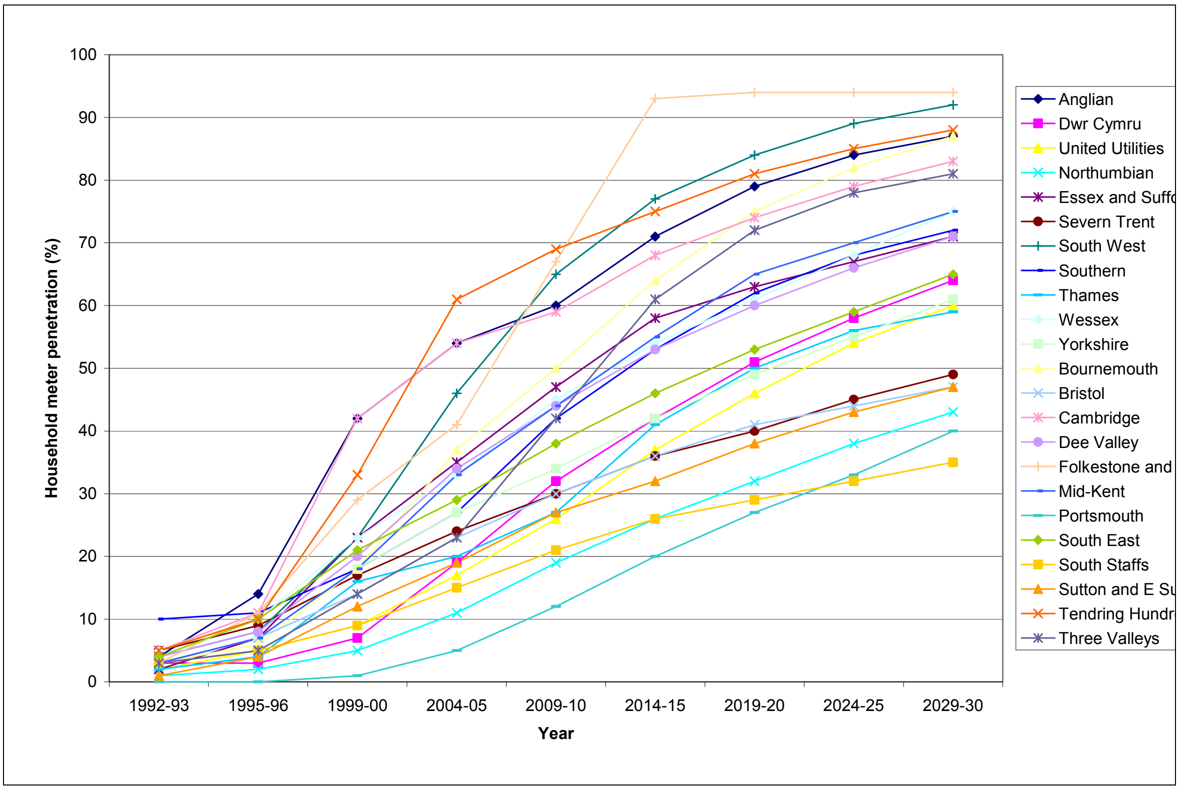

Figure 3.1 Household metering predictions from PR04

Water companies have updated their PR04 plans as shown in the recently published Strategic Direction Statements. These are summarised in Table 3.1. Detailed statements from each company on metering extracted from the Strategic Direction

Statements are given in Appendix 3. According to these Statements, only four companies are currently looking to pursue compulsory metering, though five others have indicated that this is a possibility for the future. Nine companies are planning to achieve full (90% or more) metering though over timescales ranging from 5 years to 25 years. For the industry overall, these plans represent an acceleration of metering when compared with the PR04 plans. However, for many companies in water stressed areas they still fall short of the Environment Agency's ambitions.

Table 3.1 Metering plans from Strategic Direction Statements

			Policies to be pursued		
Company	**% HH meters**	**By**	**Optant**	**COM**	**Compulsory**
Anglian Water	Full	2035	Y		
Bournemouth & W Hants	Full	2035	Y	Y	Possible
Bristol	Full	2035	Not stated		
Cambridge	Full	2035	Not stated		
Dwr Cymru	No commitment		Y		
Essex & Suffolk	Full	2020	Y	Y	Possible
Folkestone & Dover	90%	2012	Y		Y
Mid-Kent	>60%	2015	Y	Y	
Northumbrian	40%	2020	Y		
Portsmouth	80%	2035	Y		Possible
Severn Trent	No commitment		Y	Y	
South East	>60% 80%	2015 2020	Y	Y	Y
South Staffs	70%	2025	Y	Y	
South West	85%	2015	Y		
Southern	Full	2015	Y		Y
Sutton & East Surrey	70% 90%	2020 2025	Y	Y	Possible
Thames	50% 80%	2015 2035	Y	Y	
Three Valleys	81%	2030			Y
United Utilities	Full	2035	Y	Y	Possible
Wessex	70% 85%	2015 2035	Y	Y	
Yorkshire	No commitment		Y		

3.5 Regulatory issues that influence meter penetration

3.5.1 Promotion of metering

The primary reasons cited for moving to full metering are:

- **Demand control / reduction** – the evidence suggests that a reduction in demand is achieved when people are moved on to meters (see Section 5.6.1). Full metering would also allow the use of alternative tariffs which could be used to further influence consumption and demand patterns. Demand control and reduction also has benefits in terms of limiting the need for water resource development, and reducing pumping and treatment needs, hence contributing to carbon reduction;

- **Charging** – full metering would provide a basis for an equitable charging mechanism across all customers. Each consumer would pay for what they used. The method of charging based on out-dated rateable values would be eliminated. It could also facilitate the development of tariffs and support mechanisms to address affordability affecting those on low incomes and other vulnerable groups;

- **Improved data on water use –** better information on actual usage would enable the uncertainty in leakage calculations to be reduced and allow better targeting of leakage detection and reduction effort.

The objective of a well designed metering strategy should be to capture all these benefits. However the way that full metering is encouraged or promoted by the government and regulators through public statements or the regulatory regime may affect how full metering is implemented. A lack of clear unequivocal direction to date from Government in favour of metering was cited by a number of those consulted for this project as a significant barrier to metering.

For example, if the goal was set to achieve full metering and companies were simply pushed to drive up meter numbers, they could initially target areas and properties that were easier to meter, thereby putting in large numbers of meters. However, this could be viewed as unfair to certain customer groups, as some types of property are easier to meter, making the policy open to challenge. This policy may not address supply demand or affordability issues and will not maximise the opportunities for better leakage targeting. Thus, the early rise in meter numbers could be quite rapid but tail off as the more difficult (or expensive) to meter properties have to be tackled. The benefits would increase more slowly and only be fully realised as the properties harder to meter were tackled.

If, however, metering for demand management were to be encouraged, companies would initially prioritise those resource zones that have a supply demand deficit or relatively high leakage. This would generally have a mix of property types and include some more difficult to meter properties. The benefits of leakage identification and targeting would be better achieved within a fully metered area. However, when viewed company wide, the overall meter penetration may be lower at first, though the growth in meter numbers over time might be more even.

Both approaches would reach the same point eventually, though in the second case the benefits would start to accrue earlier.

Certain property types, such as flats or terraces with very small or no gardens, tend to have low discretionary use. A full metering policy promoted to reduce demand may have less impact on customers living in these types of property compared with those living in properties with large gardens and higher discretionary usage. The question arises as to how much effort is justified in metering flats and certain terraces if there are little water savings to be made. However, metering coupled with an appropriate tariff mechanism could be effective in controlling demand patterns, for example reducing peak demand, which could be beneficial in certain areas. The arguments for leakage targeting and equitability of charging also remain.

3.5.2 Funding and change from current policies

Current optant and COM metering policies allow companies some discretion as to who they meter and how. Existing regulations allow companies not to install a meter if it is deemed too expensive or technically difficult. It is clear that different companies have different policies on where they draw the line. This even varies within a company depending, for example, whether it is an optant or COM meter. Generally, companies try harder to install an optant meter as that is being driven by a willing customer.

In WRc project CP222A[9] the 8 companies participating in that project were asked for data on the number of successful and unsuccessful meter surveys carried out under existing policies. A successful survey was one that culminated in a meter being fitted either at the time of the survey or on a subsequent visit. An unsuccessful survey was one where the survey was carried out and a meter was not installed. The success rate for COM meters averaged 70.3% across those companies carrying out a COM policy, though there was a wide range from company to company from less than 50% to more that 90%. The success rate for the optant policy averaged 83% across all 8 companies, with over half the companies surveyed reporting success rates of 88-92%.

Under a compulsory metering policy, companies will need to try and meter as many customers and connections as possible. Thus serious consideration would need to be given to metering those properties currently deemed “too difficult” to meter. This is likely to impact on costs and customer attitudes (see Section 3.7). The question then is one of what cost is deemed too high.

One key point that came over in the discussions with water companies was that the level of funding is a key driver in the increase of meter penetration. Companies are currently funded an average of £200 per meter to install meters, though Ofwat permit some variation depending on local conditions, such as cost of contractors, and the proportions of internal and external meters fitted.

The actual costs vary considerably from a simple low cost installation in an existing boundary box to a complex installation in a flat or a remote rural property. Currently companies try and balance out the costs so that, overall, all costs are covered by the funding provided. Concerns were raised that the unit costs currently used for funding have been derived during a period when water companies could effectively choose whether to meter a property or not (i.e. companies would probably not do an expensive meter installation), and would not adequately reflect the actual costs under a compulsory metering programme.

Inadequate funding of meter installation, particularly to cope with the difficult to meter cases, therefore, could be a significant barrier to universal metering. Under a compulsory programme, companies would need to evaluate the proportions of different

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[9] Godley A, Mobbs P, Davey A Cost-benefit Analysis of Metering Policies. WRc Report UC7381 June 2007

types of installation that would be required throughout their region, given the factors that are described in the following Sections. Ofwat could then take a view on how to fund the installations (based on an average cost or on different installation scenarios) and at what level. Funding allowances also need to recognise the on-going costs of metering. Meters need to be replaced - typically the mechanical meters currently used have a life of 15 years - read and incur higher costs through increased enquiries, for example (see Section 5).

3.5.3 DG8 targets

Ofwat defines DG8 as a performance indicator that shows the percentage of metered customers who receive at least one bill during the year based on a meter reading taken by either the water company (or its representative) or the customer (Ofwat definition). Water companies see this indicator as one barrier to increasing meter penetration. Companies would rather not install an internal meter, unless it can be read from outside the property, as this leads to problems getting access to a meter, and hence potentially falling short of their DG8 target. The costs of reading an internal meter can rapidly spiral if individual appointments need to be made, or repeat and evening visits are required. If the target reading rate for internal meters were reduced or even excluded from the DG8 register, it would remove this barrier. The alternative is to fit internal meters with AMR capability but this adds to cost.

3.6 Technical issues that influence meter penetration

3.6.1 Shared supplies

In a full metering programme, it would be desirable to meter every property. A modern property has a dedicated connection to the water main that allows the installation of an external meter on that supply. However, it was not until the 1991 Water Industry Act that individual properties were required to have a single supply. Therefore any property built up to this time could have a shared supply, although this is less likely in less densely populated areas. A shared supply can feed from 2 to 10 or more individual houses.

Precise data on the number of shared supplies are hard to come by as they are not a reported figure. Bristol Water estimated in 2005[10] that up to 20% of the 400,000 properties in the Bristol Water area were on shared supplies. As poor pressure complaints are common on shared supplies, some data is published in the supporting documentation to the June Returns in the sections dealing with levels of service in relation to pressure. Table 3.2 summarises this information, where it has been possible to identify such data in the 2006/07 returns.

[10] New supplies customer information. Bristol Water. March 2005

Table 3.2 Estimates of shared supplies

Company	Estimated % shared supplies	Basis
Anglian	19%	Review of common services in 2000.
Bristol Water	24%	Information is obtained from a GIS report, which details the number of single and common communication pipes for all surveyed connections. The GIS report indicated that 24% of Bristol's connections are by common supply pipe (119,958 common connected properties).
Cambridge	16%	During 1995-96, a study of five Cambridge wards and eleven rural parishes (representing 30% of the Company's connected properties) was undertaken to assess the number of properties served by a common service pipe. By extrapolating these figures, the estimated number of properties served by a common service pipe is 20,500 properties.
South West	10.5%	A study of properties fed from common supply pipes was undertaken by SWW Rehabilitation Department in 2006.
Tendring Hundred	14%	Review of communication pipes in 2003
Thames	30%	Thames Water has previously assumed 30% of its properties are on common supplies. During 2006/07 the Company employed an external consultant to survey the properties on the DG2 register at the end of the 2005/06 report year. 93% of these properties were surveyed. Of the properties surveyed, 19% were fed from a common supply, 5% were not possible to conclude and 1% were recorded as a single supply however were in fact a common supply. Thames concluded that its overall estimate of 30% was reasonable.
Yorkshire	16%	Not given

On the basis of this data, the assumption can be made that, nationally, between 15 and 25% of properties are likely to be on shared supplies. There is variation from company to company depending on the types and ages of properties prevalent in each area and historic plumbing practices. Inner city areas, particularly those with significant amounts of terraced houses built in the 19th and early 20th centuries will have higher proportions of shared supplies than urban and rural areas or areas with more newer housing.

Case study – Distribution of shared supplies

A detailed study for a major water company carried out in 1999 looked at some 1200 service pipes across all areas of the company. The area covered by this company included a large city and several smaller towns and cities with strong industrial heritages. The service pipes were analysed by various factors, including number of properties supplied, property age and type. The detailed tables in Appendix 4 show the relative proportions of shared supplies by property type and age.

For this water company, the proportions of properties served by shared supplies were:

- 32% of properties overall;
- 40% of properties built before the end of the Second World War;
- 54% of terraced properties built before 1979.

Conclusion

Shared supplies are common and more likely to be found on certain types and ages of properties.

The options for metering shared supplies include:

- Metering at the point where the individual property supply comes off the common pipe. However, experience shows that this could often be under a paved yard, building extension or outbuilding; it would not allow losses in the common pipe to be identified or accounted for and it would preferably require some form of AMR to avoid access problems if the metering point was, say, in a locked back yard;
- Installing internal rather than external meters. In older terraced properties it was common to have an outside lavatory, the water supply for which often branched off the common supply pipe leading to the house. Whilst the majority of outside lavatories have been demolished or turned into sheds or other outbuildings, it is not uncommon for these supplies to be still live, e.g. feeding an outside tap. Clearly such supplies would not be captured with an internal meter but would need to be identified and either re-routed or metered independently;
- Replacing shared supplies with individual supplies. Separating supplies can be a time-consuming and expensive exercise, generally involving installing a complete new supply to one or more of the properties affected, and, under the current rules, one for which the customer generally has to pay (typically an overall cost of £1500-£3000). However, customers are unlikely to be willing to pay for this simply in order to allow the water company to fit a meter. Many shared supplies were installed at a time when demand was lower and hence customers on such supplies now experience low pressures at times of peak demand. Customers may be persuaded to contribute to costs if they see significant benefits in service improvements. In some cases water companies will contribute towards the costs of separating shared supplies, if there is a benefit in leakage reduction or part of the pipe is made from lead which companies are funded to replace. There may also be the possibility of the water company carrying out such replacements more efficiently during, for example, mains replacement programmes.

Case Study - Separation of shared supplies

A pilot exercise[11] was carried out by South East Water in Basingstoke, whereby shared supplies in a DMA were targeted due to high leakage levels. Waste notices were sent to customers on shared supply pipes known to be leaking. Many customers responded that they were suffering poor pressure and a recommendation was made to separate the supplies. Initial customer response was hostile so a public meeting was held with residents to explain the problem and the responsibilities of customers for supply pipes. The solution of separating supplies was accepted by the residents as the only viable solution. For a particular group of 10 properties on a shared supply, the overall costs, including meter installation and administration came to around £2000 per property. South East Water bore almost 40% of the cost with the remainder being paid for by the customers.

Conclusions

Separation of supplies can be beneficial to the water company (e.g. reducing leakage) and the customer (improving service).

The cost of separating supplies and installing meters is around 10 times the cost of installing a meter on a discrete supply.

Customers need to be persuaded of the benefits of individual supplies and be better informed of their responsibilities regarding supply pipes, especially where these are common to a number of properties.

- Bulk metering. The bulk metering of shared supplies as a basis for billing is unlikely to be acceptable to customers and consumer groups and unlikely to achieve any benefits in demand reduction. However, a bulk meter could provide detail on the actual volume being used which might be valuable in leakage estimation and targeting leakage activity within an area, and so even though not used for billing, would still have a benefit.

The view of the water companies was that, although expensive, separating shared supplies to allow individual external meters was the optimum solution.

Case Study – Dealing with shared supplies

Folkestone and Dover Water found a number of properties on shared supplies whilst implementing compulsory full metering in Lydd, a small town close to the South East coast. In such cases, internal meters were fitted where possible. However, in a number of properties considerable modification to fitted kitchen units would have been required in order to fit a meter. Installers do not have the powers or skills to carry out such modifications and hence the meters could not be installed. For some shared supplies, Folkestone and Dover also installed bulk meters on the common supply. This allows for the identification of leakage on the common pipe and allows usage for any properties on that supply that are not individually metered, to be estimated based on the reading from the bulk meter less the sum of the readings from the individually metered properties. This approach requires that all meters are read at the same time which would be facilitated by an AMR system. Modifications to the billing system were also required to allow the difference to be calculated.

[11] Moss R, Bradley D. A Practical Approach to Analysing and Repairing Private side Leakage. Presentation to SBWWI Leakage Seminar November 2007

Conclusion
Folkestone and Dover estimate that if installers had the powers and skills to modify kitchen units, projected household meter penetration could be increased from 90% to 95%.

3.6.2 Internal or external meters

There are two common places for a meter to be located: on the supply pipe at the property boundary (external) and at the termination of the supply pipe as it enters the property (internal). The choice of internal and external meters is not in itself a barrier to increasing meter penetration though meter location influences the costs and has other implications, e.g. for regulatory reporting (see 3.2.8).

The pros and cons of internal and external meters are summarised in Table 3.3.

Table 3.3 Main issues regarding internal and external metering

	Internal meters	External meters
Installation	If straightforward, generally cheaper than an external fit (unless the boundary box is already present), though under a compulsory programme access could be a problem Installers do not have powers or skills to modify fitted kitchen units	Generally more expensive than internal as a boundary box has to be fitted. However, if boundary box already exists, installation costs are cheaper than internal
Meter reading	Access to meter can be more difficult, unless touch pad system or other AMR is fitted.	Generally easier, but can be problems with flooded chambers and obscured registers. Touch pad or other AMR can help.
Customer reads	Easier for customers to take own reads	More difficult for customers to take own reads
Meter replacement	More difficult to access meter so cost is higher. Greater skill level required.	Easier and cheaper.
Operating environment	Generally more benign operating conditions	Harsher conditions, leading to more misting on the register, broken registers, corrosion and possibility of third party damage
Supply pipe leakage (SPL)	No information can be gained regarding SPL.	Potential to identify supply pipe bursts and larger leaks.
Meter technology	In-line or manifold meter types possible. Wider choice of meters (rotary piston, jet, disc, fluidic, ultrasonic, electromagnetic)	Manifold format only. Limited choice (rotary piston, fluidic).
Customer	Customer more aware of water	Customer less aware of usage,

perceptions	usage as meter is easier for them to read. Under compulsory metering programme, non co-operation of customers could hamper internal fits	meter is remote, easily forgotten and difficult for customer to read.
Security	Easier to tap off from supply before meter	Harder to by-pass meter

External meters are the preferred option for most situations. Meters can frequently be installed in the footway, eliminating the need to gain access to the property, and any leakage on the supply pipe can be more readily detected. However, there are a number of instances where external installations can still be difficult or expensive, for example where there is no footway and a meter has to be installed in a driveway, particularly if that driveway has a decorative surface, e.g. block paving, which can make re-instatement difficult.

With the older terraced houses, particularly those on shared supplies, supply pipes frequently run under backyards which are paved or have had outbuildings built, often on top of the supply pipe. This makes locating the supplies difficult, both technically and from the point of gaining access into locked back yards etc. Many, particularly very old, properties may not have individual external stopcocks. The choice then is to install an internal meter, probably the cheaper and easier option but negating any potential benefit of service pipe leakage detection, or put extra effort into locating the supply and fitting an external meter. Some properties will have branches off to feed outside lavatories or taps.

A key consideration for locating meters externally is that supply pipe leakage (SPL) is picked up more quickly since the consumption due to the leak shows on the meter reading (at least for larger bursts). Starting flows for mechanical meters are typically around 2 litres/hour (starting flows for solid state meters tend to be higher) and hence they are not guaranteed to identify smaller leaks on the supply pipe and a supply pipe leak of around 25 to 50 l/day could run undetected. Adding intelligence to the meter can allow continuous low flows to be detected and an alarm to be raised. More frequent reading, for example via AMR, can also improve the detection of supply pipe bursts and reduce leak run times. For supply / demand control therefore, external meters have benefits over internal meters and intelligent meters have benefits over traditional meters.

A third option starting to see use in new developments is the installation of meters within an insulated wall box on the wall of the property (as is common practice with gas and electricity meters).

Case study – Wall Boxes

Portsmouth Water has adopted wall boxes (8) for many of its meters in new build properties. The advantages are:

- the elimination of costly problems associated with boundary boxes arising from working in the highway / footpath
- they are simple for a developer to fit;
- they avoid crossed supplies;
- the meter is readily accessible to the customer.

Portsmouth Water insists on a continuous supply pipe to the box with the stopcock also located inside the box. This eliminates any joints and hence potential sources of leakage and both reduces and simplifies stopcock replacement; stopcocks in boundary boxes are prone to seizing and failure and are costly to replace. On new builds, the use of the wall box had improved installation productivity for the water company. On the whole, customers were positive about the boxes but some had been covered up and mention was made about the need to have separate boxes for each utility.

Conclusion

Wall boxes offer an alternative installation to boundary boxes and internal installations. They give benefits in terms of accessibility and, when a continuous supply pipe is used, reduce the number of joints and therefore potential of leakage.

A push towards full metering is likely to lead to a larger proportion of internal meters in order to accommodate shared supplies, flats etc.

3.6.3 Flats and other multi-occupancy dwellings

There are a number of specific issues associated with flats and multi-occupancy dwellings that impact on the ability of a water company to easily install a meter and hence the costs of installation. These can apply equally to purpose built blocks or conversions of older properties, regardless of whether they are currently classified as households or non-households (see Section 3.1).

Plumbing

Whilst the water supply in many blocks of flats is via a single service pipe to each flat and a common accessible area for meter installation, the plumbing in other blocks of flats is not straightforward or designed to facilitate metering of individual flats. Complications include:

- More than one water entry point for each flat (e.g. one common supply for all kitchen supplies and a second feeding all bathrooms);
- Hot water supplies fed from a common hot water header tank, known as back supplies. These are frequently found in converted properties and old blocks;
- Cross supplies. Even where each flat has a separate supply it can be difficult reconciling each supply to the corresponding flat;
- Common pipe leakage. In the case where there is a single riser with an individual take off for each flat, it would be feasible to put an internal meter at the entry point to each flat. However, identifying and accounting for any losses in the common supply pipe then becomes a problem.

There are solutions to all the above issues, though they would add cost to the metering installation. For example:

- In cases where a flat has more than one water entry point, there are no technical barriers to installing a meter on each supply and summing their readings for the total consumption. This obviously adds to the installation cost and may require amendments to billing systems to accommodate multiple meters against a single household. It would probably also require some form of AMR to ensure that readings could be captured from all the meters at the same time.

- Reconciliation of supplies to individual flats requires sufficient time, resources and the co-operation of tenants. There are also methods and tools available that may help in some situations.
- A mass balance from simultaneous readings of a bulk meter on the common supply with individual meters on each flat should enable serious leaks on the common pipe to be identified.

Changes to the planning rules or building regulations could also ameliorate some of these problems, for example if there were to be a statutory requirement for each individual flat to be converted to a single supply or have a meter, or meter box, installed during refurbishment or conversion to flats.

Identification of conversions

There is currently no obligation on developers or councils to inform water companies of a planning submission for the conversion of a large property to flats. For a small water company only dealing with a small number of local authorities, it is feasible to subscribe to local planning registers and obtain this information. For large water companies dealing with many authorities, this is likely to prove more complex and expensive. It was suggested by the water companies that under a compulsory metering programme, there should be provision made in the planning process to automatically notify water companies of flat conversions.

Mixed use

Typically this refers to the supply to a property with a small commercial premises, e.g. shop, on one floor with one or more flats above. Currently some mixed-use properties are classified as non-households (see Section 3.1). Typical meter penetration on small commercial properties is of the order of 80%. Many small commercial properties only use water for drinking and sanitation purposes and hence have very low consumption and little discretionary use. These may not be metered but are charged by some form of flat rate or assessed charge. It would be desirable to meter any flats individually and include them in the household count. Internal meters are likely to be needed in such cases.

Bulk metering

Some blocks of flats are bulk metered with the account ascribed to the management agent who is then responsible for allocating bills to individual tenants. Where the management agent is a local authority or housing association, it is often beneficial to the water company to deal with that one organisation, rather than the individual tenants. Firstly, the bill is more likely to be paid in full, thus debt is minimised. Secondly, there is greater continuity. Many flats are subject to frequent changes of occupant. This can be difficult to keep track of and some short term tenants may leave unpaid bills for relatively small amounts that are difficult and expensive to reclaim. Thirdly, billing and administrative costs are minimised with one account rather than several. However, under current regulations, each tenant has right to have a meter and some tenants prefer to have their own meter, particularly if they are a low user, as they do not wish to subsidise those using more water. Discussions with the water companies revealed differences in policy between those who were reluctant to split managed accounts and others who preferred to meter individual flats.

Access to meters

The choice of meter location in flats depends on the plumbing configuration. It is common for flats with individual supplies to be metered from a common area, e.g. basement or common meter box. In these cases access to the meters for reading or maintenance only requires access to this point. Flats with a common riser, or a common supply fed from a common header tank, will require an internal meter. In some cases it may be feasible to site this in a wall box in a common service area such that readers do not require access to individual flats but can read the meters from areas which are easier to access. However, for many flats the meter would have to be fitted internally. These meters are likely to require AMR to enable them to be read efficiently.

An estimate was made by the water companies that currently around 50% of individual flats could be easily metered with a single meter located externally or in a common boundary box or other area with easy access. If meter penetration was considered on a per property basis such that a block of flats counted as a single property, meter penetration for flats and multi-occupancy dwellings could be much higher, say 90-95%.

3.6.4 Proving supplies

In many cases, it is reasonably straightforward to identify which supply feeds which property. However, it is not unusual to find cross supplies or other complications that make it unclear. Under a compulsory metering programme, it will be necessary to ensure that properties, their supplies, and hence their meters and bills, are correctly matched, therefore companies will need to continue to carry out meter surveys prior to installation and prove supplies. The media would quickly pick up on any mistakes where, for example a vulnerable customer was billed for the large family next door. Proving supplies generally requires the co-operation of the customer to turn appliances on and off, or at least allow access inside the property, whilst the meter is being observed. Experience from the water companies suggests that under current policies, optants will co-operate in this process but unwilling COM customers can be unhelpful and problematic. There is also always the possibility of legal challenges requiring companies to prove the validity of bills issued to particular properties which could result in additional costs. However surveys may have additional benefits, like finding new customers and identifying properties that have been converted into flats.

Proving supplies should not a significant barrier to meter penetration if there was public support for metering but it has to be done rigorously otherwise it could delay a programme or significantly increase costs.

3.6.5 Technology constraints

Meters

There is a wide range of technical solutions on the market to meet most of the problems that might occur in metering domestic premises. These include a growing variety of meter types in addition to the traditional mechanical rotary piston meter. The new meters offer alternative performance levels and installation requirements, and a range of AMR solutions that allow meters to be read remotely and the readings to be transmitted by a variety of media (e.g. touch-pad, radio, satellite, power line etc.) There will be very few installations where a technical solution (suitable meter plus reading system) cannot be found, though there may be some where the need for a particular solution increases the cost.

Pipe work

In a small minority of properties the existing plumbing arrangement may make it difficult to install a single meter safely, at least without significant work to reconfigure the plumbing. There is no technical reason why multiple meters could not be used in a single property, though the cost of this and complexities of billing systems may make this very expensive.

One company reported that, under current policies, it tends to avoid installing meters where there is a black polyethylene (PE) pipe as their experience suggests that this has a tendency to fail if it is disturbed, leading to expensive repairs. This is an added cost, rather than, technical constraint.

Companies are funded to replace lead pipes and it may be that a full metering programme would force the replacement of the remaining lead service pipes, or conversely that a schedule to replace lead pipes could be carried out in conjunction with meter installation thus providing cost efficiencies to both programmes.

Most water companies operate policies for supply pipe repairs which typically allow the customer one free repair. The reduction in supply pipe leakage is seen as a significant benefit from an external meter installation. A full metering policy is therefore likely to increase the number of such repairs. The installation process will locate a certain proportion of such leaks and further leaks may become apparent with intelligent meters. The costs of such repairs generally come from leakage budgets and so would not impact directly on the cost of metering. However, there may be some conflicts with resources.

3.7 Customer issues

Research shows that customers generally consider metering to be a fair way of charging, though some are opposed to water metering on a variety of grounds. Customers are concerned about the level of water bills as metering will have to be paid for.

It will be important to get, and keep, customer support, especially if full metering is a part of a demand reduction strategy. The co-operation of customers will be needed in the shift across to full metering, especially to get access to properties where internal metering is the only option, in proving supplies and to fully realise the potential water savings.

A clear and consistent message will be needed from all agencies involved including the regulators and water companies. There are examples of good practice within the industry where major change has been implemented effectively partly thanks to good communication. These include the compulsory metering programme in Folkestone and Dover Water, Thames Water's Victorian mains replacement programme and the widespread "Beat the Drought" campaign to in 2005.

Water affordability is an area of concern. While metering may be used as one of the tools to help with this, measures will need to be in place to assist vulnerable customers and those with special needs. The recent Defra pilot study[12] in the South West Water region showed that whilst moving to a metered tariff helped some customers to better afford their water bills, some customers already on a meter were not helped by the existing measures. These tended to be low income customers who were receiving their full benefit entitlements but did not qualify for the social tariff. Thus there may be a need to develop alternative charging or support mechanisms for the lowest income groups. Meters could play a positive role here by enabling consumption based tariffs that did not penalise high water use for identified needs, e.g. those with specific medical needs or large families.

[12] Waylen C, Glennie E, Mobbs P. South West Pilot scheme on Water Affordability – Final Report. WRc Report No. UC7532. November 2007

Under current policies, customers are generally helpful and co-operative when it comes to having a meter fitted. Optants have chosen to have a meter and therefore are helpful and accommodating regarding appointments for installation etc. Companies do report opposition from a minority of COM customers. However, letters explaining the legal position and the companies' rights to install a meter on change of occupancy generally allow the installation to go ahead, though the process can be delayed by the non co-operation of the customer.

Adoption of a full metering policy without a clear and consistent explanation may result in a higher proportion of non-cooperative customers. However, experience from Folkestone and Dover suggests that very few customers are adamantly opposed to metering. This may be because the water scarcity status of Folkestone and Dover had been widely published and customers accepted the need to take steps to reduce demand.

3.8 Metering environments

As noted above, one of the principal influences on the feasibility or costs of meter installation in a given area is the prevalence of flats and shared supplies, the latter being more commonly found in terraced properties. Detached or semi-detached properties are generally the more straightforward to meter and it was the opinion of the water companies that under a full metering programme 90% or more of such properties could be metered. The relative proportion of different property types depends on whether they are in inner cities, urban or rural areas. Figure 3.2 shows the relative incidence of property types for each of these environments.

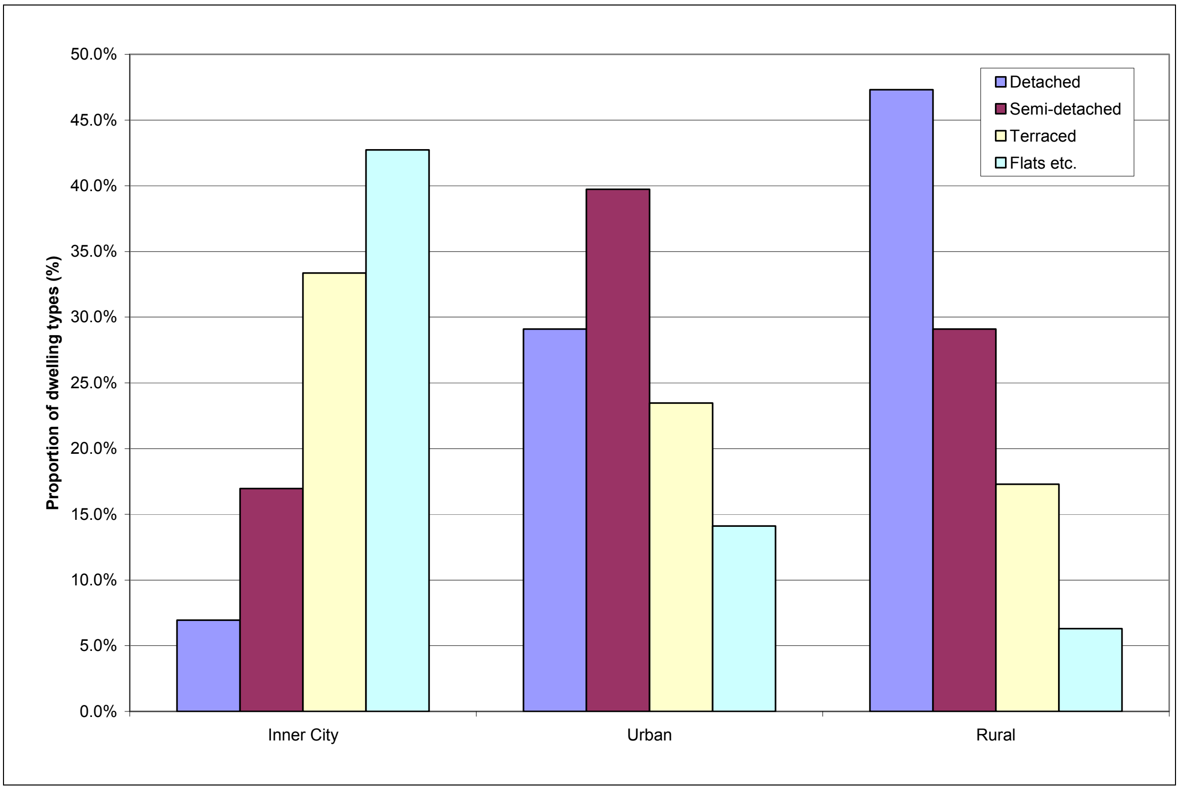

Figure 3.2 Percentage of household spaces in inner city, urban and rural areas by type of accommodation

The data in Figure 3.2 has been taken from the Univariate tables (Accommodation Type – Household Spaces (UV56)[13] produced as part of Census Area Statistics from 2001 Census. The dataset used is related to geographical wards. Classification of wards into Inner City, Urban and Rural is based on National Statistics 2001 Area Classification[14]. For each geographical region in England a number of different wards were chosen to represent inner city, urban and rural wards. 25 wards were chosen for each environment covering a total of 290,450 dwellings.

3.8.1 Inner city

The inner city areas are considered to be those currently least metered. As can be seen from Figure 3.2, the property types most common in inner cities tend to be the more difficult types to meter – around 34% are terraced houses (approximately half of which are likely to have shared supplies) and around 43% are flats. Only 24% are detached and semi-detached properties which are likely to be the most straightforward to meter. This supports the water companies' estimate that up to 40% meter penetration with single external meters would be possible in an inner city area under a compulsory programme without separating shared supplies. However, even this may require multiple visits and some effort. The overall penetration could be raised with internal meters, preferably with AMR to facilitate reading.

3.8.2 Urban

The situation in an urban area is slightly easier than for an inner city area. Locating and identifying supplies is usually easier - stopcocks are generally located in the footpath and are visible and there are less shared supplies. However, there will still be some flats and conversions (around 14% according to Figure 3.2), particularly in areas with large old houses. Other problems include the difficulty in matching reinstatement if a meter has to be installed inside the property boundary, say in a drive, and the potential need to modify fitted kitchen units if an internal meter has to be fitted.

One company currently implementing COM metering reported a success rate of around 50% in urban areas. Folkestone and Dover Water estimate that they will be unable to meter around 10% of properties in their compulsory metering area (Lydd – predominantly urban) due to physical constraints.

As shown in Figure 3.2, almost 70% of properties in urban areas are detached or semi-detached, with only 23% terraced and 14% flats, therefore in an urban environment, 70% to 80% metering should be readily achievable.

Case Study Isle of Wight Metering Trials

As part of the National Metering Trials in the early nineteen-nineties, there was a programme to meter the Isle of Wight. The following level of meter penetration was recorded[15].

Metered properties included under trial	49969
Newly connected properties during trials	1839

[13] http://www.neighbourhood.statistics.gov.uk/dissemination/ (> Home page > Topics > Housing > Accommodation Type – Household Space (UV56))

[14] http://www.statistics.gov.uk/about/methodology_by_theme/area_classification/wards/

[15] National Metering Trials final report 1993

Total metered properties	51808
Properties not metered	
No access	2189
Not practicable	1065
Not programmed	685
Other commercial properties (metered pre-trial)	2153
Total IOW properties	57900

Total domestic properties = 55747, so 93% of available properties were metered as part of the trial.

By way of comparison, from JR07, number of metered households on the IOW = 55345 and unmeasured households = 4131, representing 93% metered.

Conclusion

Over 90% household metering is feasible in an urban / rural environment.

3.8.3 Rural

Meter penetration in rural areas is thought to be currently the highest of the three types of area being considered here. Many farms are already metered as businesses. There is a high proportion of optants and few flats (6%). Most properties have individual supply pipes. Terraced properties constitute only 17% of the properties but there may be further shared supplies, for example on farm estates or where farm outbuildings have been converted to residential units.

The biggest problem when installing meters in rural areas can be finding stopcocks, particularly where there is no footpath. Stopcocks are often found then just inside the property boundary.

Supply pipes can be long and can cross other properties, hence finding and repairing leaks can be time consuming and expensive. Customers could be reluctant to have a meter when they realise that they will be responsible for leaks on long supply pipes.

There are specific areas which are subjected to various environmental protection measures, for example National Parks, areas close to or within designated conservation areas and sites of special scientific interest (SSSIs) where the potential disruption caused by meter installation may be a barrier to meter installation. This is only likely to affect a very small number of properties and may be circumvented by fitting internal meters.

So, despite there being around 76% of detached and semi-detached properties in rural areas, a higher proportion of these might require more effort to meter than in the other settings.

3.8.4 Distribution of installations

Meter installations have been divided up into 6 categories ranging from straightforward external installations to complex internal installations, as shown in Table 3.4. Based on the data presented above and further feedback from the water companies, an estimate has been made for the typical distribution of households within each installation category. This has been broken down by environment – inner city, urban and rural. The preferred options for installation are listed from top to bottom of the table. As there will be a technical solution to all but very exceptional cases, even if some of these solutions will be expensive, each column adds up to 100%. The precise proportions of properties in each category vary considerably from company to company. By estimating the costs of installation in each category, this data can be used to estimate either:

- The average cost per meter required to achieve a given meter penetration; or
- The meter penetration that can be achieved at a given cost.

This is explored further in Section 5.

Table 3.4 Estimated proportions of installations in different environments

	Inner city	Urban	Rural
Simple external fit - identifiable single supply, external fit with boundary box if necessary in footpath / verge / highway	40%	52.5%	60%
Harder external fit – requires more effort than a simple external fit, e.g. needs additional effort to locate supply, meter may need to be in driveway or garden	20%	25%	20%
Simple internal fit – with touch-pad / AMR if necessary to facilitate reading, including flats with individual supplies and easy to access common area for meters	12.5%	5%	2.5%
Harder internal fit – requires more effort than a simple internal fit including touch-pad / AMR if necessary, e.g. minor alterations to plumbing or fitted units (with agreement from customer), flats with individual supplies but where meters need to be fitted internally or in wall boxes	15%	10%	7.5%
Complex external fit – would require considerable effort to install an external meter, e.g. separating shared supplies, excavating in paved yard, very remote (non-standard reading solution required)	7.5%	5%	5%
Complex internal fit – would require considerable effort to install an internal meter e.g. extensive alteration to plumbing or fitted units, or more than 1 meter	5%	2.5%	5%

If meters are installed in all but the most complex internal and external installations, then the degree of meter penetration that should be achievable is 87.5% in inner city areas, 92.5% in urban areas and 90% in rural areas. Allowing for the distribution of property types over the population (Figure 3.2) and current meter penetration, this gives an estimate of the overall household meter penetration of 92.7% that could be achievable by metering all but the most difficult properties. This is consistent with that achieved on the Isle of Wight in the National Metering Trials and is currently being achieved by Folkestone and Dover Water under its compulsory metering programme.

3.9 Summary and discussion

Water companies have increased meter penetration in line with the forecasts made in PR04. The recently published Strategic Direction Statements for each water company show that they are seeking to accelerate metering, though only four have indicated that they will pursue compulsory metering in the short term. The factors that might constrain increasing meter penetration have been explored in this section.

- **Regulatory and political -** The Environment Agency is the only regulator calling unequivocally for progression to full metering, with a priority for water stressed areas. There needs to be a clear and consistent policy agreed by all regulators if compulsory metering is to be driven forward.

  A full metering programme will need to be adequately funded as there will be a need to deal with some of the properties that are currently deemed too difficult / expensive to meter. The consequential costs of a wider metering programme, for example increases in supply pipe repairs or replacements, will also need to be recognised.

  Regulators need to review regulatory structures and policies in order that wider metering can be accomplished in the most cost effective manner and to enable the full benefits to be realised. Two particular areas that have been identified are the classification of bulk metered properties and the DG8 reporting requirement for meter reading.

  Changes to planning and building regulations, particularly requiring notification to water companies of conversions, would facilitate the metering of flats.

- **Technical -** There will be very few households that cannot be metered for technical reasons. However, there may be some where the cost of the particular metering solution required or the additional work necessary to be able to install a meter would be difficult to justify. Two particular groups of properties where metering can sometimes be more challenging (or expensive) are:

  - Households on shared supplies (estimated to be approximately 20% of properties overall); and
  - Flats.

  The prevalence of such properties varies depending on the location. Shared supplies are common in inner city terraces, particularly those built before 1945. Flats are also more prevalent in inner city areas. By building up a profile of the housing in an area, the likely distribution of costs can be assessed which will help determine what level of funding will be necessary to achieve a given meter penetration. This is explored further in Section 5 of this report.

- **Customers -** Whilst the majority of customers think that metering is the fairest way to pay for water, they realise that metering will have to be paid for and they are concerned about the impact on bills. There is wider concern that water will become less affordable to those on low incomes or with specific water needs (for example large families and medical needs). Mechanisms to help those customers will need to be developed.

Communication with customers to explain the need for compulsory metering will be needed to enable the efficient deployment of meters and for the benefits to be fully realised.

If meters are installed in all but the most complex internal and external installations, then the degree of meter penetration that should be achievable is 87.5% in inner city areas, 92.5% in urban areas and 90% in rural areas. Allowing for the distribution of property types over the population (Figure 3.2) and current meter penetration, this gives an estimate of the overall household meter penetration of 92.7% that could be achievable by metering all but the most difficult properties. This is consistent with that achieved on the Isle of Wight in the National Metering Trials and is currently being achieved by Folkestone and Dover Water under its compulsory metering programme.

4 Rate of metering

4.1 Current rates of metering

Table 4.1 shows the current numbers of household meters being installed by each company, based on data extracted from the 2006/07 June Returns. Two rates are shown – the total rate (including new builds) calculated from the difference in metered households between the totals given in the 2006/07 and 2005/06 June Returns, and the rate for selective and optant meters, as given in Table 8 of the 2006/07 June Returns. Table 4.1 also shows how many years it would take to achieve 100%, 90% and 80% household metering based on the current rates for selective and optant metering and the number of currently unmetered properties. As new-build properties are metered when they are built, this shows the catch-up rate to meter the existing unmetered stock. The top half of the table shows the companies in the south east of England in water stress, and the lower half of the table shows the remaining companies.

In Table 4.2 the total numbers of unmetered households for each company have been divided by 5, 10 and 20 years to determine how many meters would need to be installed each year, on average, to reach 80%, 90% and 100% of households on a meter over each time period. The ratios of those rates to current meter installation rates (shown in Table 4.1) are calculated to show by how much current metering rates would need to increase to reach each target meter penetration over each time span. Two comparisons are made:

- Comparison with the selective and optant rate shows the increase in rate required to meter the current unmetered households; and
- Comparison with the total rate shows the market for new water meters and equipment that the supply chain would need to provide for, over and above the scheduled replacement of existing meter stock, including new builds, assuming that these continued at the present rate.

Detailed figures by company are given in Appendix 5.

This analysis shows that for the companies in water stressed areas to achieve between 90% and 100% metering in over a single AMP period, 5 years, metering rates would have to increase approximately 5 fold across those companies. A 3 to 4 fold increase in current rates would be needed to get the remaining companies to achieve similar metering levels over 2 AMP periods (10 years).

There is considerable variation between companies, however, as can be seen from the detailed figures in Appendix 5. Portsmouth Water and Thames Water stand out from the group of companies in water stressed areas where the rate of meter installation will need to increase by almost 10 fold to reach penetrations of 90%+ in 5 years. These two companies have the lowest penetration currently; Portsmouth in particular has a very low base (7.9% in 2006/07) from which to start. This compares with Bournemouth, where between 2 and 3 times the current rate would lead to a similar penetration over 5 years from a current position of over 45%. Even over a 10 year period, Thames and Portsmouth would still require a sustained 4 to 5 fold increase in their current rate of metering to reach over 90% household penetration.

Table 4.1 Current metering rates

Company	Unmetered house-holds (1) (000's)	Total meters added in 06/07 (2) (000's)	Selective + optant in 06/07 (3) (000's)	No. years for 100% metering	No. years for 90% metering	No. years for 80% metering
Anglian	791.0	42.5	25.5	31.0	27.9	24.8
Bournemouth	95.3	8.9	6.4	15.0	13.5	12.0
Cambridge	48.2	2.2	1.5	32.9	29.6	26.3
Essex and Suffolk	422.6	20.5	22.1	19.2	17.2	15.3
Folkestone and Dover	32.3	4.5	5.1	6.3	5.7	5.0
Mid Kent	138.3	7.9	6.1	22.7	20.4	18.1
Portsmouth	250.7	5.3	5.8	43.2	38.9	34.6
South East	366.2	12.9	15.9	23.1	20.8	18.5
Southern	628.8	32.3	35.8	17.5	15.8	14.0
Sutton & East Surrey	190.7	8	8.9	21.5	19.3	17.2
Thames	2471.8	52.7	47.2	52.4	47.1	41.9
Three Valleys	817.7	47.2	40.9	20.0	18.0	16.0
TOTAL water stressed	**6253.6**	**244.9**	**221.1**	**28.3**	**25.5**	**22.6**
Bristol	329.4	10.5	7.3	45.2	40.7	36.2
Dee Valley	63	5.1	2.7	23.7	21.3	19.0
Dwr Cymru	895.4	28.5	18.8	47.7	43.0	38.2
Northumbrian	882.9	26.7	19.7	44.8	40.4	35.9
Severn Trent	2205.6	50.3	38.6	57.1	51.4	45.7
South Staffs	408.4	9.2	6.2	66.1	59.5	52.9
South West	297.2	34.3	26.3	11.3	10.2	9.0
Tendring Hundred	22.7	1.7	1.1	20.5	18.4	16.4
United Utilities	2172.8	56.2	39.5	55.0	49.5	44.0
Wessex	309	15.4	11.3	27.3	24.6	21.8
Yorkshire	1316.9	42.9	32.4	40.7	36.6	32.5
TOTAL Not water stressed	**8903.3**	**280.8**	**203.8**	**43.7**	**39.3**	**34.9**
Overall total	**15156.9**	**525.7**	**424.9**	**35.7**	**32.1**	**28.5**

(1) From Security of Supply 2006-07 report. Ofwat 2007

(2) Calculated from total metered properties given in Security of Supply reports 2005-06 and 2006-07. Ofwat

(3) From Table 8 June Returns 2007

Table 4.2 Metering rates required

	100% households metered			90% households metered			80% households metered		
	Number of meters 000's/yr	Ratio to current total rate	Ratio to current selective and optant rate	Number of meters 000's/yr	Ratio to current total rate	Ratio to current selective and optant rate	Number of meters 000's/yr	Ratio to current total rate	Ratio to current selective and optant rate
Over 5 years									
Water stressed companies	1250.7	5.1	5.7	1125.6	**4.6**	**5.1**	1000.6	4.1	4.5
Non-water stressed companies	1780.7	6.3	8.7	1602.6	5.7	7.9	1424.5	5.1	7.0
All companies	3031.4	5.8	7.1	2728.2	5.2	6.4	2425.1	4.6	5.7
Over 10 years									
Water stressed companies	625.4	2.6	2.8	562.8	2.3	2.5	500.3	2.0	2.3
Non-water stressed companies	890.3	3.2	4.4	801.3	**2.9**	**3.9**	712.3	2.5	3.5
All companies	1515.7	2.9	3.6	1364.1	2.6	3.2	1212.6	2.3	2.9
Over 20 years									
Water stressed companies	312.7	1.3	1.4	281.4	1.1	1.3	250.1	1.0	1.1
Non-water stressed companies	445.2	1.6	2.2	400.6	1.4	2.0	356.1	1.3	1.7
All companies	757.8	1.4	1.8	682.1	1.3	1.6	606.3	1.2	1.4

Shaded cells indicate preferred scenarios.

With the current metering policies (free meter option and change of occupancy metering), the rate of change of meter penetration is largely determined by the rate at which properties change hands and the rate at which customers opt for a metered tariff. The rate of optant meters is largely driven by customers being able to save on their water bills, hence South West Water with the highest bills in England has one of the highest rates of optant metering. The addition of new-build, metered, households will also influence the meter penetration as will the removal or redevelopment of old, unmetered, properties.

With the introduction of compulsory metering these constraints will largely be removed. Assuming that full metering was the adopted policy and companies were funded adequately for that, the rate at which meters could be installed would be largely dependent on the ability of the water companies to manage the process and the supply chain to be able to deliver.

4.2 External constraints

4.2.1 Equipment supply

The water companies have expressed concern that a sharp increase in metering may put significant pressure on the equipment suppliers. The view of the supply chain, however, was that as metering is a global business and equipment (principally boundary boxes and meters) are made in large quantities for the global market, there should be no issues with the supply of equipment. The caveat that many suppliers put on this though was that it would be preferable if there was a planned and co-ordinated strategy such that the overall demand was spread evenly over time and manufacturers were given notice of any impending sharp increase in demand in order to be able to schedule manufacturing accordingly.

The situation with AMR equipment might be slightly different. Whilst there are various systems on the market and being used successfully overseas, the uptake for AMR in the UK to date has been slow. Various trials have been undertaken or are underway, but the proportion of meters with AMR at the moment is very low (<0.5%). There are a number of reasons for this which include the cost of AMR systems, and the difficulty in justifying that cost against the benefits that can be achieved with current metering policies. However, in order to maximise all the benefits from full metering as noted in Section 3.4.1 and overcome the problems with access to internal meters for reading, AMR will be necessary. Companies will therefore have to evaluate what they will require from such systems, either to meet their own needs or the needs of the industry as a whole. Whilst studies are underway on several fronts, this will take some time to work through, so there may be a period while the industry reviews its requirements, compares these against available equipment and stimulates development of systems to meet UK needs before there can be extensive procurement of AMR equipment. However, once the relevant decisions have been made, the supply chain will be able to meet those needs. This need not delay the deployment of the meters themselves as many AMR systems can be retrofitted to meters by means of clip on readers and transmitters, though clearly this is not ideal as it would require an additional visit to the meter once it had been installed, increasing the overall cost.

4.2.2 Meter installation

The majority of water meter installation is carried out by contractors. In a survey of 10 water companies carried out in 2006, only 1 installed all its own meters. Four other companies retained capability in this area and installed a minority (up to 15%) of meters. Typically the average installation rate for external meters, based on a two man gang, is 4 installations per day. For internal meters, with a single installer, 3.6 installations/day is the average rate.

There was a consensus among the water companies and the supply chain that any significant increase in the rate of meter installation above that currently being achieved would lead to difficulties in sourcing sufficient trained manpower. Various skills are required – plumbing, traffic management, reinstatement etc. – and all installers need to be trained in appropriate health and safety and hygiene (Blue Card) requirements. Major projects such as the Thames Gateway development and preparation for the 2012 Olympics will be competing for these resources. This is likely to lead to an increase in costs over the short term (say 5 years). One company currently seeking to install around 40,000 meters this year did report having difficulties in finding sufficient appropriately skilled resource.

A well planned and co-ordinated strategy across all priority areas for metering would help installers schedule training and deployment of resources.

4.2.3 Traffic Management Act

The requirements of the Traffic Management Act 2004 (TMA) may have an impact on the planning of meter installation programmes and cost. The TMA contains a broad range of measures aimed at tackling all causes of disruption and congestion and making the most of the existing road network. The Act contains 7 parts as follows:

1. Traffic Officers
2. Network Management by Local Traffic Authorities
3. Permit Schemes
4. Street Works
5. Highways and Roads
6. Civil Enforcement of Traffic Contraventions
7. Miscellaneous and General

Parts 3 and 4 affect utilities directly. They allow for a wide range of new powers and revisions to existing powers to be set out in regulations and codes of practice. In particular, the Act aims to achieve a better balance between the need for utilities to carry out street works and the negative impacts these can have. The government has also reviewed the Overrun Charging Scheme (Section 74). Although the Section 74 powers do not come from the TMA, it seemed sensible to introduce these changes at the same time.

The result is a much tighter regulatory framework with greater powers for street authorities to control utility works. A tougher enforcement is expected with significantly higher fines and overrun charges and the introduction of fixed penalty notices.

The TMA substantially amends existing street works legislation, New Roads and Street Works Act (NRSWA1991) and other Acts.

Progress on implementation

The first wave of secondary legislation, directly affecting utilities, includes:

1. Revision of the Street Works (Registers, Notices, Directions and Designations) Regulations 1992 and Code of Practice for Co-ordination of Street Works and Works for Road Purposes. Referred to as "Notices" for short.

2. Rules for operating permit schemes.

3. Regulations and guidance for operating Fixed Penalty Notice (FPN) regimes.

4. Revision of section 74 overrun charging regime.

The first commencement order, made on 4 October 2004, included higher fines for utilities' street works offences. The second commencement order, made on 4 January 2005, included the new Network Management duty on local traffic authorities, and new s56 powers to direct utilities.

The new regulations covering Registers, Notices, Directions and Designations, FPNs and s74 charges will come into force on 1 April 2008. The new permits regulations will come into force on 1 October 2008.

General impact on the water industry

The main TMA measures are summarised in Appendix 6.

The overall effect of the notices and permit regulations will be to further restrict utilities' access to the public highway, and restrict current working practices, with potentially significant cost and level of service implications. The tougher enforcement regime will significantly increase liability for fines, fixed penalties and overstay charges. All of this will require improvements in planning and execution of street works.

Some impacts will depend on the response of individual street authorities and are difficult to predict and quantify. Authorities will have the power to choose whether to run permit schemes, how those schemes operate and the level of charges up to the limits defined in the Act. The impact will also depend on mitigating measures adopted by companies. The TMA will impact on whoever does the work and therefore higher contractor costs will potentially be passed through to the utility companies and customers. The TMA also has the potential to affect performance indicators if restrictions are imposed on current working practices.

Implementation of the TMA is taking considerably longer than the Government intended and utilities have now had several years to prepare to meet the challenge. Most water companies have made major investments in re-engineering of business processes and supporting IT systems, and changes to working practices.

Implications for metering

Specific TMA impacts on metering programmes will depend on a number of factors. External installations may involve a range of street works activities including:

- Installing meters in existing boundary boxes
- Installing new boundary boxes
- Reconfiguration of supply pipe work in some cases, e.g. common supplies

- Retrofitting AMR to existing meters
- Replacement of meters and/or boundary boxes

In most cases meters will be installed in the footway or verge. In some cases meters may be located in the carriageway or cycleway. In many cases there will be a requirement to park vehicles, store materials, divert pedestrians or otherwise restrict the public highway.

Where these activities involve excavation or working in a traffic sensitive street, then notices or permits will be required and most of the TMA impacts identified in the table in Appendix 6 will be applicable. Separate notices or permits will be required for each separate street (as defined in the National Street Gazetteer). The type of notice or permit application will depend on the duration of the works; if the estimated duration is greater than 10 days (e.g. working along a street to install boundary boxes and meters for each property) then the works are classified as Major works and will require an advance notice or application for a provision advance authorisation (permit) at least 3 months before the proposed start date. It seems unlikely that increased use of restrictions will affect metering programmes unless the work involves excavation of the carriageway, e.g. for new service pipes.

The TMA aims to target the most disruptive activities. Therefore, programmes in urban areas will be affected the most, whilst some works in rural areas but not be affected at all. The requirements and charges for permits will be set by local authorities and are likely to vary from authority to authority.

All of these factors make it difficult to generalise about the impact of the TMA on metering programmes. Specific impacts will therefore have to be considered on a case-by-case basis. However generally it may increase costs through:

- Increased costs of applications and permits;
- Administration in applications for permits;
- Risk of penalty notices if works over-run.

As many local authorities have yet to decide on or publish the details of their proposed schemes it is too soon to be able to quantify the financial impact.

4.3 Internal company factors

The impact of the following internal factors was considered:

- The scale of the programme and how it is managed – not thought to be an issue, as water companies are used to managing large scale projects.
- The increase in customer contact – Water companies have large departments handling customer contact at present, both on a company-wide and a local basis, to publicise current metering policies, promote water efficiency, advise on local disruption to supply etc. and hence this should not be a constraint.
- Staffing - Water companies would need to recruit and train additional staff, both on contact to cover the short term increase in workloads whilst the installation programme intensified, and on a permanent basis to deal with on going requirements for reading, maintenance and enquiries. However, this should not present a significant problem.

- Billing system changes - Water companies felt that as most companies upgrade their billing systems every few years, any move towards increased reliance on metering for billing would be taken care of as systems were upgraded, so again this would not present a significant constraint. Experience from a limited number of trials currently underway, see Section 6.2, suggests that this may be optimistic and that there may be problems in processing and storing the significant increase in data that will come with more meters, particularly if the meters are read more frequently than at present in order to implement alternative tariffs.

4.4 Summary

To achieve 90% household metering by 2015 in the water stressed areas of the UK would require a five fold increase in the rate of meter installation from that currently being achieved. This would present a major challenge to parts of the supply chain. The principal constraint identified was the lack of suitably trained personnel to carry out the installation programme. The supply chain would prefer a co-ordinated and planned strategy across water companies to ensure that demand was even and could be planned for, and met, with maximum efficiency. Water companies were, on the whole, confident about their ability to deal with the demands of an increased metering programme, provided that adequate funding was allocated.

5 Cost efficiencies

5.1 Current costs

Costs related to optant and COM metering from eight water only and water and wastewater companies for 2005/06 were collated in project CP222A[16]. Not every company was able to provide data for each individual item as, for example, some did not implement COM metering. The figures include the cost of the meter, other materials and labour. Table 5.1 summarises the average, minimum and maximum costs (rounded to the nearest £1) across the companies that were able to supply data. The weighted average figure is calculated from the overall cost divided by the number of meters installed and therefore takes account of the relative proportions of internal and external installations.

Table 5.1 Ranges for metering costs

	Optant			COM		
Type of installation	**Average**	**Min**	**Max**	**Average**	**Min**	**Max**
Internal	£168	£96	£272	£176	£113	£286
External into an existing boundary box	£45	£20	£64	£52	£44	£58
External with new boundary box	£219	£183	£263	£228	£207	£276
Internal meter replacement	£158	£96	£245	£157	£96	£257
External replacement	£58	£43	£100	£52	£44	£58
Weighted average per meter	£183	£112	£231	£181	£134	£192

It should be noted that that these figures are based on current metering policies where companies can walk away from difficult cases.

COM is perceived as an expensive policy to implement, in terms of administration and customer resistance which can delay the process if customers fail to be in for appointments for meter surveys etc. However, the installation costs of COM meters are comparable with those for optants.

5.2 Meter installation

Meter installation is carried out by a mix of in-house and contractor staff. Some water companies prefer to keep this activity in-house to ensure better quality control and customer care. Others contact out meter installation to specialist companies.

[16] Godley A, Mobbs P, Davey A Cost-benefit Analysis of Metering Policies. WRc Report UC7381 June 2007

The view of the water companies at the workshop was that full metering would not offer much scope for significant cost savings on meter installations. Three principal reasons were cited for this:

- the likely increase in costs due to increased demand on contractors and lack of skilled resource in the short term;
- the need to deal with some of the more difficult cases from which companies can currently walk away;
- the potential impact of the Traffic Management Act.

This is not necessarily the view of all water companies[17].

Case study **Meter installation efficiencies**

Folkestone and Dover Water carry out meter installations with in-house crews. Between July 2006 and March 2007, they employed 3 two-man gangs to install meters and boundary boxes. These were supported by 2 surveyors, 1 supervisor and administrative support. Installation rates between July and December 2006 when the company was only implementing optant and COM policies were typically 140 installations/month for the three gangs. Between January and March 2007 when the company were carrying out compulsory metering in Lydd, average rates rose to over 200 per month, with peak rates being around 230/month.

When installing compulsory meters on a zonal basis, Folkestone and Dover found scope for efficiencies through modifications to working practices. Examples of efficiencies found include:

- 1 support vehicle supporting multiple crews working in close proximity, rather than requiring 1 vehicle/crew when crews scattered;
- Surveyors operating in an area can see when people are in, or come home, and hence minimise multiple visits to individual customers;
- A single large team working in an area where staff can swap between jobs as and when required was more efficient than several separate teams;
- Use of alternative re-instatement methods and materials to enable excavations for boundary boxes to be re-filled and re-instated immediately, avoiding the costs associated with leaving holes open for later re-instatement by a specialist contractor.

However, it should be noted that to change working practices it is essential to have the buy-in from staff and to achieve maximum efficiency good motivation and morale is essential.

Conclusion

There are efficiencies to be gained through changes in working practices when moving from current metering policies to a compulsory programme.

The installation contractors thought that significant gains in productivity could be achieved through a compulsory programme where meters were installed on a planned zonal (area) basis. Gains were likely to be greater for boundary box than internal installations. Estimates in cost reduction were in the range 20% to 50%.

[17] In their strategic Direction statement, South East Water anticipates that savings will be possible.

Under full metering, efficiencies are likely to occur in like for like installations, i.e. the average cost of a straightforward external boundary box installation will be reduced. However, to hit a penetration above 90% over a short time scale may mean that the average cost per meter will rise.

Companies that have installed, or are installing, boundary boxes as part of mains rehabilitation exercises or stopcock replacement programmes have an advantage of being able to install meters quickly at such sites, if they can be identified and are appropriate for the metering solution adopted.

Case Study – Existing boundary boxes

Folkestone and Dover Water had had a policy of replacing failed stopcocks with boundary boxes that could take meters for a number of years prior to embarking on their compulsory metering policy. The marginal cost of installing a boundary box capable of taking a meter compared with one containing just the stopcock was very low, less than £3. This small additional cost could be justified against the future likelihood of a meter being required for that property under COM and optant metering. Having the boundary boxes in place meant that when fitters moved into an area a significant number of meters (estimated at 37%) could be readily screwed into the existing fittings. However, as this policy had been in place for a number of years, records were not always available of where the boundary boxes were fitted and surveys were still required to identify the types and numbers of installations required.

Conclusion

Installing boundary boxes capable of taking meters at a small marginal cost during other works can lead to significant savings for future meter installations.

5.3 Equipment costs

Water companies expect that the unit price of meters may fall a little with increased demand, though this may be offset by the increasing costs of materials (particularly brass for traditional brass bodied meters). It is likely that in the medium to longer term more use will be made of plastic bodied meters, though currently the options for plastic bodied meters equivalent in performance to the meters now used are limited. Costs of boundary boxes and wall boxes may also drop a little with increased procurement.

A similar view was voiced by the supply chain. As noted previously, water metering equipment is a global business and highly competitive. Established manufacturers are already producing high volumes with highly efficient manufacturing processes. Therefore prices are low and whilst there may be scope for further discounts through a commitment to procure larger quantities of meters and boundary boxes, these are not likely to be huge, say 5 to 10%. This variation will depend on, not just the quantity and specification of the meters required, but also the support required, e.g. spares or delivery times, that are negotiated in individual contracts. There may be scope for higher discounts if manufacturing of newer types of meter is stepped up but the effect of this may be just to bring those technologies down to prices comparable to current mechanical meters.

Scaling up of the need for AMR may stimulate that market in the UK and offer scope for some price reductions.

5.4 Meter reading

Meter reading is currently carried out by in-house staff for most water companies. In a survey of water companies carried out in 2006, only 3 out of the 10 companies surveyed used contractors for meter reading.

Typical meter read rates in the water industry are of the order 80 – 120 reads per reader per day. An average of 3.5 minutes per read for visual readings in an urban area was quoted by one water company. This gives around 130 reads/day or 650 reads/week. This compares with visual read rates quoted by the gas and electricity sector, with a higher meter density, of 200 reads per reader per day and with a mix of internal and external (wall box) meters.

There should be scope for productivity improvements in water meter reading as the density of meters increases, even using manual or semi-manual methods. The reading rate for a meter reader with touch pads on all meters could be expected to increase to 500 reads a day in an urban environment where the distances between meters was small. One supplier reported that their experience in the United States was that reading rates of 800 reads per day were being achieved using touch pad systems. Overall, taking into account all areas, a reading rate of 1200 reads/week should be possible, provided meters were read via touch pads.

Full metering will lead to a need for AMR capability to cover certain situations. These include:

- The increased number of internal meters;
- Meters installed in difficult to access locations (back-yards, under heavy covers etc.)
- Multiple meters for a single household.

With full metering in place, even with manual or semi-manual reading methods there are likely to be many improvements to efficiency of reading that can be made that will reduce costs and enable the full benefits of metering to be achieved. Changes to current working practices might be needed to realise these. For example, Folkestone and Dover will be looking to move to zonal reading once all meters are in place in an area. Thus instead of a single reader having charge of a patch and all meters being read at intervals throughout the year, a team of readers will go into an area and read all the meters in that area in a short space of time. This will enable a better correlation of consumption to the zonal meter for leakage management. As with any significant change in practice however, there is likely to be a transitional period where costs will rise and additional resources will be required. Reading of customers scattered elsewhere throughout the company's area who were metered through previous policies will need to continue while carrying out zonal reading in the fully metered areas.

5.5 Supporting systems

5.5.1 Enquiries

It is known that the rate of customer enquiries rises with the number of meters. Data collected during WRc project CP222A shows that typically the rate of enquiries from unmeasured customers is 0.52 contacts/customer/year. This rises with metered customers to 3.65 (COM) and 2.02 (optant) contacts/customer/year. Also the enquiries become more complex. The unit cost of an enquiry from an unmeasured customer was

£2.17 which rose to £2.82 for a COM customer and £2.58 for an optant. This is also reflected in data collected by CCWater who recently state that billing complaints were 50% higher for measured customers as compared to unmeasured customers. With increasing meter penetration, water companies are also seeing an increase in challenges to meters.

With a compulsory programme therefore, customer enquiries will rise with an increased level of metering, particularly in the short term. In the longer term as people get more used to meters they are likely to fall again. Companies will also get more efficient in dealing with such enquiries.

Experience from Folkestone and Dover Water to date suggests that the level of enquiries from the compulsorily metered customers is no greater than that from customers metered under previous selective and optant policies.

5.5.2 Billing

Data from CP222A also showed that billing costs rose from £0.74 /customer/year for an unmeasured customer to £2.69 /customer/year for a measured household.

5.6 Benefits

The benefits from metering are not always easy to quantify and some of the potential benefits depend on how sophisticated and widespread metering is. For example, full metering in a district metering area (DMA) may facilitate a mass balance across the DMA which will accurately determine leakage. Demand reductions, or influence on demand patterns will depend on the tariff structures used. However, benefits from full metering could include the following:

- reduced demand which results in:

- lower production and pumping costs,
- reduced carbon costs;

- reductions in supply pipe leakage which results in

- lower production and pumping costs,
- reduced carbon costs;

- better information for leakage management;
- increased efficiency in targeting of leakage crews etc.;
- improved accuracy of leakage data;
- savings in infrastructure through:

- deferment of investment in resource development,
- reductions in peak demand (through appropriate tariffs);

- better engagement with customers and increasing their awareness of how much water they use;
- an equitable system of charging (pay for what you use);

- potential income from services such as customer side leak detection;
- environmental and social benefits;
- development of tariffs and mechanisms to tackle water affordability.

5.6.1 Demand reduction

The effect of metering on consumption has been the subject of a number of studies. Research has shown that domestic metering reduces water use by 5-15% with larger peak savings. Customers tend to use less water when they pay for it by volume used rather than on the basis of an assessed charge.

Case study – Demand reduction in IOW trials

The National Metering Trials (1993) was undertaken at 11 small scale sites and the Isle of Wight. The small scale sites ranged in size from 320 to 1,174 properties each, with 8,622 properties in total. The four year trial involved households having one year of unmeasured charges (based on Rateable Value (RV)) and three years of a measured tariff. Meters were installed up front so that four years of consumption data was available. Average household consumption fell by approximately 11% due to metering. On the Isle of Wight, 50,000 households had meters installed and there was a 22% decrease in the distribution input. It was estimated that leakage control and metering each induced a reduction of around 10% in the Isle of Wight.

There are no definitive conclusions on the demand effects of different metering strategies; optional, selective and compulsory metering, though some data is available.

Compulsory metering

Several studies (Flyde Water board (1971-72), Malvern (1976), Anglian Water (1996), Mid-Kent (1997)) on the demand effects of compulsory metering have been conducted in the UK. Many reported reductions in annual demand of between 10 and 15% following metering. Savings of up to 30% are reported for peak demand, which is usually defined as peak week or summer demand. However, there are few studies on the longer term impacts of metering and there are many difficulties in measuring the demand impacts of metering, for example separating out the effects of metering from other effects (such as behaviour, occupancy and weather effects), data quality and socio-economic factors.

Optant metering

The UKWIR optants study on the effect of optional metering on household consumption is the most comprehensive study of its kind, analysing consumption data from over 8,600 properties from 8 water companies. The main findings of the report are:

- The average effect of optional metering on consumption, as estimated from an econometric model, is about 9% (but varies from 2% to 14%, depending on the volumetric charge);
- Optants tend to have lower water use before switching than those who do not opt for a meter. This difference is about 22% of non-optants' consumption: observable differences in occupancy and other household characteristics only account for 2 to 5% lower consumption for optants, with the large remainder being an unexplained "frugality" effect;
- The savings in water use are predicted to increase over time by approximately 0.2% per month relative to what the household would have

used were it to have remained on an unmeasured tariff, though it is unknown how long this will continue.

There are, however, some caveats about the findings:

- Impact of the “frugality effect” where it is thought that those opting for a water meter are more conscious of water use in the first place and hence tend to be lower than average users;
- Representativeness of the sample;
- High variability in consumption;
- High unexplained difference between optants’ pre-metering consumption and non-optants’ consumption;
- High variability in the raw difference between pre and post-metering consumption;
- Low percentage of variability in water use explained by the econometric model;
- No information is given about the applicability of alternative modelling approaches or the consistency of results across different companies’ customers.

COM metering

The WRc collaborative project CP222[18] and the follow-on project CP222A attempted to look at the effect on consumption of metering on change of occupier, taking a similar approach to the UKWIR optants report described above. However, only Bournemouth and West Hampshire Water had a reasonable dataset, as it had been implementing a COM policy for almost five years. Other companies had only implemented the policy more recently and then only in trial areas. It was not possible therefore to define precisely the reduction in demand from COM metering. Early indications from Bournemouth suggested that it was of a similar order of magnitude to the effect of optant metering, i.e. 10 to 15%, though there was high uncertainty around that figure.

No specific studies investigating the effect of other forms of selective metering on consumption could be identified. The majority of these households are large users, either sprinkler users or swimming pool owners. Since they are being metered due to their large water use, there appears to be little motivation for them to reduce their consumption significantly. In fact, anecdotal evidence may suggest that they are more likely to maintain the consumption at high levels: WRc is aware of several instances where calls for water reductions in times of water shortage have had no effect on the consumption of such customers.

There is some anecdotal evidence which suggests that measured customers are actually less likely to conserve water during peak periods due to the ‘pay for what you use principle’. As customers are paying volumetrically they consider it is acceptable to use water freely.

Whilst there is general agreement that there is a reduction in demand on switching to a meter, the long term view is less clear. There is concern that the initial reduction in water use following meter installation may decrease over time, with the initial reduction on per capita consumption decaying over a long period. This effect is sometimes

[18] Mobbs P, Murray D, Creasy J. Quantifying the Effects for Changes of Occupancy Metering. WRc Report P6721. WRc October 2005

referred to as kick back. One water company estimated that whilst consumption reduced by up to 13% on installation of a meter, around half of these savings were not sustained and the reduction after 5 years was around 6.5% of the original consumption. The UKWIR report[19] on optants, however, could find any firm evidence of this.

5.6.2 Supply pipe leakage

For external meters, the impact on supply pipe leakage (SPL) has been estimated and figures are reported in the Ofwat Security of supply, leakage and water efficiency report 2006/07 (Table 5). Overall SPL is estimated at 42.5 l/property/day for unmetered households and 19.5 l/property/day for externally metered households, giving an overall difference of 23 l/property/day. However, the estimates vary considerably from company to company with the difference ranging from 0 to 58 l/property/day.

5.6.3 Other benefits

The other benefits listed are much harder to quantify and no reliable data has been found to be able to quantify them.

5.7 Cost benefit modelling for full metering

It is important to note that the benefit from an individual meter installation is generally not related to the cost of installation. As shown in Section 3, the latter is driven by technical considerations relating to the nature of the installation, whereas the benefits are largely driven by the response of the household to a meter and how the water company uses the information obtained.

A cost benefit model was used to develop the average incremental cost, including social and environmental costs, or AISC. This allowed the estimates of costs and benefits discussed above to be entered and varied to test the impact of different scenarios. The base costs and benefits used and any assumptions are listed in Appendix 7.

The cost benefit model has been run for a fictitious water company with typical industry values (the central data set). In reality, every water company is different. Each will have a different cost structure, property type and household distribution, and hence the results will vary significantly from company to company. This example is an attempt to illustrate how different assumptions of costs and benefits affect the cost of metering and the benefits obtained.

As there is considerable variation and uncertainty in costs, an uncertainty analysis has been carried out, based on a Monte Carlo simulation, to give an estimate of the likely variability of the results. Appendix 7 also shows the assumptions on the costs and benefits that have been used in the model. The limits for each distribution are based on data given to WRc project CP222A, where such data was available.

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[19] UKWIR. A Framework Methodology for Estimating the Impact of Household Metering on Consumption. UKWIR report 03/WR/01/4 2003.

5.7.1 Costs

Costs have been estimated for each of the metering installations identified in Table 3.4. In reality there will be a continuum of costs from the cheapest screw-in installation into an existing boundary box (£20 from Table 5.1) to a highly complex installation, for example involving the separation of shared supplies, which could cost £3000 or more.

An average cost of simple external installations into existing and new boundary boxes has been calculated weighted by the relative proportions of each. For the internal installations, the cost obtained from CP222A has been used. Installations that require more effort have been estimated at an average of double a simple fit. Complex installations have been estimated at an average of 5 times the cost of a simple installation.

Meter surveys are likely to be more efficient under a compulsory programme with a surveyor working through an area. It has been assumed that every property will be surveyed and that this will be 20% more efficient than at present.

There will be costs associated with setting up and operating the policy. This may include modifications to billing systems, publicity, recruitment of additional staff etc. It has been assumed that these will be double those for setting up and running a COM policy to reflect the need for widespread customer communication.

5.7.2 Benefits

The model only calculates benefits arising from water savings. The intangible benefits arising from fairness and affordability are not included. For benefits, the reduction in consumption has been set at 10% and the reduction in supply pipe leakage has been calculated from the data given in the June Returns. Reductions in supply pipe leakage are only applied to externally metered households. It is generally assumed that additional benefits will accrue, particularly in terms of leakage management, as metering penetration increases. The model allows an estimate of additional benefits to be entered and a meter penetration at which these benefits will start to accrue.

Most studies on consumption reduction quote an overall range for the population studied. It might be expected that reductions in consumption are significantly higher for properties with high discretionary use, e.g. large gardens to water. However, these households also tend to be more affluent and water bills tend to represent a modest proportion of their expenditure. The UKWIR report[20] does give a breakdown for optants by property type, as shown in Figure 5.1. However, there is a high uncertainty put on this analysis as the numbers of households studied in particular bands are quite small and the variation between different property types is also small. For the purposes of the current exercise, it has been assumed that the reduction in consumption is consistent across all properties.

[20] Baker W, Herrington P, Metcalfe P, Miller T, Toft S. A Framework Methodology for Estimating the Impact of Household Metering on Consumption – Supplementary Information. UKWIR report 03/WR/01/5 UKWIR 2003.

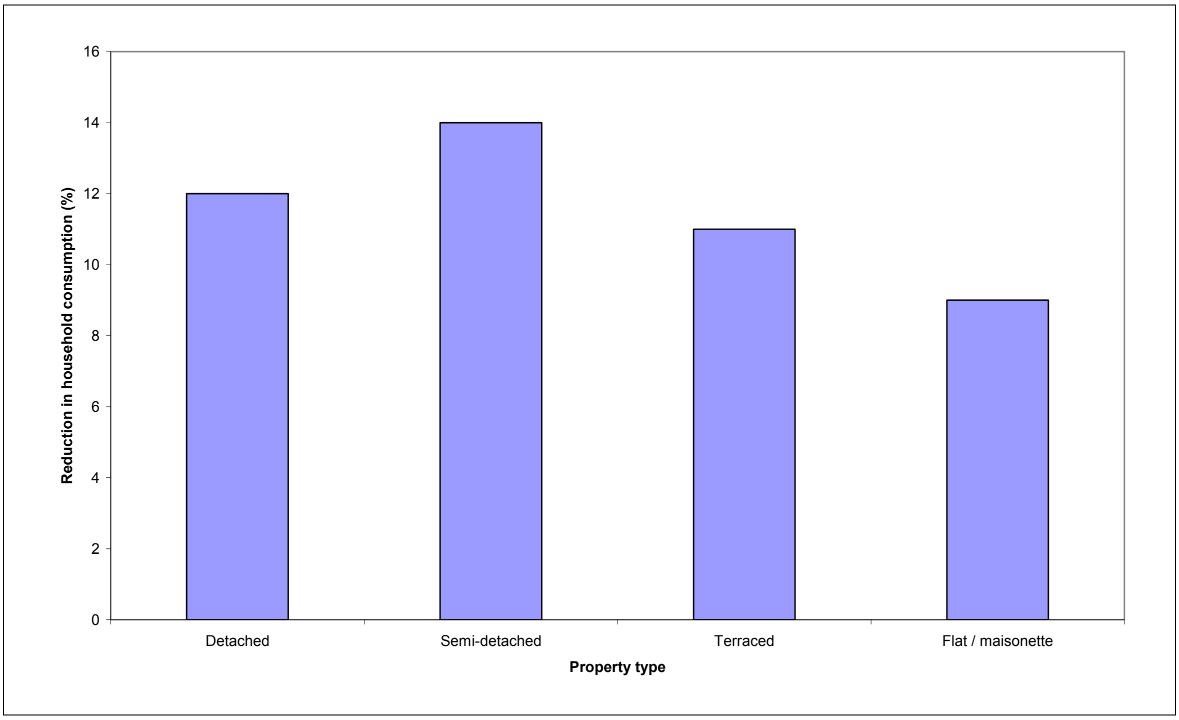

Figure 5.1 Consumption reduction for optants by property type

5.7.3 Results

The model has been run with 5 scenarios based on the installation types given in Table 3.4. In each the resultant meter penetration, average installation cost per meter and AISC have been calculated. The Monte Carlo simulation has then been run to give a median value and the upper and lower limits for the 95% confidence limits in each case.

Meter penetration

The resultant meter penetration for each scenario is given in Table 5.2. The central data set includes a starting meter penetration of 30% so the resultant penetration is the overall figure including the existing meters.

Table 5.2 Meter penetration rates

Scenario	Explanation	Resultant meter penetration
1	All properties metered	100%
2	No complex installations carried out	92.7%
3	No complex installations or harder internal installations	84.3%
4	Simple external and internal installations only	78.5%
5	Simple external installations only	64.3%

Average cost per installation

Holding all else constant, as meter penetration increases and the harder to meter cases have to be considered, the average cost per installation will rise. Figure 5.2 shows this increase with increasing penetration for the scenarios described in Table 5.2.

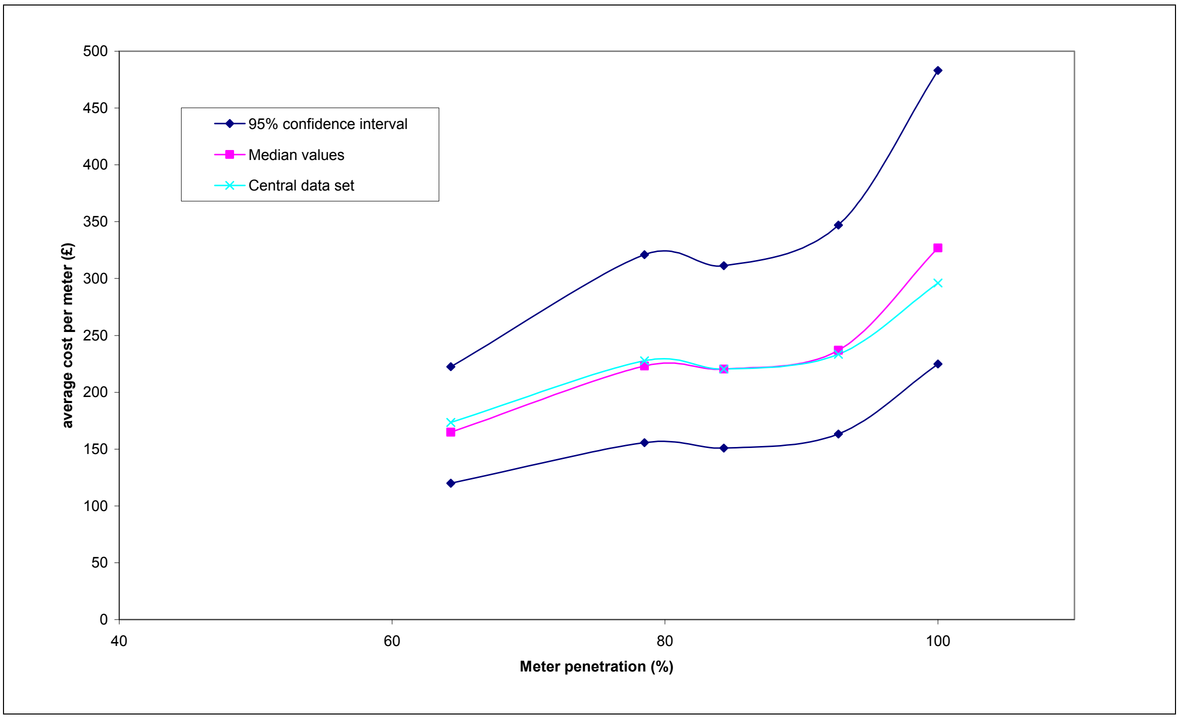

Figure 5.2 Increase in average cost per installation as penetration increases

Average incremental cost

Figure 5.3 shows the change in the average incremental cost as meter penetration rises based on the same scenarios as above. The AISC increases less sharply than the average cost per installation shown in Figure 5.2. This is because for any meter, the benefits are independent of the type (cost) of the installation, so as meter penetration rises, the benefits also rise proportionally. However, the AISC includes other costs, in addition to meter installation cost. One of those other significant costs is for meter replacement. Once a meter has been installed, the replacement cost will be the same regardless of the complexity of the original installation. Hence the ratio of costs to benefits, as measured by the AISC, does rise as steeply with increasing penetration as the average installation cost.

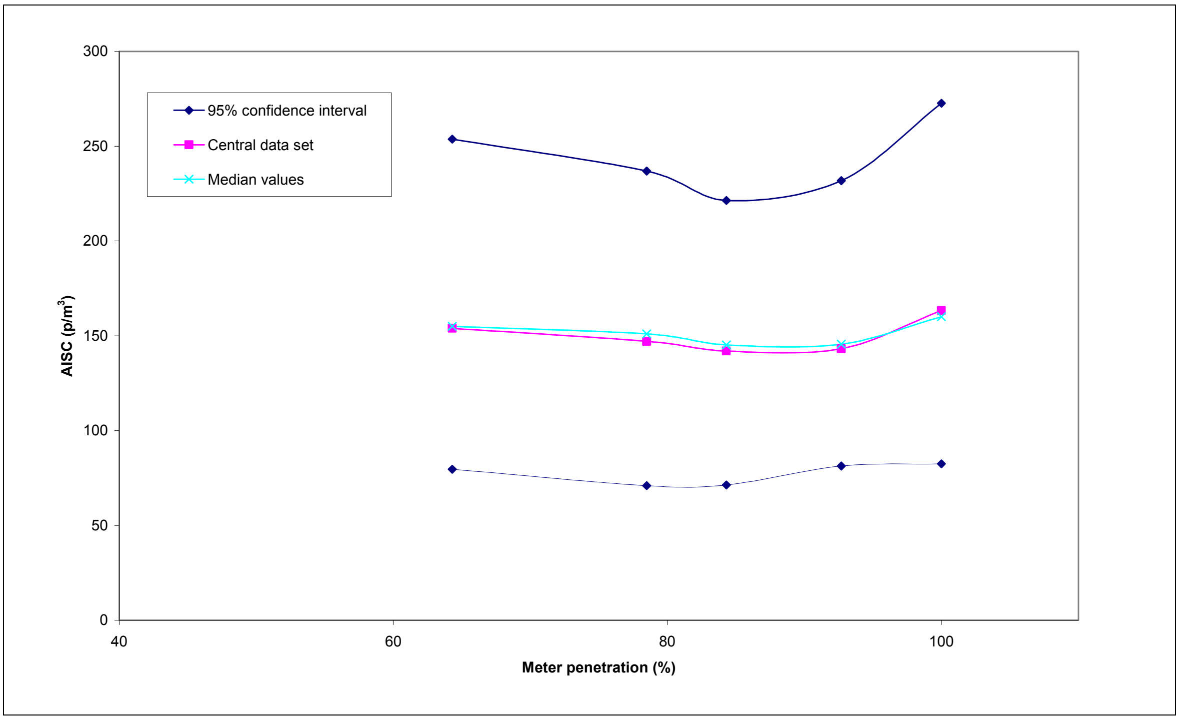

Figure 5.3 Increase in AISC as penetration increases

Sensitivity analysis

The model has been run with different values for certain parameters to test the influence of those parameters. The results are given in Table 5.3. In each case only the parameter indicated was varied, all others are held constant. The model runs were based on Scenario 2 in Table 5.2, i.e. the population and meter installation distributions are as for the scenarios above and the most complex installations are not metered, giving a resultant meter penetration of 92.7%. For each group of cases the baseline case is highlighted.

Table 5.3 Sensitivity to cost and benefit assumptions

Case	New average meter cost (£/meter)	Change in cost from baseline (%)	New AISC (p/m^3)	Change in AISC from baseline (%)
Cost efficiency savings on meter installation or equipment				
No savings	259.32	+11.1	155.5	+6.9
10% savings	**233.39**	**-**	**145.6**	**-**
20% savings	207.46	-11.1	135.8	-6.7
50% savings	129.66	-44.4	106.1	-27.1
Timescale for full (92.7%) metering				
5 years	233.39	-	141.2	-3.0
10 years	**233.39**	**-**	**145.6**	**-**
20 years	233.39	-	159.5	+9.5

Additional savings in leakage with full metering as % baseline savings				
No further savings	233.39	-	193.3	+32.9
25%	233.39	-	166.1	+14.1
50%	**233.39**	**-**	**145.6**	**-**
75%	233.39	-	129.6	-11.0
100%	233.39	-	116.8	-19.8
Proportion of external meters that can be fitted into existing boundary boxes				
0%	265.62	+13.8	157.9	+8.4
20%	**233.39**	**-**	**145.6**	**-**
30%	217.28	-6.9	139.5	-4.2

These results show that:

- If cost efficiency savings can be made in installation and equipment procurement, this will significantly reduce the average installation cost and the cost benefit as shown by the AISC;
- The timescale over which full metering is achieved does not impact on the average installation cost but does affect the cost benefit. A slower rate of meter installation of meters means that benefits are accrued more slowly and this outweighs the slowdown in spending for installations and meter replacement;
- Assumptions made about any additional water savings through better leakage management that results from having more meters significantly affects the cost benefit;
- Companies can achieve significant savings in future meter installations if appropriate boundary boxes are fitted during other programmes, as noted in Section 5.2, which reduce average meter installation costs and improve the cost benefit.

The sensitivity of resultant meter penetration, average installation cost and AISC to the distribution of properties and installation conditions is explored in Table 5.4. In every case, it is assumed that the complex installations are not metered. For the sensitivity to population distribution the extremes were taken, i.e. all remaining installations were either inner city, urban or rural, together with a case where the installations were split evenly across those environments. To test the sensitivity to installation conditions the model was run with half the meters in each installation type moved to the next category up (easier) or down (harder).

Table 5.4 Sensitivity to population distribution and installation conditions

Case	New meter penetration	Change in meter penetration form baseline	New average meter cost (£/meter)	Change in cost from baseline (%)	New AISC (p/m^3)	Change in AISC from baseline (%)
Baseline	92.7	-	233.39	-	145.6	-
Population distribution						
All inner city	91.3	-1.4	235.66	+1.0	153.5	+5.4
All urban	94.8	+2.1	235.08	+0.7	140.3	-3.6
All rural	93.0	+0.3	223.57	-4.2	136.0	-6.6
Even split	93.0	+0.3	231.47	-0.8	142.9	-1.9
Installation conditions						
Easier	94.4	+1.7	209.04	-10.4	132.9	-8.7
Harder	83.5	-9.2	277.34	+18.8	176.1	+20.9

These results show that:

- The distribution of population has little impact on the resultant meter penetration, average cost per meter and AISC;
- If meters prove easier to install than anticipated, the resultant meter penetration will rise a little whilst the average cost will drop significantly and there will be a significant benefit to the AISC;
- If meters prove harder to install than anticipated, the resulting meter penetration will be significantly lower, the average cost will rise significantly and the AISC will also be significantly higher.

A number of cases were also run with intelligent meters. This assumed that there is an additional cost for an intelligent meter - 2 rates were looked at £10 and £30 – and monthly readings are taken at a cost of 10p/read. Table 5.5 shows the results of different assumptions about the benefits intelligent meters can bring.

Table 5.5 Intelligent meter cases

Additional cost per meter	Additional consumption reduction	Max additional benefits	AISC p/m^3	Average cost /meter £
Baseline	**0**	**50%**	**145.6**	**233.39**
£10	0	50%	148.3	245.78
£10	10%	50%	88.1	
£10	10%	100%	70.7	

£30	0	50%	157.7	
£30	10%	50%	93.8	270.55
£30	10%	100%	75.2	

This shows that the AISC is almost halved if an intelligent meter that costs little extra to install and read than a conventional meter yields additional water savings equivalent to 10% of consumption.

5.8 Summary

Under a full metering programme, there are likely to be efficiencies in meter installation and discounts on procurement but there is uncertainty on how much this will be. This is because a rapid expansion of metering will put pressure on resources and there is uncertainty over the impact of the TMA.

In order to achieve meter penetration over 90%, the average cost of a meter installation may rise because of the need to meter some of the properties that are currently deemed too expensive to meter, though some of the increased cost may be offset by efficiency gains.

A full metering programme will impact on the operational costs of the industry. Clearly, the meters themselves will need to be maintained and replaced, but supporting services may also need to expand, for example dealing with increased customer enquiries. This could be viewed as a positive opportunity to build better relationships with customers, reinforce messages on water conservation and offer additional services.

The evidence for a reduction of consumption with metering in the UK is quite strong but evidence on other benefits that are claimed for full metering, for example overall reductions in the level of leakage is limited. Also most of the evidence for reductions in consumption comes from studies of optants, many of whom are water conscious before they switch. Recent information on the effect of compulsory metering is lacking.

The cost benefit modelling carried out in this project was based on typical figures from across the industry. However, each water company has a different cost structure and population distribution which will yield different results. To facilitate comparisons and explore different metering scenarios in the context of individual companies, a consistent approach should be adopted across the industry.

The modelling carried out in this project shows that increasing meter penetration above 92% by tackling the most complex installations would significantly increase the average cost per meter and the AISC. Clearly any scope for efficiencies in meter installation will yield benefits and one practical example is the fitting of appropriate meter boundary boxes during other works, for example stopcock replacement or mains rehabilitation. The marginal cost of a boundary box capable of taking a meter over one that does not is low and the potential savings when meters come to be installed are high.

The model used in the project assumes the relative proportions of different meter installation types based on feedback provided by the industry. However, there is considerable uncertainty in this due to lack of data in certain areas, e.g. number of shared supplies. If meter installation proves more difficult than anticipated then the average cost per installation could rise significantly.

The impact of intelligent metering is difficult to assess at the present time. To realise the full benefits of intelligent metering, e.g. in overall leakage management, requires close to full metering over an area. The modelling suggests that if the additional costs of installing and reading intelligent meters are not excessive, the additional benefits would only need to be modest to make the use of intelligent meters worthwhile.

6 Implications of tariffs on metering technology

6.1 Current situation and developments

Currently domestic water metering in the UK is mainly carried out using mechanical meters which are read visually or via an inductive touch pad. This gives a single bulk figure at each read of the overall consumption that has passed through the meter since it was made.

A number of automatic meter reading (AMR) systems that allow readings to be captured more frequently are being trialled. Many more AMR systems are now available, or close to market, following the rapid developments in communications systems over recent years, which also offer the ability to capture more frequent readings from meters.

There have also been developments in meter technology. Of particular interest here is the development of electronic registers which can incorporate multiple registers with automatic switchover based on time or some other pre-defined criteria, enabling more than one total to be stored. These can be fitted to mechanical meters (the term "hybrid meter" is being adopted to describe a traditional mechanical meter with an electronic register) and also tend to be found in the new generation of solid state meters. More advanced meters incorporate data logging facilities which means that it is possible to capture many more readings within the meter. Meters are also becoming available that include processing capability enabling more detailed storage and analysis of consumption, e.g. weekly or monthly totals and peak week data. Such developments enable many types of tariff structure to be considered.

Water companies are looking to develop alternative tariffs to help influence demand and consumption patterns. There are various options for alternative tariffs which can be implemented as a development from the simple yearly volumetric billing, depending on the behavioural modification that is being sought. These include;

- rising block tariff – defined volume at a low price (to comply with water required for basic hygienic living i.e. drinking, toilet flushing, bathing) and water consumed beyond that threshold is charged at a higher rate (this water is for 'discretional' use i.e. non essential consumption e.g. garden and car watering);
- seasonal tariff – winter water (i.e. non peak demand) is cheaper than summer water (during critical peak periods) to encourage wise water use during periods when water is potentially limited;
- time of day tariff – similar to the 'Economy 7' concept. Water is cheaper at times of low demand and when electricity is cheaper, usually during the night time.

A report by WRc[21] looked at the technology required to implement certain types of tariff structures by the number of readings required for effective implementation. This section summarises and updates the key findings from that report.

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[21] Godley A. Technology for Tariffs WRc Report UC3323, WRc, 1998

6.2 Traditional meters and tariffs

For an annual bill, with existing single register meters read visually or by touch pad, the following tariff structures could be readily implemented with no significant additional costs or changes to the metering technology:

- Flat-rate;
- Annual block.

These only require a single reading per billing period (year).

It may also be possible to implement a two band seasonally based tariff, but only if the changeover periods from summer to winter tariffs and vice versa could be spread over a period sufficiently long (say, 4 weeks) to enable all meters to be read. This would require intensive use of temporary labour during these periods and may be problematic to manage, give rise to a high reading error rate, many missed reads and be at a high risk of failure due to factors outside the companies' control such as labour supply or weather conditions.

For any other metered tariff, some additional capability in the meter and / or reading system will be required.

6.3 Data requirements for different tariffs

In order to prepare a customer bill, the minimum data requirement is a cumulative total of consumption in each tariff band during each billing period. Table 6.1 summarises the data that would be required to issue bills for different tariff structures, assuming an annual bill. There may be additional benefits in obtaining more data for the other purposes, for example leakage reduction, more detailed consumption data, resolving disputes or more frequent billing. Table 6.1 also shows the options for this data to be captured and the minimum number of reads per year in each case which may be carried out via telemetry or by a manual read or download. Note the readings can be stored in the meter and downloaded later. The frequency of downloading data depends on how quickly the water company wants the information for billing or other purposes.

For more frequent bills, the data requirements can be multiplied up as appropriate.

Table 6.1 Data requirements for tariffs (annual bill)

Tariff	Explanation	Data requirement (totals / year)	Options to achieve	Minimum number of individual readings
Flat-rate	All consumption charged at same rate	1	Single register	1
Annual block	Set amount of consumption per year at one rate, consumption in excess at a different rate	1	Single register	1
Daily block (2 blocks)	Set amount of consumption per day at one rate, consumption in excess at a different rate	2	Two registers with automatic changeover based on time and volume	2 (1 each register)
			1 register that counts to base block limit then resets at end of day + excess register with automatic changeover based on volume	1 (excess register)
			Single register read once per day	365
			Meter incorporating data logging	1
Simple seasonal (two bands)	Year split into 2 periods each with a different charging rate	2	Single register read at each tariff changeover	2
			Two registers with automatic changeover based on date	2 (1 each register)
			Meter incorporating data logging	1
Seasonal with summer rising block	As above, but “summer” rate includes a block element	2	Single register read at each tariff changeover	2
			Two registers with automatic changeover based on date	2 (1 each register)
			Meter incorporating data logging	1

Drought	Certain conditions trigger higher rate	2	Two registers with automatic changeover based on external trigger	2 (1 each register)
			Single register read by customer when trigger announced	1 + 1 customer read
			Meter incorporating data logging	1
Time of day (two bands)	Day split into two periods each with different charging rate	2	Two registers with automatic changeover based on time	2 (1 each register)
			Single register read each time tariff changes	730
			Meter incorporating data logging	1
Peak demand (weekly)	Set number of weeks with highest consumption charged at higher rate	2	Single register with weekly reads	52
			Meter incorporating data logging	1
Rate (two bands)	Consumption above a certain flow-rate charged at a different rate	2	Two registers with automatic changeover based on flow-rate	2 (1 each register)
			Meter incorporating processing and data logging	1
Discretionary use (2 categories)	Different rates for different uses, e.g. essential and non-essential use	2	Main meter plus sub-meter(s) on defined non-essential use outlet(s)	1 each meter
			Meter with two registers and inbuilt intelligence to discriminate use	2 (1 each register)

6.4 Cost implications

6.4.1 Meters

A traditional mechanical meter of the size typically used for domestic consumption (Class D Qn1) currently costs around £20, though prices can from around £15 to £25 or more depending on supplier, quantity ordered etc. An output unit, such as an encoder or pulse unit for connecting to a remote logger or telemetry will add £5 to £20, depending on its precise nature. Typically such a meter, if well installed and not subject to excessive wear factors such as high amounts of particulate, will require replacement in 10-15 years. Normal wear will cause a small degradation in performance leading to an under-registration, and hence loss in revenue, over time. Previous WRc studies[22,23] have shown this to be around –0.3% per 1000 m^3 consumption.

A more intelligent meter, such as an electronic solid state meter, currently costs around £50 to £70. However, as the market grows for more sophisticated meters and production volumes increase, it is likely that prices will fall. Manufacturers are claiming a 20+ years lifetime, though as the oldest in service meters of this type are only around 12 years old, this is unproven. Such meters require batteries to be changed typically after 10 years, though this may be more frequent if the batteries are also used to power an output, e.g. radio. As there are no moving parts, a solid state meter should not give rise to revenue loss through under-registration.

6.4.2 Installation

Installation costs are not significantly higher for a meter equipped with a radio transmitter, though there may be a small cost associated with programming the transmitter if it is a modular design that clips onto a meter and has to be programmed with the meter number and index. Fitting a meter with a touchpad to allow semi-manual reading does add cost to the installation.

6.4.3 Reading systems

Estimates of the current cost of reading using manual methods typically average about £2 per year per account. This includes management and supervision costs but also includes re-reads, for example, where the meter could not be accessed or there were problems with the reading. The cost per read of a manual read on a pre-planned route, excluding factors such as missed and special reads, has been estimated at as low as 20p per read where there is a dense population of meters.

Annual visits to download data from meters with integral logging facilities are likely to be of a similar magnitude, possibly slightly higher if many readings have to be collected, making the time at the meter longer. If physical connection is required to download then this could raise the costs significantly. It is more likely that reading would be carried out via infra-red, an inductive link or other non-contact method.

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[22] Mobbs P, Godley A, Windsor S The Long-Term Performance Of Domestic Water Meters. WRc Report P6625A. WRc 2004

[23] Bond A. The Long Term Performance Of Domestic Water Meters. WRc Report UC3320, December 1998

There is very little UK data for reading costs via AMR systems as most such systems have been done on a trial basis. There is some data from overseas, especially US and Canada, but costs given vary widely and are frequently bound into large meter replacement programmes making identification of specific reading costs difficult. It is also apparent that justification for investment in AMR systems is not solely based on reading costs – accuracy of data, the ability to yield more frequent reads than manual systems, the elimination of estimated readings and the ability to trigger special reads (e.g. due to dispute or change of occupancy) remotely also contribute to the cost benefit model. This suggests that cost per read, excluding such factors, is higher than for manual reading but this is offset when the other benefits are taken into account. Much of the cost benefit data are also given by manufacturers trying to sell AMR systems and hence need to be approached with some caution.

The costs of AMR fall into two parts – the capital cost of establishing the infrastructure for an AMR system and the operation costs of retrieving the data. Both will vary depending on the system used. For systems using existing infrastructure, e.g. those using established SMS or GPRS networks, the capital cost is likely to be relatively low. There will then be an operational cost each time a meter is read, typically for an SMS message this will be 10p per message (read); reads via GPRS are typically £2/Mbyte.

If a company installs its own infrastructure, say a fixed radio network, the capital costs will be high but the operational costs become linked to the maintenance of the system rather than individual reads. Such infrastructure can also then be used to obtain data from assets other than domestic meters, for example district meters or sensors in the water and wastewater networks[24]. This further complicates the costing.

Figure 6.1 shows estimates presented by Severn Trent Water at a conference on domestic metering in 2005[25]. Here the installation cost represents the overall cost of installing the meter and reading system.

Table 6.2 shows some further data given by Sensus[26]. This is based on metering an urban area comprising 8000 domestic single meter properties, 11800 flats and 200 commercial premises. The investment costs include the meter communications connection but exclude the cost of the meter itself. Figures quoted are in Euros.

[24] Flynn A. Radio Driving the Spread of AMR. Paper to the Global Smart Metering Technology Summit. June 2006

[25] Archibald G. Household Metering – Outstanding Issues. Paper to the National Conference on the Future of Domestic Metering for Water Customers. July 2005

[26] Metzger J. Automatic Meter Reading – A Business Case. Paper to the Global Smart Metering Technology Summit. June 2006

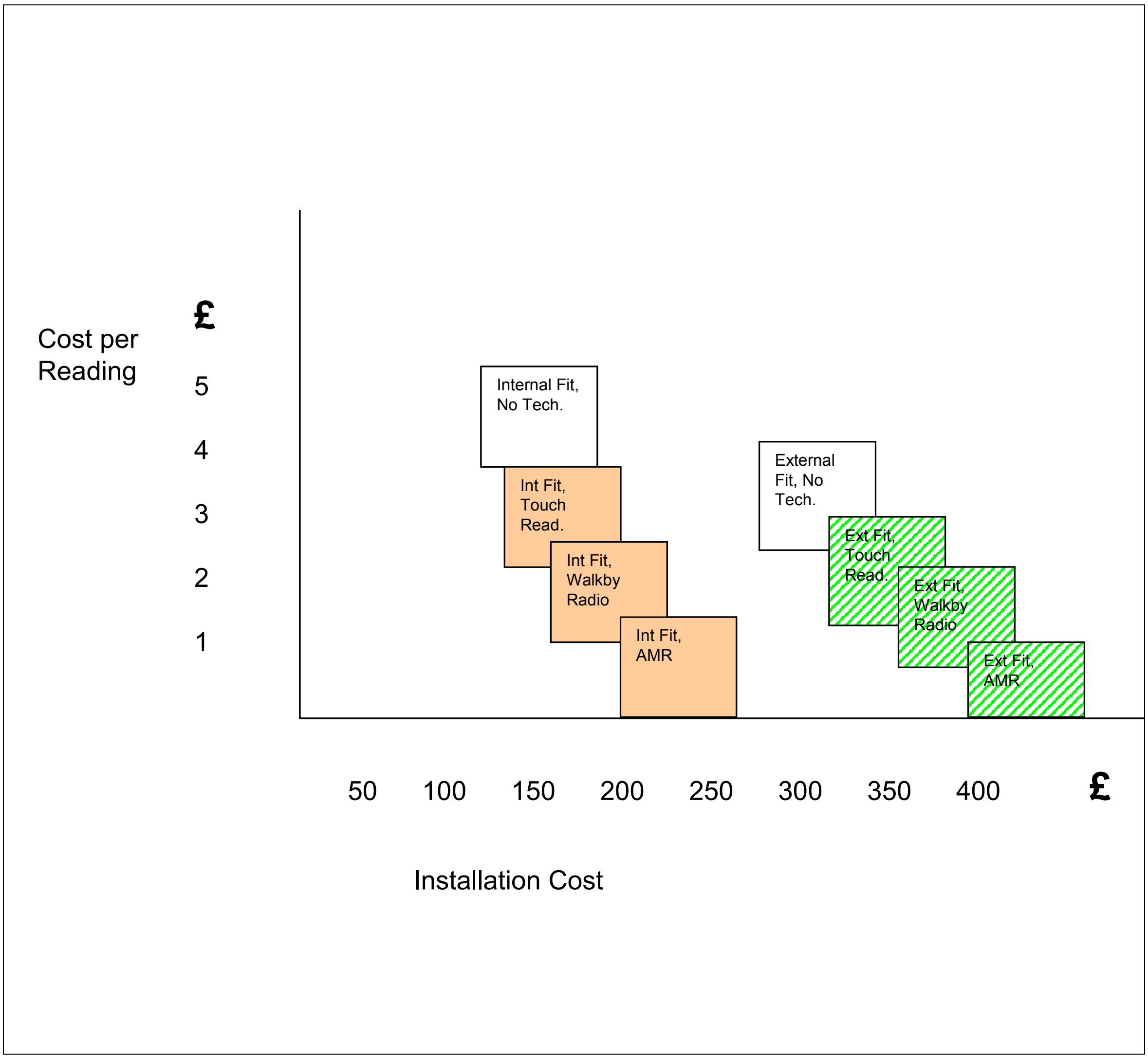

Figure 6.1 Estimated metering costs (example from STW)

Table 6.2 AMR costs in Euros (Sensus meters)

Reading method		Domestic	Flat	Commercial
Visual	Investment	0.50€	0.04€	0.50€
	Reading	3.00€	1.00€	10.00€
Touch pad	Investment	45.50€	37.54€	45.50€
	Reading	1.20€	0.70€	5.00€
Walk by radio	Investment	55.50€	45.04€	55.05€
	Reading	0.50€	0.20€	2.00€
Fixed network radio	Investment	56.00€	45.07€	57.00€
	Reading	0.0025€	0.0025€	0.0025€

As noted before, reliable data for reading costs using AMR systems is not widely available for the UK and further analysis of the existing data combined with a more rigorous examination of overseas data is recommended.

A further complication, or opportunity, may be that of a multi-utility intelligent metering system. Trials for intelligent metering of energy are currently being developed. One embodiment of the system proposed also includes a water meter. It is not inconceivable that in the not too distant future, water meters could be part of an intelligent home management system with communications through other household systems, e.g. broadband or digital television. In the short term, however, water meters are likely to remain as an independent system.

6.5 Tariff trials

The potential for alternative tariffs to influence demand is known in other sectors, principally energy and telecommunications, but its impact on water consumption in England and Wales is currently untested. Three companies are currently embarking on trials which are summarised below. As these trials are either still at an early stage or are yet to be formally started, there is no data yet upon which to assess the impact of the tariffs being explored.

6.5.1 Mid Kent Water

Mid Kent's 'Savings on Tap' project is a 5 year programme set up in 2005. Its objectives include trialling:

- water efficiency of new buildings
- the impact of variable tariffs
- new metering technology

The trial has three groups which are described in Table 6.3.

Table 6.3 Mid-Kent tariff trials

	Number of houses	Water efficient appliances (beyond that of standard new homes)	Tariff
T1	60	No	Standard tariff
T2	100	Yes	Standard tariff
T3	100	Yes	Variable tariffs

The additional water efficiency appliances built into the houses include flow restrictors on all taps, aerated shower heads, dual flush toilets, water butts and very efficient washing machines.

The houses were all fitted with intelligent meters. The system selected gives a range of data including a backflow index, leakage detection, and 13 rolling indexes with a reading at the end of each month.

The sample houses have been surveyed to ascertain the profile of the household and their attitudes to water. The first survey took place in autumn 2006 (54% response), the second in summer 2007 (94% response). A further survey is planned in 2008.

The initial results suggest that the water use of the T1 (control) group is slightly lower than base measured houses for Mid Kent Water, although this may be because the supply pipe leakage of the newer houses is less as well as a general trend in more water efficient appliances in new homes. There may also be greater awareness of water efficiency on the estate as although the company has tried to keep contact with and between customers to a minimum, there is nothing to stop neighbours influencing each other.

On average the water efficient houses (T2) had 10% lower consumption than base metered households. As yet, there is insufficient data to judge the impact of the variable tariff on the T3 group.

The sample size of 250 is small, but the trial is highlighting some technical and administrative issues. The main problem is that of storing and analysing data on a large scale, and in particular the difficulties of using this data in automated billing.

6.5.2 Folkestone and Dover Water

Folkestone and Dover Water have embarked on a tariff trial covering approximately 1600 properties in the town of Lydd. This was the first area targeted under Folkestone and Dover Water's compulsory metering programme and has close to full metering. New Romney is a nearby town of a similar size and composition to Lydd. It is being used as a control and has a metering penetration of 50%.

During summer 2006 there was an overall increase across the company area of 2% in pcc, whereas Lydd experienced a reduction of 7%. The company is confident that Lydd's reduction in pcc is due to metering.

A further trial in Lydd will start on 1 April 2008 with approximately 1100 properties. The company is looking to select properties with an ACORN profile similar to the rest of the customer base. The trial will last between 2 and 5 years. If the trial is successful the company will roll out the tariff across the whole company area by 2012. The trial will include three customer groups as shown in Table 6.4.

Table 6.4 Folkestone and Dover tariff trials

	Group 1	Group 2	Group 3
Year 1	Detailed bills	Detailed bills	Detailed bills
Year 2	Detailed bills Rising block tariff	Detailed bills Rising block tariff	Detailed bills
Year 3	Detailed bills Rising block tariff Retrofitting of water efficient devices	Detailed bills Rising block tariff	Detailed bills

All customers in the trial will get new format bills giving historical consumption information. This includes the:

- forecasted bill if the customer continues to use water at the current rate;
- comparison with similar households;
- link between water and energy costs (e.g. for a power shower - water costs around 6-7p, whereas energy is around 40p).

The company's rising block tariff designates 219 litres/property/day as essential use which is charged at 25% less than the current standard rate. Additional water is charged at twice the standard measured rate. The tariff is designed to be revenue neutral with a 7.5% reduction in total water use.

Thirty percent of customers could be worse off, these are likely to be homes with lots of children or high occupancy. Therefore the company will give extra allowances for the following households with:-

- 3 children under 19 – extra 15m^3/year at lower rate;
- 4 children or more under 19 – extra 30m^3/year at lower rate;
- Medical reasons – extra 15m^3 allowance per year at lower rate.

The company has set a maximum additional allocation per property of 110m^3/year. Birth certificates were used to check the existence of children.

The variable tariff structure will not be applied to sewerage, which is provided by Southern Water, so it may be that the potential savings difference is not as big as it could be.

Folkestone and Dover's experience shows that complete meter penetration might not be as difficult as has been suggested. Furthermore the manual reading of a fully metered area has proved to be surprisingly time effective which might question the need for intelligent meters.

The trial has highlighted that the billing system is unable to cope with the amount and type of data being recorded. Currently the bills are being calculated manually.

6.5.3 Wessex Water

Wessex Water will be running three types of trials; each trial will have half the customers on a rateable basis and half on the standard rate. In total 5000 properties are involved, of which 2000 are controls. The trial properties are to be chosen through change of occupancy from 1 April 2008. There is an agreed division of 30% tenants to 70% owners. The three tariffs to be trialled are;

- Rising block tariff - 50% increase in charge for use above 60m^3;
- Standard seasonal tariff – summer use charged at 50% above winter use, with winter use specific to each household;
- Peak seasonal tariff – April to October is defined as summer. Any use in summer above the household's winter use is charged at an increased rate. The 'winter consumption' is a standard volumetric charge.

Customers will be offered an in house meter reader. The cost of this is approximately £50 - £60 above the cost of the meter and logger. Loggers will record half hourly readings.

6.5.4 Concerns raised so far

Although the tariff trials have yet to start fully, they have already highlighted some issues for discussion. These have included:

- Customer acceptance - One of the biggest fears amongst the water companies in these trials was that of customer acceptance; however with the right amount of communication this has not yet proved to be an obstacle. Folkestone and Dover Water stated that it had received only one objection to compulsory metering;
- Equipment availability - The issue of hardware and software is seen as significant. There is some concern that manufacturers might not be able to supply the numbers of meters needed should companies implement full metering by 2015. Software programmes also need significant development
- Vulnerable users - Most companies were in agreement that there should be some way of protecting vulnerable groups. However there was some concern that customers do not like subsidising vulnerable groups. Defra stated that there is no appetite for a specific water targeted benefit system – the benefits system is already complex enough. There was considerable interest in Wessex Water's 'peak seasonal' tariff as it was commented that this could be potentially one of the fairest tariffs.

6.6 Summary

The implementation of alternative tariffs is likely to require some form of intelligent metering in order to be able to capture an increased number of readings. There is considerable uncertainty in the costs associated with this and predictions vary depending on the degree of meter penetration and the actual systems considered. The effect of alternative tariffs on water demand is not yet known, but evidence will emerge from trials that are commencing in a number of water companies. The efficacy of tariffs to achieve their aims in changing behaviour will depend on getting information back to the customer effectively and in a timely manner. This can be done retrospectively through bills or live, via multiple meter registers or a home display unit. Such units are currently being developed and trialled for energy and many of those currently on trial include the facility to also display water use. This is an area which will require further investigation such that equipment suppliers can develop appropriate solutions.

7 Conclusions and recommendations

7.1 Conclusions

- An overall household meter penetration of slightly over 90% should be feasible though this will require some of the cases that are more difficult to meter to be tackled.
- The average funding per meter allowed by Ofwat is currently based on metering the more straightforward properties. To achieve over 90% household meter penetration, this will need to rise.
- Customers need to be supportive of metering to ensure that any compulsory metering programme can be implemented efficiently and enable the full benefits to be realised.
- It is likely that more internal meters will need to be installed, particularly to help meter flats and properties on shared supplies. Hence the DG8 requirement for meter reading should be reviewed.
- Consideration should be given to the classification of all individual dwellings as households. This would enable all individual customers to be made aware of their water use.
- Changes to the planning process are required to ensure that water companies are automatically informed of the conversion of individual properties into flats or apartments.
- In the South East of England current metering rates will need to increase by a factor of 5 to achieve over 90% household meters by 2015. This will be a major challenge to the supply chain.
- Both water companies and suppliers are concerned about the availability of appropriately skilled labour if there were to be a rapid acceleration of metering, particularly with competing draws on labour such as the Thames Gateway and preparation for the Olympics in 2012.
- Water companies are confident that there are no internal barriers to expanding metering, though initial experience suggests that changes to billing systems will be required.
- There may be scope for efficiencies in meter installation costs if compulsory metering is carried out in an area by area programme, though they may require changes in current working practices.
- The implementation of the Traffic Management Act will affect many activities of water companies, though the precise impact on metering programmes is as yet uncertain.
- There is uncertainty over the full level of benefits likely to arise from a compulsory metering programme.
- Automatic meter reading systems are likely to be needed for efficient and frequent reading of meters, particularly the growing number of internal

meters. This should yield increased benefits but their higher cost will need to be recognised and funded.

- The implementation of alternative tariffs is likely to require some form of intelligent metering to capture readings at tariff boundaries. The effect of alternative tariffs on water demand is not yet known, but evidence will emerge from trials that are commencing in a number of water companies.

7.2 Recommendations

- The level of funding of meter installations should be reviewed.
- Water companies should build up a profile of the housing stock in their areas to identify the likely distribution of installations, and hence cost, to strengthen their case for funding.
- The DG8 requirement for meter reading should be reviewed to ensure that it does not form a barrier to increasing meter penetration, particularly with regard to internal meters.
- The water industry and its regulators should lobby for changes to planning procedures regarding flats and property conversions to ensure that all households have a single supply and that water companies are informed of conversions of individual properties into separate dwellings.
- A co-ordinated programme of engagement with customers by water companies, regulators and government should be developed to explain the need for and benefits of full metering.
- A co-ordinated strategy for increasing metering across all companies in water stressed areas should be developed.
- A consistent approach to cost benefit analysis for metering should be developed that would facilitate comparisons and exploration of different metering scenarios in the context of individual companies. This would include agreement on what cost items were included and how benefits should be calculated.
- Further trials to assess the impact and costs of intelligent metering should be conducted.
- The impact of alternative tariffs should be reviewed and disseminated when data becomes available from the current trials.

Appendix 1 – Supply Chain Questionnaire

The following questionnaire and explanation was sent out to targeted suppliers identified from the membership of SBWWI as those with an interest in household metering. Eight responses were received covering equipment manufacturers and contractors.

ENVIRONMENT AGENCY METERING PROJECT

Input from the supply chain

Following the government consultation in early 2007, the Water Regulations were changed to allow water companies to undertake compulsory metering in areas defined by the Environment Agency as being under serious water stress. Companies who operate in areas defined as under serious water stress will need to assess compulsory metering alongside other supply/demand options considered in Water Resource Management Plans.

WRc are currently carrying out a project for the Environment Agency to take an independent look at the potential implications of a compulsory metering programme for domestic properties. The Environment Agency are seeking this information in order that they might take a balanced and realistic approach to assessing company Water Resource Plans which incorporate extended metering programmes.

There are three questions on which WRc have been asked to consult with stakeholder groups, including water companies and the supply chain, to ensure that a balanced view can be obtained. SBWWI is working with WRc to survey the views of the supply chain on these issues.

We are therefore seeking your input, based on your practical knowledge and experience to assist with this project. There is no doubt that an extension of current metering policies to one of full metering can provide opportunities for suppliers, but it is important to be realistic in terms of what is achievable.

We would be very grateful if you could take a few minutes to provide your response to the following questions. We appreciate that not everyone will feel they are able to comment on all questions, but we would be grateful for any response that you can provide.

All responses will be treated in confidence and only used by SBWWI and WRc to input into the project report. Comments will not be attributed to any individual or organisation.

1. What level of cost efficiencies might arise from a move from the current selective metering policies to a compulsory full metering programme?

a) In equipment – meters, boundary boxes, etc.?

b) Through a planned and systematic installation programme, rather than the current scatter-gun approach?

c) In meter reading?

d) Where else will there be opportunities to improve efficiency, and what level of saving is achievable?

2. What will be the constraints on the rate at which meters can be installed?

a) In the supply and availability of meters, boundary boxes and other equipment?

b) In the availability of appropriately skilled installers and resources?

c) What local or regional constraints are there (e.g. other schemes competing for resource) that will affect the installation of meters?

d) Comparisons against current meter installation rates suggest that this rate will have to increase by a factor of 2 to 3, if all South East England is to be metered in the next two AMP periods. What problems will this bring, and is this feasible?

3. What level of metering penetration can be realistically achieved, and how will this vary in different areas?

a) What are the constraints from an installer / contractor's point of view when installing meters in inner city areas?

b) What level of meter penetration is achievable in inner city areas where there is a large percentage of flats (purpose built and newer conversions), dense housing, frequently older properties with shared supplies and busy roads?

c) What are the constraints from an installer / contractor's point of view when installing meters in urban areas?

d) What level of meter penetration is achievable in urban areas where there is a mix of all property types, lower density housing and more new builds?

e) What are the constraints from an installer / contractor's point of view when installing meters in rural areas?

f) What level of meter penetration is achievable in rural areas where there are more scattered communities and a large proportion of single family dwellings?

Appendix 2 – 2006/07 Meter Penetration

Company	Household meters	Non household meters	Total proportion of billed properties metered
Anglian	57.2%	87.8%	59.2%
Bournemouth	45.6%	93.7%	49.6%
Cambridge	57.0%	89.9%	59.7%
Essex and Suffolk	39.4%	92.7%	42.3%
Folkestone and Dover	51.5%	84.6%	53.9%
Mid Kent	37.9%	92.5%	42.7%
Portsmouth	7.9%	87.3%	13.0%
South East	33.3%	87.1%	37.3%
Southern	33.0%	80.5%	36.0%
Sutton & East Surrey	23.2%	85.3%	26.9%
Thames	23.1%	87.5%	27.0%
Three Valleys	30.3%	84.2%	33.0%
TOTAL Water stressed	34.3%	87.1%	37.6%
Bristol	26.6%	81.0%	30.7%
Dee Valley	41.4%	91.6%	45.0%
Dwr Cymru	24.9%	89.7%	30.0%
Northumbrian	15.6%	84.0%	19.4%
Severn Trent	27.6%	93.1%	31.6%
South Staffs	18.7%	86.6%	22.5%
South West	55.4%	88.9%	58.7%
Tendring Hundred	65.9%	97.6%	67.8%
United Utilities	21.3%	89.6%	25.6%
Wessex	37.3%	86.7%	42.1%
Yorkshire	31.0%	86.7%	34.6%
TOTAL rest	27.3%	88.9%	31.4%
TOTAL all	30.3%	88.2%	34.1%

Figures taken from Security of Supply 2006-07 report. Ofwat 2007

Appendix 3 – Metering Plans in Strategic Direction Statements

Water Company	Metering Policy (as taken from Strategic Direction Statement)
Anglian Water	Current meter penetration: **62%** Target of achieving total metering of water supply customers' within 25 years except where it is not practical. Encouraging customers to switch voluntarily is the preferred option for extending metering, and AW will look at ways to increase the rate of switching. AW's statement identifies intelligent metering as a likely area of future research.
Bournemouth & WH	Current meter penetration: **48.5%** Over the next 25 years B&WH plan to achieve full metering. General policy on metering is that it is both a fair basis of charging and a means of managing demand, particularly when deployed alongside the appropriate tariff signals. B&WH's main demand management tool is metering, and with the implications of the new water-stressed areas provisions they will progress towards full metering using both optional and on change of occupier strategies. Metering is a tool to promote sustainable water use. They are currently assessing the costs and benefits of a programme of compulsory metering as part of their WRP.
Bristol Water	Current meter penetration: **28.6%** Consider that paying by the amount of water used to be the fairest and most environmentally friendly system of charging and so are moving to all properties being metered as soon as possible using "smart" technology to maximise the benefits. Aiming for effectively 100% metered by 2035 and adopt "smart" metering to improve customer service. Introduction

	of rising block tariffs from around 2025 to send strong price signals to customers to minimise environmental damage.
Cambridge Water	Current meter penetration: **58.4%** Aim to achieve universal metering by 2035. Change to remotely-read smart metering to reduce dependence on mobile meter readers. Implementing innovative seasonal tariffs that place a premium on water used at peak times which will require smart meters.
Dwr Cymru	Current meter penetration: **28.1%** Most domestic customers are charged for water on an unmeasured basis. Although customers will continue to have the right to opt for a meter, Welsh Water will adopt a cautious approach to the promotion of metering as it is believed that for Dwr Cymru universal metering is not cost effective.
Essex & Suffolk	Current meter penetration: **42.1%** Aim to achieve as near to universal metering by 2020 In addition to metering new households and providing customers with the option of a meter free of charge, a selective metering strategy where meters are installed when the occupier in a household changes is also in operation. However, as time passes there is likely to be a reduction in the number of new meters by these methods and so it is likely that metering will have to be introduced by compulsory means sometime between 2011 and 2015. It is not practical or economic to meter all properties. Where this is the case charges will have to be raised on an unmeasured basis, or by assessed volume.
Folkestone & Dover	Current meter penetration: **57.4%** Having been granted 'Area of Water Scarcity' status by the Secretary of State, F&D have commenced a programme of compulsory metering that currently will mean 90% of our domestic customers receive a measured bill by 2015.

	Plan to accelerate the compulsory metering programme from the current target of 90% by 2015 to ensure all customers that can be metered are by the end of 2012. Plan to develop, test and implement new socially-responsible charging structures which will reduce the price for water.
Mid Kent Water	Current meter penetration: **40.3%** Currently meter penetration is a result of the existing policy to meter all new properties, offering free meters to those who would choose to have them and a selective metering programme. Aim to increase the number of customers on a meter during 2010-15 to over 60%.
Northumbrian Water	Current meter penetration: **17.8%** Aim to meter 40% of properties by 2020. Current policy is to install meters in all new properties and actively promote the option of installing a meter free of charge to existing customers. Most customers are not in favour of compulsory metering of existing properties even though they recognise metering as being the fairest way to pay for water. As a result NW will continue with the current metering policy.
Portsmouth Water	Current meter penetration: **10.6%** Most customers feel that metering should not be compulsory. Non-metered households are concerned that metering would lead to higher bills even whilst recognising that metering would make them more efficient in their water use. PW's entire supply area has been designated at as 'water stressed' and as a result a compulsory metering programme could be implemented. The programme would initially target those areas where it is relatively inexpensive to fit a meter, thereby minimising the impact on overall bills. The metering programme will aim to have 85% of domestic properties metered by 2035.
Severn Trent Water	Current meter penetration: **29.6%** Plan to move to a predominantly metered charging basis and develop more alternative tariffs to enable management of water usage and demand. Customers do not want bills to increase to pay for a rapid extension of metering so we will need to ensure an appropriate rate of increase of metering. The acceleration of the rate of meter

	installation may be achieved through metering properties where there is a change of occupier.
South East Water	Current meter penetration: **35.6%** The current meter penetration has been achieved through current company strategy to meter all new properties, offer free meter installation to those that wish to opt for a meter, and a number of smaller local initiatives focused on metering properties when there is a change of occupier. Aim to achieve 60% of metering during 2010-15 to over 60%. The minimum level of metering that can be achieved by 2020 is believed to be 80%. SEW's view of the current ad-hoc metering regime is that it is uneconomic and using recent change in legislation will allow a larger, more focused programme which would reduce the cost per household thus, having considered the views of all Stakeholders SEW believe a universal metering strategy is the favoured solution.
South Staffordshire Water	Current meter penetration: **20.9%** Metered customers are increasing by around 2% per year. Continuation of current strategies will achieve meter penetration of 50% by 2025. South Staffs will adopt a two-pronged approach to metering. Firstly, the introduction of a metered seasonal tariff that has a lower volumetric rate in the winter and a higher volumetric rate in the summer which would require smart meters. Secondly, to install a meters in unmetered household properties when there is a change of occupier. With the adoption of these strategies meter penetration is estimated to achieve 70% by 2025.
South West Water	Current meter penetration: **59.9%** Continue with voluntary metering to attain 100% Many of South West Water's customers have taken advantage of the option to have a free meter fitted since it was first offered in 1997 and that trend is expected to continue with anticipated rates by 2010 of 70% and by 2015 85%. The voluntary metering policy will be continued, coupled with active promotion through targeted marketing. Metering will begin to approach 100% after 2015. Ultimately smart meters will be required to allow for new tariffs and to provide better information on water use to customers.

Southern Water	Current meter penetration: **36.5%** The whole of Southern Water's supply area is classed as an area of serious water stress. This means that compulsory metering can be implemented from 2010. SW supports metering for all homes where possible and is planning to achieve full metering by 2015.
Sutton & East Surrey	Current meter penetration: **26.8%** By 2010 meter penetration is expected to be 35% of billed households. Customers consider that metering is the only equitable way to pay for water. S&ES will consider the option of compulsory metering but it is unlikely that it will be most economic way of balancing supply/demand. Aiming for a meter penetration level of at least 70% by 2020 and 90% by 2025. This will be achieved by a combination of metering on change of occupancy, providing free meters to optants, and compulsory metering.
Thames Water	Current meter penetration: **25.0%** Metering is seen by most as a fair way to pay, but many customers expressed concern about compulsory metering. It is also recognised that plumbing complexities within flats may limit full meter penetration especially with the large number of flats in London and this will limit what can be cost beneficially achieved. A progressive and targeted metering programme is believed to be the best approach which will focus initially on areas of greatest water stress and where water savings are most likely to be made. This will achieve at least 50% meter coverage by 2015. Between 2015 and 2035 aim to achieve 80% meter coverage of domestic properties.
Three Valleys Water	Current meter penetration: **34.4%** Vigorous promotion of compulsory water metering and demand management tariffs as this will encourage customers to think of water as a valuable resource. Estimate meter penetration of 81% by 2030. Consultations show that a growing majority of customers support metered charging as the fairest way to pay.
United Utilities	Current meter penetration: **23.0%** Significant scope for innovation across a broad front including trialling new metering technology: intelligent meters. Aim for universal water metering by 2035. On current trends 60% metering would be achieved by 2035. This would

	be accelerated, initially through voluntary initiatives, alongside a national commitment to metering in all homes no later than 2035.
Wessex Water	Current meter penetration: **40.3%** Predict that approximately 70% of domestic customers will be metered by 2015 and 85% by 2020. This will be achieved by installing a meter when a property changes ownership and by introducing tariffs aimed at encouraging customers to use water wisely. Metering will encourage wise water use and it makes it easier to control leakage Risks to vulnerable groups as meter penetration increases can be militated against.
Yorkshire Water	Current meter penetration: **32.4%** Yorkshire water is not water stressed and consequently no requirement to introduce compulsory metering. Metering will be based on customer choice and be demand led and this will be reviewed every 5 years. Customers view metering as providing the basis for equal and fair prices. The benefits in terms of reducing consumption were also recognised. YW considers that achieving full metering would result in an increase of 10% to the customer's bill.

Appendix 4 – Shared Supplies

These tables contain the detailed breakdown of the proportions of shared supplies form a survey carried out on over 1200 service pipes across a large UK water company.

Proportion of shared supplies by property age

	Proportions			CoSPs/ prop	Props/ CoSP	Property count
House age	**Single**	**Dual**	**Multiple**			
pre 1920	0.60	0.15	0.25	0.73	1.38	246
1920-45	0.60	0.14	0.26	0.72	1.39	356
1946-79	0.71	0.09	0.21	0.79	1.26	442
post 1979	0.86	0.05	0.09	0.90	1.11	114
Unknown	0.89	0.08	0.03	0.94	1.06	38
Overall	0.68	0.11	0.21	0.77	1.29	1196

CoSP denotes Company service pipe.

Proportion of shared supplies by property age and type

		Proportions			CoSPs/	Props/	Property
House age	**Property type**	**Single**	**Dual**	**Multiple**	**prop**	**CoSP**	**Count**
pre 1920	Detached	0.96	0.02	0.02	0.97	1.03	50
	Semi	0.56	0.29	0.15	0.74	1.35	55
	Terraced	0.50	0.16	0.34	0.65	1.54	120
	Flat	*0.42*	*0.00*	*0.58*	*0.54*	*1.86*	*12*
	Overall	0.60	0.15	0.25	0.73	1.38	246
1920-45	Detached	0.98	0.02	0.00	0.99	1.01	42
	Semi	0.66	0.18	0.16	0.79	1.27	174
	Terraced	0.38	0.12	0.50	0.55	1.83	113
	Flat	*0.41*	*0.06*	*0.53*	*0.55*	*1.81*	*17*
	Overall	0.60	0.14	0.26	0.72	1.39	356
1946-79	Detached	0.97	0.02	0.01	0.98	1.02	98
	Semi	0.74	0.15	0.11	0.84	1.19	178
	Terraced	0.50	0.10	0.40	0.63	1.58	94
	Flat	0.36	0.04	0.60	0.51	1.97	47
	Overall	0.71	0.09	0.21	0.79	1.26	442
post 1979	Detached	0.96	0.02	0.02	0.97	1.03	51
	Semi	0.85	0.08	0.08	0.90	1.11	26
	Terraced	0.77	0.09	0.14	0.85	1.18	22
	Flat	*0.64*	*0.09*	*0.27*	*0.74*	*1.35*	*11*
	Overall	0.86	0.05	0.09	0.90	1.11	114
Overall	Detached	0.97	0.02	0.01	0.98	1.02	252
	Semi	0.71	0.17	0.12	0.82	1.22	447
	Terraced	0.51	0.12	0.37	0.65	1.54	359
	Flat	0.44	0.05	0.51	0.57	1.76	89
	Overall	0.68	0.11	0.21	0.77	1.29	1196

CoSP denotes Company service pipe.
Where the number of properties is not sufficient to provide reliable estimates of the proportions, the figures are in *italics*.

Appendix 5 - Rates need to achieve increased household meter penetration

Company	Rate for 100% in 5 years	Ratio to current total rate	Ratio to current selective and optant rate	Rate for 90% in 5 years	Ratio to current total rate	Ratio to current selective and optant rate	Rate for 80% in 5 years	Ratio to current total rate	Ratio to current selective and optant rate
Anglian	158.2	3.7	6.2	142.4	3.4	5.6	126.6	3.0	5.0
Bournemouth	19.1	2.1	3.0	17.2	1.9	2.7	15.2	1.7	2.4
Cambridge	9.6	4.4	6.6	8.7	3.9	5.9	7.7	3.5	5.3
Essex and Suffolk	84.5	4.1	3.8	76.1	3.7	3.4	67.6	3.3	3.1
Folkestone and Dover	6.5	1.4	1.3	5.8	1.3	1.1	5.2	1.1	1.0
Mid Kent	27.7	3.5	4.5	24.9	3.2	4.1	22.1	2.8	3.6
Portsmouth	50.1	9.5	8.6	45.1	8.5	7.8	40.1	7.6	6.9
South East	73.2	5.7	4.6	65.9	5.1	4.2	58.6	4.5	3.7
Southern	125.8	3.9	3.5	113.2	3.5	3.2	100.6	3.1	2.8
Sutton & East Surrey	38.1	4.8	4.3	34.3	4.3	3.9	30.5	3.8	3.4
Thames	494.4	9.4	10.5	444.9	8.4	9.4	395.5	7.5	8.4
Three Valleys	163.5	3.5	4.0	147.2	3.1	3.6	130.8	2.8	3.2
Bristol	65.9	6.3	9.0	59.3	5.6	8.1	52.7	5.0	7.2
Dee Valley	12.6	2.5	4.7	11.3	2.2	4.3	10.1	2.0	3.8
Dwr Cymru	179.1	6.3	9.5	161.2	5.7	8.6	143.3	5.0	7.6
Northumbrian	176.6	6.6	9.0	158.9	6.0	8.1	141.3	5.3	7.2
Severn Trent	441.1	8.8	11.4	397.0	7.9	10.3	352.9	7.0	9.1
South Staffs	81.7	8.9	13.2	73.5	8.0	11.9	65.3	7.1	10.6
South West	59.4	1.7	2.3	53.5	1.6	2.0	47.6	1.4	1.8
Tendring Hundred	4.5	2.7	4.1	4.1	2.4	3.7	3.6	2.1	3.3
United Utilities	434.6	7.7	11.0	391.1	7.0	9.9	347.6	6.2	8.8
Wessex	61.8	4.0	5.5	55.6	3.6	4.9	49.4	3.2	4.4
Yorkshire	263.4	6.1	8.1	237.0	5.5	7.3	210.7	4.9	6.5

Company	Rate for 100% in 10 years meters/yr	Ratio to current total rate	Ratio to current selective and optant rate	Rate for 90% in 10 years meters/yr	Ratio to current total rate	Ratio to current selective and optant rate	Rate for 80% in 10 years meters/yr	Ratio to current total rate	Ratio to current selective and optant rate
Anglian	79.1	1.9	3.1	71.2	1.7	2.8	63.3	1.5	2.5
Bournemouth	9.5	1.1	1.5	8.6	1.0	1.4	7.6	0.9	1.2
Cambridge	4.8	2.2	3.3	4.3	2.0	3.0	3.9	1.8	2.6
Essex and Suffolk	42.3	2.1	1.9	38.0	1.9	1.7	33.8	1.6	1.5
Folkestone and Dover	3.2	0.7	0.6	2.9	0.6	0.6	2.6	0.6	0.5
Mid Kent	13.8	1.8	2.3	12.4	1.6	2.0	11.1	1.4	1.8
Portsmouth	25.1	4.7	4.3	22.6	4.3	3.9	20.1	3.8	3.5
South East	36.6	2.8	2.3	33.0	2.6	2.1	29.3	2.3	1.8
Southern	62.9	1.9	1.8	56.6	1.8	1.6	50.3	1.6	1.4
Sutton & East Surrey	19.1	2.4	2.1	17.2	2.1	1.9	15.3	1.9	1.7
Thames	247.2	4.7	5.2	222.5	4.2	4.7	197.7	3.8	4.2
Three Valleys	81.8	1.7	2.0	73.6	1.6	1.8	65.4	1.4	1.6
Bristol	32.9	3.1	4.5	29.6	2.8	4.1	26.4	2.5	3.6
Dee Valley	6.3	1.2	2.4	5.7	1.1	2.1	5.0	1.0	1.9
Dwr Cymru	89.5	3.1	4.8	80.6	2.8	4.3	71.6	2.5	3.8
Northumbrian	88.3	3.3	4.5	79.5	3.0	4.0	70.6	2.6	3.6
Severn Trent	220.6	4.4	5.7	198.5	3.9	5.1	176.4	3.5	4.6
South Staffs	40.8	4.4	6.6	36.8	4.0	6.0	32.7	3.6	5.3
South West	29.7	0.9	1.1	26.7	0.8	1.0	23.8	0.7	0.9
Tendring Hundred	2.3	1.3	2.0	2.0	1.2	1.8	1.8	1.1	1.6
United Utilities	217.3	3.9	5.5	195.6	3.5	5.0	173.8	3.1	4.4
Wessex	30.9	2.0	2.7	27.8	1.8	2.5	24.7	1.6	2.2
Yorkshire	131.7	3.1	4.1	118.5	2.8	3.7	105.4	2.5	3.3

Company	Rate for 100% in 15 years meters/yr	Ratio to current total rate	Ratio to current selective and optant rate	Rate for 90% in 15 years meters/yr	Ratio to current total rate	Ratio to current selective and optant rate	Rate for 80% in 15 years meters/yr	Ratio to current total rate	Ratio to current selective and optant rate
Anglian	52.7	1.2	2.1	47.5	1.1	1.9	42.2	1.0	1.7
Bournemouth	6.4	0.7	1.0	5.7	0.6	0.9	5.1	0.6	0.8
Cambridge	3.2	1.5	2.2	2.9	1.3	2.0	2.6	1.2	1.8
Essex and Suffolk	28.2	1.4	1.3	25.4	1.2	1.1	22.5	1.1	1.0
Folkestone and Dover	2.2	0.5	0.4	1.9	0.4	0.4	1.7	0.4	0.3
Mid Kent	9.2	1.2	1.5	8.3	1.1	1.4	7.4	0.9	1.2
Portsmouth	16.7	3.2	2.9	15.0	2.8	2.6	13.4	2.5	2.3
South East	24.4	1.9	1.5	22.0	1.7	1.4	19.5	1.5	1.2
Southern	41.9	1.3	1.2	37.7	1.2	1.1	33.5	1.0	0.9
Sutton & East Surrey	12.7	1.6	1.4	11.4	1.4	1.3	10.2	1.3	1.1
Thames	164.8	3.1	3.5	148.3	2.8	3.1	131.8	2.5	2.8
Three Valleys	54.5	1.2	1.3	49.1	1.0	1.2	43.6	0.9	1.1
Bristol	22.0	2.1	3.0	19.8	1.9	2.7	17.6	1.7	2.4
Dee Valley	4.2	0.8	1.6	3.8	0.7	1.4	3.4	0.7	1.3
Dwr Cymru	59.7	2.1	3.2	53.7	1.9	2.9	47.8	1.7	2.5
Northumbrian	58.9	2.2	3.0	53.0	2.0	2.7	47.1	1.8	2.4
Severn Trent	147.0	2.9	3.8	132.3	2.6	3.4	117.6	2.3	3.0
South Staffs	27.2	3.0	4.4	24.5	2.7	4.0	21.8	2.4	3.5
South West	19.8	0.6	0.8	17.8	0.5	0.7	15.9	0.5	0.6
Tendring Hundred	1.5	0.9	1.4	1.4	0.8	1.2	1.2	0.7	1.1
United Utilities	144.9	2.6	3.7	130.4	2.3	3.3	115.9	2.1	2.9
Wessex	20.6	1.3	1.8	18.5	1.2	1.6	16.5	1.1	1.5
Yorkshire	87.8	2.0	2.7	79.0	1.8	2.4	70.2	1.6	2.2

Company	Rate for 100% in 15 years meters/yr	Ratio to current total rate	Ratio to current selective and optant rate	Rate for 90% in 15 years meters/yr	Ratio to current total rate	Ratio to current selective and optant rate	Rate for 80% in 15 years meters/yr	Ratio to current total rate	Ratio to current selective and optant rate
Anglian	39.6	0.9	1.6	35.6	0.8	1.4	31.6	0.7	1.2
Bournemouth	4.8	0.5	0.8	4.3	0.5	0.7	3.8	0.4	0.6
Cambridge	2.4	1.1	1.6	2.2	1.0	1.5	1.9	0.9	1.3
Essex and Suffolk	21.1	1.0	1.0	19.0	0.9	0.9	16.9	0.8	0.8
Folkestone and Dover	1.6	0.4	0.3	1.5	0.3	0.3	1.3	0.3	0.3
Mid Kent	6.9	0.9	1.1	6.2	0.8	1.0	5.5	0.7	0.9
Portsmouth	12.5	2.4	2.2	11.3	2.1	1.9	10.0	1.9	1.7
South East	18.3	1.4	1.2	16.5	1.3	1.0	14.6	1.1	0.9
Southern	31.4	1.0	0.9	28.3	0.9	0.8	25.2	0.8	0.7
Sutton & East Surrey	9.5	1.2	1.1	8.6	1.1	1.0	7.6	1.0	0.9
Thames	123.6	2.3	2.6	111.2	2.1	2.4	98.9	1.9	2.1
Three Valleys	40.9	0.9	1.0	36.8	0.8	0.9	32.7	0.7	0.8
TOTAL W/s	312.7	1.3	1.4	281.4	1.1	1.3	250.1	1.0	1.1
Bristol	16.5	1.6	2.3	14.8	1.4	2.0	13.2	1.3	1.8
Dee Valley	3.2	0.6	1.2	2.8	0.6	1.1	2.5	0.5	0.9
Dwr Cymru	44.8	1.6	2.4	40.3	1.4	2.1	35.8	1.3	1.9
Northumbrian	44.1	1.7	2.2	39.7	1.5	2.0	35.3	1.3	1.8
Severn Trent	110.3	2.2	2.9	99.3	2.0	2.6	88.2	1.8	2.3
South Staffs	20.4	2.2	3.3	18.4	2.0	3.0	16.3	1.8	2.6
South West	14.9	0.4	0.6	13.4	0.4	0.5	11.9	0.3	0.5
Tendring Hundred	1.1	0.7	1.0	1.0	0.6	0.9	0.9	0.5	0.8
United Utilities	108.6	1.9	2.8	97.8	1.7	2.5	86.9	1.5	2.2
Wessex	15.5	1.0	1.4	13.9	0.9	1.2	12.4	0.8	1.1
Yorkshire	65.8	1.5	2.0	59.3	1.4	1.8	52.7	1.2	1.6

Appendix 6 – Impacts of Traffic Management Act

Main TMA provisions		Impacts and required mitigating measures
Changes to criteria for registerable (notifiable) activities	An activity that meets one or more of the following criteria will require NRSWA notices or permits: • involves the breaking up or resurfacing of any street (i.e. carriageway, cycleway, footway or verge) • involves opening the carriageway or cycleway of traffic sensitive streets at traffic sensitive times (e.g. lifting manhole or chamber covers etc.). • requires any form of temporary traffic control • reduces the lanes available on a carriageway of three or more lanes • requires a temporary traffic regulation order or notice (e.g. road closure, parking suspensions etc.), or the suspension of pedestrian facilities • requires a reduction in the width of the existing carriageway of a traffic-sensitive street at a traffic-sensitive time.	More activities will require notices or permits and will be subject to controls (see below).
Changes to criteria for designation of streets as traffic sensitive (TS)	A street may be designated as traffic sensitive if one or more of the following criteria are met: • the street is one on which, at any time, the street authority estimates traffic flow to be greater than 500 vehicles per hour, per lane of carriageway, excluding bus or cycle lanes. • the street is a single carriageway two-way road, the carriageway of which, is less than 6.5 metres wide, having a total traffic flow in both directions of not less than 600 vehicles per hour. • the street falls within a congestion charges area. • traffic flow contains more than 25% heavy commercial vehicles. • the street carries in both directions more than eight	Works in traffic sensitive streets are subject to much tighter controls. Changes to criteria will result in more streets being designated with corresponding greater impact on utility works.

	buses per hour. • the street is designated for pre-salting, by the street authority as part of its programme of winter maintenance. • the street is within 100 metres of a critical signalised junction, gyratory or roundabout system. • the street, or that part of a street that, has a pedestrian flow rate in both directions at any time, of at least 1,300 persons per hour, per metre width of footway. • the street is on a tourist route or within an area where international, national, or significant major local events take place.	
General restrictions on works	Restrictions on the number of planned works phases. Intended to minimise the number of separate street occupations and resulting disruption.	Changes to working practices with increased emphasis on "getting it right the first time".
	Scope of Emergency and Urgent works limited to essential works to deal only with the immediate problem. Any related works must be 'severed' from the Immediate works and noticed (or permits obtained) separately. Intended to minimise the impact of unplanned works.	Changes to working practices. Increased costs of severing works, e.g. less efficient deployment of resources.
New noticing regime (NRSWA)	A separate notice is now required for each street. Need to provide much more information including accurate spatial co-ordinates in notices and reinstatement registrations. New requirements for statutory cancellation notices.	Increased noticing administration costs.
	Significantly longer notice periods (increased from 1 month to 3 months for Major works, and from 1 day to 3 days for Minor works). Other, more demanding timing constraints introduced.	Increased costs of planning and executing works. Difficulties of ensuring that work gangs are kept fully loaded.
Directions (NRSWA)	Changes to s56 directions on timing of works. A street authority can direct a utility to work (or not work) at specific times on specific days.	Increased planning costs. Risk of delays and increased costs due to directions.
	New s56A directions on placement of new apparatus. A street authority can direct a utility to install new apparatus (e.g. a new water main) in a different street.	Increased planning costs. Need to consider alternative, costed options for routes for new assets to provide a case to the street authority.

Permits (TMA)	Requires undertakers to apply for permits and variations to permits for all registerable works. An application for provisional advance authorisation is also required for Major works. Applications require more information than NRSWA notices (see below). Application and response periods are the same as for notices.	Increased planning and administration costs.
	Fixed time window for carrying out the work, i.e. street occupation is effectively booked for a fixed period.	Risk of increased costs associated with applying for variations to permits. Implications of working illegally without a valid permit.
	Conditions can be attached to permits covering timing, amount of road space, working method, traffic management and publicity/consultation. A permit can be refused (e.g. equivalent to s56A direction). Permits are intended to allow better control and coordination of works compared to NRSWA notices-only regime.	Increased costs resulting from more onerous requirements for planning and executing works.
	Fees are payable for each application to cover the increased permit authority costs in providing better coordination. The maximum fees are set in the Regulations and vary from £40 to £240 per application depending on works and road categories and other factors. The maximum permit variation fee is set at £45.	Significant unavoidable costs.
	10% increase in rechargeable inspections to cover additional checks on permit compliance and s74.	
Restrictions	Amendment to S58 to allow significantly longer embargoes on utility works following major road works, e.g. 5 years for major reconstruction works. Allows highway authorities to protect investments. However, some prescribed activities (e.g. new customer connections) are exempt. The process does allow an opportunity for undertakers to carry out works before the major road works and before the restriction comes into force.	Undertakers may be prevented from carrying out planned works for several years.
	S58A embargoes following substantial utility works. Intended to avoid a succession of disruptive works and give respite to local residents and road users etc. Maximum duration is 12 months for traffic-sensitive	As above. Will increase the overall number of embargoes.

	streets and streets in road category 0, 1 or 2 which are not traffic-sensitive.	
	Initial 20 embargo on customer connections. Applicable to both s58 and s58A restrictions.	
Enforcement	Higher fines for utilities' street works offences (in force since 4 October 2004). Fines increased from Level 3 (£1,000) to Level 4 (£2,500) or Level 5 (£5,000).	
	Introduction of Fixed Penalty Notices. Amounts are set at £120 for noticing-related offences and for violating permit conditions, and £500 for working without a permit.	Risk of substantial FPN costs (utilities carry out many 1000's of works per annum)..
Overrun charging	Changes to focus on the most disruptive works. Much higher charge rates will apply for busier streets with the introduction of reinstatement category as one of the determinants of the overrun charge. Charge rates are set in Regulations at £100 per day for Minor works and up to £2,500 per day for Major works in streets of road category 0 or 1.	Substantially increased costs when overruns occur.

Appendix 7 - Cost Benefit Data

Central data set

			Units	Derivation of data
Company data	Total number of households	1,000,000		Assumed value
	Starting meter penetration	30	%	Industry average
	Timescale to implement metering	10	years	Assumed value
	Proportion of households in inner cities	49	%	From analysis of census data
	Proportion of households in urban areas	34	%	From analysis of census data
	Proportion of households in rural areas	17	%	From analysis of census data
	Proportion of properties with existing boundary boxes	20	%	From CP222A data
Unit cost per meter	Simple external	192.71	£/meter	Weighted average from CP222A data
	Harder external	385.42	£/meter	Assumed to be 2 x simple fit
	Simple internal	176.33	£/meter	Average from CP222A data
	Harder internal	352.66	£/meter	Assumed to be 2 x simple fit
	Complex external	963.55	£/meter	Assumed to be 5 x simple fit
	Complex internal	881.65	£/meter	Assumed to be 5 x simple fit
	Internal replacement	157.29	£/meter	Average from CP222A data
	External replacement	51.72	£/meter	Average from CP222A data
	Efficiency savings purchase and install	10	%	Assumed value
	Efficiency savings replacement	10	%	Assumed value
S&E costs	Social and environmental costs	4.00	£/meter	Fixed assumption used in CP222A
Set-up costs	Fixed set-up costs	60,000	£	Assumed 2 x set up costs for COM
Policy operating costs	Fixed costs	50,000	£/yr	Assumed 2 x set up costs for COM
	Variable costs	3.25	£/hh/yr	Average from CP222A data
Survey cost	Activity cost	19.20	£/survey	Average from CP222A data less an efficiency of 20%

			Units	Derivation of data
	Efficiency	20	%	Assumed value
Customer contact cost	No. of contacts per metered customer per year	3.65	/hh/yr	Average from CP222A data
	No. of contacts per unmeasured customer per year	0.52	/hh/yr	Average from CP222A data
	Unit cost per metered customer contact	2.82	£/contact	Average from CP222A data
	Unit cost per unmeasured contact	2.17	£/contact	Average from CP222A data
	Additional cost per metered customer per year	*9.15*	*£/hh/yr*	Calculated
Billing cost	Billing cost per metered customer per year	2.69	£/hh/yr	Average from CP222A data
	Billing cost per unmeasured customer per year	0.74	£/hh/yr	Average from CP222A data
	Additional cost per metered customer per year	*1.95*	£/hh/yr	Calculated
Meter reading cost	No. reads per metered customer per year	1	/hh/yr	Fixed in line with majority value
	Unit cost	2.21	£/read/yr	Average from CP222A data
	Additional cost per metered customer per year	*2.21*	*£/hh/yr*	Calculated
Asset lives	Meter	15	yr	Average from CP222A data
	Boundary box	30	yr	Fixed assumption
Consumption	Metered customers	125.9	m^3/hh/yr	Average from CP222A data
	Modelled unmeasured customers	139.9	m^3/hh/yr	Fixed to give reduction of 10%
	Demand reduction	*10.0*	*%*	Calculated
Supply Pipe Leakage	Externally metered households	7.1	m^3/hh/yr	From JR data
	Unmeasured households	15.5	m^3/hh/yr	From JR data
	SPL savings	*54.2*	*%*	Calculated
Additional benefits	Additional benefits	50	%	Assumed value
	Penetration at which additional benefits start to accrue	60	%	Assumed value
Discount rate	Discount rate	5.5	%	Fixed assumption from CP222A

Variations for uncertainty analysis

Variables not listed were held constant.

		Distribution	Min	Max	Mean	Standard deviation
Unit cost per meter	Simple screw in to existing boundary box	Normal	-	-	51.72	6.08
	Screw in + boundary box	Normal	-	-	227.96	32.23
	Proportion of existing boundary boxes	Uniform	10%	40%	-	-
	Simple internal installation	Lognormal	-	-	5.11	0.39
	Harder multiplier	Uniform	1.5	3.0	-	-
	Complex multiplier	Uniform	4	10	-	-
	Internal replacement	Lognormal	-	-	4.99	0.41
	Efficiency savings purchase and install	Normal	-	-	10	3.2
	Efficiency savings replacement	Normal	-	-	20	6.5
S&E costs	Social and environmental costs	Uniform	2	6	-	-
Policy costs	Variable costs	Lognormal	-	-	1.05	0.49
Survey cost	Activity cost	Normal	-	-	24.07	3.11
	Efficiency	Normal	-	-	20%	6.5%
Customer contact cost	No. contacts per metered customer in first year	Normal	-	-	3.65	0.49
	Drop-off	Normal	-	-	2.0	0.65
	No. of contacts per unmeasured customer per year	Lognormal	-	-	-0.75	0.60
	Unit cost per metered customer contact	Lognormal	-	-	1.01	0.25
	Unit cost per unmeasured contact	Lognormal	-	-	0.73	0.38
Billing cost	Billing cost per metered customer per year	Lognormal	-	-	0.85	0.65
	Billing cost per unmeasured customer per year	Normal	-	-	0.73	0.18
Meter reading cost	Unit cost	Lognormal	-	-	0.64	0.60
	Efficiency	Normal	-	-	20%	6.5%
Supply Pipe Leakage	Externally metered households	Normal	-	-	6.73	0.54

Glossary of Terms and Abbreviations

AMR – Automatic Meter Reading. Readings are captured from a meter without needing to look at the meter register through an inductive touch-pad or radio system.

COM – Change of occupancy metering. Water companies have had powers since the 1999 Water Industry Act to install a meter when a property changes hands.

DMA – District Meter Area. A discrete part of the water distribution network that typically contains between 200 – 2000 properties the input of which is measured with a district meter. Ideally a DMA will only have one inlet and be isolated from the rest of the network by closed boundary valves. In practice, some DMA' will have more than one inlet and may export water to neighbouring DMAs. In such cases the input to the DMA is calculated from the net volumes recorded by the inlet and export meters.

Intelligent meter – Water meter that has additional functionality to a traditional meter read by manual or semi-manual means. This could include the ability to store multiple readings, or readings at tariff boundaries, communicate data to external systems or provide alarms for leakage, tampering or failure. Intelligence may be integral with the meter or enabled through an ancillary device connected to the meter.

Optant – Customer who has elected to have a meter installed under a free meter option scheme.

Shared supply – Supply pipe that comes off the water main and feeds two or more properties.

Touch-pad – Device mounted on a wall or other convenient location that is linked by wire to a water meter and allows the meter reader to retrieve the reading from the meter without needing to visually examine the register.

Traditional meter - Water meter that provides a single cumulative reading read by manual or semi-manual (touch-pad) means.

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