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Water and the environment

International comparisons of domestic per capita consumption

Prepared for the Environment Agency by Aquaterra

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Executive summary

This work presents a review of methods used to estimate domestic per capita consumption (PCC) of water in selected countries. It focuses on countries that are reported to have lower average PCC than England and Wales. Northern and western European countries that have climates and economies similar to England and Wales have been selected to provide meaningful comparisons. These include Austria, Belgium, Denmark, Finland, Germany and the Netherlands. The reported PCC values have been analysed in terms of:

- Metering
- Average household size or occupancy
- Inclusion/exclusion of supply-pipe leakage in the estimated PCC
- Water charges
- Any demand management measures that may have played a part in the reported PCC

The review indicates that the major differences between the water sectors in the countries reviewed and in England and Wales are the extent of metering and scale of demand management measures. All of the countries reviewed have universal metering, although in most cases flats are not individually metered. There have been prominent demand management drives in Copenhagen and Hamburg since the 1980s. All of the countries reviewed, with the possible exception of Austria, have run national water conservation schemes. Water charges are based on the cost-recovery principle, except in Austria, and in most cases are higher than in England and Wales. Profit making is not always allowed, and in Belgium, the water charging system has a strong social element. In terms of components of domestic use, toilet flushing in England and Wales stands out, using between 13 and 21 more litres per head per day (l/h/d) than in the countries reviewed. This suggests that many toilets in England and Wales have high-volume cisterns. Direct comparisons of ownership and frequency of use of appliances could only be made with the Netherlands. There are no significant differences in ownership of water-efficient appliances, which suggests that the differences in consumption mainly result from differences in frequency of use.

In view of the above, universal metering stands out as a key area for England and Wales. Water companies in England and Wales, particularly those in the water stressed South East of England, have considered universal metering in their draft Water Resource Management Plans (WRMPs) covering the period up to 2035. Metering can potentially reduce consumption by between ten and 15 per cent which will significantly reduce PCC. However, metering alone will not be enough to lower PCC to the desired level and additional measures, such as fitting older cisterns with variable flush mechanisms, will need to be considered.

When developing their WRMPs, all water companies in England and Wales should adopt the 'twin track approach' to consider the full range of options available for reducing demand as well as increasing supply. However, in most cases demand management focuses on metering and reducing leakage. Traditionally water resources plans have focussed on resource development due to perceived uncertainty around the potential savings of demand management. This is perhaps the area where strategies need to be re-considered.

Comprehensive demand management strategies, which involve not only metering and leakage reduction, but also high-profile water efficiency programmes aimed at changing

behaviour and attitudes towards water use, are in place in countries around the world. National or regional water efficiency strategies with mandatory targets that take into account relevant demographic and socio-economic factors could help to reduce average PCC in England and Wales.

Further research should focus on obtaining more detailed information from one or two selected countries for a thorough analysis of the methods used to calculate PCC. Good quality data is available for the Netherlands which has ten water suppliers, so it is a possible candidate for such an analysis. It is also important to understand the differences in PCC reported by the water companies in England and Wales.

A broad consensus on the likely nature of future trends in domestic water use will help in developing consistent demand management strategies to be implemented regionally or nationally rather than by water companies.

Contents

1 Introduction

1.1 Background

The Environment Agency (EA) commissioned Aquaterra UK Ltd to carry out a review of per capita consumption (PCC) in selected countries.

The Government's vision for the water sector as outlined by Defra in Future Water (2008) highlighted the need for such a study. Accordingly, it is recognised that there is a need to change existing water management and water use in order to avoid threats to the security of supplies and sustainability of the environment from a range of factors, such as increasing population and climate change. The average PCC in the UK is 150 litres per head per day (l/h/d) (Ofwat, 2007a). One of the visions in Defra (2008) for future management of water resources is 'reduced per capita consumption of water through cost effective measures, to an average of 130 litres per person per day by 2030, or possibly even 120 litres per person per day depending on new technological developments and innovation'. This represents a reduction of between 20 and 30 l/h/d on the current average PCC.

In England and Wales there is a distinction between 'normal' and 'dry year' consumption. PCC in a dry year is likely to be higher than in a normal year. Defra (2008) recognises that for this vision to be realised a fundamental change towards more sustainable approaches in domestic water use will be required. Demand management tools such as metering strategies, tariff structures and building codes, such as the Code for Sustainable homes, designed to achieve water efficiency will also need to be used. There is a regulatory requirement for water companies in the UK to promote demand management but a key question is whether the vision outlined in Defra (2008) is realistic and achievable within the time frame.

The figures compiled by Ofwat (2007a) show that the average PCC in a number of European countries is less than 130 l/h/d. In Belgium and the Czech Republic it is less than 110 l/h/d. This suggests that it is possible to lower the average PCC in line with the Government's vision.

PCC depends on a number of factors; not only the climatic factors that influence 'natural' supply and demand, but also socio-economic variables and cultural and religious practices. These factors also influence the outcome of any demand management programmes which rely as much on changes in attitudes toward water use and in some cases cultural practices, as on technological advances. Consequently, PCC can vary significantly even within countries and regions.

There are fundamental questions about how a household is defined and how domestic consumption is calculated. Per household consumption (PHC) can be directly measured and PCC can be calculated by dividing the PHC by the household size. While this is a simple concept, there are practical issues around the measurement of PHC, particularly in unmetered households. Even where a property is metered, the location of the meter determines whether the reading is a direct measure of consumption (i.e., if the meter is inside the property) or if allowance has to be made for supply-pipe leakage (i.e., when the meter is outside of the property boundary).

Very low flows are not recorded by some meters and adjustments have to be made for 'meter under-registration' (MUR) either at the District Metered Area (DMA) level and/or at the property level if the property is fitted with a meter. The correction factor applied for MUR may vary with meter type, water supplier etc. leading to a difference in PHC and consequently PCC.

Despite MUR, PHC can be determined with a relative degree of certainty. Once the PHC of an area is known, PCC can be determined by dividing the total consumption of the area by the total population. However, such a determination will overlook the role of property type and household size. It won't take household characteristics or socio-economic variables into account either.

Household characteristics may include, for example, the ages of the occupants, which determines the day-time occupancy and certain factors affecting water use such as the preference of baths over showers and vice versa. Socio-economic variables may include, for example, water features such as swimming pools and garden ponds which are likely to be found in more affluent households and give them a different water-use profile from less affluent households. While average PCC calculated in this way will be broadly representative of the area, it can't be directly applied to existing housing stock or future developments. For example, if the average PCC has been determined from an area with mostly detached houses then it cannot be directly applied to areas or developments where there are mainly flats, even if the two areas are otherwise comparable. It can only be applied if the differences in PCC resulting from differences in property types have been accounted for. A more accurate determination of PCC needs to take account of all the factors that will cause it to vary between different property types, household sizes, household composition and socio-economic groupings so that it can be applied more widely.

A better understanding of the links between PCC and its related variables also allows future trends to be predicted more accurately. However, such determinations are likely to be resource intensive and the time and effort suppliers take to estimate PCC will determine the quality of the estimates (Tynemarch, 2007). Care needs to be taken when comparing PCC across water suppliers, regions or countries. Some of the apparent differences may be a result of the approach taken to calculate PCC rather than real differences in PCC. For example, a PCC estimate of 165 l/h/d including 15 l/h/d supply-pipe leakage will practically be the same as a PCC of 150 l/h/d excluding supply-pipe leakage but the difference in calculation method will need to be known for this to be recognised.

Developed western European economies such as the UK, Germany, France, Denmark and the Netherlands are culturally and climatically similar, so meaningful comparisons can be made. However, methods used for collecting and compiling data can vary widely. For example, supply-pipe leakage is excluded when calculating domestic PCC in England and Wales, which may or may not be the case in other countries. Average household leakage in England and Wales is estimated at 36 litres per property per day (Ofwat, 2007a) which equates to an additional 16.4 l/h/d using the average occupancy of 2.2 people per household in England and Wales. It is important to be aware of any differences that might exist when comparing data from different countries and regions.

1.2 Scope of work

The project consisted of the following main tasks:

1. Conduct a literature review, focusing on countries that are comparable with England and Wales, to gather data on PCC in other countries.
2. Investigate and discuss whether the methods used in these countries to calculate PCC are broadly consistent with the approach taken in England and Wales.
3. Discuss the factors that influence PCC in the countries reviewed.
4. In light of the above, identify possible measures that can be taken in England and Wales to reduce the average PCC to 130 l/h/d by 2030.

1.3 Methodology

For the purpose of this work, national average PCC is used for comparison while recognising that:

PCC will vary within a country due to different environmental and socio-economic factors between regions and supply areas, and using the national average PCC will mask regional trends and factors that may be locally important.

It was decided to use national averages as the Government aims for an average PCC of 130 l/h/d across England and Wales. Regional variations are implicit in this aim. Secondly, it is relatively easy to lower PCC in smaller regions but the real challenge is to bring about a national change.

The research focuses on countries reported in Ofwat (2007a) to have lower PCC than England and Wales. Northern and western European countries with similar climates and economies to the UK were selected so the comparisons were meaningful. Purchasing-power-parity per capita GDP, as reported in International Monetary Fund (2008), was used as the main indicator of economic compatibility with England and Wales.

The reported PCC values have been analysed in terms of:

- Metering
- Average household size or occupancy
- Inclusion/exclusion of supply-pipe leakage in the estimated PCC
- Water charges
- Any demand management measures that may have played a part in the reported PCC

1.4 Data sources

The main sources of data for this study were:

1. Waterwise

In 2007, Waterwise sent a questionnaire to its partner organisations around the world asking for information on:

- overall meter penetration;
- sub-metering of flats;
- leakage levels;
- the method used for estimating leakage;
- estimated domestic PCC;
- the breakdown of domestic PCC into various usage components;
- the nature of any demand management measures used.

Responses were received but the quality varied and some of them did not answer all of the questions.

2. Environment Agency

As some responses to the Waterwise questionnaires were incomplete, the demand management team at the EA contacted relevant organisations around the world to gather information specifically for this work.

3. Ofwat

Reports published by Ofwat and data from www.ofwat.gov.uk have been used to collect figures about the water industry in England and Wales as well as the Netherlands.

4. Internet

The internet was used to see if the figures reported in Ofwat (2007a) could be verified from other sources, and for getting additional information, including any updates on the Ofwat (2007a) figures.

5. Personal contact

Where the information needed was not available publicly, e-mails were sent to relevant organisations and individuals. However, the response rate was disappointing.

1.5 Limitations of the study

This work depended on information being either available in the public domain or being provided by organisations and individuals contacted by Waterwise, the EA and Aquaterra. There was a lot of information available for some countries. However, there was not always enough detail. This influenced which countries were chosen to analyse and the extent to which the figures could be analysed.

2 Review of PCC estimates

2.1 Overview of PCC in England and Wales

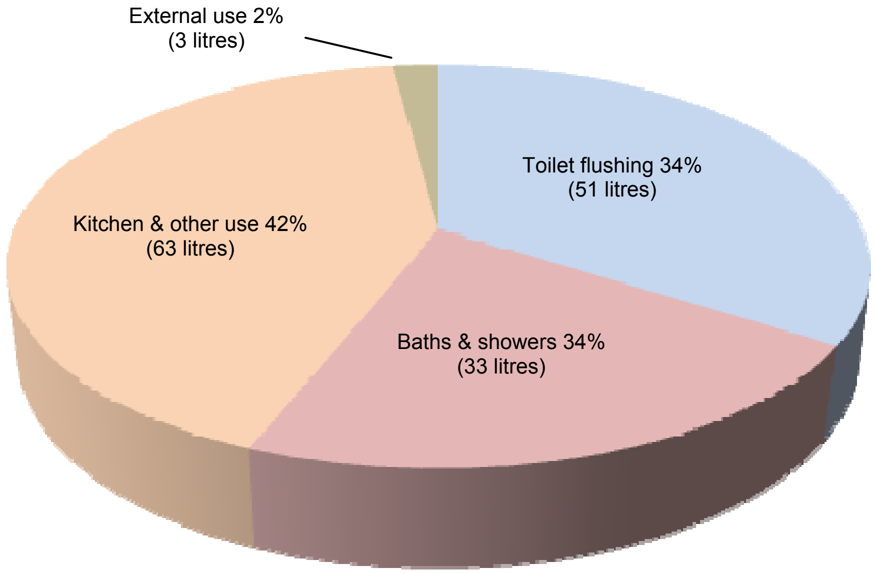
The population of England and Wales is about 54 million (www.statistics.gov.uk). The per capita GDP for the UK is around US$36,000 (International Monetary Fund, 2008). No separate figures for England and Wales was available so the UK figure has been used for comparison.

Private water companies supply water to around 25 million households in England and Wales. Around a third of these households have a water meter. Water companies in England and Wales are required to submit estimates of PCC to the regulators as part of their June Returns (JR) submission. For the financial year 2006-07, the water companies submitted data which shows that the PCC for unmetered customers varies between 131.5 l/h/d and 177.0 l/h/d with an average of 153.8 l/h/d.

For metered customers the range varies from 113.7 l/h/d to 149.5 l/h/d with an average of 133.4 l/h/d (Table 2). However, 2006-07 was a non-dry year. The figures for 2003-04, which was a dry year, are higher. The unmetered and metered PCC figures for 2003-04 were 158 l/h/d and 141 l/h/d respectively (Ofwat, 2005) representing three per cent higher PCC for unmetered households and six per cent higher PCC for metered households compared to the 2006-07 figures.

The general breakdown of domestic PCC in England and Wales is shown in Figure 1 and given in Appendix A.

Figure 1: Breakdown of average PCC in England and Wales into various usages (from Ofwat, 2007a)



Differences in PCC between water companies, and between various supply areas of a water company, are mainly because of variations in environmental, demographic and socio-economic factors. Other factors that influence PCC are water pressure and religious and cultural practices (Tynemarch, 2007).

Water companies in England and Wales base their calculation of PCC on two main parameters: PHC and occupancy. As the majority of households in England and Wales are unmetered, consumption monitors are generally set up to determine PHC. This can either be an Individual House Monitor (IHM) where each property is measured individually (but charged as unmeasured) or an Area Monitor (AM) where an area consisting mainly of unmeasured households is monitored.

The number of properties in an AM can vary from a few to several hundred. A water company typically uses several monitors to determine PHC and occupancy. Water consumption is either logged continuously, usually at 15-minute intervals, or read manually at periodic intervals. Surveys are periodically carried out to determine the occupancy levels. In metered properties, PHC is determined directly from the meter readings. Occupancy, as in unmetered properties, is usually determined by surveys (Tynemarch, 2007).

In some cases, socio-economic influences on PCC are factored in using either the ACORN (A Classification of Residential Neighbourhoods – www.caci.co.uk) or Mosaic (www.business-strategies.co.uk) classifications.

Table 2: PCC (l/h/d) for unmetered and metered households as submitted by the various water companies in England and Wales for 2006-07 (from Ofwat, 2007b)

Water Company	Unmetered households	Metered households
Anglian Water Services	155.8	136.9
Bournemouth & West Hampshire Water	155.4	149.5
Bristol Water	160.6	129.3
Cambridge Water Company	148.8	133.5
Dee Valley Water	164.6	115.2
Essex & Suffolk Water	160.1	144.5
Folkestone & Dover Water Services	150.1	130.9
Mid Kent Water	164.9	131.4
Northumbrian Water	151.1	140.3
Portsmouth Water	162.8	136.2
Severn Trent Water	145.7	117.3
South East Water	155.5	148.9
South Staffordshire Water	150.7	126.4
South West Water	164.3	139.0
Southern Water Services	149.4	136.0
Sutton & East Surrey Water	166.2	130.0
Tendring Hundred Water Services	131.5	113.7
Thames Water Utilities	156.8	142.7
Three Valleys Water	177.0	143.4
United Utilities Water	143.5	121.8

Water Company	Unmetered households	Metered households
Welsh Water	156.6	126.7
Wessex Water Services	153.8	137.9
Yorkshire Water Services	151.6	135.6
Industry average	153.8	133.4

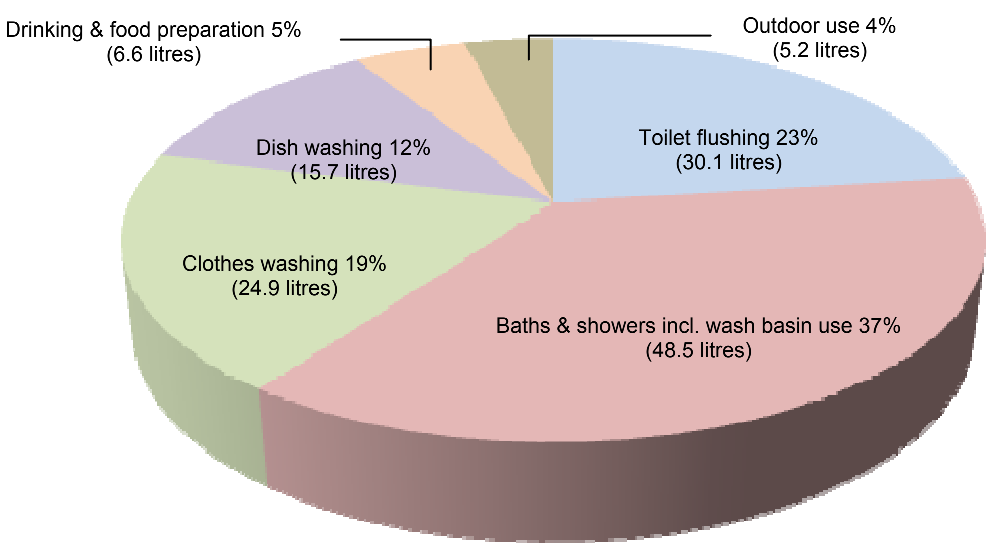
2.2 PCC in countries reviewed

The data available determined the countries selected for review. The chosen countries are discussed below.

2.2.1 Denmark

Denmark has a population of about 5.5 million with a per capita GDP of around US$34,500 (International Monetary Fund, 2008). Ofwat (2007a) quotes the average PCC as 131 l/h/d which has been confirmed as part of this work using data from Statistics Denmark (www.dst.dk). Figures compiled by Statistics Denmark report 'water loss in pipes' as a separate category. All households are metered. Meters are normally located inside the property[1] and leakage is measured up to where the meter is installed[2]. Distribution system losses and supply-pipe leakage are therefore excluded from estimates of PCC. A breakdown of domestic PCC in Danish households is shown in Figure 3 and given in Appendix A.

Figure 3: Breakdown of PCC in Denmark (131 l/h/d) into various usages (data from Pramod Seth of Lyngby Tarbaek Council)



[1] Information provided to the EA by Martin Skriver, Agency for Spatial and Environmental Planning, Denmark
[2] Based on information provided to Waterwise by Pramod Seth of Lnygby Tarbaek Council

Copenhagen Water supplies water to more than 1.1 million customers in the Greater Copenhagen Area. In response to environmental and regulatory pressures, Copenhagen Water started a comprehensive water conservation programme in 1989. This included education campaigns, consultancy services, leak detection and repair as well as changes to water price and taxation structure. It specifically targeted the domestic sector which accounts for over two-thirds of total water use. As a result, domestic consumption in the area supplied by the company dropped from 168 l/h/d in 1989 to 131 l/h/d in 1998 (www.eaue.de/winuwd/80.htm); a 22 per cent decline over the ten year period. The estimated PCC for the Greater Copenhagen Area for 2005, based on data from Statistics Denmark, is 126 l/h/d (Table 4). Details of how these figures have been calculated are not provided.

However, as Table 4 shows, PCC in the Greater Copenhagen Area is not the lowest in the country, despite the focused demand management campaign since 1989. A number of Danish counties have PCC lower than the national average. The six most populous counties, accounting for 66 per cent of the population, have a PCC of 130 l/h/d or less. PCC for four of these counties is less than 125 l/h/d (Table 4).

Table 4: Population and PCC figures for 2005 based on data from Statistics Denmark (post-2005 figures were not available at the time of writing of this report)

Region	Population	PCC (l/h/d)
Greater Copenhagen Area	1,212,485	126
Århus County	657,671	130
North Jutland County	495,068	123
Funen County	476,580	123
Frederiksborg County	375,705	120
Vejle County	358,055	112
West Zealand County	304,761	165
Ringkøbing County	274,574	149
Storstrøm County	262,144	142
South Jutland County	252,980	154
Viborg County	234,434	145
Roskilde County	239,049	117
Ribe County	224,454	138
Bornholm County	43,347	152
Denmark total	5,411,307	131

This suggests that the Greater Copenhagen Area is by no means an exception in terms of water consumption. This is confirmed by figures from the Danish Water and Waste Water Agency (DANVA) which reports 18.5 per cent reduction in overall water consumption over the ten year period from 1997 to 2006. The decline in household consumption during this time was 12.6 per cent, attributed to three main factors (DANVA, 2007):

1. Installation of water-saving devices (e.g., showers and toilets)
2. Metering
3. Water prices

Details on the trend towards water-saving devices are not available but it is fair to assume that metering and water prices have at least partly driven this trend. Denmark has had a compulsory metering policy since 1998 and all properties are required to be individually metered, including flats where possible[1]. The water price paid by the consumer consists of three components:

1. The price of drinking water
2. The price of wastewater
3. Green taxes and VAT

Tariffs are based on the cost-recovery principle. Production and treatment costs vary with the service provider so the unit price of water can vary significantly from region to region (www.danva.dk). As many of the costs associated with producing and treating water are fixed, a reduction in water consumption has led to an increase in the unit cost of water, in absolute terms, by about 32 per cent since 1996. However, due to reduced water consumption and increased household incomes, the average household bill has remained stable at 0.13 per cent of the total household income. Therefore, there has been no relative rise in the water bill since 1996 (DANVA, 2007). Based on this evidence, DANVA (2007) concludes that 'there is no relation between water consumption and economic growth'. All new homes in Denmark are required to have 2/6 litres dual flush systems but there are no national schemes that offer any financial incentives to domestic consumers for adopting water efficient technologies. However, public awareness campaigns are run nationally, regionally and locally and water saving technologies are used in public buildings[2].

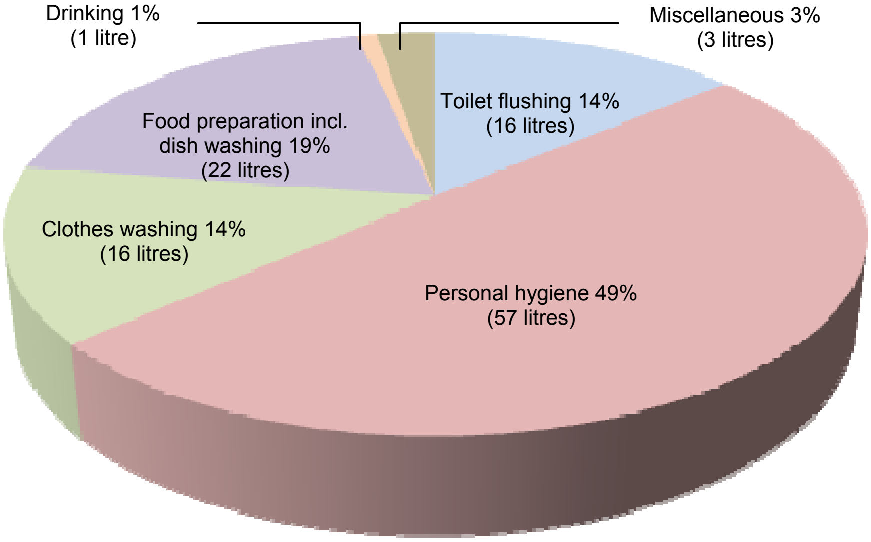
2.2.2 Finland

Finland has a population of about 5.27 million with a per capita GDP of around US$37,000 (International Monetary Fund, 2008). Ofwat (2007a) reports an average PCC of 150 l/h/d. However, there is evidence to suggest that the actual PCC could be lower (e.g., Etelämäki, 1999) and that is why Finland has been included in the review.

In Finland, 89 per cent of the population is connected to the central water supply network while the remaining 11 per cent gets water from private wells or boreholes. All properties connected to the central water supply system are metered. However there is usually a single meter for an entire block of apartments. Meters are located inside the premises to protect against frost during winter and supply-pipe leakage is not included in the billed volume[3]. A 1998 study of water consumption in urban areas of Finland, based on on-site tests and interviews, estimated the PCC to be 115 l/h/d (Etelämäki, 1999). The breakdown is shown in Figure 5 and included in Appendix A.

[3] Information provided to the EA by Tapio Katko and Pekka Pietilä, Tampere University of Technology, Finland

Figure 5: Breakdown of Finnish PCC into various usages (from Etelämäki, 1999)



Finland has seen a decline in PCC since the mid-1970s. Until the early 1970s, PCC increased continuously reaching 350 l/h/d in the largest cities and up to 420 l/h/d in Helsinki. Higher water prices, better technology in households and utilities, increased consumer awareness and better utility management are given as the main reasons behind the downward trend in PCC (Katko et al., 1998).

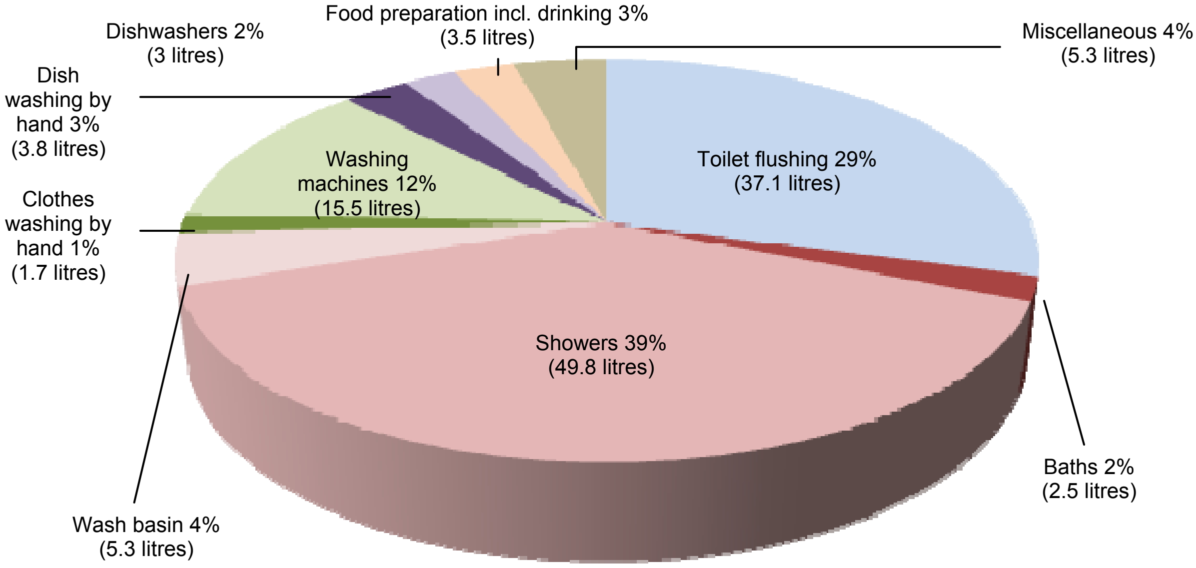
Rajala and Katko (2004) carried out an analysis of several years worth of data from 185 cases (some consisting of more than one building) at 37 different locations in various parts of Finland. These were categorised according to housing type (flats, terraced houses, semi-detached houses etc.), occupier status (owner/tenant) and metering arrangements (shared/individual). They found that PCC for properties with a shared water meter (i.e., apartment blocks) was about 150 l/h/d and about 120 l/h/d for individually metered properties. Water and wastewater charges for these communities have increased by almost 70 per cent since 1978 (Ympäristöhallinto, 2001). Rajala and Katko (2004) concluded that with proper management, PCC levels of 120 l/h/d can be achieved for all categories. Katko and Pietilä[3] estimate that with most modern devices and systems PCC could be reduced to 88 l/h/d.

2.2.3 The Netherlands

The Netherlands has a population of about 16.7 million and a per capita GDP of around US$40,000 (International Monetary Fund, 2008). In 2007, there were ten water companies supplying drinking water to about 16.5 million households. The water supply companies are limited liability companies with associated municipalities and provincial bodies functioning as shareholders (Vewin, 2008a).

Ofwat (2007a) reports that the average PCC in the Netherlands is 125 l/h/d. However, the latest report from the Association of Dutch Water Companies (Vewin) gives the average PCC as 127.5 l/h/d (Vewin, 2008a). The breakdown of PCC, based on a 2007 customer survey, is shown in Figure 6 and given in Appendix A.

Figure 6: Breakdown of PCC in Dutch households into various usages (from Vewin, 2008a)



In 2007, domestic consumers used 72 per cent of all potable water produced and 63 per cent of all water produced. 96 per cent of the water connections are metered (Vewin, 2008a) and 75 per cent of flats are individually metered.[4]

There has been a seven per cent drop in domestic PCC since 1995 when the estimate was 137.1 l/h/d. There have been noticeable decreases in per capita use for baths (6.5 l/h/d), toilet flushing (4.9 l/h/d) and washing machines (ten l/h/d) since 1995. At the same time there has been an 11.5 l/h/d increase in shower use (Vewin, 2008a). This suggests that, over time, showers have become more popular than baths for personal washing. The increase in per capita shower volume is much greater than per capita reduction in bath volumes. This could be as a result of increased frequency of showers compared to baths, increase in average duration of shower, increase of shower flow rate or a combination of all of these factors. As a result, part of the saving from the installation of water efficient devices has been offset by change in personal washing habits.

Water price in the Netherlands consists of the following components:

1. Volumetric charge
2. Standing charge
3. Tap water tax
4. VAT

Volumetric and standing charges vary from company to company and in various sub-areas of individual companies. In sub-areas, variations in water prices can also result from distribution and concession charges levied by local government. The unit cost of water for an average household, excluding water tax and VAT, increased from about €0.80/m^3 in 1990 to €1.43/m^3 in 2007. However, when adjusted for inflation and taxes, the average price of water has declined since 1997, although not by much - €0.09/m^3 over the ten year period (Vewin, 2008a).

[4] Information provided to Waterwise by Kees Poortema of Vewin in February 2007

The Dutch government requires devices that use water to be labelled to show how efficient they are. This allows people to distinguish between products based on their water consumption and promotes water conservation. The national government also provides information on sustainable water use, including water saving tips, and supports organisations involved in public awareness campaigns on water use[4].

2.2.4 Germany

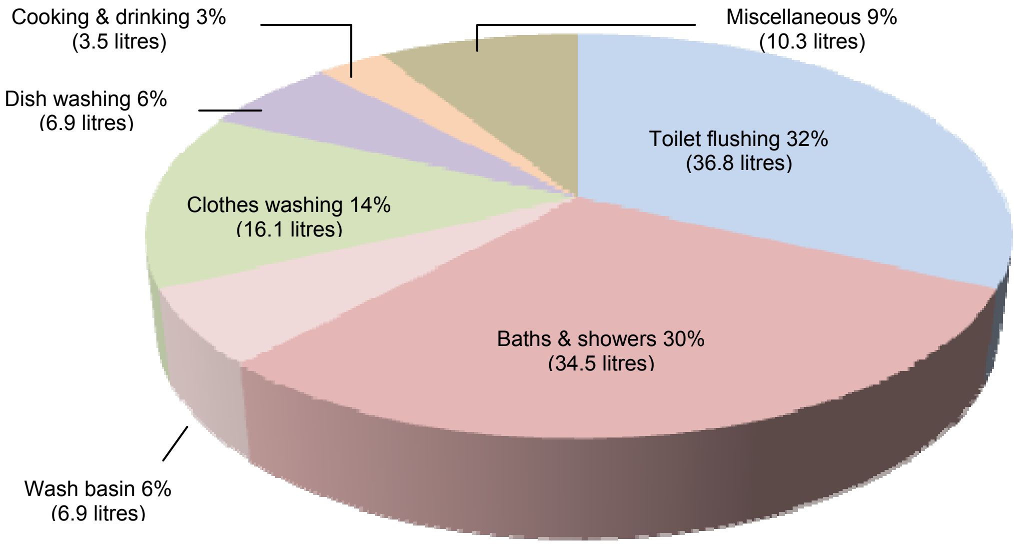
Germany has a population of about 82.1 million with a per capita GDP of around US$35,000 (International Monetary Fund, 2008). 99 per cent of the population is connected to the mains network (www.env-it.de). There are 6,383 water utilities in the country, both private and public. The largest 100 of these serve over half of the total population (Statistiches Bundesamt, 2006). All properties are metered; however sub-metering of individual flats is not very common[5]. Residential PCC is reported as 126 l/h/d. However, this estimate includes small businesses which contribute about 11 l/h/d to this figure (BMU, 2006). Therefore, the purely domestic PCC is 115 l/h/d. Distribution system losses are estimated at 7.3 per cent (BMU, 2006). However, it is not clear if this estimate includes supply-pipe leakage. Since distribution losses are estimated separately, it is assumed that leakage is excluded from PCC estimation. Breakdown of domestic PCC is shown in Figure 7 and given in Appendix A.

Overall domestic PCC in Germany dropped by 14 per cent between 1990 and 2004. Reasons for this include increasing awareness among consumers and promotion of water-saving devices (BMU, 2006). PCC in the former East German states (the ‘new’ states) and West German states (the ‘old’ states) was similar in the early 1990s. However the drop in PCC between 1990 and 2004 has been much more dramatic (34 per cent) in the new states than in the old states (nine per cent). This can be partly attributed to sharp increases in water prices during the early 1990s, which were significantly higher in the new states. The average water price in 2005 was €1.81/m^3 (Schleich and Hillenbrand, 2007).

There have been demand management initiatives in Germany. One of the well known programmes was started by the Hamburg Water Company, which supplies the city of Hamburg and surrounding areas, in the mid 1980s (http://www.eaue.de/winuwd/132.htm). However, there is not considered to be much potential to reduce PCC in Germany any further (Schleich and Hillenbrand, 2007).

[5] Information provided to WaterWise by Thomas Dworak of Ecologic (Institute for International and European Environmental Policy) in July 2007

Figure 7: Breakdown of PCC in German households into various usages (from Umwelbundesamt, 2007)



2.2.5 Belgium

Belgium has a population of about 10.7 million and a per capita GDP of around US$36,000 (International Monetary Fund, 2008). Ofwat (2007a) reports that PCC in Belgium is 107 l/h/d. This figure is based on a survey commissioned by the Belgian Federation of Water Sector (Belgaqua) where all water suppliers in Belgium are required to provide consumption figures for domestic and non-domestic customers. Belgaqua then uses these figures to calculate PCC. All households are individually metered, with the exception of flats in older buildings, and meters are located inside the property[6].

The exact reasons for the low PCC in Belgium have not been determined but the following factors are thought to have played a part[8]:

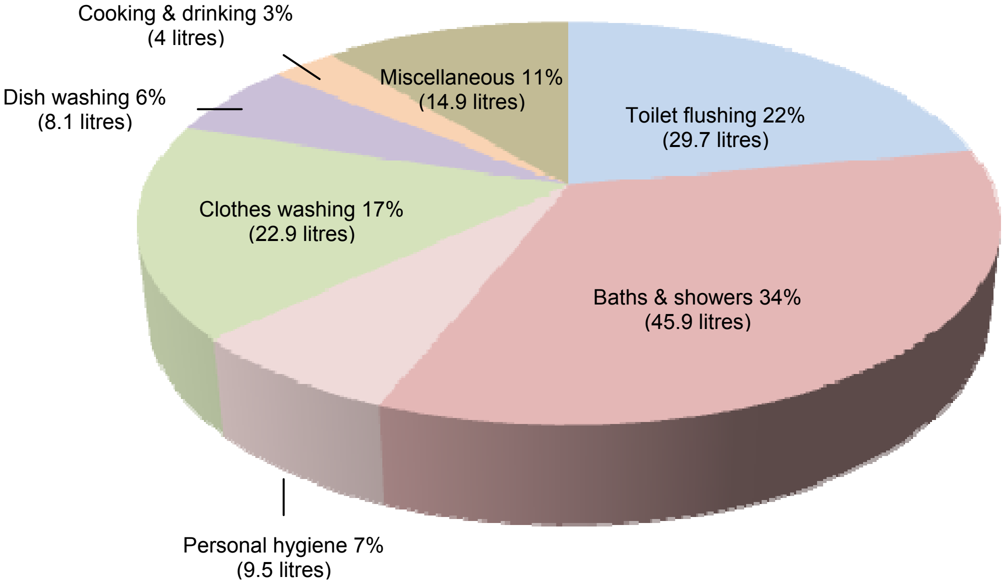
- Implementation of universal metering decades ago
- Historical use of rainwater as a substitute for tapwater for certain domestic (and industrial) uses
- Increased awareness of water conservation following the 1976 drought
- Intensive public education campaigns on water conservation
- Adoption of water-efficient technologies
- The adoption of cost-recovery principle in water pricing

2.2.6 Austria

Austria has a population of about 8.3 million and a per capita GDP of around US$40,000 (International Monetary Fund, 2008). Ofwat (2007a) reports that PCC is 125 l/h/d. However, the Federal Ministry of Agriculture, Forestry, Environment and Water Management (BMLFUW) gives the figure as 135 l/h/d (BMLFUW, 2006). The breakdown is shown in Figure 8 and given in Appendix A.

[6] Information provided to the EA by Cedric Prevedello of S.A. Aquawal (Union of Water Professionals in Wallonia) in July, 2008

Figure 8: Breakdown of PCC in Austrian households into various usages (from BMLFUW, 2006)



There are over 5,000 water suppliers in Austria and 87 per cent of the population is supplied through a central network. The remaining 13 per cent get their water from private wells or springs (BMLFUW, 2006). Exact figures on metering could not be found but Kölbl et al. (2007) report billed unmetered consumption to be 'negligible' and have estimated water loss per connection which would suggest that most households are measured and consumption figures take account of leakage. However, this could not be confirmed. The cost of water is €1.30/m^3 but the water sector in Austria is subsidised. Federal Government subsidies for municipal water supply in 2005 were close to €600 million (BMLFUW, 2006).

3 Analysis and discussion

3.1 Comparability of estimates

Domestic water consumption is influenced by a range of factors including climate, socio-economic, demographic and religious and cultural factors. Metering and tariff structure or water price are also recognised as key influences on water consumption. However, differences in estimates of PCC could also be due to the methods used to estimate PCC, or any of its associated variables.

For the purpose of this work, selection of countries was restricted to advanced economies in northern and western Europe in order to minimise the impacts of climatic, socio-economic and religious and cultural factors. In terms of climate, all of the countries reviewed generally have temperate climates with cool summers although seasonal maximum and minimum temperatures may vary. The per capita GDP is between US$34,500 and US$40,000; all of them are culturally similar.

According to Ofwat (2007a), all the countries reviewed except Finland have a lower PCC than England and Wales. Finland is reported to have the same average PCC (150 l/h/d) as England and Wales. However, there is evidence to suggest (e.g., Rajala and Katko, 2004) that the average PCC in Finland is less than 150 l/h/d.

Not only is the current national average PCC lower in the countries reviewed than in England and Wales, but PCC is also historically lower. Domestic PCC in England and Wales has been increasing over the years due to greater affluence and declining occupancy (UKWIR/EA, 1997). The opposite trend is seen in the countries reviewed, where the average PCC has declined, quite significantly in some cases such as in Finland, despite greater affluence as shown by the trends in per capita GDP (International Monetary Fund, 2008).

Before analysing the reasons for low PCC in the countries reviewed, it is important to establish whether the estimates, and the methods used to calculate them, are comparable.

A key question is how ‘household’ or ‘domestic’ consumption is defined. This can vary from country to country and between different suppliers in the same country. In England and Wales, Ofwat’s definition of a ‘household’ differs from the definition used for Census (Tynemarch, 2007). It is not clear if the definition of household used by the water companies follows Ofwat, or indeed if it is consistent across all the water companies. In Belgium, the definition of domestic consumption varies across the 80-plus water suppliers in the country[6] and this probably is true for some of the other countries as well. In Germany, residential consumption includes small businesses (Section 2.2.4) but as a separate estimate is given for consumption by these businesses, it is possible to calculate the purely domestic PCC. The availability of data breaking down domestic PCC into various components provides an opportunity to compare different types of domestic use, but does not address the issue of ‘household’ definition.

A second fundamental question is the way in which domestic consumption, however it may be defined, is calculated. In its simplest form, PCC could be calculated as the total water abstracted for domestic consumption divided by the total population supplied. A more rigorous calculation would involve a more accurate determination of actual consumption by excluding various types of system losses (e.g., treatment loss, distribution loss, supply-pipe leakage etc.), including up-to-date population estimates in the areas served and taking account of any adjustments that need be made to account for either technical (e.g., MUR) or statistical (e.g., Maximum Likelihood Estimation) uncertainties.

In all of the countries reviewed, leakage figures are quoted separately and meters in half of the countries (i.e., Belgium, Denmark and Finland) are reported to be located within the property. It can therefore be assumed that supply-side leakage is excluded from the PCC estimate. This information is missing for Austria, Germany and the Netherlands. One of the reasons for focusing on countries with lower PCC than England and Wales was to counter any uncertainty about whether supply-side leakage had been included in PCC estimates.

PCC estimates in the countries reviewed have mostly been compiled centrally based on data from the individual suppliers. The exception is Finland where the primary source of data is the research conducted at the Tampere University of Technology (Section 2.2.2). The methods used by individual water suppliers, and the variables accounted for in calculating PCC in the countries reviewed have not been determined. In some cases, e.g., in Austria, where there are more than 5,000 water suppliers, such an exercise may not be feasible but in other countries, such as the Netherlands which has ten water suppliers, it may be worth exploring the methods. However, the available breakdowns of PCC are useful for comparison as such estimations normally require direct observations even if on a small scale.

In summary, there is not enough data available to be certain that PCC in the countries reviewed is calculated in the same way as in England and Wales. However, there is enough information for a broad-based correlation, especially considering that water companies in England and Wales also use different methods of calculating PCC.

For the purpose of comparison the following variables were considered important and relevant:

- Metering
- Occupancy
- Tariffs
- Components of domestic PCC
- Demand management

These factors are discussed in more detail in the sections below.

3.2 Metering

All of the countries reviewed have nearly universal metering. By comparison, in England and Wales only around a third of households are metered. Metering is estimated to achieve water savings of between ten and 15 per cent of domestic consumption (UKWIR, 2005). It could be argued that only the PCC of metered households in England and Wales (133.4 l/h/d) should be used for comparison. However, the metered households in England and Wales include the 'optant' category whereby households choose to get water meters. The customers in this category are usually low users who expect to save money by switching to volume-based billing. Water companies can also install meters in households that have certain appliances or features that use a lot of water (e.g., swimming pools) – the 'selective' category. Metered households in England and Wales therefore do not represent a random subset of all households. It is therefore questionable whether the average metered consumption would still be the same if the selection of metered households was completely random or universal.

Secondly, metering in the countries reviewed is universal in terms of all billing being metered. In most cases, a block of flats is considered a single property or connection for billing purposes and the bill is normally divided equally between flats. In Denmark, individual metering of flats has been required by law since 1998 and a high proportion of flats is presumably metered. However, there is no figure to confirm this. The number of individually metered flats could only be obtained for the Netherlands (Section 2.2.3). As the water bill is not directly related to the consumption in individual flats, which in most cases share a meter, the impact of metering in such cases (or in other instances where multiple households share a water connection) is not likely to be the same as in individually metered households. For example, in Finland all water supplied through the centralised network is charged based on volume. Apartment blocks, with a single meter for all apartments in the block, account for 44 per cent of the total households[3] and the average PCC for such households is estimated to be between 140 and 150 l/h/d. For individually metered households (detached or terraced houses) the range is between 100 and 120 l/h/d (Rajala and Katko, 2004). Occupancy is also likely to be lower for flats which could also contribute to the higher PCC.

In the context of this work, the argument is academic because even the metered PCC in England and Wales is higher than in most of the reviewed countries.

A number of water companies in England and Wales, particularly those in the water-stressed South East of England, are considering putting universal metering in place by 2035[7]. However, it is unlikely that this would include individual metering of flats, particularly in older buildings. Assuming that all households in England and Wales are metered by 2030 and assuming that metering results in a ten per cent reduction in the average PCC, the current unmetered PCC of 153.8 l/h/d will come done to around 138.4 l/h/d, provided all other factors remain unchanged. The overall average will be 135.9 l/h/d. So metering is likely to make a significant contribution to reducing PCC reduction but by itself will not be enough to reduce the PCC to the desired level. Metering, however, is not a means to the end in itself. It is a fairer system of charging for water and, besides having a direct impact on consumption, provides an incentive to adopt other potential measures such as water-efficient technologies. Metering also increases the effectiveness of any economic instruments (e.g., new tariff structures) that may be put in place.

3.3 Occupancy

The average occupancy of households in the countries reviewed is given in Table 9. The data is sourced from Economic Commission of Europe and not from the water sector of these countries as the individuals and organisations contacted by the EA for this work as well as other sources of data for Austria, Belgium, Denmark, and Germany did not provide average occupancy estimates.

The average occupancy in the countries reviewed ranges from 2.1 to 2.4 (Table 9). Data from England and Wales suggests that PCC varies inversely with occupancy. Tynemarch (2007) estimates a five l/h/d decrease in PCC per 0.1 increase in occupancy. The inverse relationship between occupancy and PCC is true for Germany (Schleich and Hillenbrand, 2007) and probably for other countries as well. However, the quantitative relationship between occupancy and PCC given in Tynemarch (2007) may not be true for the reviewed cases.

[7] According to the dWRMPs submitted to Ofwat

Table 9: Average household size in the countries reviewed (United Nations Economic Commission for Europe, 2005)

Country	Household size	Year
Finland	2.1	2001
Denmark	2.2	2002
Germany	2.2	2001
Netherlands	2.3	2001
England and Wales	*2.3	2001
Austria	2.4	2001
Belgium	2.4	2001

*The average of figure in Ofwat (2007a) for 2004-05 (2.2) and in Ofwat (2007b) or 2005-06 (2.4)

The average household size in most of the countries reviewed is either equal to or smaller than in England and Wales. This suggests that occupancy is not the major factor behind the differences in national PCC.

3.4 Tariffs

The price of water can influence demand. Table 10 gives an overview of the average price in the countries reviewed. As water prices vary regionally in all cases, prices in Table 10 are for the capital cities. As the table shows, water tariffs in England and Wales are towards the lower end of the range. These figures are for 2004-05. The latest figures and ranking may therefore be slightly different from those given in Table 10.

Tariffs in most countries are based on the cost-recovery principle and profit-making is not always allowed. Average water prices in England and Wales have risen by more than 42 per cent since the water sector was privatised in 1989 (Ofwat, 2007c). The same is true for almost all countries, even though increases have varied in both absolute and relative terms. Unlike England and Wales, however, the increases in water price over time have been accompanied by a decline in water consumption. However, the decline in consumption may not be entirely attributable to price increases. Price increases have had an impact on domestic consumption in Finland (Rajala and Katko, 2004) and, combined with low income in the former East German states, are believed to have been the main cause of the lower PCC (104 l/h/d) compared to the former West German states (139 l/h/d) (Schleich and Hillenbrand, 2007). However, the water sector is heavily subsidised in Austria and in Belgium, which has the lowest PCC of all the reviewed countries, there is a strong social element to water tariffs in all three main regions (United Nations Office of the High Commissioner for Human Rights – www2.ohchr.org). Tariffs therefore do not appear to have the same impact or purpose in all of the countries reviewed.

Table 10: Average cost of water in p/m³ (from Ofwat, 2007a)

Country	Cost (p/m³)
Finland (Helsinki)	63.98
Austria (Vienna)	90.96
England and Wales (London)	112.51
Netherlands (Amsterdam)	113.43
Germany (Berlin)	153.72
Belgium (Brussels)	184.61
Denmark (Copenhagen)	378.55

3.5 Components of domestic PCC

Toilet flushing and baths/showers are usually the main components of domestic use. Table 11 shows the figures for toilet flushing and baths/showers in the countries reviewed and their contribution to the overall PCC.

Table 11: Consumption for toilet flushing and baths/showers and their combined percentage of the total PCC

Country	Toilet flushing (l/h/d)	Baths/Showers (l/h/d)	Percentage of total PCC
Austria	29.7	45.9	65.7
Belgium	n/a	n/a	n/a
Denmark	30.1	48.5	60.0
Finland*	16.0	**57.0	63.5
Germany	36.8	34.5	62.0
Netherlands	37.1	52.3	70.1
United Kingdom***	51.0	33.0	56.0

*Based on urban households, not necessarily national average
**The figure is for 'personal hygiene' which might include bathroom sink use
***The figure is taken from Ofwat (2007a) which does not give a separate figure for England and Wales

Table 11 reveals two interesting trends. Firstly, the UK ranks first in volume consumed in toilet flushing and the lowest in baths/showers consumption. Disregarding the toilet flushing figure from Finland, which is significantly lower than in any of the countries reviewed and appears too low for a national average, the consumption in toilet flushing in the UK is between 13 and 21 litres higher than in the other countries. This could be the result of a higher per capita flushing of toilets or greater volume per flush in the UK or both. Similarly low consumption in baths/showers could result from lower frequency of baths/showers, shorter duration of showers, lower volume per bath or shower or a combination of these. In the Netherlands, which has the same average occupancy as the UK, consumption in toilet flushing is based on a frequency of 6.3 flushes per person per day (Vewin, 2008b). The average volume per flush is thus 5.9 litres. In 2004, the frequency was estimated to be six flushes per person per day and per capita consumption at 35.8 l/h/d. This gives an average flush volume of six l/h/d. Assuming the same per capita average flushing frequency in England and Wales, the average volume per flush is 8.1 l/h/d. WRc (2005) estimates the average volume per flush in England is 9.4 litres.

This suggests that there is a significant proportion of older, high-volume cisterns being used in the UK which apparently is not the case in the countries reviewed. Similarly, the low per capita bath/shower consumption in the UK could be due to a lower frequency and/or lower volume per bath/shower.

Secondly, while toilet flushing and baths/showers account for over half of all domestic consumption in the UK, their combined proportion of the total domestic PCC is less than in any of the countries reviewed. This suggests that the consumption in other major domestic uses, such as laundry and dishwashing, is higher in the UK than in the countries reviewed. Since white goods such as washing machines and dishwashers typically have short life cycles, figures from the Netherlands from 2004 are compared with WRc (2005). In 2004 the average washing machine use frequency and volume per use in Dutch households were 0.28 uses per person per day and 64 litres per use respectively, with average per capita consumption of 18 l/h/d (Vewin, 2008b). The corresponding figures in WRc (2005) are 0.33 per person per day and 61 litres per use with average per capita consumption of 18.8 l/h/d. For dishwashers, the frequency of use and volume per use in the Netherlands in 2004 were 0.25 per person per day and 18 litres per use, with a total per capita consumption of three l/h/d (Vewin, 2008b). The corresponding values in WRc (2005) are 0.29 per person per day, 21.3 litres per use and 2.8 l/h/d respectively. So it would appear that in terms of ownership of water using devices other than toilets, England and Wales do not lag behind other countries in ownership of water efficient models. The differences in consumption appear to be related to higher frequency of use in England and Wales. It should be noted that the average occupancy in the WRc (2005) sample was 2.46. The overall ownership of dishwashers – 37 per cent in England and Wales (WRc, 2005) and 58 per cent in the Netherlands (Vewin, 2008b) – could be an additional factor but for washing machines, the overall ownership is comparable (94 per cent for England and Wales, 99 per cent for the Netherlands). Details for other countries could not be found.

In terms of toilet flushing, it is estimated that fitting older cisterns with variable flush mechanism can, on average, lead to an 8.5 per cent reduction in consumption per property. This figure could rise if fitting was carefully targeted (EA, 2005). However, not all cisterns can be fitted with these devices and there are a number of factors that can influence take-up rate. Nevertheless, this should be seriously considered, as there is a significant proportion of older cisterns in England and Wales and considerable scope for reducing domestic consumption.

3.6 Demand Management

The campaigns run by Copenhagen Water Company and Hamburg Water Company are well-publicised examples of focused demand management in the countries reviewed.

Copenhagen Water Company's campaign started in 1989. By 1998 the current PCC of 131 l/h/d had been achieved with a net reduction in PCC of 22 per cent over the period. This represented a ten million m^3/year saving for the company over a period when the total population served increased by 20,000 (www.eaue.de/winuwd/80.htm). Although the use of water-saving devices was encouraged as part of the programme, it does not appear to have included retrofitting on a large scale.

Hamburg Water Company's programme was similar to the one in Copenhagen as it included an intensive media campaign and individual metering. However it also provided financial incentives (DM100) for households to get metered. As part of the campaign, the law was changed to overcome resistance by some sections of the population to install meters. The new laws not only required all new properties to be individually metered but also set a ten-year transition period for all unmetered properties (excluding flats) to be metered. The aim was to achieve this by 2004. In order to encourage individual metering of flats, the Hamburg Water Company worked with meter manufactures to develop new types of meters that could be installed without breaking into walls and incurring high additional costs (http://www.eaue.de/winuwd/132.htm).

However, there is a much wider application of water conservation strategies in all of the countries reviewed although they may not be as focused as the examples above, and are likely to vary from supplier to supplier. Public awareness campaigns run in all the countries reviewed except in Austria where no evidence of such a campaign could be found. Germany and the Netherlands require devices that use water to be labelled to show water-efficiency. In Belgium, rainwater has been used for certain tasks for a long time.

3.7 Summary

The major differences between the water sectors in the countries reviewed and in England and Wales appear to be the degree of metering and scale of demand management measures. All of the countries reviewed have universal metering, although in most cases flats are not individually metered. There have been major demand management drives in Copenhagen and Hamburg since the late 1980s. Some water conservation schemes have been run at national level in all of the countries reviewed with the possible exception of Austria. Water charges are based on the cost-recovery principle, except in Austria. Profit making is not always allowed, and in Belgium, the water charging system has a strong social component. In terms of individual components of domestic use, toilet flushing in England and Wales stands out with consumption of between 13 and 21 l/h/d higher than in the countries reviewed. This suggests that a lot of toilets in England and Wales have high-volume cisterns. Direct comparisons of ownership and frequency of water appliances could only be made with the Netherlands. This shows that there is no significant difference in terms of ownership of water-efficient devices. The differences in consumption mainly result from differences in frequency of use.

In view of the above, universal metering stands out as a key area for England and Wales. Water companies in England and Wales, particularly those in the water stressed South East of England, have considered universal metering as part of their draft Water Resources Management Plans (dWRMPs) covering the period up to 2035. Metering can potentially reduce consumption by ten per cent which alone will not be enough to lower the PCC to 130 l/h/d. The trials for the Hamburg Water Company in the 1980s found that metering combined with use of water saving devices can reduce consumption by up to 25 per cent (http://www.eaue.de/winuwd/132.htm). EA (2005) estimates an average reduction of 8.5 per cent in total domestic consumption by fitting older cisterns with variable flush systems.

All water companies in England and Wales must follow the ‘twin track approach’ when preparing their Water Resources Management Plans (WRMPs) to consider the full range of options available for reducing demand as well as supply-side options. However, in most cases demand management focuses on metering and reducing leakage. All water companies currently offer water-efficient devices or services either free of charge or at a subsidised rate. These include cistern displacement devices, water butts, water audits, and leakage repairs. However, it is generally considered unlikely that water efficiency initiatives will save enough water to help meet the projected increase in demand. This is perhaps the area where strategies need to be reconsidered.

Aquaterra (2008) provides examples of comprehensive demand management strategies used around the world. These include not only metering and reducing leakage, but also high-profile water efficiency drives aimed at changing behaviour and attitudes towards water use. National or regional water efficiency strategies with mandatory targets that take into account the relevant demographic and socio-economic factors in England and Wales could be a possible step towards demand management.

As highlighted by Tynemarch (2007), the quality of PCC estimates made by water companies in England and Wales varies significantly. This is due to the significant variations in effort and resources used to do this and inconsistent application of the recommended best practice. It may be worthwhile carrying out a qualitative assessment of various companies' PCC estimates to understand not only the factors behind current estimates but also the assumptions used to predict future trends.

4 Conclusions and further research

4.1 Conclusions

1. A review of northern and western European countries with similar climates and economies to England and Wales suggests that PCC estimates can be broadly compared.
2. All of the countries reviewed with average PCC lower than England and Wales have nearly universal metering. However, sub-metering of flats is not very common.
3. Average PCC in most of the countries reviewed has declined in recent decades.
4. As in England and Wales, PCC can vary significantly within regions in the countries reviewed. However, in most cases the national average PCC has decreased over the past decade or so.
5. Average household size in the countries reviewed is comparable to England and Wales.
6. Water tariffs in England and Wales are generally lower than those in the countries reviewed.
7. Water prices in all of the countries reviewed have gone up in recent years and are believed to have contributed, at least partly, to a reduction in water consumption. In some cases, this has been one of the main factors.
8. Average household size and national water charges do not explain the differences in average national PCC.
9. A strong national focus on water efficiency, combined with metering and economic instruments, is responsible for the lower PCC in the countries reviewed.
10. Toilet flushing is the component of PCC that is significantly higher in England and Wales than in other countries. Fitting older cisterns with variable flush mechanisms is one of the strategies that can be used to reduce domestic consumption in England and Wales.
11. England and Wales compare favourably with the countries reviewed in terms of ownership of water efficient devices – the differences in overall consumption result mainly from differences in frequency of use.
12. Universal metering alone will not reduce average PCC in England and Wales to the desired level.
13. Comprehensive demand management strategies aimed at changing behaviour and attitudes towards water use are needed to lower PCC in England and Wales to the desired level, rather than simply using technology and economic incentives.

4.2 Further research

1. More detailed information should be gathered from one or two selected countries for a thorough analysis of the methods used to calculate PCC. Good quality data is available for the Netherlands, which has ten water suppliers so it is a possible candidate for such an analysis.

2. Various scenarios for metering in England and Wales should be developed, with associated cost-benefit and sensitivity analyses. These could be used to estimate the reduction in PCC that metering alone can realistically achieve.
3. The reasons for different trends in domestic water consumption in England and Wales compared to the countries reviewed need to be explored in more detail.
4. More work needs to be done to understand the differences in PCC reported by water companies in England and Wales.
5. Retrofitting older cisterns with variable flush mechanisms should be promoted as a way of reducing toilet flushing volumes to levels comparable with the countries reviewed.
6. A broad consensus on the likely future trends in major components of domestic water use will help to develop consistent demand management strategies to be implemented regionally or nationally rather than by water companies.

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Appendix A

Tables showing breakdown of reviewed PCC estimates into various components

Breakdown of PCC into various usages (from Ofwat, 2007a)

Usage	Consumption (l/h/d)	Percentage of total PCC
Toilet flushing	51	34
Baths & showers	33	22
Kitchen and other use	63	42
External use	3	2
Total	150	100

Breakdown of PCC in Denmark into various usages (data from Pamod Seth of Lyngby Tarbaek Council)

Usage	Consumption (l/h/d)	Percentage of total PCC
Toilet flushing	30.1	23
Baths & showers including washbasin use	48.5	37
Clothes washing	24.9	19
Dish washing	15.7	12
Drinking & food preparation	6.6	5
Outdoor use	5.2	4
Total	131	100

Breakdown of Finnish PCC into various usages (from Etelämäki, 1999)

Usage	Consumption (l/h/d)	Percentage of total PCC
Toilet flushing	16	14
Personal hygiene	57	49
Clothes washing	16	14
Food preparation (incl. dish washing)	22	19
Drinking	1	1
Miscellaneous use	3	3

Usage	Consumption (l/h/d)	Percentage of total PCC
Total	115	100

Breakdown of PCC in Dutch households into various usages (from Vewin, 2008a)

Usage	Consumption (l/h/d)	Percentage of total PCC
Toilet flushing	37.1	29
Baths	2.5	2
Showers	49.8	39
Washbasin	5.3	4
Clothes washing by hand	1.7	1
Washing machines	15.5	12
Dish washing by hand	3.8	3
Dishwashers	3	2
Food preparation (incl. drinking)	3.5	3
Miscellaneous	5.3	4
Total	127.5	99*

*the total does not add to 100 per cent due to rounding

Breakdown of PCC in German households into various usages (from Umwelbundesamt, 2007)

Usage	Consumption (l/h/d)	Percentage of total PCC
Toilet flushing	36.8	32
Baths & showers	34.5	30
Washbasin	6.9	6
Clothes washing	16.1	14
Dish washing	6.9	6
Cooking & drinking	3.5	3
Miscellaneous*	10.3	9
Total	115	100

*includes gardening, cleaning and car washing

Breakdown of PCC in Austrian households into various usages (from BMLFUW, 2006)

Usage	Consumption (litres)	Percentage of total PCC
Toilet flushing	29.7	22
Baths & showers	45.9	34
Personal hygiene	9.5	7
Clothes washing	22.9	17
Dish washing	8.1	6
Cooking & drinking	4	3
Miscellaneous	14.9	11
Total	135	100

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