BN DW TAPS: Briefing Note relating to projections of internal tap water consumption

Version 1.0

This Briefing Note and referenced information is a public consultation document and will be used to inform Government decisions. The information and analysis form part of the Evidence Base created by Defra's Market Transformation Programme.

1 Summary

This Briefing Note sets out the information, rationale, assumptions and methods used within the demand scenario model for internal tap water consumption reported in the Policy Brief for internal taps[1]. An overview of the modelling process is given, followed by detailed explanations of the derivation and evidence behind all of the Reference, Policy and Earliest Best Practice scenarios.

2 Demand forecasting model

MTP models annual water demand for domestic internal taps, baths, showers and WCs. Stock and sales information is used in combination with information on consumption per use and frequency of use to derive the water consumption scenario per appliance across the UK to 2020[2]. The impacts of proposed UK policy are then considered to formulate two additional projections of consumption for each appliance - the Policy scenario (P1)[3] and the Earliest Best Practice (EBP)[4] scenario.

The main variables for each appliance are:

- Stock - the number of appliances established[5] in UK houses.
- Sales volume - the number of appliances sold annually.
- Product life expectancy - this allows the proportion of sales that accounts for the replacement of existing appliances, and therefore not adding to ownership levels, to be calculated.
- Volume per use - the volume of mains water consumed at each use. For taps, this is a function of duration of tap use and the flow rate.

[1] Policy Brief: improving the water efficiency of internal taps.
[2] Reference, or 'REF', provides a baseline that can be used to monitor progress towards absolute consumption targets, to evaluate delivered policy measures and to assess the need for new policy decisions.
[3] Policy, or 'P1', estimates the outcome, in terms of water consumption by end-users, of an ambitious, but feasible, programme of critically timed policy measures and other logistical actions, judged to be necessary and sufficient to deliver the specified market transformations.
[4] Earliest Best Practice, or 'EBP', sets a boundary condition for the most ambitious practical rate of market transformation; EBP shows what could happen if, in any year, the market were to take up the most resource efficient, identified (Best Practice) options, taking into account the likely timing and introduction to the market of specific innovations and technologies.
[5] Installed and in use.

- Frequency of use - expressed as uses per appliance per year.

The equation for annual water demand is as follows:

*Annual water demand = ownership * frequency of use$_{app}$ * volume per use*

3 Product types

This document defines a tap as a 'small diameter manually operated valve from which water is drawn' (BS 6100[6]). For the purposes of modelling, each product is defined as a pair of individual internal taps (separate hot and cold water) or one mixer tap providing both hot and cold water.

There are four sub-models underlying the internal tap water consumption projections. These cover:

- Washbasin taps.
- Kitchen taps in homes without dishwashers.
- Kitchen taps in homes with dishwashers.
- Water efficient tap inserts.

Bath taps are covered separately in the document BNDWBATHS: *Actions to improve bath design and efficiency - Briefing Note relating to policy scenario objectives in Policy Brief*[7]. Outdoor taps are not covered.

Currently, within each of the categories listed above no distinction is made between hot and cold taps, and pillar and mixer taps, as no evidence is currently available which indicates there is any difference in water consumption between these types of taps when installed in domestic properties. A single value for frequency of use, ownership, flow rate and duration of use is used in each model.

4 Reference scenario

4.1 Key factors influencing the market and established base[8]

The demand for additional housing, in line with changing demographic factors including a higher proportion of single person households, will stimulate the new-build sector. The new-build sector is expected to grow, with an estimated 4 million homes required over the next 20 years. Plans for around 1.2 million new homes by 2016 in the South East have been announced by the Government and this will influence growth in the market. The increasing number of households has a direct impact on the number of taps being sold, installed and used across the UK.

Emphasis on design and style has prompted refurbishment projects and increased the replacement rate of kitchens and bathrooms. In addition, many homes are having en-suite and additional cloakroom facilities installed. The significant cost of replacing

[6] BS 6100: Section 3.3: 1992, Glossary of building and civil engineering terms.
[7] Briefing Note BNDWBATHS: *Actions to improve bath design and efficiency - Briefing Note relating to policy scenario objectives in Policy Brief*.
[8] MTP Report and Model (2006), *Water Appliances Data Acquisition,* commissioned by MTP with AMA Research.

a bathroom or kitchen does, however, mean that the purchase is more likely to be deferred during times of economic uncertainty.

Mixer brassware continues to gain market share, at the expense of pillar taps. This growth is largely due to design trends and the aesthetic benefits of mixers. Functionality benefits include the use of ceramic disc technology (a quarter turn, smooth control can be achieved), and consumer awareness of this has increased. This could have a long-term impact, as maintenance of ceramic disc technology is easier than the traditional spindle tap design[9].

The growth of mains pressure hot water systems and the demand for contemporary continental-style brassware have resulted in a large proportion of European manufacturers exporting to the UK. This has led to growth of high-pressure mixer products.

Basin monobloc, single-hole mixers remain popular in a range of market sectors. Two-hole mixers continue to retain the largest share in terms of basin brassware[10].

4.2 Market sales estimates

The internal tapware models are based upon sales data for washbasin taps and kitchen taps. The sales data have been collated from the Bathroom Manufacturers Association (BMA)[11] and from AMA Research[12]. The BMA provided sales data for each of the years 2004 to 2006, whilst AMA provided estimates and projections of sales in each of the years 1985 to 2020.

The data provided by BMA are assumed to represent approximately 62%[13] of the total UK tap market in each of the years 2004 to 2006, and this has therefore been scaled up to represent 100% of the market.

The AMA Research dataset has been adjusted to bring it in line with the BMA dataset. This was effected by altering the sales ratio of kitchen to basin taps from 40:60 to 30:70. The ratio of 30:70 kitchen to basin tap sales is a more likely assumption, based on the premise that houses are most likely to have one kitchen (with one tap or a set of taps for hot and cold) and two or three basins (in the bathroom, cloakroom, en suite). Also, bathrooms are replaced more frequently than kitchens. Market and Business Development (MBD)[14] states:

"The trend has been for additional bathroom facilities to be created, such as cloakrooms, wet-rooms and en-suites in both new and old properties. A significant proportion, approximately 60% of the total bathroom market is accounted for by the domestic refurbishment sector, reflecting the rise in home improvements, whereby putting in a new bathroom is seen as one of the main contributors to increasing the value of a property for selling."

[9] Briefing Note BNWAT26: Household tapware - an overview.
[10] For an explanation of tap types and mechanisms, please see BNWAT26: *Household tapware - an overview.*
[11] Personal communication with BMA, 17 September 2007.
[12] MTP Report and Model (2006), *Water Appliances Data Acquisition,* work commissioned by MTP with AMA Research Ltd.
[13] Personal communication with BMA, 17 September 2007.
[14] MBD (2007), *UK Bathroom Equipment Market Development 2007*.

The market size estimates from AMA have therefore been adjusted to better reflect the likely proportions of washbasin taps and kitchen taps in line with evidence from the BMA.

4.3 Product lifespan estimates[15]

The life expectancy of basin taps has been estimated at 15 years, in line with the overall estimated bathroom replacement rate.

The life expectancy of kitchen taps has been estimated at 25 years, because kitchens are replaced less frequently than bathrooms.

4.4 Installed stock estimates

The sales data and product life expectancy are combined within the models to produce stock estimates for each of washbasin taps and kitchen taps in homes with and without dishwashers.

Checks have also been made to ensure that the stock estimations are reasonable, based on:

- The number of washbasin taps must always be greater than the total number of installed WCs[16].
- The number of kitchen taps must always be greater than the total number of houses in the UK[17].

4.5 Consumption

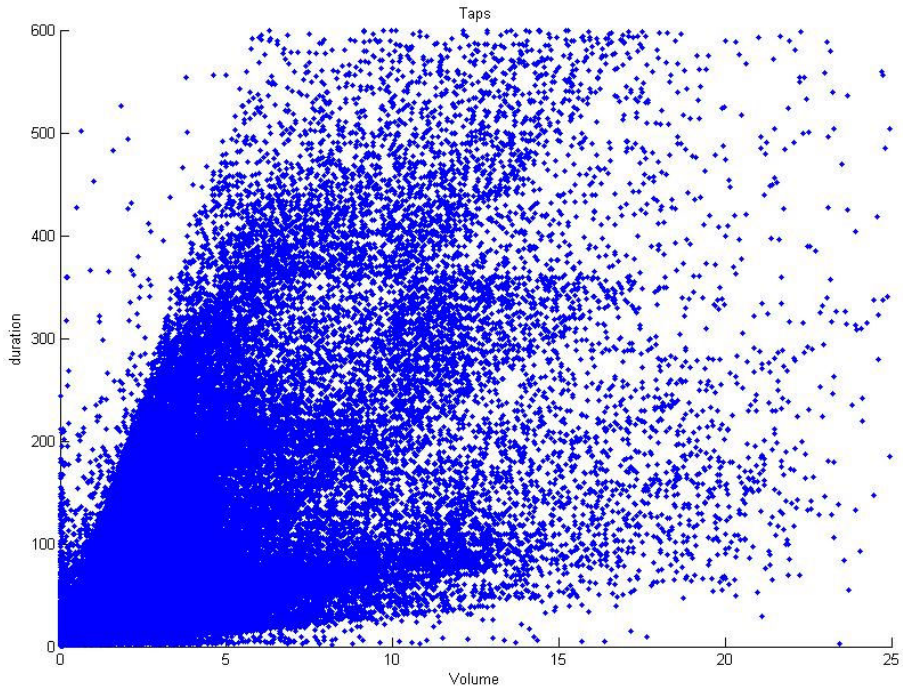
Water consumption per internal tap varies (depending on purpose of use, free flowing or vessel filling).

Evidence on the water consumption of internal taps in use is available from WRc's Identiflow dataset of over 400 properties[18].

Detailed analysis has been carried out on the dataset of internal tap uses to determine if differences in flow rates, duration of use and volume per use were evident between kitchen taps and basin taps. The complete dataset is shown in Figure 4.1, for volume (litres) versus duration of use (seconds).

[15] MTP could not find any published literature on the life expectancy of tapware. Expert judgement has been made to formulate the values provided. If more information becomes available, the Evidence Base and modelling will be updated.
[16] It is assumed that at least one basin, and therefore one set of taps, will be present for each WC installed in houses. In some cases, a washbasin may be present in addition to a basin with WC (eg in homes with a separate bathroom and WC or homes with 'his and hers' basins). Therefore, the number of WCs has been used as the minimum possible number of basin taps that could be present as a sense check.
[17] It is assumed that every house has a kitchen, and therefore a kitchen sink with a set of taps installed. In some cases, an additional sink and set of taps may be present (eg in homes with a separate utility room). Therefore, the number of houses has been used as the minimum possible number of kitchen taps that could be present as a sense check.
[18] WRc Plc (2005), *Increasing the value of domestic water use data for demand management - summary report.*

Figure 4.1 Internal tap uses, volume versus duration of use for entire dataset



Internal tap uses at different hours of the day were statistically analysed against all three variables to identify differences. The results showed, however, that there was no significant difference between the flow rate distribution of internal tap events between the times of day when washbasin use was likely to be prevalent, and the times of day when kitchen tap use was likely to be prevalent (see Figures 4.2 and 4.3[19]).

[19] Note, tap events of less than 0.2 litres were excluded from this analysis, as many are the result of, for example, a tap left dripping and not a conscious event brought about by the user.

Figure 4.2 Flow rate of tap events between midnight and 5am (mostly basin)

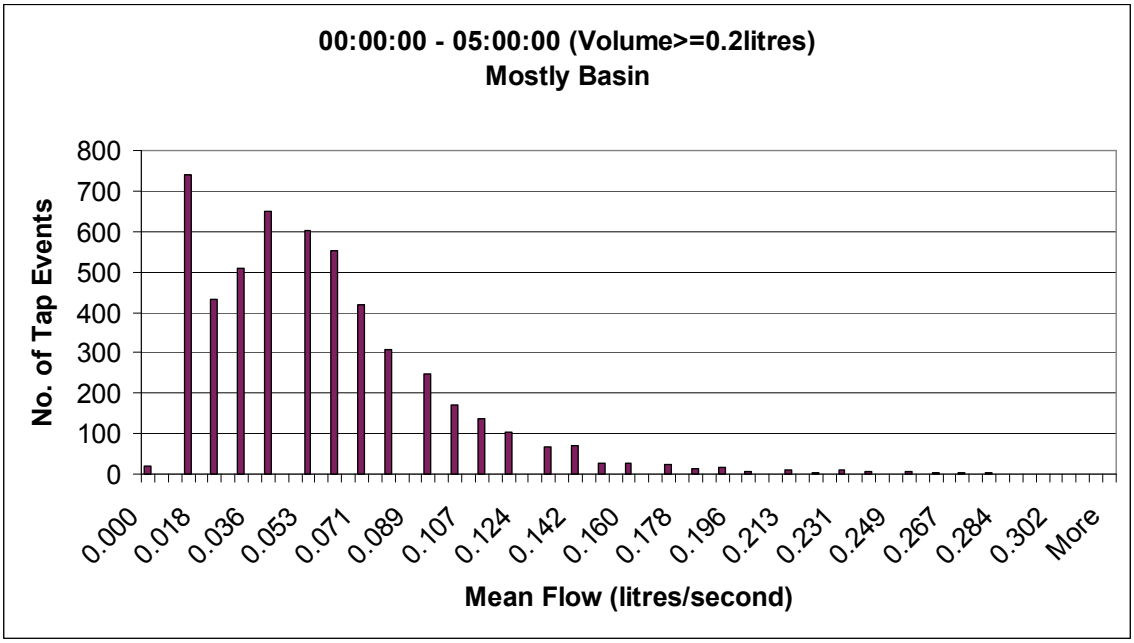
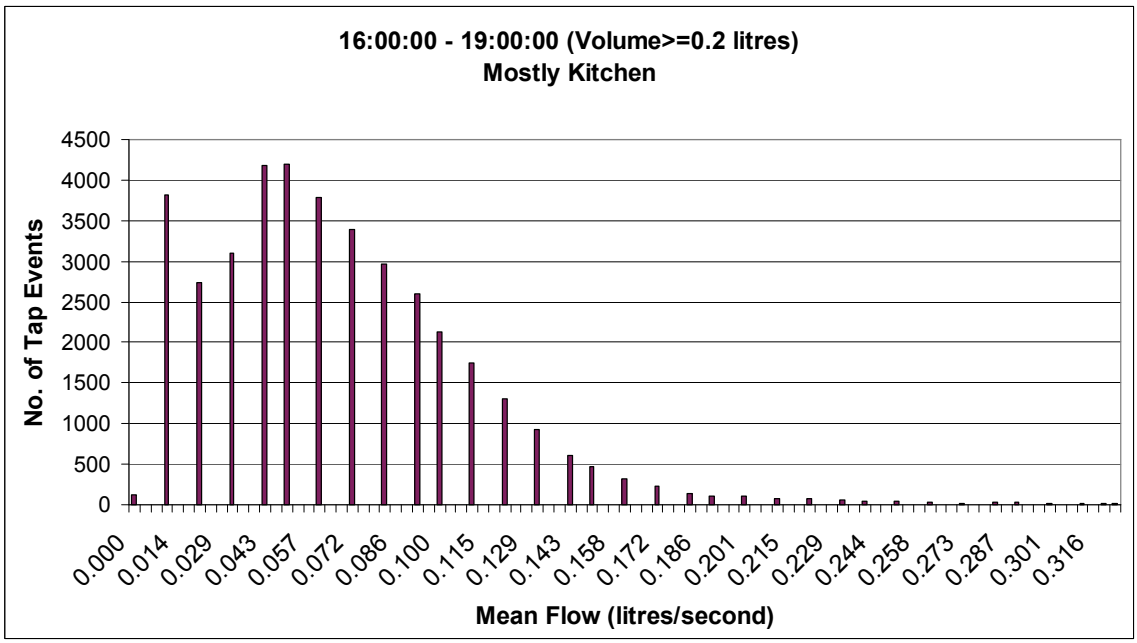


Figure 4.3 Flow rate of tap events between 4pm and 7pm (mostly kitchen)



In both Figure 4.2 and Figure 4.3 a double peak can be seen, with a large number of events having a low flow rate, around 0.014 litres per second (0.8 litres per minute), and then a wider peak around 0.06 litres per second (3.6 litres per minute). This is seen at all times of day, indicating that the same trend occurs at both washbasins and kitchen taps.

Further analysis reveals that the average volume per use of the events at the lower flow rate peak is higher than the average volume per use of the events at the higher flow rate peak. It is possible that this is a result of hot taps (with a lower flow rate) and cold taps (with a higher flow rate) being run for differing durations. However, further evidence is required before this can be confirmed. It is unlikely that Figure 4.2 and Figure 4.3 indicate that more efficient taps are run for longer, as Figure 4.1 shows clearly that there are many events of high volume which have both short and long durations (high and low flow rates).

The causal factors of the trends described are unknown, so it is not possible to carry out modelling work which encompasses them. It is currently not possible to forecast how future policy might impact on usage in each of the two flow rate groups. The average flow rate across all groups has therefore been modelled because the impacts of policy on overall tap usage are simpler to estimate, and the modelling can therefore be considered to be more robust. If more information becomes available, the modelling can be expanded to include more detailed usage categories.

The assumptions included within the modelling scenarios are therefore:

- Average flow rate of both kitchen and basin taps is 0.059 litres/second (3.54 litres per minute).
- Average duration of both kitchen and basin tap uses is 39.27 seconds.
- Average volume per use of both kitchen and basin taps is therefore 2.32 litres.

No differentiation between kitchen and basin tap uses is possible with the current evidence available. In addition, no differentiation between hot and cold tap uses is possible with the current evidence available.

4.6 Frequency of use

The frequency of use of washbasin and kitchen taps per household is related to the occupancy of the household. The number of internal tap events per person reduces as the occupancy of the household increases[20]. This means that as occupancy is expected to decrease to just under 2.2 by 2020 (from about 2.3 in 2007), the frequency of tap use per person will, on average, increase slightly by approximately 3% from 2007 to 2020. This factor has been built into the model.

The frequency of internal tap use has been taken from the same dataset as the volume per use information. Data for households of occupancies of one to six have been analysed in detail, and an average frequency of use calculated at 39 uses per household per day in 2007.

4.6.1 Kitchen tap frequency of use

It is thought that the frequency of kitchen tap use varies according to, amongst other factors, whether a household owns, and uses, a dishwasher. In homes where a dishwasher is installed it is estimated that kitchen taps are used on average just over 17 times a day per household. In homes where no dishwasher is used, kitchen taps

[20] WRc Plc (2005), *Increasing the value of domestic water use data for demand management - summary report.*

are used on average just over 24 times a day per household[21] [22]. This is equivalent to 55% of all tap uses across all homes.

The overall frequency of kitchen and utility tap usage is therefore expected to reduce slowly as the increase in households owning and using dishwashers continues. The stock of dishwashers has been incorporated into the model and will be updated in line with the dishwasher model[23].

4.6.2 Basin tap frequency of use

Basin taps are thought to account for the remaining 45% of all internal tap uses in domestic properties. This is equivalent to 50% of tap uses in homes with dishwashers, and 41% of tap uses in homes without dishwashers.

5 Policy scenario

The impacts of all policies[24] below have been assessed with respect to the ownership, frequency of use and volume per use of the following types of taps: washbasin, kitchen taps in homes without dishwashers, and kitchen taps in homes with dishwashers.

- Water Supply (Water Fittings) Regulations.
- Code for Sustainable Homes.
- Metering in areas of serious water stress.
- Building Regulations.
- Water efficiency in existing buildings[25].
- Ofwat's voluntary targets for water efficiency for water companies.

5.1 Ownership

No policies are expected to influence the overall ownership rates (internal taps per household) away from the Reference line.

5.2 Frequency of use

Metering in areas of serious water stress has the potential to effect a reduction in the frequency of use of taps across both new and existing properties[26]. This policy is likely to impact between 2010 and 2020.

[21] Analysis from WRc data (2005) *Increasing the value of domestic water use data for demand management*. The ratio of tap uses in homes with and without dishwashers from EcoHomes was used as an initial estimate, and then corroborated with the Identiflow dataset. The number of basin tap uses has been assumed to be 50% of total tap uses in homes with dishwashers, and 41% of uses in homes without dishwashers. The two ratios for homes with and without dishwashers combined give a ratio of 45:55 basin to kitchen tap uses across all homes.

[22] EcoHomes guidance is available at http://www.breeam.org/filelibrary/Ecohomes_2006_Guidance_v1.2_-_April_2006.pdf. The ratio of kitchen tap volume:basin tap volume is calculated from the guidance under 'Internal taps'.

[23] Briefing Note BNW07: *Assumptions underlying the energy projections for domestic dishwashers.*

[24] It is assumed that any policy implemented by the Government to cover England and Wales will be similarly implemented by the appropriate bodies in Scotland and Northern Ireland. MTP modelling covers UK water consumption. Metering in areas of serious water stress will impact only in England.

[25] CLG is leading a review of policy levers/drivers that might be implemented or implemented more rigorously to improve water efficiency in existing properties.

[26] The policy is likely to influence either duration of tap use or frequency of use. In this case, the decision has been taken to model the impact on frequency of use.

The frequency of internal tap use in each home has been reduced by 1%[27] in 4.38 million homes[28] fitted with a meter compulsorily between 2010 and 2020.

5.3 Volume per use

The volume per use is affected by the expected in-use flow rate of internal taps installed under the following policies:

- Code for Sustainable Homes.
- Building Regulations.
- Water Supply (Water Fittings) Regulations.
- Water efficiency in existing buildings.

Initially, only the Code for Sustainable Homes will impact on the flow rates of new internal taps installed. Subsequently, the proposed changes to the Building Regulations will bring about a further reduction in the flow rates of internal taps installed in new properties. Changes are introduced more rapidly for basin taps than kitchen taps as fewer vessel filling activities are likely to occur in the bathroom environment,

From 2016 onwards it is likely that the impacts of changes to the Water Supply (Water Fittings) Regulations and any policy on water efficiency in existing buildings will begin to be seen, and therefore internal taps sold for replacement in existing properties begin to increase in efficiency from this year onwards.

These policy influence factors have been consolidated into the average installed flow rate of new internal taps sold under the Policy scenario, as given in Table 5.1.

Table 5.1 Average installed flow rate of new taps sold under the P1 scenario

Year	Average flow rate (litres per minute)
2008	3.5
2009	3.5
2010	3.4
2011	3.4
2012	3.4
2013	3.4
2014	3.4
2015	3.4
2016	3.4
2017	3.3
2018	3.3
2019	3.3
2020	3.3

Additionally, Ofwat's voluntary targets for water efficiency are likely to encourage the continuing distribution of water efficient tap inserts by water companies. It is assumed that 0.1% of existing taps each year from 2008 onwards will have water

[27] 1% has been selected as an arbitrary, but reasonable, expectation of reduction in frequency per use due to compulsory metering.
[28] 90% meter penetration by 2020 has been assumed for water companies in the South East region. Average meter penetration across the UK will then be approximately 69%, against a penetration of 54% if no policy intervention takes place. This is equivalent to an extra 4.38 million households.

efficient tap inserts successfully installed, reducing the flow rate from those shown in Table 5.1 to 2 litres per minute in taps with inserts installed.

6 Earliest Best Practice (EBP) scenario

In the Earliest Best Practice scenario, the best possible outcome from the implementation of policies outlined in section 5 (Policy scenario) is considered. The impact of policies is accelerated to project how water consumption would change if the most efficient internal taps were selected over less efficient products at the earliest opportunity that is technically feasible.

6.1 Ownership

No policies are expected to influence the overall ownership rates (internal taps per household) away from the Reference line.

6.2 Frequency of use

Metering in areas of serious water stress has the potential to effect a reduction in the frequency of use of internal taps across both new and existing properties[29]. This policy is likely to impact between 2010 and 2020.

The frequency of internal tap use in each home has been reduced by 1%[30] in 4.38 million homes[31] fitted with a meter compulsorily between 2010 and 2020.

6.3 Volume per use

Within the EBP scenario it is assumed, following Policy influence (as outlined in section 5.3), that the most efficient products are selected for installation at the earliest opportunity, resulting in accelerated impact of policies over the P1 projection.

The average flow rate of new internal taps sold under the EBP scenario is given in Table 6.1.

Table 6.1 Average installed flow rate of new taps sold under the EBP scenario

Year	Average flow rate (litres per minute)
2008	3.4
2009	3.4
2010	3.4
2011	3.4
2012	3.4
2013	3.4
2014	3.4
2015	3.4
2016	3.3
2017	3.3
2018	3.2

[29] The policy is likely to influence either duration of tap use or frequency of use. In this case, the decision has been taken to model the impact on frequency of use.
[30] 1% has been selected as an arbitrary, but reasonable, expectation of reduction in frequency per use due to compulsory metering.
[31] 90% meter penetration by 2020 has been assumed for water companies in the South East region. Average meter penetration across the UK will then be approximately 69%, against a penetration of 54% if no policy intervention takes place. This is equivalent to an extra 4.38 million households.

2019	3.2
2020	3.1

Additionally, Ofwat's voluntary targets for water efficiency are likely to encourage the continuing distribution of water efficient tap inserts by water companies. It is assumed that 0.1% of existing taps each year from 2008 onwards will have water efficient tap inserts successfully installed, reducing the flow rate from those shown in Table 6.1 to 2 litres per minute in taps with inserts installed. No further impact over the P1 scenario is expected.

7 Water consumption pattern changes

Table 7.1 indicates the percentage of total water consumption by product sub-type for the years 2007, 2010 and 2020 under each of the Reference, Policy and EBP scenarios.

Table 7.1 Water consumption as a percentage of total consumption for REF Policy and EBP scenarios in 2007, 2010 and 2020

% of total internal tap water consumption	*2007*			*2010*			*2020*		
Product sub-type	*REF*	*P1*	*EBP*	*REF*	*P1*	*EBP*	*REF*	*P1*	*EBP*
All basin taps	44.5	44.5	44.5	44.5	44.5	44.5	44.6	44.3	44.2
All kitchen taps	55.5	55.5	55.5	55.5	55.5	55.5	55.4	55.7	55.8

Note: all numbers are rounded to one decimal place.

Under the Reference scenario there is a slight shift towards a higher proportion of water consumption by basin taps by 2020 over 2007, as an increasing penetration of dishwashers results in a decrease in kitchen tap frequency of use.

The cumulative impacts of policies, as stated in sections 5 and 6, result in the proportional changes under the P1 and EBP scenarios seen in Table 7.1. Kitchen taps account for a higher percentage of total consumption under the P1 and EBP scenarios by 2020, as preferential installation of efficient taps in bathroom basins means that ownership levels of efficient basin taps are higher than efficient kitchen taps by 2020.

Related MTP information

- Briefing Note BNWAT26: Household tapware - an overview
- Policy Brief: Improving the water efficiency of internal taps
- Briefing Note BNDWBATHS: Actions to improve bath design and efficiency - Briefing Note relating to policy scenario objectives in Policy Brief
- Policy Brief: Improving the water efficiency of baths

Consultation and further information

Stakeholders are encouraged to review this document and provide suggestions that may improve the quality of information provided, email **info@mtprog.com** quoting the document reference, or call the MTP enquiry line on +44 (0) 845 600 8951.

For further information on related issues visit **www.mtprog.com**