Water Labelling Options: Cost Benefits Analysis for Wales

Welsh Government

Contents

1 Executive Summary 2
2 Background 3
3 Methodology Overview 4
4 Results 5
5 Discussion 8
6 Appendix: Detailed Scenario Modelling Assumptions 9

1 Executive Summary

Energy Saving Trust have previously carried out research for Waterwise, Defra, and the water companies' Collaborative Fund into the viability of different options for improving the labelling of water using fittings and appliances across the UK. Seven different options were assessed, and the work concluded that a Government-led mandatory water label, linked to minimum standards for new build properties and for general sales, was the most effective and cost-effective option. Over 25 years, this option could reduce per capita water consumption by over 30 litres per person per day, compared to just 13 litres per person per day for a mandatory label alone.

The report therefore recommended a UK-wide mandatory label be introduced, along with increasing minimum standards for the sale of new product, and that each devolved nation should link their building regulations water efficiency requirements to the new label.

Welsh Government have now commissioned this follow-on study to assess the impacts, costs and benefits of such an approach in Wales specifically. The original calculations were remodelled using data specific to Wales, where available, and otherwise using pro-rata values from the UK. Four versions of the preferred option above were modelled, with differing levels of ambition.

The study concludes that the same approach would still be highly effective, reducing per capita consumption by **22 litres per person per day** after 25 years for the most ambitious scenario modelled. This most ambitious version is also the most cost effective, with a **cost:benefit ratio of 1:51**. The energy saved through avoided water heating adds up to **12,800 gigawatt hours** over 25 years.

These figures mirror the UK results in general, but with lower savings and cost:benefit ratios. However, the total savings remain significant and the cost:benefit ratio remains highly attractive.

Total Cumulative Water Saved over 25 years	Million Litres (Ml)	**442,388**
Water Savings in year 25	Litres per capita per day	**22.4**
Total Bill Savings over 25 years	£ Million	**1,396**
Total Emissions Savings over 25 years	MtCO2e	**3.07**
Cost:Benefit Ratio		**1:51**

2 Background

There is ever growing pressure on governments, water companies, manufacturers, and wider society to reduce demand on water resources. As the impacts of climate change and population growth are realised by way of drought and flooding events across the UK, the need to act has never been more urgent. The framework for action exists. The UK Government has outlined plans to align with industry to define ambitious consumption targets as part of their 25 year environmental plan “A Green Future”.

Energy Saving Trust were previously commissioned by Waterwise, Defra, and the water companies’ Collaborative Fund to carry out a cost benefit analysis into options for improved water efficiency labelling of domestic fittings and appliances in the UK. That work considered a number of options for water labelling, including voluntary and mandatory schemes, led by government or industry, supported by marketing campaigns, and linked to minimum standards for fittings and appliances in new-build properties and in general refurbishment. The analysis included efficiency improvements for kitchen and bathroom taps, showers, baths, toilets, washing machines, dishwashers and external water products, in new and existing domestic properties.

The study concluded that the most cost-effective option would be to introduce a mandatory, government led water label, and to link it to standards in building regulations, and to new minimum performance standards for the sale of fittings and appliances. This option saved the most water of all the options, reducing per capita water consumption by over 30 litres per person per day, compared to just 13 litres per person per day for a mandatory label alone, while also giving the most favourable cost benefit ratio.

The study also concluded that new UK-wide labelling regulations, incorporating increasingly tighter minimum standards for sale of products, could be complemented by changes to the building regulations in each nation of the UK, with each government choosing the rate at which different label ratings are set as minimum requirements for new-build properties and major refurbishments.

The cost benefit analysis was carried out for a UK-wide initiative, based on data sets and assumptions applicable to the UK as a whole. Welsh Government have now commissioned this follow-on work to re-run the calculations using Wales-specific data where available, and so to give an indication of the costs and benefits from a Welsh perspective. Wales-specific data sets have included:

- Welsh water metering figures
- Welsh fuel mix for water heating
- Welsh new build projections
- Welsh population projections
- Wales’s marginal cost for supplying water
- Welsh Water’s and Hafren Dyfrdwy’s embodied carbon factors for water supply and wastewater treatment

Where no Wales-specific data is available, UK data has been applied on a pro-rata basis.

3 Methodology Overview

The cost benefit analysis was carried out as follows:

- Existing and potential water consumption figures for each product type were calculated
- Uptake rates for fittings and appliances were calculated from sales and new-build projections
- Intervention schedules were developed for each scenario, to define dates at which increased standards would be applied
- Costs were estimated for introducing and administering the scheme, and for additional costs in the manufacture and supply of compliant products
- Each scenario was modelled over a 25 year time span, and compared with a business as usual case, to calculate water saved, heating energy saved, reduction in cost of supplying water, carbon dioxide saved through reduced water supply, reduced wastewater treatment, and reduced water heating requirement
- The financial savings were combined, and compared to the combined costs for government, industry and householders, to give a cost benefit ratio for each scenario

Input to the modelling came from a wide variety of sources, including published research, Energy Saving Trust research, industry inputs, existing regulations, results from international water labelling and regulatory schemes, and proxy figures from similar interventions not directly related to water efficiency labelling. Further details on the methodology, including the range of data sources used, can be found in the Appendix.

4 Results

Four scenarios have been modelled. These were developed based on their equivalent for new builds in the building regulations:

- **Tightest new build standards in the UK currently** – as currently applied to new build properties in Wales and some parts of England, but applied here to all new purchases and installations. Equivalent to 110 litres per person per day in the building regulations water efficiency calculation methodology.
- **10% better than current best standards** – approximately 10% tighter standard than the above. Equivalent to 100 litres per person per day in the building regulations water efficiency calculation methodology.
- **Best commercially available domestic technology** – requiring all purchases and installations to use the best technology currently commercially available in the UK domestic market. Equivalent to 95 litres per person per day in the building regulations water efficiency calculation methodology.
- **Best commercially available technology** – requiring all purchases and installations to use the best technology currently commercially available in the UK, whether for the domestic or non-domestic market. Equivalent to 85 litres per person per day in the building regulations water efficiency calculation methodology.

The key results for these four scenarios, modelled over 25 years, are presented in Table 1, and the expected payback period for buyers of new homes (the period taken for reduced water and water heating bills to repay any increase in home purchase cost) are presented in Table 2.

Table 1: Savings achieved over 25 years

Cost/Benefit		Type	Units	Tightest new build standards in UK currently	10% better than current best standards	Best commercially available domestic technology	Best commercially available technology
			Building Regulations LPD Equivalent =	110	100	95	85
Costs	Sector	Government *Welsh Government's share of scheme implementation costs*	£ Million	£1.0	£1.0	£1.0	£1.0
		Manufacturers *Welsh share of implementation costs inc. testing, label printing etc.*	£ Million	£11.3	£11.3	£11.3	£11.3
		Households *Implementation costs passed on from manufacturers, plus additional product costs*	£ Million	£23.4	£24.5	£25.2	£28.0
	Total	Total Absolute Cost *Government costs plus household costs*	£ Million	£23.4	£24.5	£25.2	£28.0
		Average Cost per Household *Average full cost to a householder in Wales, over 25 years*	£ per household	£16.6	£17.4	£17.9	£19.9
Benefits for Households	Water	Total Cumulative Water Saved *Total savings over full 25 year period*	Million Litres (Ml)	297,733	362,817	383,351	442,388
		Water savings in year 25:	Million Litres per day (Ml/day) Litres per capita per day Litres per household per day	58 14.2 32.2	71 17.3 39.3	75 18.3 41.5	91 22.4 50.6
	Energy	Hot Water Energy Savings *Cumulative total reductions in energy required to heat water in homes*	GWh	7,811	10,446	11,298	12,818
	Financial	Water Bill Savings *Cumulative total reductions in water bills across all metered homes*	£ Million	£624	£809	£862	£946
		Energy Bill Savings *Cumulative total reductions in energy bills from reduced water heating*	£ Million	£196	£318	£362	£450
		Average Saving per Household *Total bill savings over 25 years per household on average*	£ per household total	£584	£801	£870	£993
		Total net saving per Households *Total savings minus costs over 25 years per household on average*	£ per household total	£567	£784	£852	£973
		New Build Water Bill Savings *Cumulative total reductions in water bills across all new build homes*	£ Million	£52	£96	£103	£166
		New Build Energy Bill Savings *Cumulative total reductions in energy bills across all new build homes*	£ Million	£18	£89	£109	£166
Benefits for Water Suppliers	Financial	Marginal Cost Savings *Total reduced costs to water companies through supplying less water*	£ Million	£15.8	£19.2	£20.3	£23.4
Benefits in CO2 Reduction		Energy Emissions Savings *Greenhouse gas reductions from avoided water heating*	MtCO2e	1.74	2.33	2.52	2.85
		Water Emissions Savings *Greenhouse gas reductions from avoided water supply and sewage treatment*	MtCO2e	0.14	0.17	0.18	0.21
		Total Emission Savings	MtCO2e	1.88	2.51	2.70	3.07
Cost:Benefit Ratio		Combined *Total 25 year costs: total 25 year savings*	Ratio	1:36	1:47	1:49	1:51

Table 2: Payback for new build home buyers

Cumulative new build payback

Scenario	Cost Benefit	Type	Unit	Year 1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25
Tightest new build standards in UK currently	Costs	Households	£ Million	£1.6	£1.0	£0.7	£0.4	£0.1	£0.1	£0.1	£0.1	£0.1	£0.1	£0.1	£0.1	£0.1	£0.1	£0.1	£0.1	£0.1	£0.1	£0.1	£0.1	£0.1	£0.1	£0.1	£0.1	£0.1
	Benefit: Financial	New Build Water Bill Savings	£ Million	£0.2	£0.2	£0.2	£0.3	£0.3	£0.3	£0.3	£0.3	£0.3	£0.3	£0.3	£0.3	£0.3	£0.3	£0.3	£0.3	£0.3	£0.3	£0.3	£0.3	£0.3	£0.3	£0.3	£0.3	£0.3
		New Build Energy Bill Savings	£ Million	£0.1	£0.1	£0.1	£0.1	£0.1	£0.1	£0.1	£0.1	£0.1	£0.1	£0.1	£0.1	£0.1	£0.1	£0.1	£0.1	£0.1	£0.1	£0.1	£0.1	£0.1	£0.1	£0.1	£0.1	£0.1
		Payback	Weeks	265.8	213.9	179.5	148.9	121.1	102.1	88.3	77.7	69.3	62.4	56.8	52.0	48.0	44.7	42.0	39.6	37.6	35.8	34.2	32.8	31.5	30.4	29.3	28.3	27.5
10% better than current best standards	Costs	Households	£ Million	£1.6	£1.0	£0.7	£0.5	£0.2	£0.1	£0.1	£0.1	£0.1	£0.1	£0.1	£0.1	£0.1	£0.1	£0.1	£0.1	£0.1	£0.1	£0.1	£0.1	£0.1	£0.1	£0.1	£0.1	£0.1
	Benefit: Financial	New Build Water Bill Savings	£ Million	£0.5	£0.5	£0.5	£0.5	£0.5	£0.5	£0.5	£0.5	£0.5	£0.5	£0.5	£0.5	£0.5	£0.5	£0.5	£0.5	£0.5	£0.5	£0.5	£0.5	£0.5	£0.5	£0.5	£0.5	£0.5
		New Build Energy Bill Savings	£ Million	£0.4	£0.5	£0.5	£0.5	£0.5	£0.5	£0.5	£0.5	£0.5	£0.5	£0.5	£0.5	£0.5	£0.5	£0.5	£0.5	£0.5	£0.5	£0.5	£0.5	£0.5	£0.5	£0.5	£0.5	£0.5
		Payback	Weeks	85.7	68.5	57.2	49.3	41.4	35.8	31.6	28.2	25.5	23.4	21.7	20.2	18.9	17.8	16.9	16.1	15.4	14.7	14.2	13.6	13.2	12.8	12.3	12.0	11.6
Best commercially available domestic technology	Costs	Households	£ Million	£1.7	£1.1	£0.7	£0.5	£0.2	£0.1	£0.1	£0.1	£0.1	£0.1	£0.1	£0.1	£0.1	£0.1	£0.1	£0.1	£0.1	£0.1	£0.1	£0.1	£0.1	£0.1	£0.1	£0.1	£0.1
	Benefit: Financial	New Build Water Bill Savings	£ Million	£0.5	£0.5	£0.6	£0.6	£0.6	£0.6	£0.6	£0.6	£0.6	£0.6	£0.6	£0.6	£0.6	£0.5	£0.5	£0.5	£0.6	£0.5	£0.5	£0.5	£0.5	£0.6	£0.6	£0.6	£0.6
		New Build Energy Bill Savings	£ Million	£0.4	£0.4	£0.5	£0.6	£0.6	£0.6	£0.6	£0.7	£0.7	£0.7	£0.7	£0.6	£0.6	£0.6	£0.6	£0.6	£0.6	£0.6	£0.6	£0.6	£0.7	£0.7	£0.7	£0.7	£0.7
		Payback	Weeks	98.6	77.3	62.7	50.3	40.4	34.1	29.5	26.0	23.3	21.2	19.5	18.1	16.9	16.0	15.1	14.4	13.7	13.1	12.6	12.1	11.7	11.3	11.0	10.6	10.3
Best commercially available technology	Costs	Households	£ Million	£1.7	£1.1	£0.7	£0.5	£0.2	£0.1	£0.4	£0.3	£0.2	£0.1	£0.1	£0.1	£0.1	£0.1	£0.1	£0.1	£0.1	£0.1	£0.1	£0.1	£0.1	£0.1	£0.1	£0.1	£0.1
	Benefit: Financial	New Build Water Bill Savings	£ Million	£0.5	£0.5	£0.6	£0.6	£0.6	£0.6	£1.0	£1.1	£1.1	£1.4	£1.3	£1.3	£1.2	£1.2	£1.2	£1.1	£1.2	£1.2	£1.2	£1.2	£1.2	£1.2	£1.3	£1.3	£1.3
		New Build Energy Bill Savings	£ Million	£0.4	£0.4	£0.5	£0.6	£0.6	£0.6	£1.1	£1.2	£1.2	£1.3	£1.3	£1.3	£1.2	£1.2	£1.2	£1.2	£1.2	£1.2	£1.2	£1.2	£1.3	£1.3	£1.3	£1.3	£1.3
		Payback	Weeks	98.6	77.3	62.7	50.3	40.4	34.1	28.1	23.6	20.3	17.3	15.1	13.4	12.2	11.2	10.4	9.7	9.1	8.6	8.2	7.8	7.4	7.1	6.8	6.5	6.3

5 Discussion

Unsurprisingly, the most ambitious option saves the most water, reducing per capita consumption by **22 litres per person per day** after 25 years.

This option is also the most cost effective, with a **cost:benefit ratio of 1:51**. The more cautious options deliver lower water savings, as expected, but also with lower cost:benefit ratios.

The energy saved through avoided water heating adds up to **12,800 gigawatt hours over 25 years** for the most ambitious scenario. Total carbon dioxide equivalent savings, including the embodied carbon dioxide of water, come to **3.07 million tonnes** over 25 years; that's the same amount absorbed by a forest larger than the size of Powys.[1]

These figures mirror the UK results in general, but with lower savings and cost:benefit ratios. Due to the size of Wales compared to the rest of the country the absolute savings are unsurprisingly lower.

In terms of impact on buyers of new build properties, the new standards are expected to add to the cost of a new home, but the savings from reduced water heating are expected to repay the additional cost many times over. For all scenarios aside from the least ambitious 'Tightest new build standards currently' scenario, the costs are paid back in **less than 2 years** for homes bought in the first year of the scheme, falling to a payback period of **less than 12 weeks** over the 25 year period. The least ambitious scenario has much poorer payback periods, as the new build standards do not improve under this scenario but some costs are nonetheless incurred.

[1] Assumes 5574 km2 of forest, absorbing 540,000 kgCO_2/year/km2, from *https://www.forestry.gov.uk/pdf/6_planting_more_trees.pdf/$FILE/6_planting_more_trees.pdf*

6 Appendix: Detailed Scenario Modelling Assumptions

Scenarios
In total, four new scenarios were modelled against the baseline. Each scenario is a variation on the original preferred scenario from the first study, with different levels of ambition for requiring efficient water fittings and appliances (including showers, baths, taps, toilets, external water using products, washing machines and dishwashers). The primary purpose of the modelling was to evaluate the effect of applying these restrictions through building regulations and to the wider market, to underpin a mandatory government water-labelling scheme.

The scenarios were originally described in terms of the litres per day (LPD) metric used in the English Buildings Regulations Part G water efficiency calculator for new homes. These scenarios were then defined in terms of maximum consumption rates for each product category covered.

6.1 Detailed Scenario Modelling Methodology

Calculations
The cost benefit analysis was structured quite simply; the uptake rates relate to the number of water efficient products compliant year on year with the total number of new build sales and current stock being the maximum potential for compliance for a given water standard scenario. The uptake rates are broken down into the seven product categories and by the eight scenarios. The uptake rates are calculated from numerous sources and peer reviewed to ensure they are as representative of the scenarios as possible and are as up to date as they can be. The uptake rates are the primary driver of both the costs and the benefits, and in the majority of instances, the scale of the uptake proportionately affects the scale of the costs and benefits.

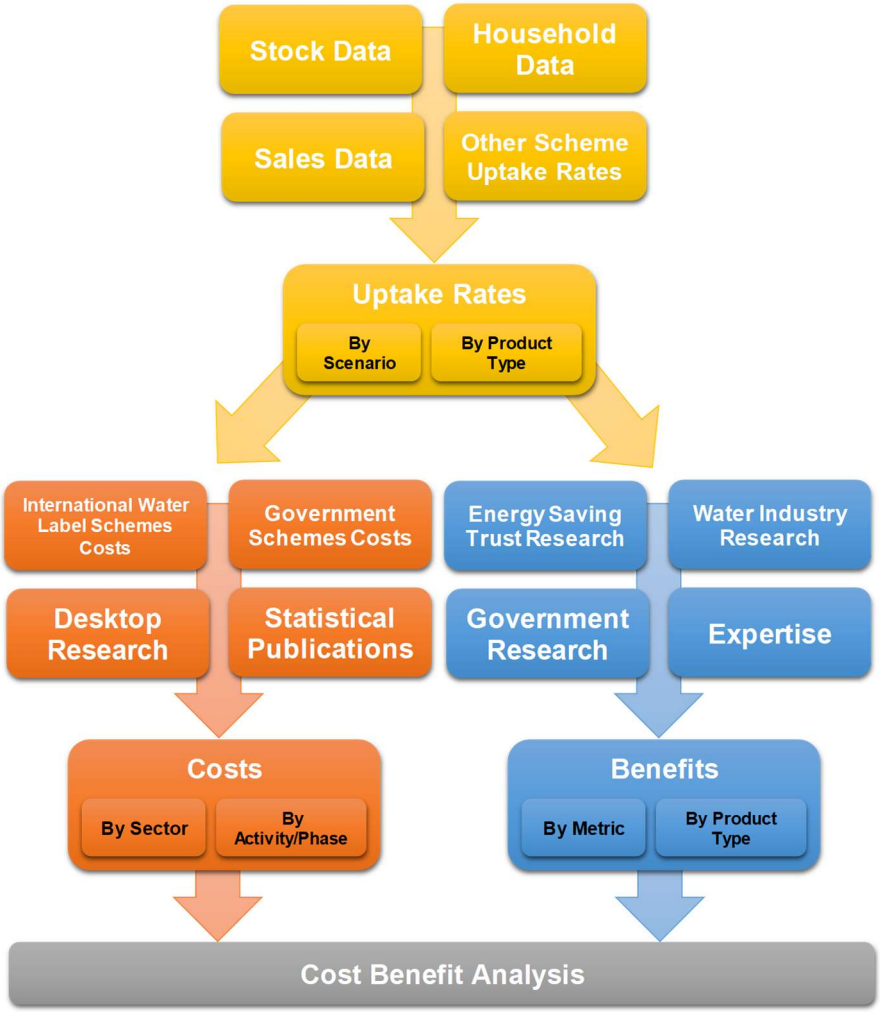

Figure 1: Workflow of detailed scenario modelling

The costs were sourced from numerous places including existing international water labelling schemes, UK and Welsh Government and industry schemes that were relevant for a particular scenario. Welsh statistics were used to adjust and proportion the costs so they are representative of a given scenario, geographic scale and future financial changes according to a projected timescale of 25 years.

The benefits were calculated using a combination of Energy Saving Trust, water industry and government research. A weighted average saving for each product category was calculated using average flow rates and projected flow rates of water efficient technologies. These per product savings were multiplied by the uptake rates for each scenario resulting in the water savings over time, which were then used to calculate all the subsequent results.

Fittings assumptions

The cost benefit analysis (CBA) model requires assumptions to be made for each product type on the amount of water consumed. The England Building Regulations Part G provides these assumptions 110 LPD or “Tightest new build standards in UK currently”. These assumptions represented the top two highest water consuming scenarios.

Table 3: Assumed water consumption by product type based on the England Building Regulations Part G Water Efficiency Calculator

Scenario	Tightest new build standards in UK currently	10% better than current best standards	Best commercially available domestic technology	Best commercially available technology
LPD	**110**	**100**	**95**	**85**
Toilet Large Flush **(l/use)**	4.00			
Toilet Small Flush **(l/use)**	2.60			
Toilet Average **(l/use)**	3.06	2.91	2.83	2.20
Shower **(l/min)**	8.00	7.41	7.11	6.50
Bath **(litres capacity)**	170.00	158.40	152.60	152.60
Basin Taps **(l/min)**	5.00	4.51	4.27	1.50
Sink Taps **(l/min)**	6.00	4.85	4.27	4.27
Dishwasher **(l/place setting)**	1.25	0.93	0.78	0.50
Washing Machine **(l/kg)**	8.17	8.17	8.17	6.70

To find the lowest possible water-consuming scenario the Australian Water Efficiency Labelling Scheme (WELS) database was analysed. For each product type the minimum water consumption values were extracted from the database. These values represented the lowest water consumption possible with current technology giving us our extreme scenario. Once entered into the English Building Regulations Part G water efficiency calculator these assumptions equated to 84.2 LPD or 85 LPD rounded, known as the “Best commercially available technology” scenario.

Uptake

Uptake rates describe the number of water products that are compliant year on year, with the maximum potential determined by the total number of sales. The uptake rates are broken down into the seven product categories and by the two uptake scenarios.

The uptake rates were calculated as a percentage of water efficient products installed; this percentage was then applied to the total sales of all the product category sales for a given year. This sales data was based on DEFRA’s Market Transformation Programme[2] projections for showers, baths, taps, washing machines and dishwashers. This data was interpolated and extrapolated to fill in the missing years and projected to the timescales of this analysis for a 25-year time horizon.

This data stopped being updated in 2011 when the government programme funding ceased; although relatively old, the basis of the projections is still reliable. However, it should be noted that only a new stock model study using current sales and up to date policy interventions would be more representative; all currently available sales data only analyses historic sales and does not project the market.

[2] http://efficient-products.ghkint.eu/

Toilet sale projections were calculated using the projected ownership rates, projected households from DEFRA's Market Transformation Programme and the assumed lifetime of the average toilet of 15 years. Year on year growth in sales was assumed for the first 15 years, thereafter the year 1 sales volume difference was added to year 16 to account for toilet purchased in year 1 needing to be replaced. There was a lack of projected sales data for toilets therefore this was the only suitable alternative.

As with toilet sales data, no external use product (i.e. garden water using products and high-pressure washers) data was available. A market study from WRAP[3] stated the number of units sold in 2013 and an increase in sales by 7% from the previous year; therefore, sales were calculated for 2014 using the 7% increase. This difference of 556,075 units was assumed to be the annual sales year on year in the absence of other sources. This is the least reliable source of data for sales.

There were two main uptake scenarios:

Uptake Scenario 1 Installations covered by building regulations for new builds homes and major domestic renovations

For this scenario the building regulations are assumed to cover all installations occurring in new build homes and major retrofit projects that are required to go through a local authority. The derived uptake rates assume that every new build home in Wales would install one of each product type except for taps where two sets were assumed to be installed.

In addition to this, it is assumed that 34% of the sales not attributed to new build homes were for major domestic refurbishments. This proportion was calculated from MTW Research where the total UK repair, maintenance and improvement market value was proportioned against the total construction market value. This proportion was used as a suitable proxy as data pertaining to the number of water product sales for domestic retrofits each year could not be sourced. This resulted in 48% of the total sales for these products attributed to this uptake scenario. This figure is effectively an estimate of all significant professional installations, and so should be considered a proxy upper limit for installations covered by Building Regulations. Actual implementation of Building Regulation requirements for retrofit schemes would achieve an unknown proportion of this depending on scope of the requirements and effectiveness of implementation.

Uptake Scenario 2 Installations by householders buying products from stores directly or by service professionals as a small-scale job

It was assumed that the remaining total sales per year after excluding the sales attributed to Uptake Scenario 1, was for householders buying products from stores directly, to be installed by themselves or by service professionals as a small-scale job. This resulted in 52% of the total sales for these products attributed to this uptake scenario.

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[3] WRAP Water Using Products: Domestic garden products market research, flow rate and performance testing

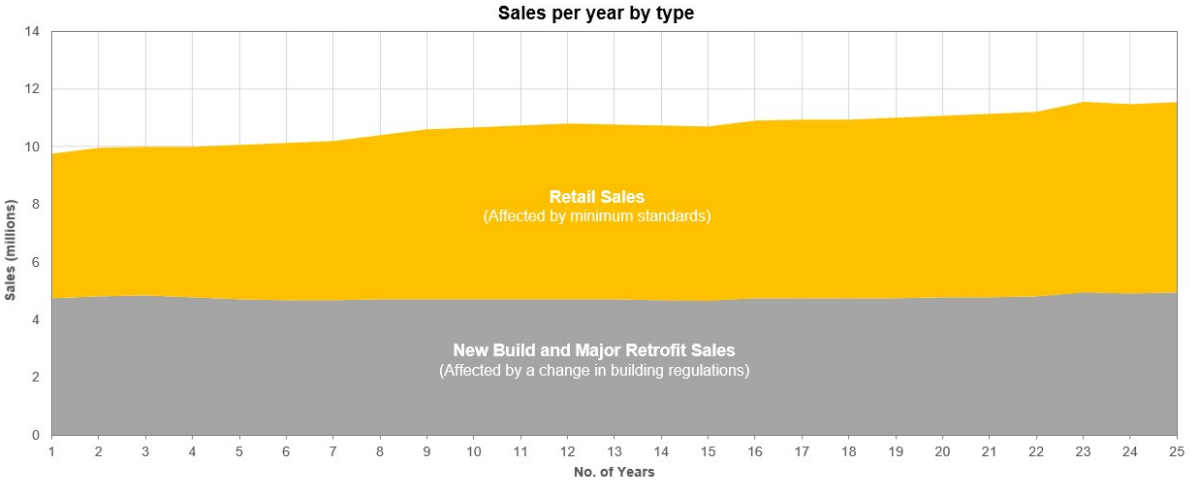

Figure 2: Sales per year by type of sales.

The figure above shows the assumed split between these two streams of sales and represent the proportion split of the sales effected if only one stream had water efficiency requirements place upon it. It shows that 56% of sales are assumed to be from retail sales and 44% are from new builds and major retrofits.

Behaviours

There are assumptions in the modelling which assume that the durations people use water using devices changes over 25 years e.g. people taking less baths and more showers. These assumptions were taken from DEFRA's Market Transformation Programme[4]. These represent the natural shift of water using behaviour (people's lifestyles favouring less baths and more showers) rather than a concerted effort from a campaign or incentive scheme to use water less overall.

The modelling does not assume that any incentivised behaviour change occurs from using products less or more efficiently (through government or water company schemes for example). The primary driver for water reduction in this modelling comes from the devices themselves using less water during use.

No adjustments were made for any rebound effect, whereby householders use fittings and appliances more often or for longer due to awareness of the increased water efficiency. What little evidence there is suggests that behaviour changes of this nature only occur for water fittings if there is a perceived reduction in performance – for example, a less effective shower head taking longer to rinse off soap. This study was based on the premise that standards in any new water labelling scheme would maintain product performance while reducing water usage, and so no rebound effects were included.

Costs

The costs were broken down by phase, aspect and ownership; with the phase relating to the initial setup of the water label, the administration of it and the practical manufacturing phase

[4] http://efficient-products.ghkint.eu/

of implementing the water label in practice. The aspects include marketing, maintaining a database, staffing enforcement etc. Some of the costs are static figures associated with a particular year and others are dynamic, depending on the amount of uptake different scenarios experience. This section will look at each aspect in turn and detail the differences between the different scenarios.

- **Standards/Policy Development**

This is a static cost only applied to year 1 of all the scenarios. It represents the initial work needed to develop the technical standards for the water label, establish the scales of the ratings for each product category, conduct a market review of the product categories, all associated external consultancy fees, research fees and research costs. This was sourced from the Australian Water Efficiency Labelling and Standards Scheme (WELS)[5] where they detailed their estimated costs for 2008-09 for the development of technical standards of $85,000. This figure was then uplifted to account for UK inflation rates up to 2018 and converted into pounds sterling using a conversion rate of $0.57 to the pound. This resulted in a UK cost of £59,908 of which £3,351 is assumed Wales' share.

- **Research Advisory Group Costs**

It is assumed that there would be four instances of this cost occurring in the first year. This cost represents a group of stakeholders and experts coming together to advise, contribute and help develop the standards as they progress in the first year. This was sourced from the Australian Water Efficiency Labelling and Standards Scheme (WELS)[6] where they detailed their estimated costs for 2013-14 for the WELS advisory group support of $9,000 for each instant. This figure was then uplifted to account for UK inflation rates up to 2018 and converted into pound sterling using a conversion rate of $0.57 to the pound. This resulted in a UK cost of £5,487 per instance and a total first year cost of £21,946, of which £307 is assumed to be Wales' share.

- **Marketing**

This is a static cost applicable to every year for all scenarios. This cost represents ongoing promotion of the scheme to help build awareness of the label which in turn will help drive the uptake in water efficient products. This was sourced from firstly the Australian Water Efficiency Labelling and Standards Scheme (WELS)[7] where they detailed their estimated costs for 2008-09 for ongoing promotion of the scheme at a cost of $70,000 or £49,336 when uplifted to account for inflation up to 2018 and converted into British pounds using a conversion rate of $0.57 to the pound. Secondly, the website budget for Energy Saving Trust's Energy Saving Recommended (ESR) scheme which was run on behalf of UK government in 2006/07 was used in combination with the above, which was of £6,500. Combined the assumed marketing budget year on year for the scenarios was assumed to be £55,836 a year of which £3,123 is assumed to be Wales' share.

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[5] http://www.waterrating.gov.au/
[6] http://www.waterrating.gov.au/
[7] http://www.waterrating.gov.au/

- **Enforcement**

This is a dynamic cost applicable to every year for all scenarios. This was sourced from the National Measurement Office monthly spend from April 2014 until March 2016[8]; this government body regulates and enforces several schemes for multiple government departments. As this government body regulates several schemes not only related to energy labelling scheme the costs had to be factored down so they were more representative; so it was assumed that as the Department of Energy and Climate Change (DECC) provided 44% of the funding to this body and there were 3 schemes the body regulated that belonged to DECC. Taking this into account the costs were factored down by 44% and then a third to get a representative cost. Those costs were then averaged into the spending categories that were listed in the data that related to enforcement: auditing, creating enforcement marketing material and legal fees.

It was assumed that for government led schemes that both enforcement marketing material and legal fees would be applicable as fixed year on year UK cost of £11,474, of which £1,041 is assumed to be Wales' share; as it was recognised that government would need to show due diligence, follow through on enforcement and be transparent which would incur more cost.

It was assumed for the variable cost that the maximum cost incurred for the mandatory schemes would be £96,147 which is a combination of the average yearly auditing and product testing costs. This represents the need for a mandatory scheme to do risk-based product testing and internal audits of documentation. This was proportion according to the uptake rates where the maximum cost would represent 100% of the years for a given year. All these costs were adjusted for inflation up to 2018.

	Mandatory Gov
Fixed Cost	£11,474
Vairable Cost (@100%)	£96,147

- **Database**

This is a static cost applied to all years of all scenarios. This cost represents the creation, maintenance and growth of a database containing all the registered products, enforcement and performance information to help administer the scheme. This was sourced from the Australian Water Efficiency Labelling and Standards Scheme (WELS)[9] where they detailed their estimated costs for 2008-09 for the database, website portal and administration of the database at a cost of $95,000. This figure was then uplifted to account for UK inflation rates up to 2018 and converted into pound sterling using a conversion rate of $0.57 to the pound.

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[8] https://www.gov.uk/government/publications?keywords=spend+2015&publication_filter_option=all&topics%5B%5D=all&departments%5B%5D=national-measurement-and-regulation-office&official_document_status=all&world_locations%5B%5D=all&from_date=&to_date

[9] http://www.waterrating.gov.au/

This resulted in an annual UK cost of £66,956, of which £3,745 is assumed to be Wales' share.

- **Staffing Costs**

This is a static cost applicable to every year for all scenarios, but each scenario staffing requirements were built on assumptions. Average salaries were sourced from the GOV.UK website detailing the salary for the Deputy Director for Green Deal and Office of National Statistics (ONS)[10]. Weighted average salaried were calculated for staff involved in head offices/management consultancy activities of £31,855 per annum, for office administration for £16,366 per annum, for professional/scientific/technical activities for £32,270 per annum and the Deputy Director for Green Deal salary was used to represent an assumed cost of a director involvement at £62,500 per annum.

Full Time Equivalent Staff

Director	Management Consultants	Office Support/ Administration	Professional/ Scientific/ Technical	Total
0.5	3.0	5.0	6.0	14.5

It should be noted that staffing structures and resourcing was researched to use a proxy, however only high level management was ever published publicly, therefore in the absence of such data assumptions based on experience from Energy Saving Trust staff was used as they have previously administered similar schemes.

- **Registration Fees**

Registration fees relates to the cost manufacturers need to pay to register their products as part of a mandatory government led water labelling scheme. For the purposes of this modelling we have assumed that all the ongoing administrative costs incurred by government (marketing, enforcement, database and staff) would be funded by government but would be fully recouped from manufacturers via registration fees. For example, in year 1 it is estimated that £63,516 was incurred by Welsh Government in operational costs; therefore this is the total cost to manufactures in registration fees. The only cost not recouped by government is the setup costs. This is similar to the Australian WELS model where they recoup 80% of the costs of the scheme in this way.

- **Testing Products**

This is a dynamic cost applicable to every year for all scenarios. This was sourced from the National Measurement Office monthly spend from April 2014 till March 2016[11]; this government body regulates and enforces several schemes for multiple government

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10 https://www.ons.gov.uk/employmentandlabourmarket/peopleinwork/earningsandworkinghours/datasets/agegroupbyindustry2digitsicashetable21

11 https://www.gov.uk/government/publications?keywords=spend+2015&publication_filter_option=all&topics%5B%5D=all&departments%5B%5D=national-measurement-and-regulation-office&official_document_status=all&world_locations%5B%5D=all&from_date=&to_date=

departments. As this government body regulates several schemes, not only related to energy labelling scheme, the costs had to be factored down so they were more representative; it was assumed that as the Department of Energy and Climate Change (DECC) provided 44% of the funding to this body and there were 3 schemes the body regulated that belonged to DECC the costs were factored down by 44% and then a third to get a representative cost. The factored down cost was then filtered according to activity and product testing was isolated and averaged to give a value of £977 per product testing.
It was assumed that 1,843 products would need to be tested for the water label under a mandatory scenario in the first year; this is based on the number of unique products sold by the retailers to consumers, based on desktop research. Thereafter it is assumed that an additional 10% of the initial number will need testing each year. This is an assumption and represents the introduction of new products each year.

It was difficult to source a total number of unique products in the market to estimate the total cost of product testing. Commercial companies do not give out this information publicly as it is deemed commercially sensitive.

- **Labelling Costs**

This is a dynamic cost applicable to every year for all scenarios. This cost represents a conservative cost to produce and print a water label including the labour. This was sourced from the Australian Water Efficiency Labelling and Standards Scheme (WELS)[12] where they detailed their conservative estimate for labelling costs in 2008 at $1 per label, using a conversion rate of $0.57 to pound sterling that equates to around 57p per label. It should be noted that the labelling estimates ranged from Australian 10 cents to $1. A UK study looking at costs for changing the food labelling system identified wide variation depending on the materials used, the printing techniques chosen, complexity of the label design and the economies of scale a particular company can manage. It was decided to go with a conservative high cost from the WELS study as, unlike food labelling, the water label will have less content that needs to be changed between product types. Also, the WELS data is from an existing mandatory water labelling scheme. The WELS estimates do cover a wide range but, in the absence of any evidence for an average figure, it was considered prudent to be conservative and adopt the upper end of the range.

This labelling costs data was then scaled up according to the total number of additional sales of water efficient products introduced in a given year.

- **Research and Development**

This is a dynamic cost applicable to every year for all scenarios. This was calculated from statistics from the Office of National Statistics (ONS)[13] detailing the total expenditure of business enterprise research and development (R&D). Firstly, the retail sector R&D

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[12] *http://www.waterrating.gov.au/SiteCollectionDocuments/cost-effectiveness-wels.pdf*

[13] *https://www.ons.gov.uk/economy/governmentpublicsectorandtaxes/researchanddevelopmentexpenditure/datasets/ukbusinessenterpriseresearchanddevelopment*

expenditure was taken of which we found that 2.84% of that related to hardware. Secondly the total value of the hardware market for 2016 and 2017 was found from ONS. The R&D expenditure was divided by the total hardware market value to calculate the percentage of the market value spent on R&D, which equated to 0.08%.

Using Statistic.com[14], WRAP study[15] and MTW Research[16] the sales value for each of the product categories was calculated, and the total value was then proportioned down to 0.08% and factor up to account for inflation up till 2018. The final value of £325,830 is assumed to represent 100% of the R&D expenditure for all the product categories for this study. This value was applied according to the proportion of uptake per year in relation to the total number of sales for that year (e.g. if the total sales for showers was 10,000 units and a scenario showed only 10% of those sales were of water efficient products it was assumed that only 10% of the R&D budget was applicable).

It should be noted that this is an estimate based on numerous assumptions to try and represent these specific markets. Actual data from manufacturers could not be sourced, as this data is commercially sensitive, and it is very unlikely this would be released to externals. It was important however that an estimated cost for this aspect was represented in the analysis to acknowledge that this would be a source of cost for the manufacturers.

- **Consumer Cost**

This cost relates to water efficient products being more expensive at point of sale, increasing the cost burden to consumers. Desk research carried out as part of this study identified the current price differential between the market average and those products that would comply with the 95LPD standard ("Best commercially available domestic technology" scenario). This differential was applied pro rata to the 110 ("Tightest new build standards in UK currently" scenario) and 100LPD ("10% better than current best standards") scenarios (86% and 95% of the full price premium). The differential was extrapolated for the 85LPD ("Best commercially available technology") scenario (112%) and then doubled (124%) to account for the fact that this scenario would require the use of some products not currently commercially available for the domestic sector.

The cost premium of buying water efficient products was staggered in the same years the minimum standards come into force. For example, for the 100 LPD scenario the first year experiences 86% of the premium and then in year 4 an additional 9% is added, making the total premium experienced to 95%. For the 85 LPD scenario, initially in year 1, 95% of the premium is experienced, then an additional 5% taking the total to 100%; and finally an additional 24% to year 7 taking the total to 124%.

[14] https://www.statista.com/statistics/327205/plastic-bath-and-shower-sales-value-uk/
[15] *WRAP Water Using Products: Domestic garden products market research, flow rate and performance testing*
[16] http://www.marketresearchreports.co.uk/

	Year 1	Year 4	Year 7	Total
110 LPD	86%			86%
100 LPD	86%	9%		95%
95 LPD	95%	5%		100%
85 LPD	95%	5%	24%	124%

These premium costs are reduced down equally over the subsequent 4 years to zero; where it is assumed market forces have brought the price of the water efficient products to the level the non-water efficient products were at before the start of the scheme.

Benefits

The benefits were calculated using a combination of Energy Saving Trust, water industry and government research. A weighted average saving for each product category was calculated using average flow rates and projected flow rates of water efficient technologies; the figures used in each scenario are shown in Table 4 below. These per product savings were multiplied by the uptake rates for each scenario, resulting in the water savings over time; these water savings are the basis for the majority of the other saving results such as the energy savings and emission savings. This section will detail the methodology, assumptions and factors used to calculate the benefits.

			Tightest new build standards in UK currently (110 LPD)		10% better than current best standards (100 LPD)		Best commercially available domestic technology (95 LPD)		Best commercially available technology (85 LPD)	
Variable	**Product**	**Units**	**Year 1**	**Year 25**	**Year 1**	**Year 25**	**Year 1**	**Year 25**	**Year 1**	**Year 25**
Ownership	Taps (Washbasin)	Pairs per HH	1.45	1.45	1.45	1.45	1.45	1.45	1.45	1.45
Ownership	Taps (Kitchen)	Pairs per HH	1.03	1.03	1.03	1.03	1.03	1.03	1.03	1.03
Ownership	Taps (Washbasin)	%	0.58	0.58	0.58	0.58	0.58	0.58	0.58	0.58
Ownership	Taps (Kitchen)	%	0.42	0.42	0.42	0.42	0.42	0.42	0.42	0.42
Baseline	Taps (Washbasin)	Litres per use	3.28	3.28	3.28	3.28	3.28	3.28	3.28	3.93
Baseline	Taps (Kitchen)	Litres per use	3.93	3.93	3.93	3.93	3.93	3.93	3.93	5.24
Baseline	Taps (Washbasin)	per person/day	4.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00
Baseline	Taps (Kitchen)	per person/day	4.50	4.50	4.50	4.50	4.50	4.50	4.50	4.50
Water Efficient Alternative	Taps (Washbasin)	Litres per use	3.28	1.98	2.96	1.79	2.96	1.80	2.96	0.98
Water Efficient Alternative	Taps (Kitchen)	Litres per use	3.93	3.64	3.17	2.94	3.17	2.80	3.17	2.80
Water Efficient Alternative	Taps (Washbasin)	per person/day	4.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00
Water Efficient Alternative	Taps (Kitchen)	per person/day	4.50	4.50	4.50	4.50	4.50	4.50	4.50	4.50
Ownership	Toilets	Per Household	1.44	1.46	1.44	1.46	1.44	1.46	1.44	1.46
Baseline	Toilets	Litres per use	3.06	3.01	3.06	3.01	3.06	3.01	3.06	4.64
Baseline	Toilets	per person/day	4.71	4.71	4.71	4.71	4.71	4.71	4.71	4.71
Water Efficient Alternative	Toilets	Litres per use	3.06	2.70	2.91	2.57	2.91	2.53	2.91	2.20
Water Efficient Alternative	Toilets	per person/day	4.71	4.71	4.71	4.71	4.71	4.71	4.71	4.71
Baseline	Showers (Average)	Litres per use	53.33	53.33	53.33	53.33	53.33	53.33	53.33	53.33
Baseline	Showers (Average)	per person/day	1.16	1.21	1.16	1.21	1.16	1.21	1.16	1.21
Water Efficient Alternative	Showers (Electric)	Litres per use	53.33	53.33	49.39	49.39	49.39	47.41	49.39	43.33
Water Efficient Alternative	Showers (Mixed)	Litres per use	53.33	53.33	49.39	49.39	49.39	47.41	49.39	43.33
Water Efficient Alternative	Showers (Electric)	per person/day	1.21	1.33	1.21	1.33	1.21	1.33	1.21	1.33
Water Efficient Alternative	Showers (Mixed)	per person/day	1.21	1.33	1.21	1.33	1.21	1.33	1.21	1.33
Ownership	Baths	Per Household	0.43	0.43	0.43	0.43	0.43	0.43	0.43	0.43
Baseline	Baths	Litres per use	68.00	68.00	74.00	74.00	68.00	68.00	68.00	68.00
Baseline	Baths	per person/day	0.63	0.58	0.63	0.58	0.63	0.58	0.63	0.58
Water Efficient Alternative	Baths	Litres per use	68.00	68.00	63.36	63.36	61.04	61.04	61.04	61.04
Water Efficient Alternative	Baths	per person/day	0.55	0.46	0.55	0.46	0.55	0.46	0.55	0.46
Ownership	Washing Machine	Per Household	0.82	0.82	0.82	0.82	0.82	0.82	0.82	0.82
Baseline	Washing Machine	Litres per year	8987.00	8987.00	8987.00	8987.00	8987.00	8987.00	8987.00	8987.00
Water Efficient Alternative	Washing Machine	Litres per year	8987.00	8987.00	8987.00	8987.00	8987.00	8987.00	8987.00	7370.00
Ownership	Dishwasher	Per Household	0.41	0.41	0.41	0.41	0.41	0.41	0.41	0.41
Baseline	Dishwasher	Litres per year	4460.05	4460.05	4460.05	4460.05	4460.05	4460.05	4460.05	4460.05
Water Efficient Alternative	Dishwasher	Litres per year	4460.05	4460.05	3330.69	3330.69	3330.69	2766.01	3330.69	1784.02
Ownership	Hose Attachment	%	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Ownership	High Pressure Washer	%	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08
Baseline	Hose Attachment	Litres per use	11.04	11.04	11.04	11.04	11.04	11.04	11.04	11.04
Baseline	Hose Attachment	Litres per year	7178.75	7178.75	7178.75	7178.75	7178.75	7178.75	7178.75	7178.75
Baseline	High Pressure Washer	Litres per use	48.46	48.46	48.46	48.46	48.46	48.46	48.46	48.46
Baseline	High Pressure Washer	Litres per year	18660.88	18660.88	18660.88	18660.88	18660.88	18660.88	18660.88	18660.88
Water Efficient Alternative	Hose Attachment	Litres per use	8.78	8.78	8.78	8.78	8.78	8.78	8.78	8.78
Water Efficient Alternative	Hose Attachment	Litres per year	5707.00	5707.00	5707.00	5707.00	5707.00	5707.00	5707.00	5707.00
Water Efficient Alternative	High Pressure Washer	Litres per use	14.70	14.70	14.70	14.70	14.70	14.70	14.70	14.70
Water Efficient Alternative	High Pressure Washer	Litres per year	5660.65	5660.65	5660.65	5660.65	5660.65	5660.65	5660.65	5660.65

Table 4: Fittings assumptions for each scenario

- **Time Horizon for Building Regulations**

It is assumed that the water fitting standards will be introduced in stages. Each devolved nation would be able to introduce progressively tighter standards for new build properties independently and according to their own preferred timetable. As Wales already has tighter new build standards than most of the UK, we have assumed a slightly more ambitious implementation plan for Wales than was assumed in the original study, as shown in Table 5.

Table 5: Assumed timeframe for introducing consumption targets for new build homes and major retrofit installations. Table displays in which year the litres per day target can be achieved based on the different scenarios.

New Build Installations Covered by Building Regulations

	Year																								
Scenario	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**	**16**	**17**	**18**	**19**	**20**	**21**	**22**	**23**	**24**	**25**
110 LPD	110	110	110	110	110	110	110	110	110	110	110	110	110	110	110	110	110	110	110	110	110	110	110	110	110
100 LPD	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
95 LPD	100	100	100	95	95	95	95	95	95	95	95	95	95	95	95	95	95	95	95	95	95	95	95	95	95
85 LPD	100	100	100	95	95	95	85	85	85	85	85	85	85	85	85	85	85	85	85	85	85	85	85	85	85

Major Retrofit Installations Covered by Building Regulations

	No. of Years																								
Scenario	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**	**16**	**17**	**18**	**19**	**20**	**21**	**22**	**23**	**24**	**25**
110 LPD	110	110	110	110	110	110	110	110	110	110	110	110	110	110	110	110	110	110	110	110	110	110	110	110	110
100 LPD	110	110	110	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
95 LPD	110	110	110	95	95	95	95	95	95	95	95	95	95	95	95	95	95	95	95	95	95	95	95	95	95
85 LPD	110	110	110	95	95	95	85	85	85	85	85	85	85	85	85	85	85	85	85	85	85	85	85	85	85

- **Time Horizon for DIY Retailers**

For products bought at DIY stores it is assumed that those markets will need more time to adjust to the new water efficiency standards. It is assumed the same standards will be introduced but with a 3 year delay to give the retail stores time to source and stock compliant products. It is also assumed within the first 3 years the savings achieved will be equally staggered up to 100% to illustrate the change in stock retail stores will have to go through.

Table 6: Assumed timeframe for introducing consumption targets for DIY store installations. Table displays in which year the litres per day target can be achieved based on the different scenarios

Householder Installations Bought from DIY Retailers

	No. of Years																								
Scenario	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**	**16**	**17**	**18**	**19**	**20**	**21**	**22**	**23**	**24**	**25**
110 LPD				110	110	110	110	110	110	110	110	110	110	110	110	110	110	110	110	110	110	110	110	110	110
100 LPD				110	110	110	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
95 LPD				110	110	110	95	95	95	95	95	95	95	95	95	95	95	95	95	95	95	95	95	95	95
85 LPD				110	110	110	95	95	95	85	85	85	85	85	85	85	85	85	85	85	85	85	85	85	85

- **Energy Savings**

These savings were calculated using the Energy Saving Trust Water Energy Calculator. Using known parameters such as the specific heat capacity of water, the temperature water is typically heated to at different points of use, weighted average UK water heating system fuel types and efficiencies (and Welsh inputs where available), the weighted average UK heating system efficiency, energy savings per product type could be calculated as kWh per litre saved. Using this factor against the total water savings per year we calculated the total energy savings in MWh for those products that will save hot water, such as water efficient taps, showers, baths, washing machines and dishwashers.

- **Water Bill Savings**

Using data provided by both Hafren Dyfrdwy and Welsh Water of the current proportion of Welsh households with water meters, a projection was created over 25 years using the rate of change of past water meter installations. It is therefore assumed that in Wales the year 1 water meter proportion is 53% climbing to 84% in year 25.

- **Energy Bill Savings**

These savings were calculated using a weighted average energy tariff according to the domestic hot water heating fuel mix calculated and derived by Energy Saving Trust and the projected domestic long-term fuel prices from government's Green Book Supplementary Guidance[17]. This resulted in a weighted average energy price of 3.48p/kWh in year 1 to 4.64p/kWh in the 25th year. This was then applied to the energy savings to calculate the total domestic energy bill savings year on year.

- **CO_2e Emission Savings**

Embodied carbon dioxide equivalent savings were based on factors for water supply and wastewater treatment totalling 0.477gCO_2e/litre, sourced from a weighted average rate from both Welsh Water and Hafren Dyfrdwy. These were applied to the water savings to calculate the total domestic embodied CO_2e emissions savings.

The water heating savings were calculated using the domestic hot water heating fuel mix for Wales, calculated and derived by Energy Saving Trust, and the projected domestic long term CO_2e emission factors from government's Green Book Supplementary Guidance[18]. This resulted in a weighted average CO_2e emission factor of 0.232kgCO_2e/kWh in year 1, falling to 0.215kg CO_2e /kWh in the 25th year. This was then applied to the energy savings to calculate the total domestic energy CO_2e emissions savings year on year.

- **Water Marginal Cost Savings**

This benefit represents the cost to water companies of supplying water to homes. This relates to the capital cost of having to invest in more infrastructure and the operational cost of supplying that water year on year. A marginal cost of £53 per million litres was used and sourced from both Welsh Water and Hafren Dyfrdwy.

[17] https://www.gov.uk/government/publications/valuation-of-energy-use-and-greenhouse-gas-emissions-for-appraisal
[18] https://www.gov.uk/government/publications/valuation-of-energy-use-and-greenhouse-gas-emissions-for-appraisal